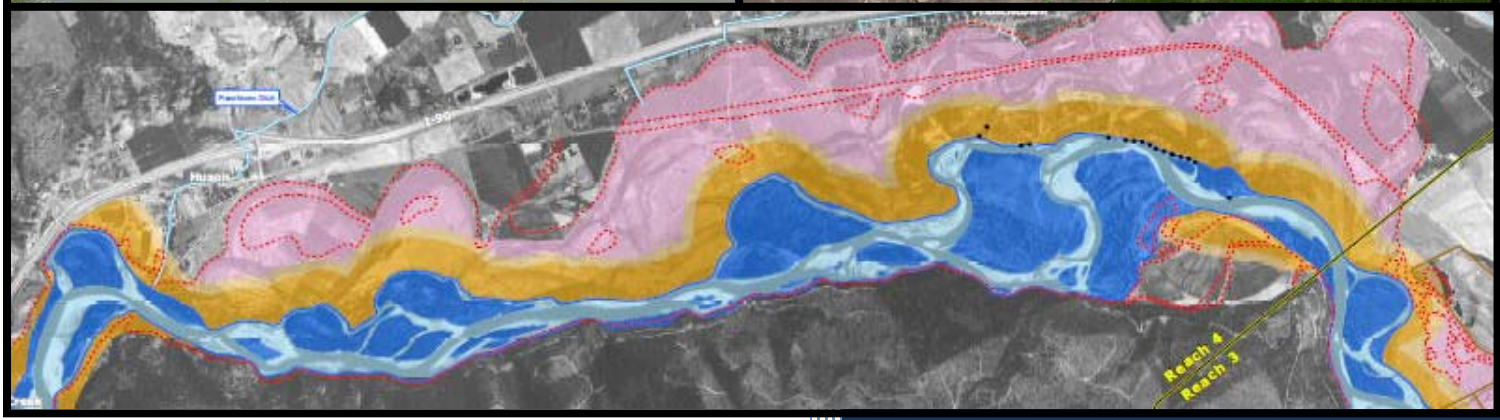
RDGP Grant Application

May 14, 2012

Upper Missouri Headwaters River/Flood Hazard Map Development



Applicant:

Ruby Valley Conservation District

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Sheridan, MT 59749

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Contents

Figures

Tables

STEP 1 - GRANT APPLICATION SUMMARY

I. APPLICANT INFORMATION

Applicant Name: **Ruby Valley Conservation District**

Mailing Address: **PO Box 295**

City, State, Zip: **Sheridan, MT 59749**

Telephone Number(s): **406-842-5741 x106**

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Federal Tax ID: **81-0414745**

Senate District(s): **34, 35, 36, 37, and 39**

House District(s): **68, 69, 70, 71, 72, and 77**

II. PROJECT INFORMATION

Project Title: Upper Missouri Headwaters River/Flood Hazard Map Development

Brief Project Description: River corridor hazard mapping and management tools based on flooding and historic rates of river movement.

Bounding Area:
Includes the major rivers of the Missouri River headwaters, including the Beaverhead, Big Hole, Boulder, East Gallatin, Gallatin, Jefferson, Madison, Red Rock and Ruby Rivers.

Upper Left (decimal degrees): 46.244, -113.663 **Lower Right (decimal degrees):** 44.528, -110.928

Estimated project start date: 7/2013 (or when funding is available) **- end date:** 6/2015

Project Budget:

As the Applicant, Ruby Valley Conservation District is requesting $300,000 from the Grant Program. A detailed breakdown of project costs and funding sources is found in Step 5 – Budget.

Funding Source	Amount	Committed
RDG Grant	$ 300,000.00	No
Ruby Valley CD	$ 28,000.00	Yes
Project Partners – Cash	$ 51,000.00	Yes
Project Partners – In-Kind	$81,900.00	Yes
Project Partners – Associated Projects	$ 36,375.00	Yes
Totals	**$497,275.00**	

III. AUTHORIZING STATEMENT

I hereby certify that the information and all statements in this application are true, complete and accurate to the best of my knowledge and that the project or activity complies with all applicable state, local and federal laws and regulations.

I further certify that this project will comply with applicable statutory and regulatory standards protecting environ-mental quality. I further certify that I am (we are) authorized to enter into a binding agreement with the Department of Natural Resources and Conservation to obtain a grant if this application receives legislative approval.

Gary Giem 5/11/12

Signature and Title of Authorized Representative — Date

Gary Giem, Chairman Ruby Valley Conservation District

STEP 2 - PROJECT ABSTRACT

River corridors contribute directly to the health of many of Montana's communities. However, communities located within dynamic river corridors are also faced with unique challenges to human safety and resource management. The 2011 floods are an urgent reminder of the need for a better understanding of the power and nature of our rivers. This project provides key datasets for developing ***comprehensive river hazard mapping*** and crucial tools for understanding and managing six key river corridors in the project area. Goals include:

1. Channel Migration Mapping for select rivers.
2. Floodplain mapping scoping for select rivers (supports 1971 state legislation requiring a Floodplain Mapping Plan).
3. Educational opportunities for stakeholders on use of the mapping.
4. Extensive mapping data provided to stakeholders and the State Library.
5. Move efforts towards a comprehensive river hazards mapping approach recommended by the 2011 report *Montana Floodplain Management Assessment: Strengthening Policies and Programs that Reduce Flood Risk and Protect Floodplains*.

Channel Migration Mapping (CMM) mapping uses the historic footprint of rivers to quantify rates of change and develop a predicted 100-year dynamic river corridor based on erosion rates. This is a separate hazard from floodplain mapping. CMM serves as a science-based tool to help the public, landowners, and decision makers develop an understanding of river dynamics, along with the inherent risks and benefits associated with those processes.

The Ruby Valley Conservation District will oversee the work. A contractor knowledgeable in CMM and floodplain processes will perform the actual work. The project area includes approximately 510 channel miles on six of the nine mainstem rivers of the Upper Missouri River watershed: Gallatin, East Gallatin, Beaverhead, Madison, Jefferson, and Ruby Rivers. Seven counties, eight conservation districts, and numerous communities are included in the project area. The work will be completed within two years of project initiation.

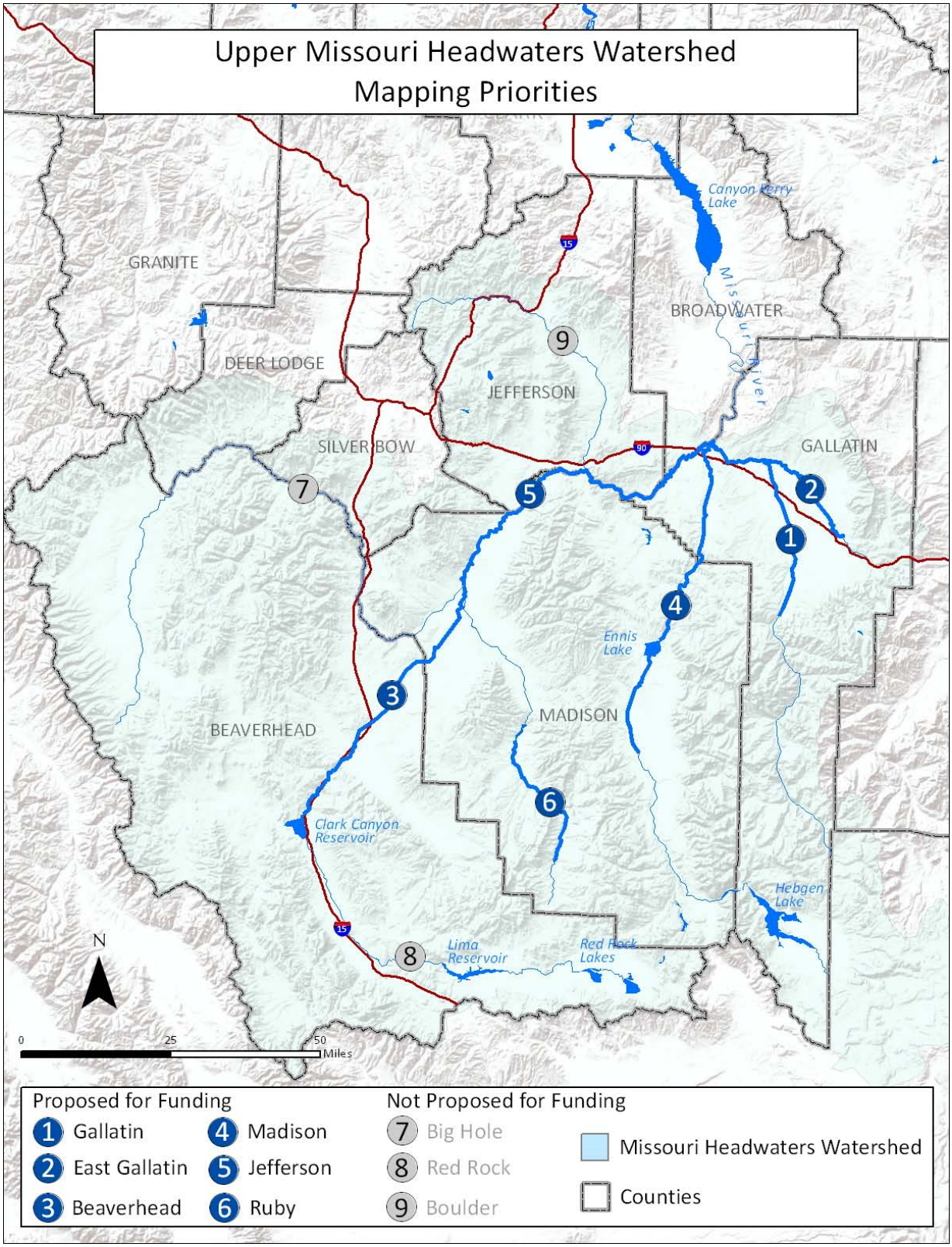


Figure 1. The Upper Missouri Headwaters Watershed showing prioritized Channel Migration Mapping rivers.

STEP 3 - TECHNICAL DESCRIPTION & ALTERNATIVE ANALYSIS

The proposed work has five key objectives that target key goals and objectives of the DNRC for managing Montana's river corridors:

1. Develop Channel Migration Mapping for 510 miles of channel on the Gallatin, East Gallatin, Beaverhead, Madison, Jefferson, and Ruby Rivers.
2. Coordinate with DNRC to develop floodplain mapping scoping for select rivers in support of 1971 state legislation requiring a Floodplain Mapping Plan for Montana.
3. Provide educational opportunities for stakeholders on use of the mapping.
4. Provide the resulting mapping data layers to stakeholders and the State Library.
5. Move river corridor mapping efforts towards a comprehensive river hazards mapping approach recommended by the 2011 report *Montana Floodplain Management Assessment: Strengthening Policies and Programs that Reduce Flood Risk and Protect Floodplains*.

These objectives were developed through a comprehensive scoping process for this project, including meetings with key stakeholders, agency personnel, a review of available data, and the natural history of each of the rivers in the study area. Though the project area includes the nine mainstem rivers of the Missouri Rivers Headwaters watershed, available funding dictated that only six rivers be selected for further mapping in this proposal (Figure 1). This selection was based on a prioritization of all rivers in terms of need, support, and how they fit in with the state's prioritization of floodplain mapping.

All project activities are consistent with Crucial State Needs to protect public health, safety, and welfare; protect the physical and natural resources of the state; manage a state floodplain management program; and meet the general provisions as stated in the Montana Code Annotated, Title 76: Land Resource and Use, Chapter 5: flood plain and floodway management. This is documented in Step 11- Crucial State Need Documentation and in Appendix III. The applicant, project partners, and contractors will work towards meeting these needs.

At the core of this proposed project is 510 miles of Channel Migration Mapping on six of the mainstem rivers of the Missouri Headwaters watershed. Channel Migration Mapping is a cost-effective method for developing scientifically-based information for one of the primary hazards associated with rivers, riverine erosion. Appendix III includes an extract from the final report for the existing Ruby River Channel Migration Mapping and details the history of the Channel Migration Mapping and the physical processes that drive riverine erosion.

The following discussion highlights the findings of this scoping process. Citations are provided for further information.

1. Problem History –

Montana has over 200,000 miles of rivers and streams. These waterways are critical resources for virtually all residents of Montana, as they provide drinking water, irrigation water, recreational opportunities, direct business opportunities, flood impact mitigation, and a multitude of aesthetic benefits. Because the river systems in Montana are typically characterized by active lateral movement, seasonal high water, and ice jams, they pose challenges to the protection of both the resource itself and the health and safety of river corridor users. In 2011, the Montana Department of Environmental Quality, working with DNRC and others on a Technical Advisory Committee, released a report detailing the management of floodplains in Montana[1]. This report listed the following primary "Challenges" to protecting Montana's river corridors:

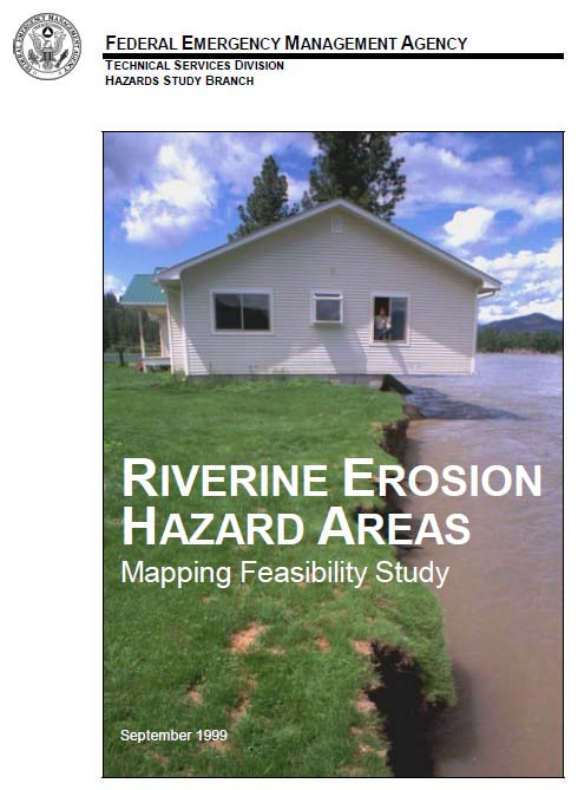
[1] Montana Department of Environmental Quality, 2011, Montana Floodplain Management Assessment: Strengthening Policies and Programs that Reduce Flood Risk and Protect Floodplains.

- A limited understanding of the importance of natural floodplains,
- A preference for living near water, and
- A lack of floodplain mapping for most of Montana's rivers and streams.

The report also notes that only 5% of Montana's streams have FEMA Special Flood Hazard Area (SFHA) maps, and where floodplain mapping does exist, "common Montana flood hazards (such as ice jam risk and channel migration) are not included" in the mapping.

This proposed project focuses on the need for additional Channel Migration Mapping, while also working towards the Department of Natural Resources and Conservation's (DNRC) legislatively-mandated goal of a comprehensive approach to river hazards in Montana.

The majority of hazard mapping in stream corridors defines the risks of river flooding (e.g. 4%, 2%, and 1% historic floods). Flood mapping is an important part of identifying threats to health and human welfare. However, flood mapping efforts are often hampered by the high costs associated with hydraulic modeling, as well as local resistance to mapping efforts that may increase the level of regulation in their communities. The DNRC is currently studying approaches to flood mapping aimed at reducing the costs by mapping the Big Hole River using a variety of techniques. Floodplain mapping throughout Montana may become more feasible as a result of that effort, although it is still important to individually address each proposed river to identify both the need and interest for such mapping. The project proposed herein will include floodplain mapping scoping for several waterways in the study area following protocols utilized by DNRC.



Although floodplain mapping is a valuable tool for the delineation of flood risk, this still leaves land owners and managers with limited tools for addressing the very real, hazardous, and well-demonstrated tendencies for rivers to shift, or migrate, and erode laterally over time. A 1999 FEMA study acknowledges the risk of channel migration and avulsion, stating "approximately one-third of the nation's streams experience severe erosion problems"[2], resulting in $450 million of erosion-related damages. For example, in 2005, during a single 24-hour rain-on-snow event in St. George, Utah, over 20 homes were lost and 15 to 20 homes were condemned, totaling over $180 million dollars in property loss. All of the damage was to homes *outside of the mapped floodplain* and the direct result of channel migration.[3]

Montana is not immune to these types of events. Below are some recent occurrences in Montana:

- In May 1997, a house on the Clark Fork River in Sanders County became the cover shot of the 1999 FEMA study after the river rapidly eroded 18 feet and undermined the house's foundation (see figure to right).

[2] FEMA, 1999, Riverine Erosion Hazard Area Mapping Feasibility Study, pp. 8.

[3] Utah Flood Relief, http://www.utahfloodrelief.com/, 2005.

- In 2011, flooding on the Musselshell River created twenty-eight avulsions up to 2.6 miles in length, multiple bridges, irrigation pump and diversion sites, and structures were damaged or lost due to channel movement (Figure 2, Figure 3). Overall, the channel lost 10% of its length during the 2011 flows. For the Musselshell and Golden Valley Conservation Districts, this resulted in an increase from five to ten permits annually, to sixty-seven permits in 2011 and twenty to date in 2012.
- During a 310 Permit review in 2012 on the Ruby River, landowners Dawne and Doug Smith noted that, had they known about the risks of channel migration, they would have likely located their house at a different site. They are now considering moving their home to avoid the costs of trying to control the river's movement.
- During the high water on the Yellowstone River in 1997, a house south of Livingston that was positioned over 20 feet *above* the 100-yr base flood elevation was intentionally burned down by the homeowner to avoid the risk of it falling into the river and damaging Carter's Bridge downstream.
- On the Clark Fork River near Frenchtown, a homeowner is involved in an ongoing struggle to either protect or sell their home that is at imminent risk of being undermined by the river (Figure 5). To quote the homeowner, "We used to love the river. Now we fight it every day." Their home is currently listed for sale at approximately 30% of its original value.
- Between 1956 and 2009 on the Flathead River downstream from Kalispell, the Wagner Lane peninsula eroded over 550 ft, effectively reducing the width of the bendway by half (Figure 6). 310 Permit applications show a nearly constant effort to stabilize the bankline.
- Winter ice jam events on numerous Montana rivers result in unpredictable flooding, erosion, and avulsion events. For example, in 2012, ice jamming on the Missouri River near Townsend flooded a house and outbuildings (Figure 7).

Figure 2. A home falls into the Musselshell River in June 2011 after the river migrated and undermined its foundation. (©www.kestrelaerial.com)

Figure 3. Avulsion at Harvey Bridge Road on the Musselshell River (flow is from left to right) requiring the construction of a new bridge.

The typical landowner response to channel migration is to armor the bankline in an attempt to restrict its movement. These efforts are expensive, shut down the natural functions of the river, and are often ineffective in the long term (Figure 4).

Figure 4. In June of 2011, high water eroded the bankline behind a section of rock riprap (brown dots) and migrated over 600 feet northward at this location on the Yellowstone River; nearly 700 feet of emergency riprap was placed to protect threatened buildings.

Figure 5. Flood-driven erosion on the Clark Fork River threatens a home.

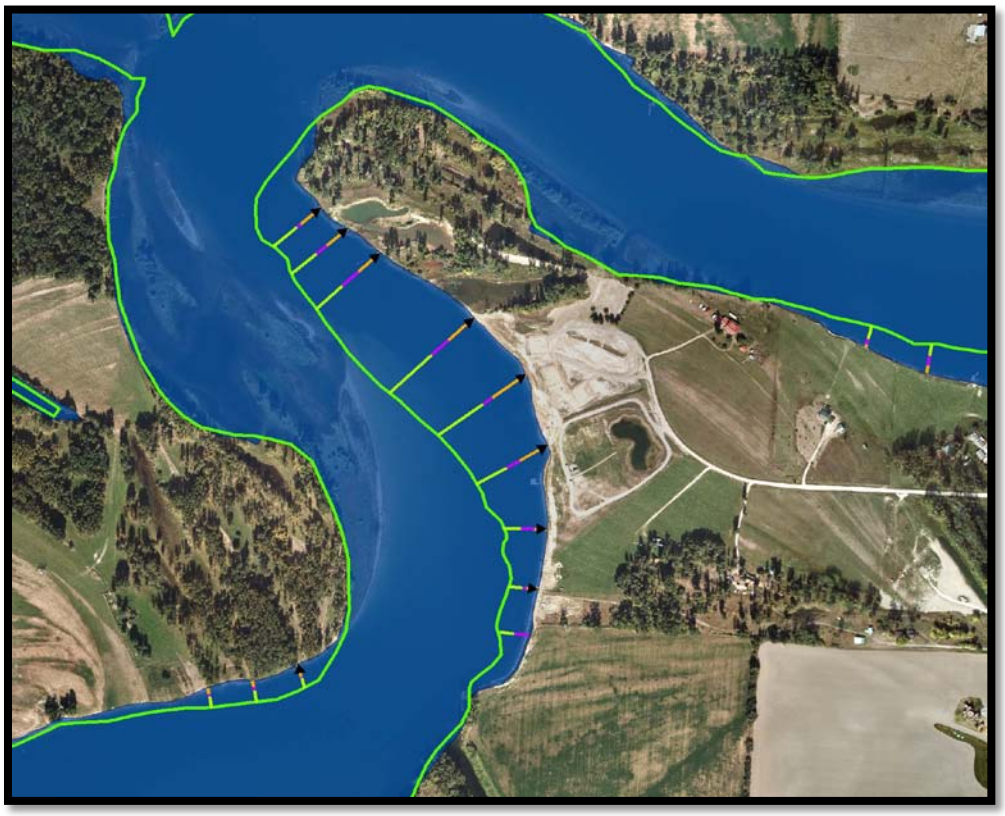


Figure 6. The Flathead River at Wagner Lane showing over 500 feet of erosion between 1956 and 2009.

Figure 7. Ice jam flooding near Townsend in Broadwater County, 2012. (Photo Credit: Steve Story, MTDNRC)

As noted in a 2010 Association of State Floodplain Managers (ASFPM) publication[4], the National Flood Insurance Program (NFIP)(44 CFR Chapter 1, Part 60.5(a)) requires that, among other things:

> *…local communities to manage development in "flood-related erosion prone areas" by (1) Requiring the issuance of a permit for all proposed construction, or other development in the area of flood related erosion hazard, as it is known to the community; (2) Requiring review of each permit application to determine whether the proposed site alterations and improvements will be reasonably safe from flood-related erosion and will not cause flood-related erosion hazards or otherwise aggravate the existing flood-related erosion hazard; and (3) If a proposed improvement is found to be in the path of flood-related erosion or to increase the erosion hazard, require the improvement to be relocated or adequate protective measures to be taken which will not aggravate the existing erosion hazard.*

In Montana, channel migration and avulsion presents an ongoing challenge for landowners and managers, alike. Channel Migration Mapping can serve as a key tool for helping manage for these risks. When combined with traditional floodplain mapping, a comprehensive river hazard picture is achieved.

Previous Work:

Several Channel Migration Mapping efforts have been completed in Montana, including two in the proposed study area (Ruby River and Big Hole River):

- Lower Ruby Channel Migration Mapping – In 2010, 54 miles of the Ruby River from the Ruby Reservoir Dam to Twin Bridges were mapped using the same methodology proposed for the rest of the rivers in the Missouri Headwaters study area.
- Big Hole River Channel Migration Mapping – In 2005, Channel Migration Mapping for 130 miles of the Big Hole River from upstream of Jackson to Twin Bridges were completed using a simplified mapping methodology. Additionally, the most recent imagery data set was the 1995 black and white Digital Orthophoto Quads that were already ten years out of date. GIS-based

[4] ASFPM Arid Regions Committee, 2010, Riverine Erosion Hazards White Paper, pp. 3.

inundation modeling was also completed for the project area, approximating the area of likely inundation during a 100-year event. This project was the first Channel Migration Mapping effort in Montana, using methodologies and data that have since been improved upon.

- Yellowstone River – In 2009, the Yellowstone River Conservation Districts Council (YRCDC) contracted Channel Migration Mapping for 564 miles of the Yellowstone River from Gardiner to the confluence with the Missouri River. Ten county-level maps were generated to cover the project reach. Approximately sixteen outreach and education workshops have been conducted along the river corridor to educate potential users about river processes, and the use of the mapping.
- Flathead River – Channel Migration Mapping for twenty-four miles of the mainstem Flathead River from Kalispell to the lake were completed in 2010.
- Clark Fork River - Channel Migration Mapping was completed for approximately twenty miles of the Clark Fork River from the Bitterroot River confluence, downstream to the Six Mile Creek confluence near Huson in 2009. This project was funded by the Missoula County.
- Clark Fork River – Mapping for the Clark Fork River from Drummond to Milltown is currently under way. Phase 1 of the mapping is complete, including compiling historic imagery, GIS mapping of banklines, and a field visit. The project is waiting continued funding for analysis and final map creation.
- Prickly Pear & Ten Mile Creeks (Helena) – Nearly eighteen miles of Prickly Pear and Ten Mile Creeks in the Helena Valley were mapped in 2010. These represent the smallest stream corridors mapped to date in Montana.
- Madison River (Earthquake Lake to Hwy 87 Bridge) – Approximately four miles of the Madison River were studied by the USGS for lateral and vertical channel movement in response to the 1959 earthquake that created Earthquake Lake[5]. While no Channel Migration Maps were developed, this study represents a very details assessment of channel response to a significant geomorphic event.

FEMA floodplain mapping exists for some sections of rivers in the proposed study area. Availability of this data is somewhat limited by the lack of Digital Flood Insurance Maps (DFIRMs) for several of the counties. Non-digital FIRMS exist for many rivers in the study area, though their availability for this review was limited. Below is a list of the extent of DFIRM floodplain mapping on the proposed rivers.

- Beaverhead River – No DFIRMs are available.
- Big Hole River – DFIRMs available only for Silver Bow County. Zone A mapping available for Merriweather Ranch, upstream to the Deer Lodge County line.
- Boulder River – No DFIRMs available.
- East Gallatin River – Zone AE for Bozeman, downstream to approximately Airport Road. Zone A for the rest of the river.
- Gallatin River – Zone A for the Big Sky area and an approximate 2 mile section upstream from Moose Creek. Zone AE for 1 mile upstream from Gallatin Gateway to the confluence with the East Gallatin River. Zone A from the confluence with the East Gallatin River, downstream to the confluence with the Missouri River.
- Jefferson River – No DFIRMs available.

[5] Lateral and Vertical Channel Movement and Potential for Bed-Material Movement on the Madison River Downstream from Earthquake Lake, Montana, USGS Scientific Investigations Report 2012-5024, 2012.

- Madison River – Zone A for a small section in Ennis. Zone A for three miles upstream of Three Forks to the town. Zone AE for the town of Three Forks. Zone A from Three Forks to Headwaters State Park.
- Red Rock River – No DFIRMs available.
- Ruby River – No DFIRMs available.

Numerous counties and cities throughout Montana have local ordinances that place restrictions on actions within the floodplain and/or riparian areas6. It should be noted that these floodplain regulations do not necessarily address either the risk of flooding or the risk of channel migration. The following is a list of locally developed regulations within the study area:

- Big Hole River - Examine all new buildings proposed within 500 feet of Big Hole River; minimum setback is 150 feet from the ordinary high water mark.
- Madison County – 500-foot setback from the Madison River, 150-foot setback from the Big Hole, Jefferson, Ruby, Beaverhead, Boulder, and West Fork of the Gallatin Rivers for all new subdivisions.
- Gallatin County - 300-foot setback from the Missouri, Jefferson, Madison and Gallatin Rivers and 150-foot setbacks for all the streams the county for residential and commercial structures.
- Bozeman City – The City of Bozeman has adopted setbacks of 100 feet from the East Gallatin River, 75 feet from Sourdough and Bozeman Creeks, and 50 feet from all other watercourses for all buildings.

Natural Features of the Project Area:

The rivers proposed for Channel Migration Mapping are all within the Missouri Headwaters watershed as defined by Three Forks and upstream. The sections of river selected for mapping are typically within relatively wide intermontane valleys that drain areas of high elevation and diverse geologic settings.

Soils:

The soils conditions within these river corridors tend to be fluvially sorted sediment that is located either in proximal riverine settings or on adjacent floodplain areas. Floodplain deposits are typically horizontally stratified sand and finer sediment, with a high degree of variability in soil development and quality. These units are commonly irrigated for agricultural uses. Closer to the active stream channels, soil conditions range from the same fine grained fraction of fluvially transported sediment to coarse bedload materials that form unvegetated bar surfaces that have no soil development.

Soils associated with Quaternary-age terraces or older rock units that impinge against active channels are highly variable in terms of both structure and maturity. These units are only integrated into the Channel Migration area if lateral movement of the river into the materials is empirically demonstrable.

Vegetation:

Because this effort is concentrated within river corridors, vegetation is overwhelmingly dominated by woody riparian species that are typical in Montana, including cottonwood, willow, water birch, alder, aspen, and dogwood. Non-woody species include a wide array of herbaceous, sedge, and rush species that are associated with wetland and riparian areas. Agricultural crops also commonly encroach into river corridors, so vegetation can include an array of commodity species. Where upland areas abut the river, vegetation types commonly include conifers, upland shrubs such as sagebrush, and upland grasses.

[6] Stream & Wetland Protection Tools: Local Government Regulations, Montana Audubon, 2009 (http://www.mtaudubon.org/issues/wetlands/planning4.html).

Geology:

The specific geologic characteristics of any given stream segment are a critical aspect of Channel Migration Mapping. In Channel Migration Mapping, when erosion rates are measured at any given site, that erosion is attributed by geologic unit, such that rates of migration into the unit can be empirically documented. Within the project area, the geology is primarily Quaternary-age alluvium, which are sediments deposited by the river itself. The nature and erodibility of these units can change on a reach scale depending on geomorphic environment (energy regime), sediment transport characteristics (tendency for deposition and storage), or tributary inputs. As a result, measurements are collected on a reach scale to address these geomorphic, geologic, and associated geotechnical variabilities.

The broad river valleys of the Upper Missouri Headwaters area commonly contain nested terraces that become sequentially younger with dropping elevation (Figure 8). Several of these terrace units were formed during the last glacial period (~10,000 years bp) when sediment loads were very coarse grained and massive in terms of volume. Since these units formed under a higher energy regime, they tend to be somewhat less erodible than active river deposits. The terraces are thus categorized in terms of elevation, and migration measurements are categorized accordingly.

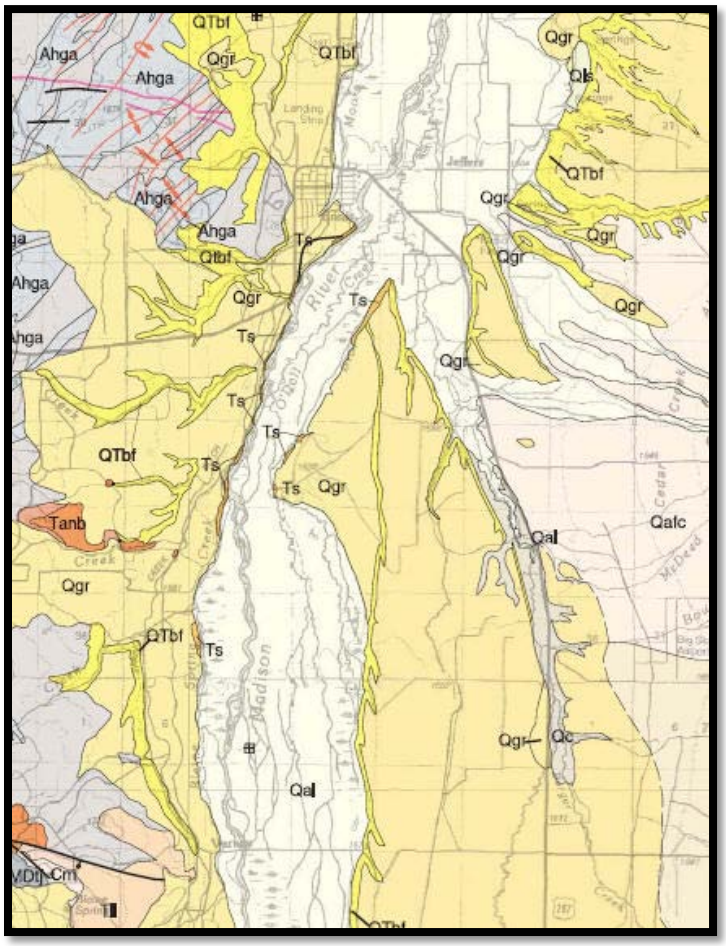


Figure 8. Geologic map of Madison Valley showing young alluvium (bright yellow) and terraces (tans).

Several of the rivers in the project area have bedrock segments that show little movement through time. This includes areas such as Beartrap Canyon on the Madison River, where crystalline rocks such as garnet gneiss is exposed on the riverbank. In these areas, hazard mapping tends to show minimal risk associated with lateral river movement.

Hydrology:

All of the watersheds in the project area are dominated by spring snowmelt runoff hydrographs that typically extend over several weeks, peaking in late spring. Over the past 50 years, however, flood magnitudes have been highly variable between the individual rivers (Figure 9). For example, whereas the Beaverhead River and Ruby River both experienced 100-year flood events in 1984, the Madison River at Cameron and Red Rock River below Lima Reservoir have not experienced any events in excess of the 10-year flood over the same time frame. The East Gallatin River has had 6 events that have exceeded a 5-year flood event in the last 10 years. All of these hydrologic events have performed work on these rivers that is commonly manifested as active channel migration or avulsion. Thus, the events will be considered in the mapping process, so that the extrapolation of historic river behavior into the future takes into account the occurrence and magnitude of historic flood impacts. It is also important to note that on the Beaverhead River, Madison River, and Red Rock River, dams have modified the natural runoff patterns, such that the long-term historic hydrologic record may not reflect the future condition. All of these factors are taken into account in the Channel Migration Mapping process to ensure that predictions of future channel movement reflect system stressors as accurately as possible.

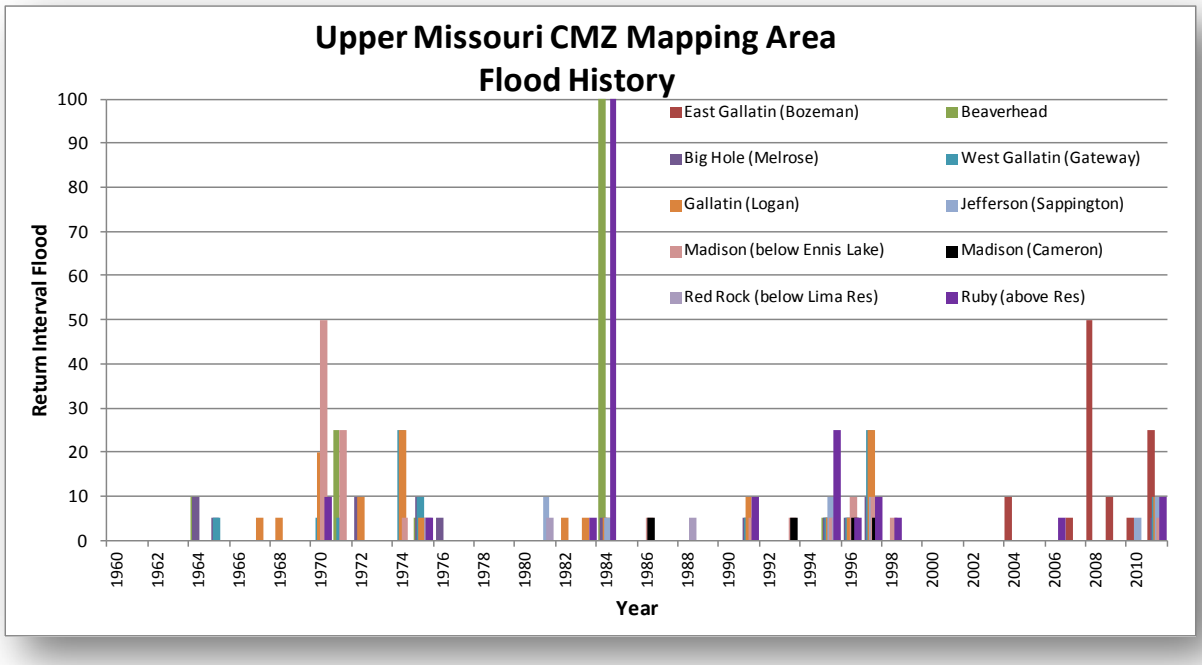


Figure 9. Flood history for the major rivers in the study area.

2. Cost/Benefit Analysis –

The following sections detail the proposed projects assessed costs and benefits.

Project Costs & Benefits:

According to a draft report from the Montana Department of Natural Resources and Conservation, "Last year, 2011, was a particularly bad flood year in Montana, with 51 out of 56 counties and 7 tribes declaring flood damages and a Presidential Declaration. There were in excess of 3,400 requests for individual assistance and public infrastructure damage estimates exceed 55 million dollars. Federal, state and local assistance due to flood losses in Montana from 1995 to 2006 totaled over 35 million dollars….Losses due to flood damage are likely to continue, and even increase, as Montana's beautiful streams and rivers

attract people who want to live near the water."[7] According to the Montana Department of Transportation, "erosion damage, debris flows, and landslides became the major issue statewide….and the highway infrastructure was severely compromised in several areas…[resulting in] 36.3 million dollars of damage to the state owned transportation infrastructure at 179 locations statewide…[including] the replacement of two bridges… and 80 river/roadway erosion sites."[8]

In terms of mapping river hazards, Channel Migration Mapping is the most cost-effective method available for developing scientifically-based information. At the scale of this project, over 500 miles of mapped channel, the mapping costs are approximately $500/mile for planning and management-level information, along with public outreach and education efforts. In contrast, floodplain mapping at the minimum level required for regulatory purposes is a minimum of $5,000 to $10,000 per mile or more. The proposed Channel Migration Mapping has the added benefit of developing a variety of useable products:

- River-based maps of comprehensive river hazards showing channel migration mapping (both existing and any developed in this project), available digital floodplain boundaries (DFIRM), and ice jam locations from the Army Corps of Engineers Ice Jam Database (http://icejams.crrel.usace.army.mil/).
- A report for each mapped river detailing regional hydrology, geology, and geomorphology; methodology and analysis for the river; and a detailed listing of each channel migration site that can be used for doing site-specific assessments.
- Historic river corridor imagery that has been spatially referenced and mosaiced for use in a Geographic Information System (GIS).
- GIS data including mapped bankline locations, reach breaks, migration vectors, and each of the Channel Migration Mapping boundaries.
- Any ancillary datasets such as physical features (rip rap, levees, diversions, etc.) that were either existing or generated for the project.

All of these products are useful tools individually for outreach efforts, educating landowners, and for assessing changes in the associated communities. For instance:

According to a recent presentation on the links between economics and conservation in Montana and the West, "Growth has a high impact on rivers," yet if the resource is maintained, growth may positively affect the economics of an area[9].

- A study of residential property values along rivers in Michigan shows that values for properties along natural rivers have "were both higher and increased faster…than non-designated rivers."[10]
- A 2002 analysis of the property values of thousands of home sales near riparian areas proposed for protection by The University of Arizona shows "a property value premium of three to six percent for homes located within a half a mile of riparian areas proposed for protection….This premium adds up to over $103 million dollars for the 25,560 homeowners."[11]

[7] Draft Report, Mary Gibson – Flood Risk Map Program Coordinator, Montana Department of Natural Resources and Conservation, May 2012.

[8] Highground,- September 2011, Floods and Montana Department of Transportation, Montana Department of Natural Resources and Conservation – Floodplain Management Program, 2011.

[9] Economics & Conservation, presentation by Headwaters Economics, December 2011.

[10] Why We Need the Natural Rivers Program – Fact Sheet #4, Michigan Land Use Institute, 2010.

[11] Riparian Areas Generate Property Value Premium for Landowners, The University of Arizona – College of Agriculture and Life Sciences, 2002.

This effort will result in a number of direct and indirect benefits.

Direct Benefits:

Properly understanding the risks and hazards presented by dynamic streams leads to direct cost savings to anyone living or working along stream corridors. This cost savings can be both monetary and in terms of psychological stress. The following are just a few examples of the broad-reaching direct costs/benefits associated with responding to flooding and channel migration issues that could be mitigated or avoided:

1. This project supports the benefits noted in the 2011 Montana Floodplain Management Assessment developed by the Montana Department of Environmental Quality[1]. The direct benefit is stated as follows:
   - *Reduce flood risk and damages, and protect the natural and beneficial functions of floodplains.*
2. Ruby Valley residents and 310 Permit applicants Dawne and Doug Smith indicate that they would not have built in their present location had they been able to access Channel Migration Mapping for the Ruby River. They are currently debating the costs associated with either defending their current home location by controlling the river, or physically moving their home outside of the mapped channel migration hazard area. The monetary and psychological costs of these decisions are both high.
3. Bitterroot Valley resident and Conservation District Supervisor Howard Eldredge shared his personal experiences of living near a small stream in a recent Montana Audubon video *Falling for the Creek*[12].

   "There is a cost in both living by the water, both in anxiety…stress…and there's a dollar cost, and it can be spendy."

   "When it starts to happen [runoff] is the absolutely worst time to try to deal with it."

   "I thought I had asked enough of the right questions, and there is very little regulation or law to protect people from doing what really doesn't make sense."
4. While a specific analysis has not been completed on the flood-related costs on the Musselshell River, most of the impacts to infrastructure (roads, bridges, pumps, diversions, etc.) and the loss of structures was associated with channel migration and avulsion. Some of these impacts may have been avoided if river hazard mapping was available. Current responses to the damage (pump relocations, road reconstruction, etc.) are being made in relation to the physical processes on the river.

Indirect Benefits:

The indirect benefits achieved through this project are numerous.

1. This project also supports the rest of the benefits noted in the 2011 Montana Floodplain Management Assessment developed by the Montana Department of Environmental Quality[1]. These benefits are as follows:
   - *Protect the property rights of existing residents by not allowing new development to cause additional flooding and/or erosion.*

[12] Falling for the Creek – Avoiding Troubled Waters, Montana Audubon, 2011 (http://www.mtaudubon.org/issues/wetlands/planning6.html#1).

- *Prevent inappropriate community infrastructure and development in hazardous areas.*
- *Reduce risk to emergency personnel attempting to rescue people in danger.*
- *Protecting the unique and important fishery and other renewable resources of Montana's rivers and streams.*

2. Water quality, aquatic habitat, and wildlife habitat protection results from allowing floodplains, wetlands, and riparian areas to perform their natural functions.
3. Channel Migration Mapping has a great variety of potential applications. Figure 10 lists some of the potential uses. Montana has no regulatory requirements for the applications of Channel Migration Mapping.

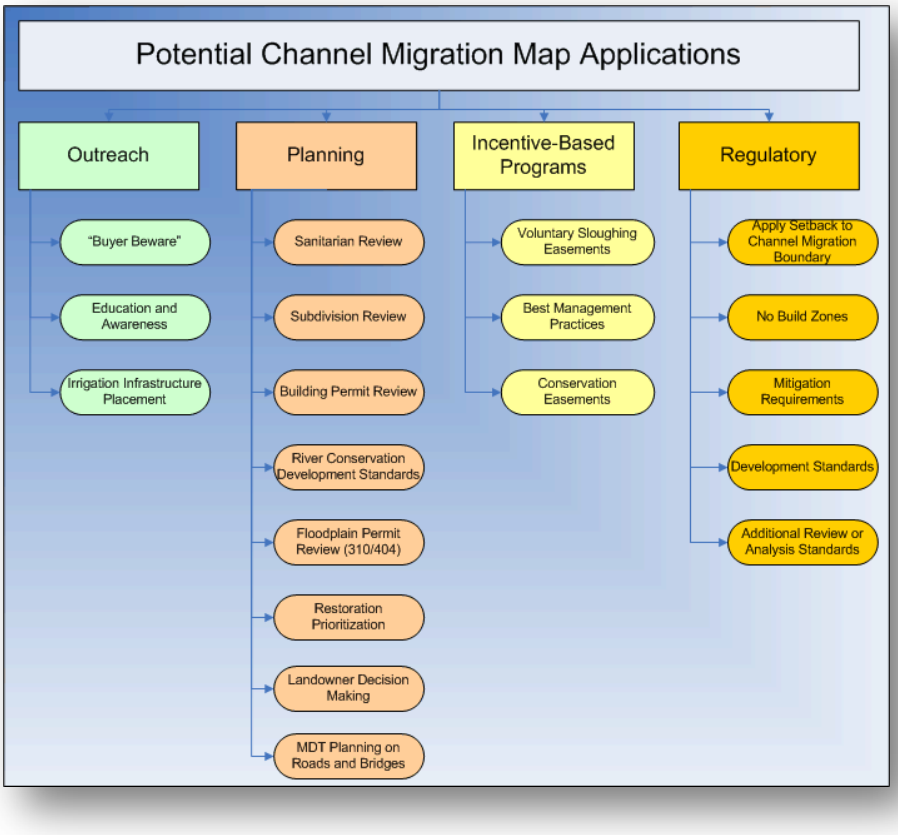


Figure 10. Potential uses for Channel Migration Mapping.

3. Project Alternatives –

This following section provides a discussion of alternatives for the proposed project work, including the proposed project as the "Preferred Alternative."

Alternative 1.	No Action
Alternative 2.	Flood Hazard Map Development (Preferred Alternative)
Alternative 3.	FEMA Floodplain Mapping
Alternative 4.	Inundation Modeling
Alternative 5.	Regulatory Building Setbacks

Alternative 1 - No Action

Montana is required by both state and federal legislation to manage for impacts from floods. As such, No Action is not an alternative. State agencies, primarily the DNRC Water Resources Division are already developing tools and guidelines for addressing flooding. However, this floodplain work does not address the very real hazards of channel migration and avulsion. As noted above in the Cost/Benefit analysis, managing for both flood and erosion hazards is critical for:

- Maintaining property values,
- Maintaining the quality of natural resources, and
- Reducing the long-term costs to managing the stream's impacts.

While it is impossible to avoid all impacts created by stream dynamics and flooding, having complete information on likely impacts from flooding and channel migration is critical to avoid many issues. Impacts to health and human safety, loss of personal and public property, and loss of agricultural infrastructure (pumps, pivots, etc.) can be expensive and result in long-term degradation of natural resources. Alternately, efforts to control the impact to property through the construction of bank protection, dikes, and levees, can be equally costly and result in similar degradation of resources. No Action would simply promote these sorts of behavior and increase the negative consequences.

Alternative 2 – Flood Hazard Map Development (Preferred Alternative)

Channel Migration Mapping (CMM), combined with floodplain modeling and outreach/education provides the most complete picture of potential hazards in a stream corridor and places these tools in the hands of the people who are making critical land use decisions along river corridors. Montana currently has a strong floodplain mapping program that is resulting in both new floodplain mapping for critical sections of river, as well as converting existing floodplain mapping into modern DFIRMs (Digital Flood Insurance Maps). Channel Migration Mapping has been in use as a hazard mapping and river corridor management tool for over a decade and is rapidly gaining acceptance in Montana and elsewhere. Comprehensive flood hazard mapping products result in the most robust set of tools for decision making within river corridors.

The preferred alternative focuses on Channel Migration Mapping for six of the mainstem rivers in the Upper Missouri River Headwaters basin (Gallatin, East Gallatin, Beaverhead, Madison, Jefferson, and Ruby (upper) Rivers) and identifying floodplain mapping needs and priorities for these rivers. At approximately $500/mile, Channel Migration Mapping is an extremely cost-effective method of developing critical river hazard mapping information. In contrast, floodplain modeling and associated mapping costs typically run around $5,000 to $10,000/mile. Channel Migration Mapping results in detailed information on local and regional rates of channel movement based on historic rates of migration. This information is used for a broad range of uses, including 310 permit review, structure locating, cost/benefit analysis for proposed actions, and sanitarian review (Figure 10).

In addition to the Channel Migration Mapping, this project will develop the Discovery reports that the

DNRC uses to assess and prioritize potential new floodplain mapping projects. These scoping reports are part of the DNRCs efforts at developing a statewide floodplain mapping strategy and meeting the legislative intent of the 1971 Montana Floodplain and Floodway Management Act.

The three-pronged approach of CMM, floodplain mapping scoping, and education/outreach on the proposed rivers is consistent with the DNRCs floodplain mapping priorities. As such, the project activities will be sequenced so that the CMM and floodplain scoping are in sync. Six of the nine rivers in the study area are included within the DNRCs top two priorities[7]:

- 1st Priority Rivers include the Gallatin River.
- 2nd Priority Rivers include the Jefferson, Big Hole, Ruby, Madison, and Boulder Rivers.

Alternative 3 – FEMA Floodplain Mapping

Floodplain modeling, resulting in FEMA Flood Insurance Rate Maps (FIRMs) are the typical approach to identifying the hazards associated with streams and river flooding. These maps identify the areas of likely inundation by flood waters at a given flood event (e.g. 100 year flood). While elevated water elevations do create damage to properties, once the waters recede, the long-term impacts are generally limited and recoverable. In contrast, channel erosion is an ongoing risk that can be exacerbated by elevated water levels. More water equates to more energy on banklines, resulting in more movement to banklines during higher water events. While DNRC is actively engaged in FIRM mapping in Montana through the Risk Map program, FIRM maps do not identify these hazards and provide no information for planning for these types of impacts.

As such, FEMA Floodplain mapping alone is insufficient for identifying the hazards associated with rivers.

Alternative 4 – Inundation Modeling

Inundation modeling is another form of floodplain mapping. It can be used for developing Approximate Zone A FIRM maps. This approach is being explored by the DNRC in a pilot project on the Big Hole River. It has the potential to greatly reduce the cost of regulatory floodplain mapping, but still does not address additional hazards such as channel migration.

Alternative 5 – Regulatory Building Setbacks

Setbacks have been used extensively to define regulatory boundaries associated with river corridors. They are an effective, low-cost method of directing development away from river corridors, and do a lot to protect water quality, aquatic habitat, and wildlife habitat. But they have numerous drawbacks when it comes to protecting people and property from river hazards. For example, fixed setback distances are somewhat arbitrary in nature and bear little correlation to the physical processes or conditions on the river. As such, they can either under or over-estimate risk. Given the scenario of a fixed 300-foot setback requirement with no channel migration information or other technical assessment taking site-specific conditions into account, a home built on a low, alluvial floodplain 300 feet from the river bank may still get flooded or face risk of erosion. Alternately, a home built on a rock bluff 50 feet above the river would be required to be set back 300 feet from the river, even though it faces no risk of flooding or erosion. This leads to another key drawback. Because setbacks are not reflective of river process, making them regulatory is usually an uphill battle in Montana, both locally and statewide.

4. Staffing and Administration –

The following sections describe the project's staffing and administrative structure.

A. Staff Roles and Responsibilities -

This work will be overseen by the Ruby Valley Conservation District, with Rebecca Mayfield Ramsey as the primary contact. The majority of work will be performed by an as-yet-selected contractor with direct experience in Channel Migration Mapping, floodplain processes, and outreach efforts. A Technical Advisory Committee will advise and review on key mapping and analysis issues. A variety of local stakeholders have provided in-kind staff time to assist with project coordination, work, and outreach and education efforts.

Name	Affiliation	Full/Part Time?	Employee or Contractor?	Role
Rebecca Mayfield Ramsey	Ruby Valley Conservation District	Part	Employee	Project and Contract Manager
Technical Working Group	State and Federal Agencies (e.g. DNRC, DEQ) and local expertise as necessary.	Part	A core mix of Stakeholders with expertise in river function, flood and Channel Migration Mapping	Select Contractor Technical Review Accuracy Assessment Oversee and Coordinate Work Scope State Agency Coordination
Local Representation	Conservation Districts, Watershed Councils, Counties, local floodplain administrators and planning staff, etc.	Part	A mix of Stakeholders, both Employees and Volunteers	Local Stakeholder Coordination
Contractor	To Be Determined	Part	Contractor	The Contractor will be responsible for performing the Channel Migration Mapping, flood mapping scoping, analysis, and reporting. They will be under direction of the RVCD, with input from the TAC.

B. Administrative Structure -

As the applicant, the Ruby Valley Conservation District (RVCD) will be the contracting agency for all project activities. A Technical Advisory Committee (TAC) of key stakeholders associated with each river will be convened to select the contractor, provide technical oversight, perform accuracy assessments, and review work products throughout the project. A contractor with knowledge of Channel Migration Mapping techniques, local knowledge of the rivers and associated issues, and a strong track record of completing projects on time, on budget, and working with local entities will be selected once funding is established. The contractor will report to the RVCD Project Manager for all project-related decisions. It is the responsibility of the RVCD to coordinate the TAC.

5. Additional Information

A. Deeds, Easements, Rights-of-Way –

This project does not entail any construction. As such, we do not anticipate any need for access to deeds, easements or rights-of-way. Any access to private property necessary to complete this project (e.g. for field visits to assess stream condition) will be secured when necessary.

B. Permits –

This project does not entail any construction. As such we do not anticipate the need to secure any permits.

C. Maps and Photos –

There are nine major river corridors that define the Upper Missouri River Headwaters. While the ultimate goal of this effort is to develop comprehensive river hazard mapping for each of these rivers, the project is currently limited by available funding for six of those rivers (Figure 11). Due to the broad extent of the project area, Section/Township/Range information was omitted from the map.

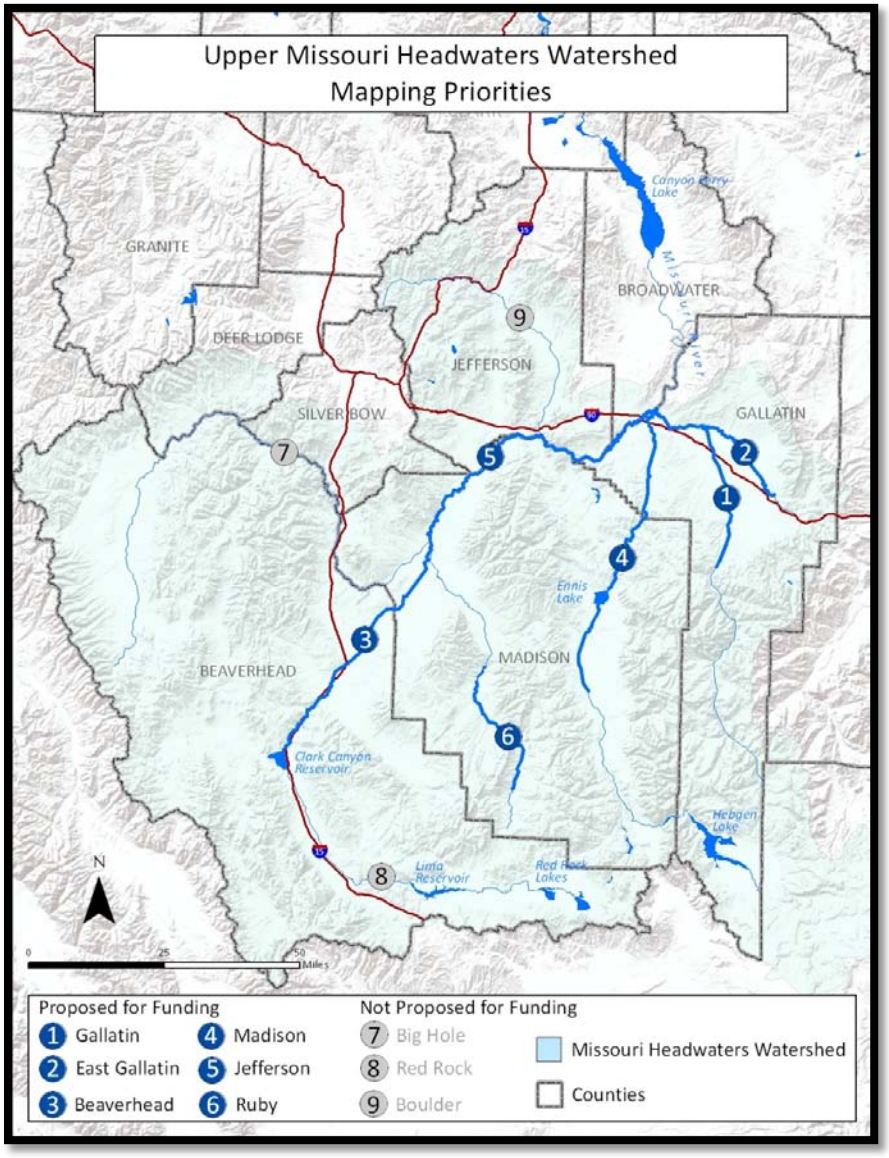


Figure 11. Project location. Six of the nine rivers of the Upper Missouri Headwaters will be mapped through this effort.

Mineral Rights and Historical Sites

The project activities will not infringe on any surface or mineral rights, or any historic or archaeological site. No construction activity is planned. As such, no investigation of historical or archeological sites is warranted.

D. Plans and Specifications –

This project does not require any construction. As such, no plans or construction specifications are included.

The details of the Channel Migration Mapping methodology are found in the Step 4 - Scope of Work section, with additional details found in the Appendices.

STEP 4 - SCOPE OF WORK

1. Goals and Objectives –

The primary objective of this project is to generate a set of planning tools to help river managers, landowners, developers, and other interested entities make informed decisions on land use and river management. In total, this project will go a long ways towards creating comprehensive river hazards mapping for the Upper Missouri River Headwaters rivers. This broad objective has three key goals and associated objectives:

1. Develop Channel Migration Mapping for the major Upper Missouri River Watershed rivers along with the required GIS datasets and reports;
2. Develop floodplain mapping scoping Discovery Reports required by the DNRC in support of the Montana Floodplain Mapping Program for selected rivers in the study area; and
3. Provide outreach and educational opportunities about river process, hazards, and management tools.

Goal 1: Develop Channel Migration Mapping for the Major Upper Missouri River Watershed Rivers

Channel Migration Mapping is a low-cost, scientifically-based methodology for defining the areas at risk of river occupation due to migration (the constant process of a channel moving laterally across a floodplain due to erosion) and/or avulsion (the rapid and often catastrophic relocation of a stream channel and the abandonment of the existing channel).

Objective 1.1: Generate the required GIS datasets and associated data documentation (metadata) for the mapping and make this information available to the local and state entities for use. These data have proven useful for assessing and documenting site conditions outside of the Channel Migration Mapping process. These data include:

- **1950's era digital photo mosaic** – Appendix IV lists the required imagery for developing an orthorectified, historic photo mosaic for each river in study. The 1950s era photography is generally at a scale of 1:20,000 and is necessary to provide the 50-plus year period of record required for Channel Migration Mapping. An example of available imagery footprints is shown in Figure 12.
- **1970's era digital photo mosaic** – Appendix IV lists the required imagery for developing an orthorectified, historic photo mosaic for each river in study. This intermediate data set often captures events in dynamic reaches and allows for a more refined determination of migration rates. The image scale is generally 1:40,000.
- **River Banklines** – A series of three GIS datasets will be developed representing the river banklines shown in the 1950s, 1970s, and 2011 (NAIP) photography. These banklines cumulatively result in the historic footprint of the river over the period of record and are used to measure the rates of migration for each bendway in the river.
- **Migration Vectors** – A series of three measurements are taken at each actively moving bendway in the river. These migration vectors are statistically summarized to produce typical migration rates for each section of the river.
- **Reach Breaks** – Each river channel will be subdivided into geomorphically similar sections for analysis.
- **Channel Migration and Avulsion Areas** – Analysis of the above datasets will result in a consistent set of channel migration and avulsion hazard areas within the GIS.

- **Other River Hazards** – The GIS database will contain all of the available associated river hazards such as flood mapping and ice jam hazards, resulting in a comprehensive river hazard dataset.

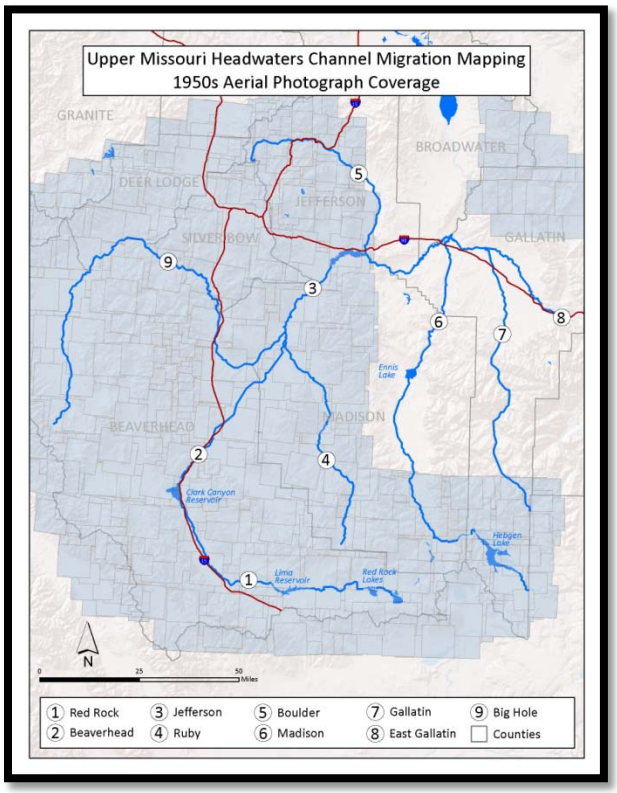


Figure 12. Available 1950's-era imagery footprints. Footprints are available for all historic imagery.

Objective 1.2: Generate Channel Migration Maps, analysis, and associated reports for the Gallatin River, East Gallatin, Beaverhead, Madison, Jefferson, Ruby (Upper) Rivers. These maps will be a comprehensive depiction of available river corridor hazards, including: channel migration areas, avulsion hazard areas, historic channel locations, floodplain mapping (in those areas that have Digital Flood Insurance Rate Maps available), and known locations of ice jams.

Objective 1.3: Produce the maps and reports in a variety of formats (printed hard copies, PDF, JPG, etc.) to allow for the most extensive distribution of the information.

Objective 1.4: Finalize the GIS data, reports, and metadata. Deliver the final reports and data to stakeholders and State Library for archiving.

Goal 2: Develop Required Floodplain Mapping Scoping

The 1971 Montana Floodplain and Floodway Management Act was enacted to minimize damage and impacts to public health and human safety due to recurring floods. Additionally, the Act was developed to meet the national flood insurance requirements implemented in 1968. The DNRC Floodplain Management Section was later developed to meet the legislative intent of the Act and continues to maintain a management plan for floodplain mapping in Montana. Scoping the needs, interest, conditions, costs, and resource availability for streams is an important part of this management plan and helps to prioritize future floodplain mapping efforts, as well as provide support for securing funding for additional floodplain mapping. It also moves the control of floodplain mapping efforts into the hands of the state and local authorities, rather than FEMA-directed sequencing plan. Goal 2 of this project is directed at

supporting the DNRC's floodplain scoping needs for prioritized rivers within the Upper Missouri Headwaters through a Discovery Process.

Objective 2.1: The project contractor will work with the DNRC Water Resources Division to develop the required floodplain mapping scoping and Discovery Process for the Gallatin, Beaverhead, Madison, and Jefferson Rivers. The spatial extents of the scoping areas will coincide with those of the Channel Migration Mapping to ensure consistent hazard mapping on each river. These rivers represent the areas with the greatest populations that have not already been scoped and/or received floodplain mapping. Additional rivers will be included if funding permits.

Objective 2.2: Prioritize scoping efforts to coincide with both the sequence of Channel Migration Mapping and with DNRC/FEMA sequencing goals.

Objective 2.3: Collect required Discovery information such as population statistics, existing floodplain mapping, ongoing/future efforts, needs, numbers of permits in the floodplain, and existing LOMCs.

Objective 2.4: Document Discovery information in a report for each river studied.

Objective 2.5: Integrate existing digital floodplain mapping (DFIRMs) into the comprehensive river hazard maps.

Goal 3: Provide Outreach and Educational Opportunities about River Process, Hazards, and Management Tools

The comprehensive river hazard mapping that results from this effort will be presented at a series of public educational and outreach workshops. Similar efforts on the Yellowstone, Clark Fork, Flathead, and Lower Ruby Rivers all included a component of public outreach. These workshops are attended by a variety of stakeholders, including: regulators, public officials, landowners, realtors and educators. Developing public and private awareness to the hazards of living along a river corridor, as well as developing knowledge of the tools available for understanding those risks, is critical for maintaining the quality and function of these resources under increasing pressures.

Objective 3.1: A series of six public workshops will be held throughout the basin. These workshops will be designed to focus on the unique aspects of each community's rivers.

Objective 3.2: Work with local regulators to ensure that the project tools are understood and available.

Objective 3.3: Follow up with regulators and project stakeholders to generate feedback on the use of the tools, potential enhancements, and continue the education process.

2. Tasks or Activities –

The following steps will be performed to generate the Channel Migration Maps. These steps can be taken for each river, or certain steps can be performed for all of the rivers at the same time. For example, all of the required imagery can be purchased and delivered to the orthorectification contractor (Objective 1a – 1 and 2) at the beginning of the contract. Then the remaining steps can be performed sequentially for each river according to their priority. This would effectively stagger required work, allowing interim products for each river to be developed.

Goal 1 - Develop Channel Migration Mapping for the Major Upper Missouri River Watershed Rivers

Objective 1.1 - Compile Required GIS Datasets

1. Acquire historic imagery from public archives representing two time periods. These data were identified in the Planning Grant and are listed in Appendix IV of this application. Medium-resolution scans from original negatives will be ordered from the USGS EROS Data Center and/or the USDA Aerial Photography Field Office.
2. Orthorectify and mosaic the historic imagery for use in a Geographic Information System (GIS). This process will be performed by MapCon of Salt Lake City, or other appropriate contractor. MapCon has been successfully used on a number of other projects and has produced excellent photomosaics that meet or exceed National Spatial Data Infrastructure's standards for spatial data accuracy.
3. Develop a GIS database to store project data and develop associated GIS data sets necessary for Channel Migration Mapping. The ESRI Geodatabase data model for performing mapping is well-established from other mapping efforts in Montana. The key datasets include:
    a. Digitize the three suites of channel banklines that are used for channel migration measurements and analysis. These will include the two historical suites of imagery, as well as the most recent NAIP imagery (likely 2011). If necessary, a fourth suite of imagery may be used (1995 DOQs) to help refine migration rates in some areas. Banklines are digitized to represent an interpreted bank full condition. Using bank full as a reference avoids the problems that arise when the available photography was acquired at different flow conditions.
    b. Reach Breaks – used to segment the rivers into geomorphically similar regions for analysis. Changes in conditions such as valley shape, river planform (braiding, sinuosity, etc.), land use, geology, and hydrology (tributaries or dams), are commonly used for defining reach breaks. Reaches typically range from one to seven miles, depending on the characteristics of a stream.
    c. Channel Centerlines – A channel centerline is generated from the most recent suite of imagery to define river stationing. This stationing is used to reference individual migration sites, reach breaks, and other key features in the river corridor to a common measure.
    d. Migration vectors are used to calculate typical migration distances. Three measurements are taken at each site and stored in the GIS project. These measurements are attributed by site, reach, and geologic unit. The values are then statistically summarized to determine typical migration rates for each reach. A range of statistical parameters such as minimum, mean, maximum, and quartiles are used to characterize the channel migration throughout the river corridor. Based on the representativeness of the time frame evaluated, an appropriate statistic is selected to represent anticipated future trends in average channel movement. Mean migration rates typically suffice as the adopted statistic.
    e. GIS-based inundation modeling is generated for each stream in the study to help identify potential sites susceptible to avulsion. Typical stage/discharge relationships are used to generate a general flood inundation surface. Intersecting this surface with the valley elevation data set produces a dataset showing potential depth of inundation. This is an excellent, low-cost approach to identifying the locations and continuity of subtle swales, historic channels, and other features that may influence water flow during extended high-water events that may lead to bendway cutoffs or other avulsions.
    f. Geologic Breaks – In systems with complex geology such as bedrock valley boundaries

or terraces, geologic breaks can be used to further stratify potential channel migration rates. For example, bedrock valley walls are typically clipped out of the Channel Migration Mapping as any channel movement in those locations is typically due to a catastrophic mass failure event, not channel migration.

g. Historic Migration Area – A composite polygon that combines historic bankfull channel traces defines the cumulative footprint of the river over the period of record which is referred to as the Historic Migration Area.

Objective 1.2 - Generate Channel Migration Maps

1. Analyze the GIS data and calculate the recommended channel migration buffers.
2. Get approval for migration buffers and analysis from the Technical Advisory Committee and stakeholders.
3. Develop the final Channel Migration Mapping areas in GIS by applying the approved buffers to the current stream channel. This will result in two additional GIS data sets:
    a. Channel Migration Area (CMA) – a buffer extending landward from the most recent channel banklines to represent the area with a high potential for future channel occupation due to lateral migration.
    b. Avulsion Hazard Area (AHA) – a mapped region encompassing floodplain areas such as bendway cores, historic swales, etc. that are prone to channel reoccupation due to avulsion.
4. Write the technical report detailing the methodology, challenges, and results for each river. Portions of each report (e.g. methodology) will be the same for all of the resulting reports. Sections that describe specific river conditions and processes will be unique to each report.
5. Generate the standardized Channel Migration Maps. These maps will provide a comprehensive depiction of several river corridor hazards, including: channel migration areas, avulsion hazard areas, historic channel locations, floodplain mapping (in those areas that have Digital Flood Insurance Rate Maps available), and known locations of ice jams.
6. Present maps and results to the stakeholders.

Objective 1.3 - Finalize the Maps & Reports

1. Perform final map edits.
2. Export the maps and reports to the necessary formats (PDF, JPG, TIFF, etc.) and print hard copies.

Objective 1.4 - Finalize the Data

1. Review and finalize all GIS data. This includes reviewing the datasets and attributes for consistency.
2. Generate any metadata to describe the datasets.
3. Deliver the datasets to stakeholders on DVD. The project Geodatabase will be relatively small, but the historic imagery (original and photomosaics) will be quite large.

Goal 2 - Develop Required Floodplain Mapping Scoping

Objective 2.1 - Floodplain Mapping Scoping

1. Contact and coordinate with the DNRC Water Resources Division to develop the current standards for the floodplain mapping Discover Process. Use this information to generate the

specific Scope of Work for this task. This process is constantly evolving, and thus cannot be finalized at this time.

2. Finalize the extent of river to be mapped.

Objective 2.2 – Prioritize Floodplain Mapping Scoping

1. Coordinate with the Channel Migration Mapping tasks and with the DNRC to ensure that the sequence of mapping and floodplain scoping is consistent with current needs and DNRC/FEMA priorities.

Objective 2.3 – Collect Floodplain Mapping Scoping Information

1. Collect and compile population information.
2. Collect and compile current floodplain mapping extents.
3. Collect and compile existing permitting information (e.g. floodplain modifications, LOMCs, etc.)
4. Assess needs through an interview process of local officials, regulators, and stakeholders.

Objective 2.4 – Compile Floodplain Mapping Scoping Discovery Reports

1. Compile information into a series of river-level floodplain mapping Discovery Reports.
2. Present results to the DNRC and revise as necessary.

Objective 2.5 – Integrate Floodplain Mapping with the Comprehensive River Hazard Maps

1. Integrate any existing digital floodplain mapping (DFIRMs) that were identified in the scoping process into the comprehensive river hazard maps.
2. Ensure that proper warnings and credits are noted on the resulting maps.

Goal 3 - Provide Outreach and Educational Opportunities about River Process, Hazards, and Management Tools

Objective 3.1 – Hold Outreach and Education Workshops

1. Coordinate with local stakeholders to organize six public workshops. Workshops that have been held in other basins can range from 1 to 3 hours and are often coordinated with other activities such as watershed council meetings, realtor workshops, floodplain workshops, and conservation district meetings.
2. Prepare meeting materials including PowerPoint presentations, handouts, and feedback forms.
3. Conduct the outreach meetings.
4. Integrate feedback into any following meetings to ensure the quality and content of the outreach/education meetings are successful.

Objective 3.2 – Work with Local Regulators

1. Contact local officials and regulators to determine needs.
2. Develop any specific tools or documentation to enhance use of the project tools.
3. Work with local officials and regulators and provide education on the mapping products, their use, and limitations.

Objective 3.3 – Follow-up on Outreach and Education Efforts

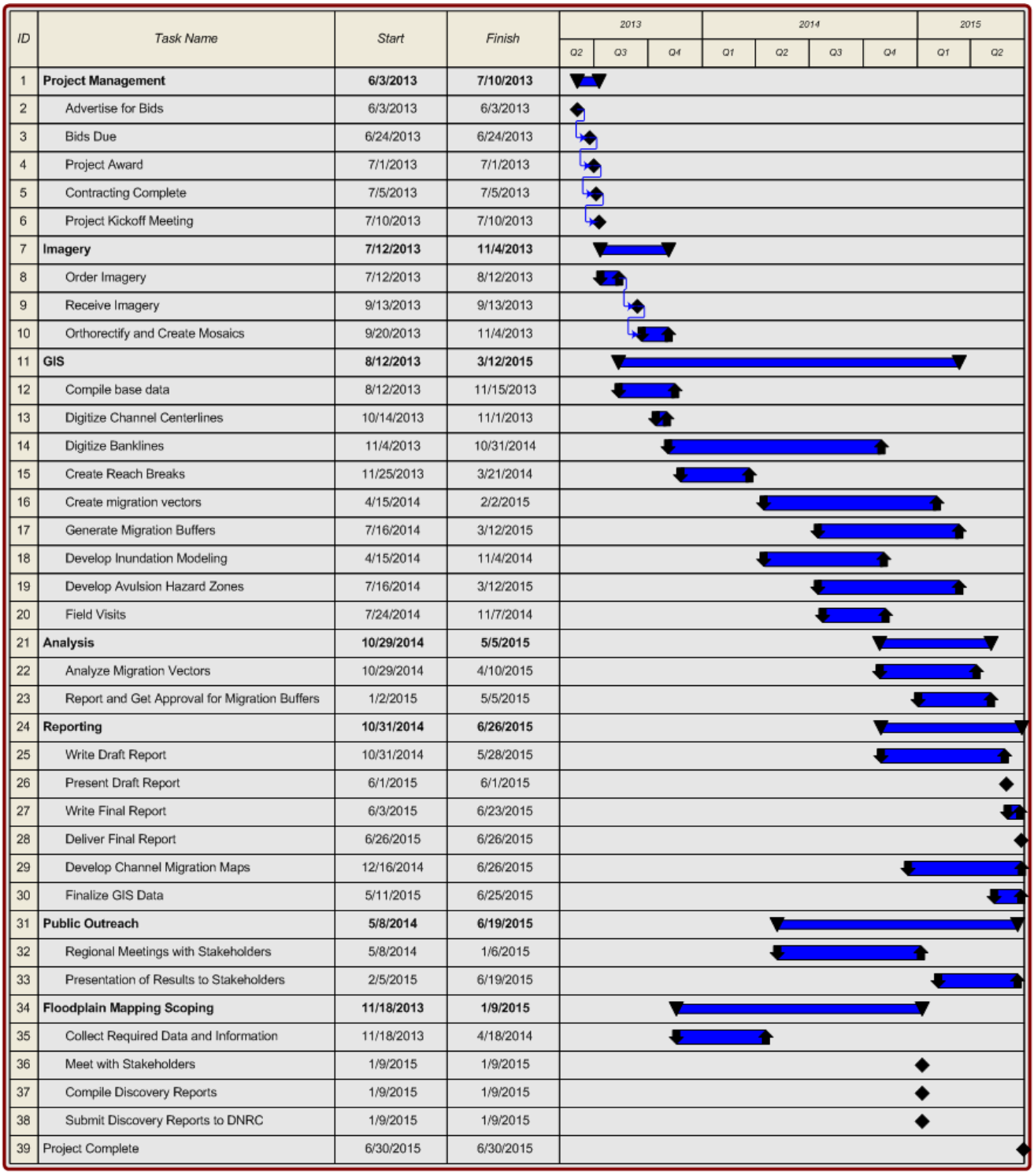
1. Contact regulators and stakeholder to follow up on the project tool use.
2. Document any use to help with performance monitoring of the tools.
3. Integrate any information into future trainings or mapping products.

3. Project Schedule –

Due to the number of river systems and the total length of river to be mapped, a two-year time frame is expected in order to complete this project. The project schedule (Figure 13) lists the major tasks and milestones required for completing this project successfully. Once contracting is complete, the selected contractor should be able to start project tasks immediately. The first step, ordering the historic aerial photography, can be implemented immediately as the required photography is listed in Appendix IV of this application. We anticipate that once the historic imagery is available, work will be staged river-by-river according to the prioritization listed in Table 1. The project should culminate with a master report and a series of public outreach meetings throughout the watershed.

Priority	River	Proposed for Funding	Channel Length*
1	Gallatin River (Gallatin Canyon mouth to confluence)	Yes	103
2	East Gallatin River (All)	Yes	46
3	Beaverhead River (Clark Canyon Res. To Twin Bridges)	Yes	106
4	Madison River (Odell Spring Creek to Three Forks)	Yes	87
5	Jefferson River (All)	Yes	123
6	Ruby River (Upstream of Ruby Reservoir, lower is already mapped)	Yes	46
7	Big Hole River (Wisdom to Twin Bridges)	No	100
8	Red Rock River (Lima Reservoir to Clark Canyon Reservoir)	No	47
9	Boulder River (All)	No	109
	*Channel Length is approximated based on the length of primary and side channels, plus a sinuosity factor.		

Table 1. River mapping prioritization.



ID	Task Name	Start	Finish
1	**Project Management**	**6/3/2013**	**7/10/2013**
2	Advertise for Bids	6/3/2013	6/3/2013
3	Bids Due	6/24/2013	6/24/2013
4	Project Award	7/1/2013	7/1/2013
5	Contracting Complete	7/5/2013	7/5/2013
6	Project Kickoff Meeting	7/10/2013	7/10/2013
7	**Imagery**	**7/12/2013**	**11/4/2013**
8	Order Imagery	7/12/2013	8/12/2013
9	Receive Imagery	9/13/2013	9/13/2013
10	Orthorectify and Create Mosaics	9/20/2013	11/4/2013
11	**GIS**	**8/12/2013**	**3/12/2015**
12	Compile base data	8/12/2013	11/15/2013
13	Digitize Channel Centerlines	10/14/2013	11/1/2013
14	Digitize Banklines	11/4/2013	10/31/2014
15	Create Reach Breaks	11/25/2013	3/21/2014
16	Create migration vectors	4/15/2014	2/2/2015
17	Generate Migration Buffers	7/16/2014	3/12/2015
18	Develop Inundation Modeling	4/15/2014	11/4/2014
19	Develop Avulsion Hazard Zones	7/16/2014	3/12/2015
20	Field Visits	7/24/2014	11/7/2014
21	**Analysis**	**10/29/2014**	**5/5/2015**
22	Analyze Migration Vectors	10/29/2014	4/10/2015
23	Report and Get Approval for Migration Buffers	1/2/2015	5/5/2015
24	**Reporting**	**10/31/2014**	**6/26/2015**
25	Write Draft Report	10/31/2014	5/28/2015
26	Present Draft Report	6/1/2015	6/1/2015
27	Write Final Report	6/3/2015	6/23/2015
28	Deliver Final Report	6/26/2015	6/26/2015
29	Develop Channel Migration Maps	12/16/2014	6/26/2015
30	Finalize GIS Data	5/11/2015	6/25/2015
31	**Public Outreach**	**5/8/2014**	**6/19/2015**
32	Regional Meetings with Stakeholders	5/8/2014	1/6/2015
33	Presentation of Results to Stakeholders	2/5/2015	6/19/2015
34	**Floodplain Mapping Scoping**	**11/18/2013**	**1/9/2015**
35	Collect Required Data and Information	11/18/2013	4/18/2014
36	Meet with Stakeholders	1/9/2015	1/9/2015
37	Compile Discovery Reports	1/9/2015	1/9/2015
38	Submit Discovery Reports to DNRC	1/9/2015	1/9/2015
39	Project Complete	6/30/2015	6/30/2015

Figure 13. Proposed project schedule.

4. Monitoring Plan –

While this project is not site-specific, measuring the performance of Channel Migration Mapping is still possible. There are two ways to accomplish this. The first is to compare the calculated buffer distances to the actual channel movement at known locations. This performance measurement is already part of the process of developing the channel migration buffer sizes (Figure 14). Since the historic imagery and the resulting digitized banklines represent at least 50 years of channel movement, it is possible to buffer the oldest bankline locations with the buffer distances, and then to note the areas in the cumulative footprint of the river (Historic Migration Area) that fall outside the buffer. If the buffer on the oldest imagery contains most of the historic migration, then the buffer is likely appropriate. Note that, since the buffer distances are usually based on the average rates of migration in a reach, one would expect for some areas of migration to exceed the buffer distance. A variation of this method can also be applied when new imagery is acquired or after significant hydrologic events such as flooding. If migration is generally contained within the mapped migration buffers, then the buffer distances are likely appropriate for the reach.

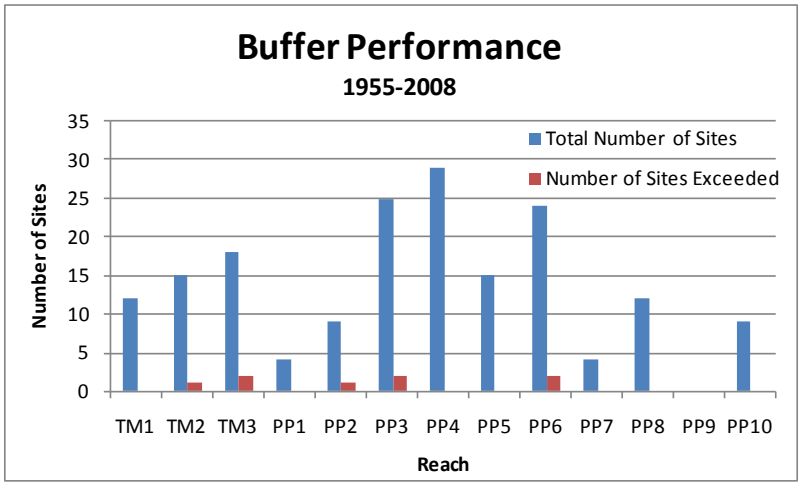


Figure 14. Buffer distance performance analysis on Prickly Pear and Tenmile Creeks.

This method was used on most of the existing Channel Migration Mapping in Montana. The reports for the Ruby River, Flathead River, and Prickly Pear/Ten Mile Creeks all include an analysis of the buffer distances in relation to the oldest channel location and the historic footprint of channel locations. In each case, there are some areas that exceed the buffer distance over the approximately 50-year time frame. This analysis was presented to the oversight committees for each project and deemed acceptable performance.

Recently, this assessment was performed on all of the rivers that currently have Channel Migration Mapping in Montana. Using the 2011 NAIP imagery was captured near the end of the record 2011 runoff. Throughout Montana, a large amount of change was noted due to erosion of existing banklines and avulsion of the rivers into new channels. Figure 4, earlier in this document, shows one such area where a great deal of erosion occurred, but it is still contained within the mapped 100-year channel migration area.

The second method requires tracking the usage of the resulting Channel Migration maps and is difficult to quantify. For example, if City or County planning departments, Conservation Districts, or other users can note where decisions such as placement of structures (houses, barns, etc.), irrigation infrastructure (pivots, pumps, etc.), or bank protection (rip rap, barbs, etc.) were influenced through using the Channel Migration Mapping, then the mapping can be considered successful. Cooperative partners will be encouraged to track such information and report it to the project manager over time.

We are aware of numerous instances within the Ruby River and Yellowstone River Channel Migration Mapping efforts in which the mapping was referenced prior to making permitting or development

decisions. These include the following:

- Yellowstone River – A proposed pivot was relocated to avoid a bendway that was migrating downstream.
- Ruby River – Dawne and Doug Smith built their home on the inside of a meander bendway that was cut off during the 2011 runoff. They are using the Channel Migration Mapping to make informed decisions of whether to try and divert the stream back into its old channel, or to move their home.
- Yellowstone River – A private citizen in Yellowstone County is utilizing the mapping for community outreach regarding a proposed subdivision in a highly-mobile section of river.

5. Equipment –

No equipment purchases will be required for this project. Contractors will be responsible for providing any equipment, software, and licenses necessary to complete the work.

STEP 5 – BUDGET

BUDGET JUSTIFICATION NARRATIVE

The estimated cost for all tasks in Upper Missouri Headwaters River/Flood Hazard Map Development project is $497,275.00, of which $300,000 is requested from the RDGP program (Table 2). The costs and methodology were developed from the knowledge and experience of seven similar mapping efforts, covering approximately 700 river miles. As such, we are confident that the project can be completed within the proposed budget.

Category	RDGP	Ruby Valley Conservation District	Other Project Partners (See Notes)	Total	Notes
Administrative Costs					
Salaries and Wages	$ 24,000.00	$ 17,000.00		$ 41,000.00	
Fringe Benefits	$ 1,500.00	$ 1,000.00		$ 2,500.00	
Supplies & Materials	$ 500.00			$ 500.00	
Communications	$ 1,000.00			$ 1,000.00	
Travel	$ 2,000.00	$ 1,500.00		$ 3,500.00	
Rent & Utilities					
Equipment					
Miscellaneous (printing & document preparation)	$ 1,000.00	$ 500.00		$ 1,500.00	
Total Administrative Costs	**$ 30,000.00**	**$ 20,000.00**	**$ -**	**$ 50,000.00**	
Activity Costs					
Personnel Cost					
Contracted Services					
Project Management	$ 11,160.00			$ 11,160.00	See Contractor Costs
Beaverhead River Channel Migration Development	$ 49,770.00		$ 5,000.00	$ 54,770.00	Beaverhead Commisioners and Planning Contribution
Big Hole River Channel Migration Development				$ -	Will not be mapped: Cost to add is $53,000 (100 miles)
Boulder River (62 miles) Channel Migration Development				$ -	Will not be mapped: Cost to add is $55,000 (109 miles)
East Gallatin River Channel Migration Development	$ 22,940.00		$ 3,750.00	$ 26,690.00	Gallatin GIS and Greater Yellowstone Coalition
Gallatin River Channel Migration Development	$ 43,322.50		$ 6,250.00	$ 49,572.50	Gallatin GIS, Turner, and Greater Yellowstone Coalition
Jefferson River Channel Migration Development	$ 56,832.50		$ 7,000.00	$ 63,832.50	Madison County Contribution
Madison River Channel Migration Development	$ 23,865.00		$ 23,000.00	$ 46,865.00	MCD: 223 Grant; Other: Madison County Contribution
Red Rock River Channel Migration Development	$ -			$ -	Will not be mapped: Cost to add is $30,000 (48 miles)
Ruby River (62 miles already mapped) Channel Migration Development	$ 8,867.50	$ 8,000.00	$ 8,500.00	$ 25,367.50	RVCD: 223 Grant; Other: Madison County Contribution
Outreach and Education	$ 13,950.00		$ 70,000.00	$ 83,950.00	See supporting documentation for breakdown
Travel - Field Work	$ 1,752.50			$ 1,752.50	See Contractor Costs
Travel - Outreach and Education	$ 1,665.00			$ 1,665.00	See Contractor Costs
Floodplain Mapping Scoping	$ 23,655.00			$ 23,655.00	See Contractor Costs
Travel - Floodplain Mapping Scoping	$ 555.00			$ 555.00	See Contractor Costs
				$ -	
Printing (Channel Migration Maps & Reports)	$ 1,080.00			$ 1,080.00	See Contractor Costs
Printing (Floodplain Mapping Scoping)	$ 80.00			$ 80.00	See Contractor Costs
				$ -	
Supporting GIS Data Management	$ 10,170.00		$ 45,775.00	$ 55,945.00	Calculated as 25% of associated project work.
Miscellaneous Costs	$ 335.00			$ 335.00	See Contractor Costs
Total Activity Costs	**$ 270,000.00**	**$ 8,000.00**	**$ 169,275.00**	**$ 447,275.00**	
TOTAL PROJECT COSTS					
TOTAL	**$ 300,000.00**	**$ 28,000.00**	**$ 169,275.00**	**$ 497,275.00**	

Table 2. Project budget summary.

How will RDGP Funds be Used?

The total RDGP funding being requested is $300,000. Grant funds will be used to pay for a portion of contracted services for each mapped river. Cash contributions by project partners will be used to offset the costs of mapping each river. Where a project partner is responsible for multiple rivers (e.g. Madison County has jurisdiction for the Ruby, Madison, and Jefferson Rivers), their contribution is divided across each river. This breakdown is shown in the "Other Project Partners" column in the Budget Summary (Table 2).

Applicant's and Other Outside Funding Sources

Included in the total project budget is a $20,000 contribution by the Ruby Valley Conservation District, $51,000 in cash match from a variety of partners, and approximately $145,500 in associated in-kind services by project partners. Detailed estimates of costs for contracted services, in-kind contributions, and associated costs are included. Documentation of the cash and in-kind match are included with the Letters of Support in Appendix I.

The Ruby Valley and Madison CDs will be actively seeking additional funding in the form of HB 223 Grants to offset mapping costs. The RVCD will also encourage the other CDs to pursue funding.

Additional funding sources that are currently being pursued, but are not currently part of the budget, include:

- Gallatin Area Planning (GAP) Grant – this grant program is funded through the Sonoran Institute for projects in the Southwest Montana region. Multiple awards of $5,000 are available every six months. Preliminary inquiries indicate that this effort would fit well with the grant program. This program has been used successfully by Conservation Districts in the study area.
- Missouri-Madison River Fund – This grant program was created as a public-private partnership between various government agencies and PPL Montana. Since 2007, nearly $1.5 million in awards has been provided through the Fund. The project team is currently discussing options with Fund representatives.

Plan for Future Funding

The proposed project is the first phase of an effort to develop Channel Migration Mapping for each of the nine rivers of the Upper Missouri Headwaters watershed. Future funding will be solicited to complete the mapping for the three remaining rivers.

Budget Discussion

The following sections break the budget down by category.

Contract Administration

The total costs for contract administration is $30,000. This includes Salaries & Wages ($24,000), Fringe Benefits ($1,500), Supplies & Materials ($500), Communications ($1,000), Travel ($2,000), and Printing & Document Preparation ($1,000). The RVCD also plans to donate an additional $20,000 of in-kind services throughout the project period.

Acquisition of professional services and contracting will comply with Sate contracting and procurement laws applicable to RVCD.

Project Management

Project Management refers to the contractor's costs for project communications, reporting, and oversight. Over the 2 year project period, $11,160 is anticipated for this category. Table 3 (Contractor Costs) and Table 4 (Contractor Direct Costs) provide the breakdown of these items.

Channel Migration Mapping Costs

The Channel Migration Mapping (CMM) costs refer to the contractor's actual costs for performing the mapping. In total, $320,685 is budgeted for the mapping. This includes the purchasing and orthorectification of historic imagery, data development, data analysis, data management, and archiving of project data. The costs associated for mapping each river are based on the item costs and rates shown in Table 5, and detailed in Table 6 (Per River Costs). For this scoping effort, costs were estimated based on the length of each reach that will be mapped, along with its characteristics such as channel breading and sinuosity. This resulted in the total length or channel to be mapped in the project.

Work Tasks		Project Manager	TBD	Geomorphologist		GIS Analyst		GIS Technician		HOUR TOTALS	COST TOTALS
	Hourly Rate	$	90.00	$	90.00	$	75.00	$	45.00		
Project Management & Communications											$ -
Ongoing phone calls, emails		50.0		30.0						80	$ 7,200.00
Monthly Reporting		24.0								24	$ 2,160.00
Oversight/Management		20.0								20	$ 1,800.00
										0	$ -
Task 1.0 Totals		94.0		30.0		0.0		0.0		124	$ 11,160.00
GIS Data Management											
Gather base data		6.0		6.0		60.0				72	$ 5,580.00
Coordinate aerial photographic order and orthorrectification		6.0				40.0				46	$ 3,540.00
Write metadata						4.0				4	$ 300.00
Finalize and deliver data sets						10.0				10	$ 750.00
										0	$ -
Task 2.0 Totals		12.0		6.0		114.0		0.0		132	$ 10,170.00
Floodplain Scoping											
Review additional data necessary for floodplain scoping		10.0		90.0		40.0				140	$ 12,000.00
Community meetings (1 per river)				40.0		10.0				50	$ 4,350.00
Write draft floodplain scoping report		4.0		40.0		10.0				54	$ 4,710.00
Revise floodplain scoping report		2.0		15.0		5.0				22	$ 1,905.00
Present floodplain scoping results				6.0		2.0				8	$ 690.00
										0	$ -
Task 3.0 Totals		16.0		191.0		67.0		0.0		274	$ 23,655.00
Outreach and Education											
Prepare presentation and associated materials		29.0		29.0		30.0				88	$ 7,470.00
Six outreach and education presentations throughout the basin		36.0		36.0						72	$ 6,480.00
										0	$ -
Task 4.0 Totals		65.0		65.0		30.0		0.0		160	$ 13,950.00
TOTALS BY CLASSIFICATION (Hours)		187.0		292.0		211.0		0.0		690	
COST BY CLASSIFICATION (Dollars)		$	16,830.00	$	26,280.00	$	15,825.00	$	-		$ 58,935.00
										TOTAL DIRECT COSTS:	**$ 5,432.50**
										TOTAL PROJECT COSTS:	**$ 64,367.50**

Table 3. Anticipated contractor costs.

QTY	Description	Rate	Amount
1500.0	Mileage for regional meetings (6 x 250 mi RT)	$ 0.56	$ 832.50
1500.0	Mileage for field work (6 x 250 mi RT)	$ 0.56	$ 832.50
1500.0	Mileage for presentations (6 x 250 mi RT)	$ 0.56	$ 832.50
1000.0	Mileage for floodplain mapping scoping meetings	$ 0.56	$ 555.00
8.0	Lodging (estimated 4 nights for 2 people)	$ 85.00	$ 680.00
8.0	Per Diem (estimated 4 days for 2 people)	$ 30.00	$ 240.00
18	Printing and Binding - Reports	$ 20.00	$ 360.00
18	Printing - Maps (River-based - 3 copies for 9 rivers)	$ 20.00	$ 360.00
18	Printing - Draft Maps (River-based - 3 drafts for 9 rivers)	$ 20.00	$ 360.00
4	Printing - Floodplain Scoping Report	$ 20.00	$ 80.00
1	Field supplies	$ 335.00	$ 335.00
	TOTAL TRAVEL COSTS		**$ 5,467.50**

Table 4. Anticipated contractor direct costs.

Item	Cost/Rate
Historic Imagery per Frame	$ 35.00
Orthorectification Cost per Frame	$ 35.00
Digitizing Hourly Rate	$ 40.00
Analysis and Reporting Rate	$ 90.00
GIS Map Development Rate	$ 90.00

Table 5. Item costs and rates used for calculating per-river mapping costs.

	River Information			Imagery Costs				River Bank Digitizing		Analysis and Reporting						Total Costs
River	Valley Length Miles	Sinuosity/ Meandering Factor	Channel Length Miles	1950s Frame Count	1976 Frame Count	Total Frame Count	Total Cost of Imagery	Digitizing Hours	Total Digitizing Cost	Geom. Assess. Hours	Digitize Migration Vectors	Analysis Hours	Maps Hours	Reports Hours	Total Analysis	Total River Cost
Gallatin River	41	2.5	102.5	43	10	53	$ 3,710	461	$ 18,450	77	103	77	10	40	$ 27,413	$ 49,573
E. Gallatin River	23	2	46	23	30	53	$ 3,710	207	$ 8,280	35	46	35	10	40	$ 14,700	$ 26,690
Beaverhead River	53	2	106	74	33	107	$ 7,490	477	$ 19,080	80	106	80	10	40	$ 28,200	$ 54,770
Madison River	58	1.5	87	57	47	104	$ 7,280	392	$ 15,660	65	87	65	10	40	$ 23,925	$ 46,865
Jefferson River	70	1.75	122.5	98	43	141	$ 9,870	551	$ 22,050	92	123	92	10	40	$ 31,913	$ 63,833
Ruby River	26	1.75	45.5	23	14	37	$ 2,590	205	$ 8,190	34	46	34	10	40	$ 14,588	$ 25,368
Totals	**271**		**509.5**	**318**	**177**	**495**	**$ 34,650**	**2,293**	**$ 91,710**	**382**	**510**	**382**	**60**	**240**	**$ 140,738**	**$ 267,098**

Table 6. Per river costs.

Notes:

- All per river and contractor costs are generated based channel migration mapping and watershed assessment work performed elsewhere in Montana.
- Valley length is taken from the low-resolution National Hydrologic Dataset.
- Sinuosity/Meandering Factor is included to get closer to the true channel length, including meanders and side channels. This directly impacts the length of channel that must be digitized, as well as the number of migration sites.
- Imagery counts represent an analysis of actual imagery footprints to achieve the stereo coverage required for orthorectification.
- Geomorphic assessment and digitizing migration vector hours are calculated based on river length and using the Item Costs in Table 5.
- Map generation and reporting hours are spread evenly across all mapped rivers.

Outreach and Education

Outreach and education costs ($83,950) include developing the maps, handouts, and presentations required for each public outreach meeting. Additionally, time is included for the contractor to work with local stakeholders to help integrate the project products into daily workflows. In-kind contributions from local stakeholders ($70,000) will largely be used within the Outreach and Education efforts.

Floodplain Mapping Scoping

The project includes $23,655 of RDGP grant funds towards producing Floodplain Mapping Scoping documents for the DNRC according to agency protocols. This effort will involve researching available data and information, community meetings, and coordination with the DNRC. These hours are detailed in Table 3.

STEP 6 - PUBLIC BENEFITS RANKING CRITERIA

- ✗ *The project repairs, reclaims, or mitigates environmental damage to natural resources from mineral development.*
- ✓ *The project develops and ensures the quality of natural resources.*
- ✓ *The project conserves natural resources.*
- ✓ *The project protects the public health, safety, and welfare of Montanans.*
- ✓ *Montanans will directly benefit from the project.*
- ✓ *Montanans will indirectly benefit from the project.*
- ✗ *Jobs are created by the project for people who need job training, receive public assistance, or are chronically unemployed.*
- ✓ *The project benefits are certain and long term.*

✓ **The project develops and ensures the quality of natural resources.**

Water and free-flowing rivers are at the top of the list of Montana's most precious natural resources. As a headwaters state, Montana is rightfully proud and protective of our water and river systems. Rivers however are unpredictable both in the amount of water they carry and their location on the landscape. They experience floods and drought, and move laterally, eroding outer banks in some places and building up point bars on inner banks in other places. These natural cycles and natural processes are critical to the health of Montana's rivers. Naturally functioning river corridors allow the river to adapt to changing inputs (floods, sediment pulses, etc.), replenish critical aquatic habitats by supplying the necessary sediments (silts, sands, and gravels) and add habitat-forming woody debris, build new bar habitats that allow the establishment of new riparian vegetation (cottonwoods, willows, etc.), and maintain the natural viewscapes sought after by corridor users. Channel Migration Mapping will provide stakeholders with information needed to make informed decisions that acknowledge the need for rivers to maintain their geomorphic balance, ensuring the long-term quality the state's river system.

✓ **The project conserves natural resources.**

Over 1,000 miles along 15 individual rivers and streams in Montana are classified as "Blue Ribbon" fisheries, five of which are part of this study. The study area also is the source for the federally designated "Wild and Scenic" portion of the Missouri River. Each land use and management decision made on any of these rivers has an impact on the quality of the resource. In many cases, a single action (riprap, barbs, etc.) may not have a large impact, but cumulatively they can shut down the natural functions of a stream corridor. Thus, having the information and tools to make educated decisions is critical for conserving Montana's natural resources. The Channel Migration Mapping and floodplain mapping scoping resulting from this project will provide some of these critical tools.

✓ **The project protects the public health, safety, and welfare of Montanans.**

"Montana has over 200,000 miles of streams, but only about 10,000 of these stream miles (5%) have FEMA Special Flood Hazard Area (SFHA) maps (which serve as the regulatory maps for Montana's floodplains) and just 2,000 miles (1%) have FEMA Base Flood Elevation (BFEs) and floodways established. Furthermore, those few areas that do have FEMA flood-hazard mapping do not include additional flood hazards such as fluvial erosion hazards or ice jam risks on the maps."[13]

Neither the State of Montana nor its local governments can afford to undertake a more concerted effort at 100-year floodplain mapping. In most areas of the state, decisions about development and other land uses are routinely made without the benefit of this information. In 2011 alone, Montana incurred an estimated $57 million in flood damage to public infrastructure, with an additional $7 million in individual assistance. To date, communities have submitted requests for assistance in repairing and/or replacing ten bridges, with more expected

[13] Montana Department of Environmental Quality, 2011, Montana Floodplain Management Assessment: Strengthening Policies and Programs that Reduce Flood Risk and Protect Floodplains, pp.7

by the state Disaster and Emergency Services[14].

Even with 100-year floodplain information, rivers and streams can migrate laterally across the landscape, in some cases well beyond the 100-year floodplain. This erosion risk is often more catastrophic and permanent than flooding. Channel Migration Mapping is an accepted tool for assessing and understanding the risks associated with this type of hazard and allows for informed decisions when working with rivers.

The project also includes developing the floodplain mapping according to DNRC protocols necessary for performing hydraulic modeling and creating FEMA floodplain maps. As such, this project will go a long ways towards protecting Montanans from the two primary risks associated with living with rivers: flooding and channel migration.

✓ **Montanans will directly benefit from the project.**

The dynamic rivers of the Upper Missouri Basin are highly influential on our economy - the agriculture, recreation, and development industries are dependent on them. In Montana, the loss of land and damage to structures in waterways is primarily caused by rivers steadily eating away their banks (migration) or jumping channel or creating new channels (avulsion). By mapping where the river has been historically, where it is currently, and how it is likely to move in the future, landowners, local agency and county decision makers are better able to determine best land use.

The Montanans that will directly benefit from this project include those that live, work, and recreate on these stretches of Montana's rivers.

Channel Migration Mapping represents an affordable way of understanding the dynamic character of a river system. Such information is essential to planning that both reduces flood risk and protects floodplains and riparian areas. The mapping process helps landowners and river and stream managers avoid or reduce costly, adverse impacts to buildings, roads and other infrastructure. Additionally, encouraging the preservation of naturally-functioning fish and wildlife habitats ensures that these critical resources will be available to future generations.

✓ **Montanans will indirectly benefit from the project.**

This project may lead the way for additional channel migration map development for other rivers and streams in Montana. Tourism is the #2 industry in Montana, and many livelihoods depend on clean water, fishable streams, and the aesthetics of healthy rivers. Preserving the natural character of Montana's rivers will bring more visitors and indirectly help local shop and restaurant owners, lodging services, and other service industries. Cost saving to taxpayers due to the risk reductions and damage prevention made possible through the use of these tools could be significant.

✓ **The project benefits are certain and long term.**

As water is a finite resource, mapping the Upper Missouri Headwaters historic channel migration, provides the science-based information that local land and water managers need to better manage our limited water supply.

Channel Migration Mapping has a proven track record as an effective information and planning tool throughout Montana. The Upper Missouri Headwaters area of Montana represents an active system of rivers and tributaries, in one of the faster growing regions of the state. The landowners, communities, counties, watershed groups, and conservation districts will all be well-served by going through the Channel Migration Mapping process together, and having the products as an additional tool to support careful development planning and flood hazard prevention/mitigation. Additionally, this basin-wide project will serve as a good pilot for tackling such issues elsewhere, in a basin-wide manner.

[14] Tim Thennis - Bureau Chief, Montana Disaster and Emergency Services Division, personal communication, April 30, 2012.

STEP 7 - NEED AND URGENCY RANKING CRITERIA

Keeping the project goals in mind is important when assessing the Need and Urgency for a project. The goals of this project are:

1. Develop Channel Migration Mapping for select rivers.
2. Coordinate with DNRC to develop floodplain mapping scoping for select rivers in support of 1971 state legislation requiring a Floodplain Mapping Plan for Montana.
3. Provide educational opportunities for stakeholders on use of the mapping.
4. Provide the resulting mapping data layers to stakeholders and the State Library.
5. Move river corridor mapping efforts towards a comprehensive river hazards mapping approach.

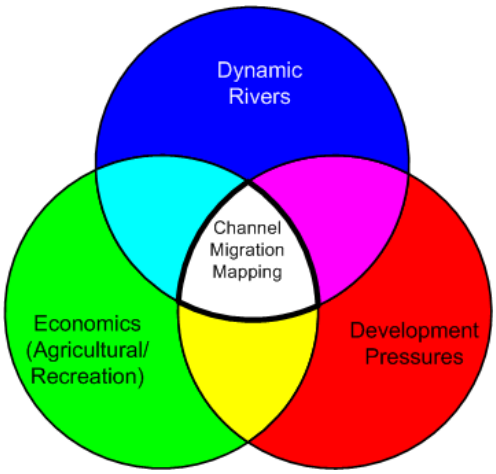
Identified Project Need

The need for this project is explicitly stated in Step 11 – Crucial State Need Documentation. The need is well-defined by the 2011 DEQ document *Montana Floodplain Management Assessment: Strengthening Policies and Programs that Reduce Flood Risk and Protect Floodplains* that explicitly calls for the actions in this grant proposal, and the statement of Crucial State Need included with Laurence Siroky's (DNRC Water Operations Bureau Chief) letter of support. These documents are included in Appendix II.

The specific need for the development of comprehensive river hazard maps that include all river hazards (channel migration, flooding, ice jams, etc.) stems from the lack of other tools to help landowners and regulators make educated decisions that impact the conditions of Montana's rivers. The high cost of FEMA floodplain mapping usually means that many landowners and communities are left without any critical information to help with planning activities within a river corridor. The Channel Migration Mapping developed in this project will provide a science-based, low-cost tool for stakeholders. The associated floodplain scoping and outreach/education efforts will ensure that these rivers progress towards comprehensive river hazard mapping and that the information is shared with stakeholders.

Immediacy of Project Need

Urgency is often measured in terms of a response to an immediate crisis. For instance, the statewide response to the 2011 flooding demonstrated just how vulnerable the people and infrastructure within our river corridors are to river hazards of all types. This project represents an opportunity to take a proactive approach and equip a significant part of the state with useful tools to inform future land-use decisions and help people avoid the stress and costs of preventable flood-related losses to homes and infrastructure.



This is especially true in the headwaters of the Missouri where the contributing rivers represent a trio of conditions that result in an urgent need for information and tools to help manage the rivers (see figure to right). The *economy* of Southwest Montana is directly tied to its rivers. Both the agricultural and recreational economies depend on the quality of the water and the visual and natural resources that are associated with that high-quality water. These high-quality economic resources are largely the result of the dynamic nature of the rivers. *Development pressures* naturally follow the desire to access these same high-quality resources, often shifting some of the economics from an agricultural to recreational base. This shift to recreational properties usually results in smaller parcels of higher value. The new landowners have an added incentive to protect their investments through bank protection, armoring, and other activities. The cumulative result is often a degradation of the very resources that the communities rely on for survival. On the Yellowstone River, unchecked bank stabilization projects has led to a court-mandated, multi-agency, multi-million dollar effort to assess the cumulative human impacts on the river.

The types of losses demonstrated in the figures in the Problem History discussion could have been avoided if channel migration information had been available at the time. These damages will continue to occur if the tools are not immediately developed. The willingness of so many partners to come together with this unified approach is further evidence of the urgency of this project.

Impact from No Action

It is possible for watersheds to go for years without experiencing any severe impacts from flooding or riverine erosion. The fact that severe events occur infrequently leads individuals to make uninformed decisions, especially when dealing with rivers. A single flood event can result in millions of dollars in loss to property, impact health and human safety, and create long-term degradation of natural resources.

The historic flooding of 2011 is a perfect example of why No Action is not an alternative. Local decision makers are requesting the information generated from this project. The No Action alternative would leave each watershed to continue making land use decisions without this information or piece meal funding from other sources and possibly result in inconsistent methods being applied. This could be challenging especially where rivers cross multiple jurisdictions. A single comprehensive project of this scope would ensure that the channel migration is addressed in a consistent manner across these six Missouri headwater rivers and provide a template for future projects to address the remaining river reaches.

Severity and Extent of Need

Local support is strong for the project as evidenced by the attached thirty-five letters of support. The scoping process included three regional meetings where input was gathered from the local stakeholders. The response to the proposal was almost universally supportive. Outreach to stakeholders included contact with over seventy individuals representing a spectrum of state, federal, and local agencies and governments; local land owners; private businesses; and not for profit organizations. The letters of support document $56,000 of cash match, $79,000 of in-kind services, and $140,000 of associated project work (Appendix I). This support comes from both the public and private sectors, demonstrating their sense of urgency and the broad need for this effort. Perhaps the greatest selling point of this effort is that it will result in *science-based, non-regulatory* tools for decision making.

The complete resetting of the Musselshell River, resulting in an overwhelming list of public and private economic, physical and psychological impacts demonstrates that this sort of event can happen at any time on any watershed. The Musselshell River lacks comprehensive river hazard mapping. As such, years of development activity resulted in impacts that could have been avoided had they had access to floodplain mapping and channel migration tools for planning. In 2007, a less than ten year event on the East Gallatin River resulted in extensive flooding of homes built in the floodplain. A 100-year event would likely have had extensive impacts.

Natural Resources Affected

Approximately 510 river miles on six rivers will be mapped by this project: Gallatin, East Gallatin, Beaverhead, Madison, Jefferson, and Ruby Rivers. They were selected through a prioritization process that included population/development pressures, need, interest, and coordination with Floodplain Mapping Program. There is interest from the three other Missouri Headwater rivers (Big Hole, Boulder, and Red Rock), but lack of funding prevents addressing all needs at this time. Our goal is to seek funding to complete the other rivers in the future. This will result in Channel Migration Mapping and Outreach/Education on over 750 river miles on nine rivers, supporting over 13,000 miles of watershed (8% of Montana's total area). These are Montana's iconic rivers, with long histories of agriculture and recreation opportunities for Montanans and visitors alike, and serving as an economic driver for local businesses.

STEP 8 - PROJECT MANAGEMENT AND ORGANIZATION CAPABILITY

Applicant:

As the applicant, Ruby Valley Conservation District has ample experience with managing large projects, state grant administration, and direct experience with Channel Migration Mapping (CMM). The Ruby Valley Conservation District (RVCD) is committed to uniting agriculture, recreation, conservation, and education to "protect the land and preserve our heritage." The RVCD, formed in 1951, has a long history of administering grants to benefit the sustainability and conservation of the natural resources in and around the Ruby Valley, as well as benefitting the people and wildlife in the area. The RVCD receives just under $12,000 in county mill levies, yet has successfully administered an average of $300,000 per year in grants to benefit conservation and education projects over the last 10 years. Successful efforts include the following:

- In 2010, RVCD contracted with Applied Geomorphology, Inc. and DTM Consulting, Inc. to develop Channel Migration Mapping for the Ruby River from the outlet of the Ruby Reservoir to its confluence with the Beaverhead River in Twin Bridges. This project involved the input and cooperation of a variety of agency and private parties to work through the decision making process and adopting the final criteria for the mapping. Avulsions, influences of scattered bank protection projects, flood events, and a dam drawdown that resulted in a large sediment pulse provided a variety of challenges for the project. RVCD responsibilities included coordination of all efforts, public and partner outreach, and grant administration.
- RVCD managed an RDGP Planning Grant and then received funding for an RDGP Contract (Alder Gulch – Phase I Improvements) in Virginia City in the 2011 legislative session. This project involves final engineering, design and construction for a historic placer mining embankment that has been deemed unsafe and in danger of imminent failure. The RVCD responsibility requires coordinating the efforts of numerous stakeholders including Madison County, Town of Virginia City, and numerous state agencies, hiring an engineering firm, and managing a very visual project on a primary ingress/egress route.
- RVCD managed an RDGP Planning Grant, and then received funding (2009 legislative session - Big Hole Cooperative Ditch Project). This project involved final engineering, design and construction for an irrigation diversion and headgate structure serving approximately 22 irrigators and 4000 irrigated acres of land. RVCD responsibilities included grant administration and coordination of partner efforts, including: US Fish Wildlife & Parks, Big Hole Watershed Committee, and numerous waters users.
- RVCD has managed numerous collaborative projects with a patchwork of funding sources (DEQ, DNRC, FWP, private foundations, and federal agencies) and in-kind service providers and have administered all of the grants. Examples include the Three Forks Corral Relocation Project, Lazyman Creek Grayling Spawning/Irrigation Efficiency Project, 42-mile Kelly Springs Pipeline Project, Groundwater-Surface Water Modeling Project, Wetland and Riparian Area Mapping Project. A complete list of details can be provided upon request.

As project manager, Rebecca Ramsey is involved with a broad spectrum of natural resource, community education, and economic related concerns in the region. In addition to being the Ruby Watershed Coordinator, working for the Ruby Valley Conservation District (4 years) and with the Ruby Watershed Council, an 11-member volunteer advisory council to the RVCD, she is also the chairperson of the Missouri Headwaters Partnership and the Executive Director of the Virginia City Chamber of Commerce. In these roles, she brings together community leaders; technical, educational, and financial partnerships; and builds camaraderie on multiple fronts for the good of the people, businesses and resources of the region. Shirley Galovic has been working as the District Administrator for the RVCD for over 18 years and handles the financial aspects of all grant reporting, District events, and operations.

Technical Advisory Committee:

The Technical Advisory Committee (TAC) will involve a variety of state agency personnel including, but not limited to, the following confirmed members:

- Lynda Saul – Wetland Program Coordinator, Montana DEQ - offers experience working with several CMM watershed pilot projects including the Flathead, Ruby and Ten Mile/Prickly Pear Creek watersheds.
- Anne Schwend – Water Resource Planner, Montana DNRC; Supervisor, RVCD; Chairperson, Montana Watershed Coordination Council - offers experience working in watersheds around the state coordinating collaborative efforts and helped in development of the Ruby CMM.
- Doris Fisher – Montana FWP Planner with 30+ years of experience working with communities (former Missoula and Madison County Planner), businesses, and landowners to develop and apply information and planning tools that help them achieve economic prosperity and maintain a healthy environment.
- Laurence Siroky – Bureau Chief, Water Operations Bureau, Montana DNRC – oversees the state floodplain programs and offers experience in floodplain map development.
- Jim Robinson – Montana DNRC Water Resources Planner – brings extensive CMM experience through his oversight of the Yellowstone River CMM efforts and associated outreach and education efforts.

Project Partners:

A variety of project partners have expressed interest and support for this effort. As a whole, they bring an enormous amount of experience, viewpoints, and opinions to the project that will help ensure its success.

- Counties – The core counties in the study area have expressed their support for the project with letters of support, in-kind service, and cash match. The four counties that share the Big Hole River have demonstrated a commitment to working together, including a unique, four-county ordinance to shape development along the Big Hole River, and a current effort with the DNRC to develop modern tools to map floodplain through a pilot study on the Big Hole River.
- Conservation Districts - The RVCD has been using their Lower Ruby CMM as a tool to work with landowners on 310 permit decisions. Through public outreach efforts, many landowners, contractors, conservation organizations and the local government officials have requested the map to use in their land use planning efforts. Support from CDs around the Basin, as well as state and regional CD organizations including the Montana Association of Conservation Districts, Missouri River Conservation Districts Council and the Yellowstone River Conservation Districts Council further show the broad support.
- Private Landowners - Landowners in the areas with existing Channel Migration Mapping have been surprised by the usefulness of the information available, and the Smiths and Turner Enterprises have written letters of support detailing their opinions on the value of the information.
- Agencies - At all levels, the RVCD has commitments of support, money and service for this project. Letters of support are included from the following federal and state agencies: United States Fish & Wildlife Service, Bureau of Land Management, United Stated Department of Agriculture, Natural Resources and Conservation Services; Montana Fish, Wildlife and Parks, Montana Department of Environmental Quality Wetland Program, and Montana Department of Natural Resources and Conservation Services.
- Not for Profits - Several conservation organizations have committed support and money to this project because of the practical, science-based information that will become available for a wide variety of people to use. These include: The Nature Conservancy, Greater Yellowstone Coalition, Trust for Public Land, Madison River Foundation, and Future West.

Contractors:

The Channel Migration Mapping and floodplain scoping methods proposed in this project are well-established and have been vetted through review of existing project work. As a result, there are a number of entities who are qualified to perform the work. Acquisition of professional services and contracting will comply with Sate contracting and procurement laws applicable to RVCD. In Montana, two contractors are responsible for the majority of Channel Migration Mapping: DTM Consulting, Inc. and Applied Geomorphology, Inc. Together they have mapped over 700 miles of river using these mapping methods. RVCD has direct experience working with both of these contractors. Regionally, there are several contractors in the Pacific Northwest who have experience in Channel Migration Mapping and were contacted as part of the planning process.

STEP 9 - ENVIRONMENTAL CHECKLISTS

Applicant: **Ruby Valley Conservation District** Project Title: **Upper Missouri Headwaters River/Flood Hazard Map Development**

Project Description: **River corridor hazard mapping and management tools based on flooding and historic rates of river movement.**

Person Preparing Checklist: **Karin Boyd, Applied Geomorphology, Inc.** Phone: **406-587-6352**

POTENTIAL IMPACTS ON THE PHYSICAL ENVIRONMENT

Because this grant application is primarily to develop Channel Migration Maps to fulfill a critical state need, the potential impacts of this project on the physical environment reflect their typical applications on the ground. These applications consist of modified land uses in high hazard areas, generated by an increased awareness of hazards and associated costs imposed by dynamic river systems.

	MAJOR	MODERATE	MINOR	NONE	UNKNOWN	COMMENTS
Topography				✓		
Geology: Stability				✓		
Soils: quality, quantity, distribution		✓ (adverse or beneficial)				Soils distributions can be altered by river movement
Water: quality, quantity, distribution		✓ (Beneficial)				Water quality improvements through riparian corridor sustainability
Air: quality				✓		
Terrestrial, avian, and aquatic: species and habitats	✓ (Beneficial)					Improves long-term riverine function and sustainability
Vegetation: quantity, quality, species	✓ (Beneficial)					Improves long-term riverine function and sustainability
Agriculture, grazing, crops, production		✓ (Beneficial)				Reduces risk of damaged agricultural infrastructure
Unique, endangered, fragile or limited environmental resources	✓ (Beneficial)					Improves long-term riverine function and sustainability
Demands on environmental resources of land, water, air, and energy	✓ (Beneficial)					Reduced environmental resource demands associated with river corridor development
Historical and archaeological sites	✓ (Beneficial)					Hazards to sites can be determined
Aesthetics	✓ (Beneficial)					Improves long-term riverine function

	MAJOR	MODERATE	MINOR	NONE	UNKNOWN	COMMENTS
Social Structures & more	✓ (Beneficial)					Creates community-level river corridor awareness
Cultural uniqueness, diversity		✓ (Beneficial)				Creates community-level river corridor awareness
Population: quantity and distribution			✓ (Beneficial)			May reduce residential population density in high hazard areas
Housing: quantity and distribution		✓ (Beneficial)				Reduces immediate hazards of stream corridor development
Human health and safety	✓ (Beneficial)					Reduces immediate hazards of stream corridor development
Community and personal income			✓ (adverse or beneficial)			May reduce personal economic gain via streamfront development; improve community income through recreation
Employment: quantity, and distribution				✓		
Tax base: local and state			✓ (Beneficial)			May increase tax base for riverfront property due to a reduction in flood-related damages and enhanced quality of resources
Government services: demand on	✓ (Beneficial)					Reduces flood response costs and hazard to government response personnel during floods
Industrial, commercial, and agricultural activities		✓ (Beneficial)				Reduces risk of infrastructure failure and associated rehabilitation costs
Recreation and wilderness	✓ (Beneficial)					Optimizes long-term ecological function and associated recreation
Environmental plans and goals, local and regional	✓ (Beneficial)					Provides basis for stream corridor management
Demands for energy				✓		
Transportation networks and traffic flows		✓ (Beneficial)				Can result in strategic placement of transportation infrastructure to minimize risk.

Individuals Contacted

Below is a list of individuals, groups, and entities contacted as part of this project scoping effort.

Name	Agency	Title	Email	Phone
Vicki Sullivan	Army Corps of Engineers			406-441-1375
Walt Sales	Association of Gallatin Agriculture Irrigators			
Danette Watson	Beaverhead CD	Administrator	danette.watson@nt.nacdnet.net	406-683-3802
James Carpita	Beaverhead County	Floodplain Administrator		406-683-3724
Larry Laknar	Beaverhead County	Floodplain Administrator	llaknar@co.beaverhead.mt.us	406-683-3770
Rick Hartz	Beaverhead County	Planner	rhartz@beaverheadcounty.org	406-683-3675
Garth Haugland	Beaverhead County Commissioners	Chairman	ghaugland@beaverheadcounty.org	406-683-3750
Katie Tackett	Beaverhead River Watershed Committee	Coordinator	beaverheadwatershed@gmail.com	406-988-0191
Carl Malesich	Beaverhead Watershed Committee	Chairman	beaverheadwatershed@gmail.com	406-988-0191
Mike Bias	Big Hole River Foundation	Executive Director	bhrf@bhrf.org	888-533-bhrf
Kevin Brown	Big Hole Watershed Committee	Director	kbrown@bhwc.org	406-370-7230
Kristin Gardner	Blue Water Task Force	Executive Director	kristin@bluewatertaskforce.org	406-993-2519
Denise Thompson	Broadwater CD	Administrator	bcd@mt.net	406-226-3146
Shawn Higley	Broadwater County	Floodplain Administrator	shigley@wwcengineering.com	406-443-3962
Katie Benzel	Bureau of Land Management		katie_benzel@blm.gov	406-683-8032
Tim Bozorth	Bureau of Land Management	Field Manager		
Steve Hess	Butte-Silver Bow County	Floodplain Administrator	shess@bsb.mt.gov	406-497-6250
Louise Bruce	Centennial Valley Association	Field Representative	vlbruce@CentennialValley.org	406-660-0310
Joseph Menicucci	City of Belgrade	Floodplain Administrator	jmenicucci@cityofbelgrade.net	406-388-3760
Joson Karp	City of Belgrade	Floodplain Administrator	jkarp@cityofbelgrade.net	406-388-3760
Diana Van Haecke	City of Boulder	Floodplain Administrator	citybоulder@jeffbb.net	406-225-9629
Richard Hixson	City of Bozeman	Floodplain Administrator	rhixson@bozeman.net	406-582-2280
J.S. Turner	City of Dillon	Floodplain Administrator	operations@dillonmt.org	406-683-4245
Suzanne Cross	City of Ennis	Floodplain Administrator	scross@ennismontana.org	406-682-4287
Ray Noble	City of Three Forks	Floodplain Administrator	rnoble@threeforksmontana.us	406-2853431
Sam Novich	City of Twin Bridges	Floodplain Administrator	townoftb@3rivers.net	406-684-5243
Susie Johnson	Deer Lodge CD	Administrator	susie.johnson@mt.nacdnet.net	406-846-1703
Connie Ternes Daniels	Deer Lodge County	Planning Director		406-563-4010
Lynda Saul	DEQ Wetlands	Program Coordinator	lsaul@mt.gov	406-444-6652

Name	Agency	Title	Email	Phone
Laurence Siroky	DNRC	Bureau Chief, Water Operations Bureau	lsiroky@mt.gov	406-444-6816
Ann Schwend	DNRC WMB	Planner	ac.schwend@mt.gov	406-444-1806
Constanza von der Pahlen	Flathead Lakers	Critical Lands Program Director	constanza@flatheadlakers.org	406-883-1346
Jennifer Boyer	Future West		jen@future-west.org	406-587-2974
Marcie Murnion	Gallatin CD	Administrator	marcie.murnion@mt.nacdnet.net	406-522-4011
Allen Armstrong	Gallatin County	GIS Coordinator		406-582-3049 x91
Chris Scott	Gallatin County	Floodplain Administrator	chris.scott@gallatin.mt.gov	406-582-3130
Sean O'Callaghan	Gallatin County	Planner/ Floodplain Admin	sean.ocallaghan@gallatin.mt.gov	406-582-3130
Joe Skinner	Gallatin County Commissioners	Commission Member		406-582-3000
Stephen White	Gallatin County Commissioners	Chair		406-582-3000
William Murdock	Gallatin County Commissioners	Commission Member		406-582-3000
Tammy Crone	Gallatin Local Water Quality District	Water Quality Specialist	tammy.Crone@gallatin.mt.gov	406-582-3145
Rose Vallor	Greater Gallatin Watershed Council	Chair		
Sierra Harris	Greater Gallatin Watershed Council	Coordinator	info@greatergallatin.org	406-219-3739
Scott Christensen	Greater Yellowstone Coalition	Representative		800-775-1834
John Heide	Jefferson Conservation District	Chair	Jvmh57@qwestoffice.net	406-287-7875
Harold Stepper	Jefferson County	Planner	hstepper@jeffco.mt.gov	406-225-4040
Megan Bullock	Jefferson County	Floodplain Administrator	mbullock@jeffco.mt.gov	406-225-4126
Ted Dodge	Jefferson River Watershed Council	Coordinator	ted.dodge516@gmail.com	406-491-4471
Kris Hugulet	Jefferson Valley CD	Administrator	jvmh57@qwestoffice.net	406-287-7875
Bob Sims	Lower Jefferson Watershed Council	Coordinator	sims@ixi.net	406-287-5117
Janet Endecott	Madison CD		madisoncd@3rivers.net	406-682-7289
Charity Fechter	Madison County	Planner	mcplanner@3rivers.net	406-843-5250
Ralph Hamler	Madison County	Floodplain Administrator	mscani@madison.mt.gov	406-843-4275
Dan Happel	Madison County Commissioners	Member		406-843-4277
David Schulz	Madison County Commissioners	Chair		406-843-4277
James Hart	Madison County Commissioners	Member		406-843-4277
Laurie Schmidt	Madison County Planning Board	President		406-843-5250
Richard Lessner	Madison River Foundation	Executive Director	info@madisonriverfoundation.org	406-682-3148
Lane Adamson	Madison Valley Ranchlands Group	Director		
Sunni Heikes-Knapton	Madison Watershed Partnership	Coordinator	mwc@3rivers.net	
Kris Hugulet	Mile High CD	Administrator	jvmh57@qwestoffice.net	406-287-7875

Name	Agency	Title	Email	Phone
Rebecca Mayfield Ramsey	Missouri Headwaters Partnership	Chair	rubywatershed@gmail.com	406-842-5741 x106
Laurie Riley	Missouri River Conservation District Council	Coordinator	mrcdc@missouririvercouncil.info	406-454-0056
Nick Schultz	Missouri River Conservation Districts Council	Chair	mrcdc@MissouriRiverCouncil.info	406-454-0056
Mike Vaughn	Montana Fish, Wildlife & Parks	Fisheries Biologist	mvaughn@mt.gov	406-994-6938
Travis Horton	Montana Fish, Wildlife and Parks	R3 Fisheries Manager	thorton@mt.gov	406-994-3155
Tom Hinz	Montana Wetlands Legacy		thinz@mt.gov	406.994.7889
Kevin Germain	Moonlight Basin	Director of Planning & Development		406-682-6666
Ed Tinsley	MT Disaster and Emergency Services	Administrator		406-324-4777
Doris Fischer	MT Fish, Wildlife, and Parks	Planner	dofischer@mt.gov	406-842-7467
Joyce Swartzendruber	Natural Resources Conservation Service	State Conservationist		406-587-6811
Tom Pick	Natural Resources Conservation Service	Water Quality Specialist	thomas.pick@mt.usda.gov	406-587-6873
Trisha Cracroft	Natural Resources Conservation Service	Sheridan District Conservationist		406-582-5741
Dawne and Doug Smith	Private Landowner	Owner	smathlawmt@gmail.com	
Shirley Galovic	Ruby Valley CD	Administrator	rvcd@3rivers.net	406-842-5741 x101
Rebecca Mayfield Ramsey	Ruby Watershed Council	Coordinator	rubywatershed@gmail.com	406-842-5741 x106
Jon Sesso	Silver Bow County	Planner	jsesso@bsb.mt.gov	406-497-6250
Randy Carpenter	Sonoran Institute	Associate Director - Northern Rockies Program	rcarpenter@sonoraninstutute.org	406-587-7331 x3002
Nathan Korb	The Nature Conservancy	SW Lands coordinator	nkorb@tnc.org	406-925-1144
Deborah Love	The Trust for Public Land	Northern Rockies Directory		406-522-7450
David Olson	Town of Lima	Floodplain Administrator	lima@3rivers.net	406-276-3521
Christopher Mumme	Town of Sheridan	Floodplain Administrator	sheridan@3rivers.net	406-842-5431
Darcy Perrenoud	Town of Whitehall	Floodplain Administrator	townofwhitehall@yahoo.com	406-287-3972
Carter Kruse	Turner Enterprises	Aquatic Resource Coordinator		406-586-8500
	USFS			
Jim Magee	USFWS Partners Program		James_Magee@fws.gov	406-683-3893
Don Youngbauer	Yellowstone River Conservation Districts Council	Chairman	dyoungbauer@yahoo.com	406-346-2131
Nicole Divine McClain	Yellowstone River Conservation Districts Council	Coordinator	coordinator@yellowstonerivercouncil.org	406-222-0266 x3

STEP 10 - LIABLE PARTY DETERMINATION

"A proposed project is not eligible for funding under the Reclamation and Development Grants Program if there is a liable party who would be relieved of financial or legal responsibility and who can reasonably be expected to be held responsible" (MCA §90-2-111). Liability **may** arise under the regulatory statutes or rules of a state or federal agency, such as the Montana Department of Environmental Quality, Montana Board of Oil and Gas Conservation, U.S. Forest Service, U.S. Bureau of Land Management, or U.S. Environmental Protection Agency. Or, it may arise under local rules or ordinances. **(Note: Existence of liability does not automatically rule a project ineligible for Reclamation and Development Grant Program funding.)** In order to assist DNRC in determining the existence of liability, the applicant **must** furnish the following information at the time of application submittal.

This project does not include any on-the-ground action, nor is it in response to a specific event or condition. As such, there is no 'liable party" that can be defined.

1. What is the legal description of the site? **Not Applicable**
2. What is the name of the current owner? **Not Applicable**
3. When did the damage occur? **Not Applicable**
4. Who was the owner/operator at that time? **Not Applicable**
5. Have there been subsequent owners/operators? **Not Applicable**
6. Who has been paying the property taxes the past 10 years? **Not Applicable**
7. Provide a statement from the current landowners that a nuisance action is not currently pending. **Not Applicable**
8. Is the project now, or has it ever been, permitted, licensed or regulated by federal, state, or local rules, regulations or statutes?

Not Applicable - This project covers multiple land owners and jurisdictions, but does not require any specific action by a land owner, nor require any on-site action. Rather, it provides a consistent set of management tools to help guide actions within a mapped river corridor to help avoid the need for reactive responses to events. The resulting tools also provide information to help guide responses for a broad range of activities within a mapped river corridor, should the need arise.

STEP 11 - CRUCIAL STATE NEED DOCUMENTATION

To support the applicant's claim of Crucial State Need for this project, two primary documents are supplied in Appendix II (Supporting Documentation). These are:

- Letter of Support and defense of Crucial State Need – Laurence Siroky, Bureau Chief, DNRC Water Operations Bureau. This letter lists six reasons for classifying the project under Crucial State Need.
- Montana Department of Environmental Quality report, 2011, *Montana Floodplain Management Assessment: Strengthening Policies and Programs that Reduce Flood Risk and Protect Floodplains.* This report is an in-depth assessment of the Montana floodplain programs and provides specific recommendations for ensuring that the program meets the needs of Montana.

Key points from these documents, along with other supporting information are summarized below.

Potential threat to public health or safety:

"Protecting public health, safety, and welfare are the key goals of Montana's Floodplain Management Act" (Siroky, 2012). Having accurate mapping information of all hazards is critical to meeting this goal. The floods of 2011 highlighted the need for better planning tools for addressing flooding and flood-related impacts such as erosion and avulsion, these processes are continually occurring throughout Montana's rivers. Examples of this are extensive and could happen along any of Montana's river corridors at any time.

- According to Montana Disaster and Emergency Services, from the 2011 floods the State incurred an estimated $57 million in damage to public infrastructure, with an additional $7 million in individual assistance. This includes requests for assistance in repairing and/or replacing ten bridges, with more expected by the state.
- According to the Montana Department of Transportation, in 2011 the highway infrastructure was severely compromised. $36.3 million of damage at 179 locations was incurred to the state owned transportation infrastructure, including compromised roadways at 80 locations. This created an immediate challenge for accessing many river areas by both landowners and emergency response personnel.
- In 1997, due to bankline erosion, a homeowner on the Yellowstone River was forced to demolish his home or risk having it fall into the river and get hung up on Carter's Bridge, downstream.
- On July 1, 2011 a 12-inch pipeline near Laurel on the Yellowstone River ruptured, spilling an estimated 100 barrels of oil into the river. On the Yellowstone River alone, thirty pipelines cross under the river and another six run parallel to the river. All of these pipelines are subject to both bankline erosion and bed scour. A study is currently under way through a RDGP planning grant to identify the risks associated with these pipelines. This situation, though, is not unique to the Yellowstone River.
- In 2010, erosion of a bendway upstream from Forsythe on the Yellowstone River caused concern that the river might avulse into a historic swale, progressing downstream and threatening the critical water intake for Colstrip. Riprap efforts to protect the bendway were breached during the 2011 flooding, leaving a navigation risk in the river.

Validity of the problem or need:

The 2011 DEQ document noted above validates the problem and need for this project. The study noted the following challenges and recommendations study that are supported directly by the actions proposed in this project.

Challenges:

1. Limited understanding of the importance of natural floodplains – Most people are not aware of the multiple functions that are served by maintaining natural floodplains, including: water-holding capacity during flood events, the ability to adapt to changing environmental conditions such as climate change, and providing and maintaining crucial wildlife habitat.

2. Preference of living near water – An analysis by the Montana Legislative Service Division of property in 17 counties found that from 1990 to 2005, more than 400 homes were built in the 100-year floodplain and that these new homes add to the existing inventory of about 3,800 homes within the 100-year floodplains in those counties.
3. Lack of floodplain mapping for most of Montana's rivers and streams and, where there are maps, common Montana flood hazards (such as ice jam risk and channel migration) are not included.

Recommendations:

1. Implement a Montana Floodplain Mapping Program
   - Map flood hazards before development is at risk. The U.S. Census Bureau projects a 45.8% increase in population in the West between 2000 and 2030.
     a. Develop and pilot cost-effective mapping methods.
     b. Map areas susceptible to additional flood hazards including erosion/channel migration areas.
     c. Develop a mechanism to support community-developed flood and erosion hazard mapping.
2. Enhance Montana DNRC's existing internal processes.
     a. Enhance the Montana Floodplain Study Reference map by georeferencing and linking related data….[including]…documentation of riverine erosion and ice jams.
3. Enhance Floodplain Outreach and Education.
     a. Tailor flood risk outreach programs to address different audiences.
     b. Provide flood mapping information to local communities as critical outreach material.

Consequences of no action or delayed action

Several of the rivers proposed for study in this application are located in some of the most rapidly-growing areas in Montana. This development is driven in large part by the physical environment and the opportunities it presents. Each delay in creating the tools and information necessary for making educated decisions regarding development of the river corridors can lead to increased degradation of those resources, catastrophic impacts, or cumulative impacts to the river corridor.

Development pressures on the Yellowstone Rivers that occurred without a complete understanding of the cumulative impacts to the river resulted in the current court-mandated Yellowstone River Cumulative Effects Study and the Special Area Management Plan in place in most of Park County.

The Musselshell River flooding in 2011 resulted in a river-wide geomorphic resetting event. Even though the area is sparsely populated, the total impacts to agricultural fields and infrastructure, structures, and the transportation network were expansive. Had this event occurred along one of the more developed areas in the study area, the loss of private structures and risk to health and human safety could have been extreme.

Number of people affected

As noted above, from 1990 to 2005 in 17 Montana counties, more than 400 homes were built in the 100-year floodplain, adding to an existing inventory of about 3,800 homes within the 100-year floodplains in those counties. The projected 46% population increase in the West is going to continue to increase pressures along the river corridors. Additionally, the combined agricultural/recreational economies support a broad array of services associated to the river corridor. Any degradation to the rivers will broadly impact a large number of people.

Agency and public support for the project

This project has been very well-received throughout the scoping process. Outreach to stakeholders included contact with over seventy individuals representing a spectrum of state, federal, and local agencies and governments; local land owners; private businesses; and not for profit organizations. This resulted in over thirty-five letters of support, $56,000 of cash match, $79,000 of in-kind services, and $140,000 of associated project work. This support comes from both the public and private sectors, demonstrating a broad need for this project.

STEP 12 - APPLICATION COMPLETION CHECKLIST

This checklist identifies the main sections that must be addressed in your application. Refer to the specific section and subsections for information or forms required. **FAILURE TO PROVIDE ALL INFORMATION REQUESTED MAY RESULT IN DISQUALIFICATION.** Complete this checklist to ensure that the submitted application is complete.

- ✓ Step 1 - Grant Application Summary
- ✓ Step 2 - Project Abstract
- ✓ Step 3 - Technical Description and Alternative Analysis
  - ✓ Problem History
  - ✓ Cost/Benefit Analysis
  - ✓ Project Alternatives
  - ✓ Staffing and Administration
  - ✓ Additional Information
- ✓ Step 4 - Scope of Work
  - ✓ Goals and Objectives
  - ✓ Tasks or Activities
  - ✓ Project Schedule
  - ✓ Monitoring Plan
  - ✓ Equipment
- ✓ Step 5 - Budget
  - ✓ Budget Justification Narrative
  - ✓ Budget Summary Form
  - ✓ Budget Detail Form
- ✓ Step 6 - Public Benefits (Form and Narrative)
- ✓ Step 7 - Need and Urgency (Narrative and Supporting Documents)
- ✓ Step 8 - Project Management and Organization Capability (Narrative)
- ✓ Step 9 - Environmental Checklists
- ✓ Step 10 - Liable Party Determination
- ✓ Step 11 - Crucial State Need Documentation (Narrative and Supporting Documents)
- ✓ Step 12 - Application Checklist for Completeness

Appendix I – Letters of Support and Match

Letters of Support and commitments to match are listed below in the following table. Copies of the original letters are included. The original letters are on file with RVCD.

Letters of support and associated match.

Representing	Contact	Position	Letter of Support	In-Kind Hours	Cash Match	Projects Match (25% used in budget)	Notes	Type
Ruby Valley Conservation District	Gary Giem	Ruby Watershed Coordinator	Yes			$ 26,000.00	Lower Ruby CMZ Mapping	Conservation District
Gallatin Conservation District	William Skinner	Chair	Yes					Conservation District
Madison Conservation District	Sunni Heikes-Knapton	Watershed Coordinator	Yes		$ 15,000.00		223 Grant	Conservation District
Jefferson River Conservation District	John Heide	Chair	Yes					Conservation District
Montana Association of Conservation Districts	Jeffrey Tiberi	Executive Director	Yes					Conservation District
Yellowstone River Conservation District Council	Don Youngbauer	Chairman	Yes					Conservation District
Gallatin County Commissioners	Stephen White, et. Al.	Commissioners	Yes					County
Gallatin County GIS	Allen Armstrong	GIS Manager	Yes	$ 6,400.00	$ 5,000.00		320 hours of in-kind hours (estimate at $20/hr). Use for digitizing?	County
Gallatin Local Water Quality District	Tammie Crone	Water Quality Specialist	Yes					County
Madison Commissioners	David Schulz, et. Al.	Commissioners	Yes	$ 36,000.00	$ 20,000.00	$ 7,500.00	1997 Flood photography and 1955 photography. 80 hrs each for 13 Commissioners, Sanitarian, GIS, Grants, and staff time.	County
Madison County Planning Board	Laurie Schmidt	President	Yes	$ 19,000.00			160 hours of staff time, 1955 air photos, growth policy base layers.	County
Beaverhead County Commissioners	Garth Haugland	Chairman, Beaverhead County Commissioners	Yes	$ 2,500.00				County
Beaverhead County Planning	James Carpita	Floodplain Coordinator	Yes	$ 2,000.00				County
Beaverhead County Planning	Rick Hartz	Land Use & Planning Coordinator	Yes	$ 2,500.00	$ 2,500.00		$5000 total of hours or financial funds.	County

Representing	Contact	Position	Letter of Support	In-Kind Hours	Cash Match	Projects Match (25% used in budget)	Notes	Type
Beaverhead County			No			$ 5,000.00	Big Hole FP Mapping Project, via Future West	County
Beaverhead County Disaster and Emergency Services	Larry Laknar	DES Coordinator	Yes				Possible In-kind, but nothing right now.	County
Beaverhead Watershed Committee	Carl Malesich	Chairman	Yes	$ 500.00			Estimate of 25 hrs of support for meetings and facilitation at $20/hr.	County
Butte-Silver Bow County	Stephen Hess	Floodplain Administrator	Yes			$ 5,000.00	Big Hole FP Mapping Project, via Future West	County
Greater Gallatin Watershed Council	Rose Valor	Chair	Yes	$ 3,000.00			Physiscal Features Inventory	Watershed Group
Big Hole Watershed Committee	Kevin Brown	Executive Director	Yes			$ 5,000.00	Lists same In-kind as Future West letter	Watershed Group
Missouri Headwaters Partnership	Rebecca Ramsey	Chair	Yes					Watershed Group
Missouri River Conservation Districts Council	Nick Schultz	Chair	Yes				Rebecca has it	Watershed Group
Landowner	Douglas and Dawne Smith	Resident	Yes					Private
Moonlight Basin	Kevin Germain	Director of Planning and Development	Yes					Private
Turner Enterprises	Carter Kruse	Aquatic Resource Coordinator	Yes	$ 5,000.00	$ 5,000.00		Hours are estimated; Funds is 2013 budget dependency	Private
Trust for Public Lands	Deborah Love	Northern Rockies Director	Yes			$ 10,000.00	Data development for the Madison River	Private
Montana Disaster & Emergency Services	Ed Tinsley	Administrator	Yes					State
Montana Fish Wildlife and Parks	Doris Fischer	Land Use Planning Specialist	Yes					State
Montana Fish Wildlife and Parks	Travis Horton	Region 3 Fisheries Manager	Yes					State

Representing	Contact	Position	Letter of Support	In-Kind Hours	Cash Match	Projects Match (25% used in budget)	Notes	Type
MT DEQ Wetlands	Lynda Saul	Wetlands Program Coordinator	Yes			$ 35,000.00	Big Hole FP Mapping Project, via Future West	State
Natural Resources Conservation Service	Joyce Swartzendruber	State Conservationist	Yes					Federal
Natural Resouces Conservation Service	Trisha Cracroft	District Conservationist	Yes					Federal
US Fish and Wildlife Service	Jim Magee	Biologist	Yes					Federal
Bureau of Land Management	Tim Bozorth	Field Manager	Yes				Rebecca has it	Federal
Future West	Jennifer Boyer	Co-Founder	Yes			$ 5,000.00	Big Hole FP Mapping Project, via Future West	Environmental Group
Madison River Foundation	Richard Lessner	Executive Director	Yes	$ 5,000.00	$ 1,000.00		Can offer labor and potential financial support. Hours and cash numbers are estimated.	Environmental Group
Greater Yellowstone Coalition	Scott Christensen		Yes		$ 2,500.00		Split between E. Gallatin and Gallatin	Environmental Group
The Nature Conservancy	Nathan Korb	Southwest Montana Director of Science	Yes					Environmental Group
Annaconda-Deerlodge County						$ 5,000.00	Additional project match listed on Future West letter	County
Madison County						$ 5,000.00	Additional project match listed on Future West letter	County
Montana Department of Natural Resources and Conservation						$ 37,000.00	Additional project match listed on Future West letter	State

Appendix II – Supporting Documentation

The following documents are included to support the application's claim of Crucial State Need.

1. Letter of Support – Laurence Siroky, Bureau Chief, Montana Department of Natural Resources and Conservation.
2. Montana Floodplain Management Assessment: Strengthening Policies and Programs that Reduce Flood Risk and Protect Floodplains, Montana Department of Environmental Quality, 2011.

Appendix III – River Process and Channel Migration Mapping Background

The following section is extracted from the Ruby River Channel Migration Zone Mapping document prepared for the RVCD by Applied Geomorphology, Inc. and DTM Consulting, Inc. in 2010, and provides a detailed explanation of the physical processes occurring on rivers, as well as the concepts behind Channel Migration Mapping:

Appendix IV – Available GIS Base Data &Required Historic Imagery

The table on the next page represents an initial inventory of the primary datasets required for Channel Migration Mapping. Only the datasets known to be reliable are included. There are some additional local datasets available that may help the mapping process (e.g. there is an older physical features inventory for sections of the East Gallatin River). These datasets were not immediately available for review and assessment. As such, they are not included. Additional exploration of these datasets will occur upon project funding.

The following pages detail the required historic imagery by river. This imagery was selected to provide the stereo coverage required for orthorectification. Data must be purchased from the USGS EROS Data Center and the USDA Air Photography Field Office. This information is noted on each index. GIS data of image foot prints is available on request.

Map ID	River	Imagery								Elevation Data	NHD Streams	FEMA DFIRM	Geology Quads	GLO Maps	Floodplain Features
		1950s		1960s	1970s		1980s	1990s	2000s						
		ASCS	Army Map Svc.	ASCS	ASCS	USGS	ASCS	USGS	NAIP						
1	Gallatin			1965	1979 (partial)		1980 (partial)	1995	2011	10m NED	1:24K	30031C	Bozeman, Ennis	partial	none
2	East Gallatin			1965	1979 (partial)		1980 (partial)	1995	2011	10m NED	1:24K	30031C	Bozeman, Livingston	partial	none
3	Beaverhead	1955			1979			1995	2011	10m NED	1:24K	300001 (Dillon and Lima), 300045 (Twin Bridges)	Leadore, Lima, Dillon	partial	none
4	Madison	1955			1979 (partial)		1980 (partial)	1995	2011	10m NED	1:24K	30031C, 300044 (limited to Ennis in Madison Co)	Hebgen Lake, Ennis, Bozeman	partial	none
5	Jefferson	1955			1979 (partial)		1980 (partial)	1995	2011	10m NED	1:24K	300120, 30093C	Dillon	partial	none
6	Ruby	1955 (lower)	1954 (upper)		1979 (partial)	1976 (partial)		1995	2011	10m NED	1:24K	300001 (Dillon and Lima), 300045 (Twin Bridges)	Dillon, Lima	partial	none