

# Clearwater Model Watershed Project



## The First Five Years



**In Partnership with the Bonneville Environmental Fund**

**May 2016**

## Clearwater Model Watershed Project – The First Five Years

---

### Background

The following Vision Statement is from the original Model Watershed proposal:

*Water quality and the integrity of streams, rivers, lakes and their associated biotic communities in the Clearwater watershed are essential elements to our mission. We envision a future for our Valley that has diverse, productive, tributary stream and riparian habitat networks that support resilient populations of bull trout, westslope cutthroat trout, western pearl shell mussels, and other native aquatic and terrestrial species dependent on those networks. We envision larger streams and rivers that maintain sufficient flows of high quality water to serve as effective connections for fish populations, riparian corridors for terrestrial species, and material supplies and export for the lakes. We also envision lakes in the Valley maintained with clean water in a near oligotrophic (low productivity, high clarity, well oxygenated cold water habitats) condition supporting viable populations of lake migratory bull trout and cutthroat trout, a diversity of other aquatic species, and high aesthetic values for recreation and tourism. Finally, we envision a community that is knowledgeable about its critical water and aquatic resources and that strongly supports conservation measures to maintain these resources for all their natural, economic and cultural values.*

*Our greatest current capacities are technical, but our opportunities are in our existing and potential links to the local and adjacent community, management agencies, and collaborating non-governmental organizations. Thus, we see our primary role in the Clearwater watershed as one of facilitation, coordination, education, and where needed, development of new capacity to accomplish meaningful conservation and restoration of terrestrial and aquatic natural resources. We do not propose in this project to conduct large scale on-the-ground restoration activities, although we do see value in smaller scale demonstration activities such as the Morrell Creek project discussed above. This perspective could change over time, but with the capabilities of our partner agencies and other organization, we see our best contribution in coordination, demonstration, outreach and education, and technical scientific assistance. We have and will continue to focus on bringing our partners together to develop a common vision for restoration and conservation priorities; to engage, inform and build support among the broader community of citizens; and to develop critical information and capacity (both technical and social) for actions needed to move forward. Our work is based in four general principles: a watershed scale perspective that links activities and process across terrestrial and aquatic systems, across ownerships and across the broader time than even this project may encompass; a collaboration among groups including agencies, NGOs, local government, citizens, and schools; an effective prioritization that can guide available, and leverage additional, resources for actual restoration work; and a process of monitoring to learn and adapt.*

From this vision we established a collection of strategies that we have pursued over the last five years. In the remainder of this discussion we outline our work under each group of strategies and briefly discuss what we have learned, what remains unresolved and any thoughts about the implications for future work.



## Agency, NGO, and Landowner Outreach and Coordination

Our intent was not to do on the ground watershed restoration, but to coordinate and guide those efforts as effectively as possible. Our stated focus was to develop working relationships, critical information, capacity and a common vision among federal and state agencies, non-government organizations (NGOs), major landowners, and members of the local community. We identified five general strategies: *Identify Key Watersheds as Priorities for Restoration; Focus Restoration Actions within Key Watersheds; Integrate Terrestrial and Aquatic Restoration Efforts; Extend Collaborative Efforts; and Link Agencies with the Community.*

### Identify Key Watersheds

This strategy had five elements: 1) Work with collaborators in the Watershed Planning Group (WPG) and available information to gain agreement on subwatersheds or collections of smaller watersheds as priorities for restoration; 2) Work with our partners, the Ecosystem Management Research Institute (EMRI) and the Southwest Crown Collaborative (SWCC) through its Collaborative Forest Landscape Restoration Program (CFLRP) project, to gain support through the broader initiative; 3) Work to establish restoration priorities through CFLRP in these key watersheds; 4) Present the results of these efforts to the community via the outreach plan; 5) Work with Forest Biologists throughout the region to refine and extend efforts like these to other systems as feasible and interest develops. We have accomplished significant work and progress on each of these elements, though efforts with outreach are only beginning and have not directly addressed issues of prioritization (*see discussion of progress with outreach under section B*).

Initial work on this strategy was already underway when the Model Watershed was initiated in 2011. In 2012 we completed a project focused on water quality and non-point source pollution funded through the Montana DEQ 319 program. The effort included two objectives: 1) formation of a Watershed Planning Group (WPG) to summarize existing knowledge on water quality issues and recommend priorities for further work, and 2) a project with the University of Montana to synthesize existing information on the status of Seeley and Salmon lakes.

The WPG included the US Forest Service, Montana Fish Wildlife and Parks, Plum Creek Timber Co., Montana DEQ, Montana Department of Natural Resources and Conservation (MT DNRC), Big Blackfoot Chapter of Trout Unlimited (BBCTU), the Blackfoot Challenge (BD), CRC, and members of the local community. The WPG identified native fisheries and the condition of valley bottom lakes as critical values. Significant conclusions of that work include: 1) recognition of the very limited information available on existing watershed conditions and non-point sources and the need to prioritize efforts to fill critical gaps; 2) recognition of the tenuous condition of Seeley and Salmon Lakes, the lack of positive trends in trophic status, and the need to develop better information on nutrient loading and sources and to continue monitoring efforts; 3) recognition of the value of collaborative efforts and a thoughtful prioritization process in leveraging additional support; and 4) recognition of the information that can be gained through volunteer efforts in the community. Priorities for further work were clearly resolved in the WPG and focus on development of better information regarding lake trophic condition and relative importance of different nutrient sources; roads and watershed disruption as sources of fine sediment and nutrients; and stream, lake and wetland riparian disruption. The final reports (CRC 2012; Watson 2012) included a pilot process to prioritize watershed restoration across the Clearwater Basin, a detailed

summary of the status of Seeley and Salmon lakes, Sampling and Analysis Plans for volunteer based lake monitoring and a matrix of existing watershed information sources.

The recommendations from this work follow from the discussions, information gaps, and priorities developed by the WPG and from the critical analysis of information available for Salmon and Seeley Lakes conducted by the University of Montana. The recommendations were as follows:

- Expand the focus on the lakes because of their key ecological, social and economic values and potential vulnerability to a “tipping point”. Develop better information on current nutrient supply and the primary sources of nutrients including, but not necessarily limited to septic systems and tributary watersheds.
- Resolve the conflicting information and views on the importance of roads and their effects on erosion, in channel substrates (e.g. fine sediment) and as a source of nutrients. Acquire the existing inventory of road crossings and BMPs conducted on Legacy Lands (lands transferred from Plum Creek Timber to Conservation Ownership) and consider replicating those inventories in priority watersheds. Develop better information on stream channel conditions to validate the conceptual tie between roads and stream habitats. Develop better information on nutrient supply in heavily roaded and lightly roaded watersheds to test the influence of roads and road management on nutrient supply. Use new analytical tools such as NetMap and inventory/monitoring tools such as GRAIP to help resolve and prioritize areas for collection of better information or focus restoration.
- Refine the prioritization process developed by the WPG to consider values associated with water supply and water quality/nutrient supply for the lakes.
- Develop a better understanding of riparian, shoreline and wetland conditions throughout the basin. Review the riparian analysis conducted by the Montana Natural Heritage Program for Missoula County. Consider next steps for restoration or better information based on current status and the potential to determine change within the spatial priorities outlined by the WPG.
- Continue volunteer monitoring and expand where possible to address key uncertainties. Continue Secchi, oxygen, and nutrient monitoring for lakes and consider expanding to include other approaches such as Chl-a, and shoreline periphyton (an index of groundwater nutrient sources). Inventory and monitor the implementation of road BMPs in priority watersheds. Seek support for monitoring the effectiveness of any restoration actions associated with other programs such as the Southwestern Crown Collaborative Forest Landscape Restoration Project. Seek funding to continue and expand support for lake monitoring and nutrient supply estimates from key tributary watersheds.
- Continue community outreach and education on riparian, shoreline and wetlands values and continue demonstration projects on riparian conservation and restoration. Continue community outreach and education on lake status and the critical processes influencing the lakes. Involve students and volunteers in monitoring and any further work wherever possible.

As we completed the initial work with the WPG and lakes we began significant involvement with the Southwest Crown Collaborative (SWCC; <http://www.swcrown.org/about/>) and CFLRP.

Our primary effort was through the aquatic monitoring program, but we also engaged in discussions on restoration planning and prioritization (see discussion on *integration of aquatic and terrestrial restoration* below), in new work to resolve the influence of roads (see discussion on *focusing restoration within key watersheds*), and in work to identify and monitor tributary nutrient sources influencing the

lakes (See Community Based Monitoring, *nutrient sampling*) below. We helped form (and chaired for 2 years) the aquatic monitoring committee and worked to engage biologists, hydrologists, and managers from each of the three forests participating in the SWCC as well as scientists from outside the region.

Our pilot watershed prioritization process developed as part of the Clearwater WPG was expanded to the entire SWCC (Mehl et al. 2012) and presented on several occasions to restoration committees on each Forest. Our process was initially adopted by the Lolo Forest with the Morrell-Trail watershed identified as the immediate restoration priority. Subsequent issues within the agency have stymied restoration planning for several years, but the approach we developed is still being considered as part of a more comprehensive planning effort.

Based on the lake and WPG work we were also funded to develop a pilot effort on water quality monitoring focused on nutrient sources (Rieman and Wallenburn 2014; Rieman and Wallenburn 2015). Our conclusions were:

1. Water quality and nutrient loading varies substantially across streams and through time;
2. Nutrient loading (P in particular) is associated with suspended sediment and likely tied to sources of erosion as well as other watershed conditions;
3. Relatively simple and inexpensive water quality sampling using citizen volunteers can be an effective approach to monitoring;
4. Further work will require frequent sampling to capture within stream variability during runoff and a substantial commitment to training and coordination of volunteers;
5. Recovery in accelerated nutrient loading from the past effects of intensive forest management is occurring in some watersheds.

### **Discussion**

*The pilot effort to guide prioritization in watershed restoration remains sound. That work, however, focused on values and presumed habitat issues linked to native salmonid fishes and their habitats in tributary streams. The WPG and review of Seeley and Salmon lakes emphasized the need to focus on the lakes as critical habitat for native fishes and as substantial natural resources of immense local value in their own right. The natural resource agencies have substantial capacity and knowledge for restoration influencing stream habitats, but virtually no capacity or information to guide restoration benefiting the lakes or the influence of watershed restoration on nutrient export. The lake synthesis emphasized the need to understand nutrient sources and subsequent work focused on developing that capacity.*

*Our effort provides a foundation for a complete synoptic survey of the Clearwater watershed (needed to identify critical nutrient sources) and longer-term lake and watershed monitoring to determine whether ongoing restoration activities are actually mitigating downstream nutrient loading. We have shown that erosion can be an important nutrient source and that recovery can occur as intensive management and use subside. Our participation with the CFLRP and the aquatic monitoring effort has been productive, and we've developed strong working relationships and support with agency staff. But agency political and administrative issues still limit the capacity to move forward in a more strategic way.*

### **Focus Restoration within Key Watersheds**

This strategy had three elements: 1) Work with agency biologists to identify known or logical restoration





needs within each key watershed; 2) Explore application of higher resolution analytical methods such as GRAIP, NetMAP or other analysis tools; 3) Implement restoration actions.

### Known Restoration Needs

Our initial work on this strategy was with the WPG. Working with technical staff from MT FWP, USFS, DNRC, MT DEQ, and Plum Creek Timber Co., we created a matrix of “known” issues and sites influencing non-point source pollution or constraining native fish habitats and summarized information by 6<sup>th</sup> code watershed (CRC 2012). The results were disappointing. There was very little hard information available with the assessment of watershed conditions based largely on subjective interpretations of road or timber harvest effects, limited sampling in 303 listed watersheds by MT DEQ, and models that had little or no local validation. The most comprehensive data available came from studies conducted in the 1970s. One particularly contentious issue was with the effects of roads, with some participants arguing that very high densities in many watersheds must be particularly damaging, and others arguing that the geology, land forms, and road drainage connections made this unlikely. Even within the Forest Service there was considerable disagreement, but very little information to resolve the debate.

### New Tools

Based on this conundrum, we began looking for new tools to inform the discussion. In 2011, with funding from the CFLRP and the Model Watershed we worked with Earth Systems Institute to pilot a tool known as NetMap (now Terrain Works) in the Clearwater Basin. NetMap has been widely used in the Pacific Northwest for spatially explicit watershed analysis and prioritization of restoration or further data collection. NetMap is a platform that incorporates existing geomorphic, hydrologic, and ecologic models and is readily updated as new models and GIS information are developed. The pilot project showed how an analysis could help identify potentially important road or other restoration issues across the Clearwater Basin (ESI 2011). In collaboration with the USFS R-1 we sponsored a 2-day workshop on NetMap and its applications for hydrologists and biologists throughout R-1. NetMap requires a library of GIS coverages and implementation of geomorphic models for the entire analysis area so the costs are not trivial. R-1 recently purchased a subscription for Terrain Works to support application across the entire region. To date, the tool has not been used for any further analysis in the Clearwater, but has been discussed as a tool to support the new CRC led Trails Project.

A second effort to inform the road discussion was with our efforts on the aquatic monitoring committee of the Southwest Crown CFLRP. Despite the inconsistent view of roads within the USFS, the original CFLRP (<http://www.swcrown.org/about/>) proposed a substantial investment (40% of \$40M over 10 years) to restore, mitigate, and monitor aquatic ecological conditions with a major focus on roads and sediment delivered to streams. In collaboration with The Wilderness Society, we championed an objective approach to the problem and brought staff from two of the three CFLRP forests and R-1, scientists from U.S. Geographical Survey (USGS) Northern Rocky Mountain Science Center (NOROCK) and the U.S. Forest Service (USFS) Rocky Mountain Research Station (RMRS), together to develop the effort. To date more than \$550,000 has been granted (principally from the CFLRP and Great Northern Landscape Conservation Cooperative (GNLCC) to develop a monitoring approach and test (with real data), the conceptual model driving the debate about roads in this region. The work has been based in two complimentary efforts. The first is an application of GRAIP (Geomorphic Roads Analysis and Inventory Procedure; <http://www.fs.fed.us/GRAIP/>) as the state-of-the-art tool to characterize road erosion across entire watersheds through complete field inventory of roads and calibration of erosion

models with local erosion plots. The second is a modified application of PIBO (Pacfish, InFish Biological Opinion Effectiveness Monitoring) stream habitat monitoring protocols to determine the condition in stream channels and their responses to upstream erosion quantified through GRAIP. Each approach provides a foundation for long-term monitoring of road restoration and stream conditions. Integration of the two approaches provides an empirical test of the conceptual model underlying past road management in the Region. For more detailed references see four workshops, series of reports, and informational documents, one journal publication in preparation and others expected (e.g., Cissell 2014; GNLCC handouts; AlChokhachy In Press; <http://www.swcrown.org/monitoring/aquatics-monitoring/> ). Important conclusions to date:

1. Roads are associated with fine sediments in streams (the conceptual model is supported), but the results are highly variable. Erosion rates in this area are among the lowest found throughout the western United States.
2. In the watersheds studied across the SWCC, most road segments are not strongly connected to streams. Most of the sediment delivered to streams (>95%) comes from a small (<5%) portion of all segments. Most of the delivered sediment is associated with road-stream crossings.
3. Road use has a very large influence on road erosion. Open roads generate approximately 10 times the eroded sediment of closed roads (which are very low). Open roads in this study have relatively low or moderate use compared to what could exist with intensive logging.

### Restoration

The USFS, MT FWP, either independently or in collaboration with BBCTU have engaged in a number of restoration actions in the watershed. Many of these have been associated with roads and road crossings targeted either at reducing erosion, channel constraint and or fish passage issues. MT FWP has focused considerable effort in the West Fork Clearwater and Marshall Creek subwatershed following transfer of these lands to conservation ownership from Plum Creek. MT FWP anticipates moving that focus to Deer Creek as part of a long-term restoration effort. The FWP work is consistent with the short and long-term priorities that emerged through the prioritization effort. Other work, while important has tended to be more opportunistic, linked to new larger forest restoration efforts and the recognition of local problem areas as biologists and others spend time in the field across the basin.

### **Discussion**

*No real application of tools to date; results of GRAIP/PIBO have created as much confusion and debate in the message to those outside the project as it has light....Because of the fear that the "information will be misused", results that address a narrow set of processes ("doesn't mean roads not important") and a necessarily limited temporal perspective ("missing storms, fires and heavy traffic so we're not really sure"), adaptation of the new information has been limited. The finding that a very small part of the system has most of the problems should be really good news that can help focus restoration in a few key places rather than working toward wholesale reduction of road densities. It should open the door for compromise on contentious road issues, but that has yet to happen. Potentially, huge benefits could be gained by simply closing roads without having to fully restore, but that seems to rob some freedom or power or control from those driving the projects. CFLRP has backed away from large-scale restoration and the future direction is uncertain. Several large projects are in process but without the benefit of new information. A strong foundation for monitoring exists and the new projects could provide important tests for the original work, but it is unclear whether it will ever be used. It seems we've fed the controversy within the agencies rather*

*than resolve it...restoration projects still tend to be opportunistic responding to local issues and available funding/support linked to other projects. These are all good projects, but not as strategic as we had hoped.*

### Integrate Terrestrial and Aquatic Restoration

This strategy was to build on the CFLRP and local community engagement with terrestrial and aquatic managers. Our hope was to further restoration of ecological processes important to both. The effort was built on past work showing the opportunity for common progress rather than the more traditional conflict between disciplines.

Our efforts included a series of presentations to the local community, local managers, and organization of a special session at the North American Wildlife Association in 2011 (Haufler and Rieman 2011; Rieman and Hessburg 2011). Ecosystem Management Research Institute (EMRI) received funding from the Seeley Lake Community Foundation and the CFLRP for a pilot project on integrated restoration. EMRI was asked by the CFLRP to develop the process for the entire SWCC. CRC subsequently worked with biologists from MT FWP and the Forest Service to adapt the Clearwater Aquatic Prioritization process to the entire region as the aquatic element. Initial work seemed to be well received both in the local community and with agency staff in the CFLRP. Early results suggested several watersheds across the SWCC could be appropriate areas to pilot integrated restoration that might require more refined analyses to guide individual projects. As a result, the Morrell-Trail subwatershed in the Clearwater was tentatively identified as highest priority for new planning in the CFLRP process.

### **Discussion**

*Little further discussion has happened with no implementation to date. The agencies seem to have reverted to more local efforts and the existing laundry list of projects because of some of the difficulties outlined above. Lawsuits, new rules favoring local control, and revision of Forest Plans seem to have diffused energy or commitment. A new planning effort emerged to take advantage of a refined forest analysis conducted by EMRI, but the initial plans called for no aquatic involvement. Several of us screamed and yelled and an aquatic component was added to the process, but commitment of resource and capable staffing remains in question. A revised aquatic conservation strategy is intended to build on the pilot process and also include prioritization based on climate change but there is no clear effort to integrate that with the terrestrial process. Recent word from the Regional staff is that the process may be dead.*

*It's not clear whether this is just too hard to do or the mechanisms for planning, integration and collaboration are still too muddled and contentious to work...(cite the TWS review of FS collaborative process?). A common complaint is that larger scale planning and priorities constrain local control. I wonder if a more effective approach is to identify priorities and processes from an aquatic perspective and hammer on those with the local community to build a consistent, clear message that the agencies can more easily find the political will to address.*

### Extend Collaborative Efforts

This strategy was intended to move beyond the traditional focus of restoration of watersheds and streams on public lands to include small private landowners and other issues such as the lack of a sewer. It included three elements 1) work toward a sewer; 2) streamside protection; and 3) relationships with neighboring NGOs.



## Sewer

The lack of a sewer has been a central issue for the community for nearly 20 years, and ground water contamination has been clearly increasing in the downtown area near Seeley Lake. The CRC board identified the sewer as the single most important issue influencing long-term health of the lakes. Over the last 5 years we've met with the sewer board on multiple occasions to update them on the information emerging from our studies. We have written 19 articles in the local paper and provided multiple presentations in public forums on water quality and the condition of the lakes. We have completed three major reports and associated non-technical summaries dealing with different aspects of lake conditions and nutrient loading (Watson 2012; CRC 2014; Rieman and Wallenburn 2014). We continue to work with volunteers, students and teachers to monitor and discuss lake conditions and nutrient sources and have produced a series of reports and webpage materials aimed at the general public, students and others (e.g. Rieman et al., 2015). We worked with the Seeley Lake Community Council to explore creation of a watershed wide "Water Quality District" to help defray initial costs to homeowners who can least afford a sewer bond (*Background on a potential Water Quality District Memo to Seeley Lake Community Council dated September 7, 2012*). We formed an *ad hoc* committee to explore issues with the community and sewer board. We have worked with the local High School to develop a nutrient budget for Morrell Creek as part of a community service project (CRC 2014). Recently, Missoula County and the local Sewer Board funded a 3<sup>rd</sup> year of work with the High School as a foundation for long-term monitoring needed when/if the sewer is built.

## Streamside protection

We have done limited work on streamside protection beyond initial efforts at the start of the Model Watershed project. Early on CRC engaged with MT FWP and the Missoula Conservation District to host public meetings and distribute brochures and other information on riparian functions/benefits and rules governing riparian development. Since that time we have continued to work with students in the Morrell Creek Riparian Classroom each spring and fall during their routine monitoring. Riparian issues have been a common theme in public and class presentations (two Loon and Fish presentations and annual classes with the High School), newspaper articles (Eye On the Environment), and comments on County planning discussions (Comments on lake shore development rules) We have provided technical support to the Double Arrow Landowners Association Parks and Natural Resources Committee (PNR) on two riparian restoration projects that followed from the original Trail Creek Demonstration project.

## Neighbor NGOs

We have developed and maintained working relationships with BBCTU, SEC, the Blackfoot Challenge and Northwest Connections on fish habitat, water and water quality issues.

Over the last three years we worked with Double Arrow Ranch Land Owners Association (DARLOA) Parks and Resources (P&R) to consider in-stream flow reservations and bull trout habitat restoration on Trail Creek, which flows through the development. We monitored water rights adjudication, which opened the door to conservation of flows and construction of a new fish friendly diversion structure. We brought BBCTU, MT FWP and the P&R together with the irrigator to move the project forward and worked with BBCTU to find funding to make the project a reality. We have continued to explore opportunities with BBCTU and have worked to highlight and extend their efforts in the local community.

Working through the CFLRP (which includes Swan Ecosystem Center (SEC), Blackfoot Challenge (BD), and Northwest Connections (NC) we established a pilot project on Citizen Science (*see Adopt a Stream*

*below*) linked to ongoing work with the local schools (*see Students in Action below*). Following that effort we (CRC, U of M, BC) were funded in 2013 through the Crown Roundtable Adaptive Management Initiative (AMI) to see if we could extend the school curriculum and stream monitoring process to a network of schools and communities in the Southwest Crown (<http://www.swcrown.org/monitoring/citizen-science-and-education/engaging-communities-in-ecosystem-and-climate-change-monitoring/stream-monitoring-with-local-schools-and-communities/>). We worked with Cory Davis (U of M) and Elaine Caton (local science education specialist), SEC and other volunteers to establish a stream and forest monitoring network and extended curriculum with schools and nearby streams in Lincoln (upper Blackfoot) and Condon (Swan River) and Seeley (Morrell Creek) (Davis et al. 2014; Caton et al. 2015). In late 2014 we were funded for a second year of work and extended the monitoring network to include the Ovando School in the middle Blackfoot. Throughout this project CRC has served as the technical lead and fiscal administrator on the stream-monitoring efforts. We have trained and supported staff and volunteers from the other NGOs and done the work in their streams when they could not. We worked with the BC to carry over funding and meet failed contractual obligations. We worked with SEC and NC to transfer funding to contractors when they ran into staffing problems. We have provided class and community presentations for both organizations. We have participated in Crown Roundtable meetings and discussions and contributed substantial material to a Crown Managers Partnership initiative on conservation of native fishes.

### **Discussion**

*The sewer has been a contentious issue in Seeley, but the local Sewer Board with leadership from the County has made significant progress toward funding and construction. Important issues remain, however. The first stages of the sewer omit much of the streamside and lakeside development, which almost certainly contributes important bacterial contamination and nutrient load. Our work with the High School shows increased Nitrogen (N) loading associated with subdivision/resort areas that are not part of the long-term plans. Most of the cabins and homes along the river use disposal systems that sit in or very close to groundwater. General discussion in the community remains poorly informed and misinformation is common in the criticism and debate. We proposed to work with others to develop and publish an objective list of questions, issues and answers for all to reference, but we were asked to sit-on-it by the Community Foundation. Some remain concerned that the focus on building a sewer has obscured the need to make sure it (when finally constructed) will effectively mitigate the environmental issues creating the need.*

*Streamside (and lakeshore) protection remains an issue on private and state-federal lease lands throughout the watershed. Frequent violations of streamside-management-zone rules still occur. Enforcement of shoreline management is inconsistent to nonexistent and discussions of regulations such as setbacks remain a contentious private property issue. Although the value of, and issues with, shoreline areas are better understood to some (e.g. growing number of volunteers with DARLOA Parks and Resources Committee, volunteers and students involved in monitoring) real progress in the community as a whole has been limited. We still lack a meaningful inventory of riparian conditions needed to understand the scope of the problem and we lack the widespread recognition that these systems are key to local values and require commitment and work to protect.*

*We have begun building good working relationships with the staff of several surrounding NGOs. We continue to work on several projects with BBCTU and have benefited from their capacity to fund and*

*implement restoration projects. They work with the local agencies as well and have done important work in the Clearwater despite the fact that it is not, and likely never will be, a high profile wild trout fishery like the main Blackfoot River. We have gained important support and had very positive interactions with BC, SEC and NC as well. With these groups we have played a different role providing technical support and coordination to extend our projects into their watersheds. The effort has had positive benefits, but not without frustration and added work. Failed commitments and follow through, inability to mobilize local volunteers, turnover in staff and poor fiscal management have contributed to the challenges. It is important to build support with these organizations because they have a significant reputation and an ability to bring new resources to the SWCC that can benefit the Clearwater. We do not have the capacity, however, to participate in “collaborative” projects where we essentially do the work for them.*

### Linking Agencies with the Community

We have done relatively limited work under this strategy. We have a good working relationship with the MT FWP and USFS biologists and higher-level staff responsible for this area. We have frequently pointed to their work in our articles, presentations, and annual picnic (e.g. road restoration that should benefit the lakes) and other outreach (new film on water quality). On several occasions we have organized volunteers to participate in special projects with MT FWP (bull trout red counts, weed control in restoration areas). We participate in their public meetings and commonly provide comments and letters of support on management issues that allow public input.

### **Discussion**

*The agency-fisheries staff value our contribution to new information and to their own restoration efforts. They have worked to find funding and other resources for our programs with the schools and water quality monitoring. It is clear that they need and value any help they can get with public opinion, but they are also very anxious about their control of habitat restoration and related management. The notion of collaboration is ok, but if that hints at subverting their individual priorities to a broader goal they become more reluctant. They want to inform, and gain support from the public on their plans, but opening the process to the public before those plans are resolved seems more troublesome. They welcome our expertise and guidance in matters related to the lakes, but would rather we not try to influence direction, priorities, or opinion associated with fisheries habitat work. Issues associated with water quality may be a different issue because the agencies lack expertise and/or capacity to focus in that area.*

### Community Outreach

Our original intent was to continue and extend ongoing outreach on aquatic issues. There were three general strategies, 1) engage and educate: community outreach and participation, 2) community based monitoring, and 3) demonstration projects. Each of the three community outreach strategies are described in the following sections.

#### Engage and Educate: Community Outreach and Participation

##### Public meetings

We have sponsored or participated in several public meetings where we presented, or coordinated the presentation of, information on the lakes or water quality issues.

Early in the program CRC worked to hold regular informational meetings on natural resource topics of



interest to the public, but we were unable to maintain the intended monthly schedule. In 2011, in collaboration with BC, we launched a new outreach program, “Pure Montana Tales, a quarterly event that features presentations on high profile natural resource topics. Some of the more successful events have featured charismatic wildlife (bears, wolves), or local personalities (e.g., Smoke Elser, Will Kats). We have included several presentations by students on their stream monitoring, which were very well received. Recently we held the premiere of a student film on climate change and student work in the streams that was among the best attended programs to date.

In the last year CRC has begun a new “Community Trails” project, intended to bring a diverse, and often divided, group of recreational trail users together to develop a collaborative approach for trail development and management. The community has engaged fully with the project and there have been at monthly meetings since October 2014 of an advisory council to direct the project. The project has engaged basically every non-profit organization in town, the community council, representatives from all recreational user groups, state and national agencies, land holders/managers and regional NGOs. The collaboration and enthusiasm has been very successful, to the extent it has generated regional interest. A significant focus of the program is community building. The community has a number of issues that it will face in the near future that will require community engagement and the ability to work through difficult decisions in a productive way. The overall project now incorporates a series of training sessions for trail participants and community leaders to teach the skills it takes to handle difficult issues effectively and move the community forward on social and natural resource issues.

CRC actively engaged in the recent Norman Mclean Literary Festival, in an effort to be more engaged in the community, raise awareness of CRC in the region, and to highlight work done by CRC in fuel mitigation. This included a wild fire tour, engagement with local and regional firefighter groups, and a barbeque dinner. We also have an annual picnic that is open to the public in which we raise funds for the organization, but also highlight what we have done in the past year. CRC was a partner with the Montana Wilderness Association in their “Wild 50<sup>th</sup> Fest”, celebrating the 50<sup>th</sup> anniversary of the Wilderness Act. CRC used this venue to highlight the work we do in this watershed on aquatics, forestry, weed management, invasive species and fire fuel mitigation.

Other publically visible activities have included formal presentations at local festivals, public comments on the proposed sewer, letters of support and comments on management of Lake Alva, and work with the Community Council on a potential Water Quality District; work with and presentation to Missoula Water Quality District on issues with Salmon Lake algae blooms with follow up on Missoula TV.

#### Eye on the Environment (now A Place for All)

The Eye on the Environment was a weekly column on natural resource and environmental topics published by the local paper. Since the inception of the Model Watershed we have done at least 19 articles in the local paper on water and fisheries related issues, with a strong focus on the lakes and streams influencing the lakes. In addition we have published two press releases and worked with the paper on several significant articles on the lakes, stream volunteers, and school related projects.

#### Primary and Secondary Education

Our work with the local schools has been a major effort since the inception of the Model Watershed. We work regularly with teachers at Seeley Lake Junior High and Seeley Swan High School (SSHS) to support their science classes and outdoor classroom activities. Each year for the last 5 years we have



assisted Patti Bartlett with 7<sup>th</sup> and 8<sup>th</sup> grade classes on water quality, stream flow measurements, and fish sampling, identification and ecology. We have donated equipment to the school and provide additional equipment and materials for laboratory and field work.

In 2011 we were approached by Tonya Smith, the SSHS science teacher, about a student service project that could make a contribution to the community on a natural resource issue. The “Students in Action” program was started as a means of generating new information on streams and nutrient loading to the lakes as well as an opportunity to bring real world science and the local environment into the classroom. Working together we developed funding for equipment, supplies and laboratory analyses needed for a nutrient budget from the Morrell Creek watershed. We now have a permanent gage and the equipment to rate and maintain that gage each year. We have completed two annual nutrient budgets and additional studies showing potential sources of nutrient loading downstream of the High School (CRC 2014). In 2012-13 it became apparent that additional curriculum was needed to make a better connection between the stream work and the classroom. We generated funding from the Seeley Lake Community Foundation to develop that curriculum with Elaine Caton, a local science education specialist. Those materials are now part of the regular teaching schedule. In 2015 Missoula County and the Seeley Lake Sewer Board funded the school to continue the work as important baseline for the sewer that is proposed to be located in the Morrell Creek watershed.

The work with teachers and students has provided a foundation for long-term monitoring and new information on other streams. Using Morrell Creek as a calibration point we worked with the CFLRP and citizen volunteers to estimate nutrient loading from 11 streams and basic water quality information on 22 streams across the Clearwater and neighboring watersheds (Rieman and Wallenburn 2014; see *adopt a stream below* and *identify key watersheds* above). This work was the basis of our project funded through the Crown Roundtable to extend stream monitoring and the curriculum to a network of schools across the SWCC (see *neighboring NGOs* above). The new project included additional curriculum on climate change, which has become the focus of a community outreach project through the Schools.

The first year of the Crown Roundtable AMI project (see *Extend Collaborative Efforts/NGOs* above) included funding for the BC to do outreach featuring the work with the schools related to climate change. When that didn’t happen we carried the money over and focused on production of a video featuring the work of the students. The AMI provided additional funding to support a student intern to work on this effort. The new film was shared at Crown Roundtable meetings in September and made available through the SWCC, CRC, Montana Film Board, and other webpages (<https://www.youtube.com/watch?v=k3JIW0u1vNE>).

### Other Aquatic Messaging

CRC maintains a website. The format and content was overhauled early in the Model Watershed work and we have engaged volunteers to help maintain the content and manage the web page. We also initiated a newsletter (Happenings) and e-mail blasts as a means of regular communication on interesting and important natural resource issues.

In 2014 we received funding from the Seeley Lake Community Foundation to begin some form of outreach on water. The original intent was a brochure and series of community meetings, but we refocused the effort on a well-produced video that would have some longevity. Over the last year we have worked with Jenny Rohrer and generated additional funding to produce a film featuring the work



of our volunteers, students, and agency biologists. We have a rough cut and trailer and anticipate completion of the video in early winter 2016 (See: <https://www.youtube.com/watch?v=FPxK1synmeE>).

### **Discussion**

*Outreach and the community presence of CRC have been mixed over the last 5 years. We have struggled to keep the web page current and the e-mail blasts and “Happenings” could not be maintained. We’ve had great volunteer help to do updating, but we haven’t managed to feed the content in a consistent way. We supported The Loon and Fish festival with presentations and other work, but the event was canceled because Alpine Artisans (primary sponsor) didn’t meet their goals. CRC did not have the capacity to take on the event. In the last two years the EOE column has been opened to others so our opportunity to participate comes only a few times during the year rather than every 5 weeks. We do have an open door with the editor and have great support getting exposure on our projects if/when we ask for it. The recent Trails Project has received good press and positive interest from groups not traditionally involved with environmental issues, but it has required a major commitment from the Executive Director (ED) to keep it alive. The annual picnic seemed to take a significant step in 2013 and 2014 going from an event that generated 20 or 30 attendees and a few hundred dollars to 70 or 80 attendees and several thousand dollars. Attendance was good again 2015, but income was down to the old levels. There were a lot of new faces at the picnic, but we didn’t get as many of the old ones. We still do not have a formal membership.*

*Recently we hired a part-time outreach director and we are very optimistic that she can help us turn a corner. The two video projects have generated interest among our volunteers and outside collaborators. It will be interesting and important to see how these are received in the community. We are already taxing the available time for the outreach director, so it seems we need a thoughtful strategic plan with clear objectives to guide outreach in the future..... what do we want to accomplish and what are the best strategies and actions to get there?*

### Community Based Monitoring

#### Adopt a Lake

The Adopt-A-Lake citizen based monitoring program is in the 7<sup>th</sup> full year (Rieman et al. 2015). Volunteers continue to participate on all seven of the larger valley bottom lakes. A second board member and a CRC staff person have taken over all coordination of the volunteers. Since the beginning of the project we have engaged more than 70 volunteers in the field monitoring or some aspect of the project support at some point. Several have been part of the effort all the way through. The project has generated an important set of data for each lake that includes enough inter-annual variation to provide a very good base line for any future comparisons. A series of algal blooms on Salmon Lake, first recognized by a volunteer, generated considerable interest and concern among agency managers and biologists, stories in the local paper, and TV stations, and offers of assistance from the Missoula Water Quality District. The condition of the lakes seems to have become a higher profile topic in the community in recent years as a result of this work.

#### Oxygen sampling

We have two volunteers that maintain detailed oxygen sampling on Seeley (3<sup>rd</sup> year) and Salmon (2<sup>nd</sup> year) lakes. The data have been used to estimate oxygen deficits for the lakes and both volunteers have become involved in the technical aspects of the work. The results provide an important second measure

of lake trophic status and a sobering look at physical conditions that can influence cold-water fish and internal nutrient loading in the lakes (e.g. Niederoest and Rieman 2014; Rieman et al. 2015). Both volunteers have become advocates among their peers for monitoring and efforts to conserve or restore water quality.

### Nutrient sampling

Our work with the CFLRP and efforts to identify Key Watersheds and Focus Restoration opened the door to new work with nutrients. Based on the work in Morrell Creek we knew that nutrient loading and Phosphorous in particular could be associated with suspended sediment (e.g., CRC 2014). The CFLRP focus on road erosion and in-channel sediment along with the work at SSHS provided a foundation for a pilot study on suspended sediment and nutrient loading. We proposed and received funding for a pilot study with citizen volunteers based on the *Adopt-a-Lake* model. We used turbidity as a surrogate for suspended sediments because it is relatively simple to collect and analyze and worked with volunteers to conduct two levels of sampling. The first was an intensive sample of nutrients, turbidity, and flow measurements on 11 select streams that could be used to estimate nutrient loading. The second was a simpler effort to collect just turbidity as an index of water quality on streams volunteers wanted to “adopt”.

Volunteers adopted 11 additional streams and generated new information on turbidity in eight of those that would have been impossible under the stricter sampling regime used for the intensively monitored streams. Volunteers contributed 180 hours of time and more than 1,900 miles of personal vehicle mileage in the collection, delivery and analysis of samples representing more than \$4,500 of cost savings for the project.

Our results indicate that relatively simple and inexpensive water quality sampling using citizen volunteers and an intensive site such as that with the schools at Morrell Creek can be an effective approach to monitoring (Rieman and Wallenburn 2014). Several volunteers expressed strong support for the program and what they learned, suggesting it had opened their eyes to what’s happening in the watershed. This response led us to the interviews with volunteers on aquatic messaging project and the proposal to the Crown Roundtable AMI to extend the Citizen Science efforts on streams to other schools and watersheds in the SWCC (see above).

We could not maintain the project for a second year lacking capacity to coordinate the effort. Further work will require frequent sampling to capture within stream variability during runoff and a substantial commitment to training and coordination of volunteers. We have received partial funding from the Forest Service to continue the nutrient work and are seeking additional funds to do a comparable work across the entire basin.

### Aquatic invasive species

In August 2011, CRC received funding from CFLRP, for its nascent AIS Monitoring and Prevention Program. Prior to receiving funding, the program was limited and consisted of: signage at boat ramps (signs provided by Flathead AIS working group), presentations to lakeshore cabin/home owners associations, volunteer lakeshore owner monitoring for adult dreissenid mussels, distribution of AIS literature at select public locations (e.g. library, ranger station), occasional Eye on the Environment articles (regular feature in the Pathfinder, a local weekly newspaper), and participation in the Flathead AIS work group and the Missoula AIS work group.

The funds from CFLRP enabled the development and implementation of more robust, comprehensive monitoring and outreach efforts. The remainder of the 2011 season was devoted to continuing the efforts already in place, beginning the aquatic vegetation mapping of the specified lakes, acquisition of equipment and development of procedures for veliger (microscopic juvenile dreissenid mussels) sampling, and the design and testing of submerged, off-shore adult mussel traps.

The AIS program also engaged volunteer Citizen Scientists to routinely collect plankton tow net samples for microscopic examination for dreissenid veligers. Volunteers sampled 6 of the 8 Adopt-A-Lake lakes. These efforts continue today. In 2013, the testing regimen was augmented to include testing for dreissenid mussels and eurasian watermilfoil by eDNA.

Additional funding for the program was obtained from MT DNRC through grants in both 2014 and 2015.

CRC coordinates with the Missoula County Weed District to map aquatic vegetation around these 6 lakes and a dozen other lakes in the watershed specified by USFS Lolo NF. CRC employee Joann Wallenburn was invited to serve on the Missoula County Weed Board (from January 2012 through December 2014) to bring a focus on aquatic invasive plants to the Board.

### **Discussion**

*Our volunteer monitoring projects were intended to be an efficient way to gather important information and simultaneously engage the community in a discussion of important watershed and natural resource issues. It has served the first purpose well and we have generated useful information that provides an important baseline for long-term monitoring of the lakes and streams.*

*Coordinating volunteers, planning the work, managing the data and generating information, and writing accessible reports, however has taken a substantial commitment. We did not have the capacity to continue adopt a stream and have struggled each year to complete the data summary and writing for adopt-a-lake. Our efforts to extend the citizen science work via the AMI network of schools and other communities fell well short of the original goals because NGOs in other locations could not find or support the volunteers needed to do the work.*

*Our efforts with community based monitoring seem to be a particularly effective way of engaging a segment of the community. Volunteers are generally enthusiastic and have commonly returned the next year or helped us find others to fill in. In some cases our volunteers have become outspoken on natural resource issues based on their experience or new interests.*

*The volunteer/citizen science program seems like one of the more effective strategies for outreach, but we still work with only a small segment of the community. The volunteers are also already part of the choir. The Aquatic Messaging video is an attempt to take that experience and enthusiasm to the larger community, but that requires another level of funding, expertise and time as well.*

*Volunteer and Citizen Science efforts have become very visible and popular in natural resource conservation circles in recent years (we have been asked to participate in two conferences with the Crown Roundtable) and may be an extremely useful tool for us. It will take a focused commitment and new capacity, however, to maintain an effective program.*

### **Demonstration Projects**

Early on we recognized that we did not have the capacity to do significant restoration in the Clearwater while the agencies and BBCTU did. We did think small “demonstration” projects could be an effective

form of outreach. Two projects were in progress at the beginning of the Model Watershed; the *Morrell Creek Riparian Classroom* with Seeley Lake Junior High and *Trail Creek Riparian Restoration and Conservation* with the Double Arrow Ranch Land Owners Association (DARLOA). On Morrell Creek we have supported the schools with fisheries, flow, and water quality monitoring but little additional work has been done in the “Classroom” proper. (An interpretive trail with the riparian classroom hasn’t gone too far but it might be an important opportunity with the Trails project.)

We have continued to work with the DARLOA Parks and Resources Committee on Trail Creek. Since the original effort they have maintained the original site and proposed, found funding, and completed two extensions of the original riparian work (i.e. new fencing and plantings). They also became interested in bull trout conservation/restoration in Trail Creek and pushed for in-stream flow rights and a new diversion structure and screen with an existing water diversion, both are now complete. We’ve acted as an advisor and liaison on these new projects and written several popular articles to help inform the larger community, but did not take the lead or coordinate the efforts.

### **Discussion**

*Attempting to do restoration projects that are large and extensive enough to have a meaningful effect on watershed conditions is well beyond our capacity. At the same time BBCTU, MT FWP, and USFS all have substantial capacity and commitment. Working with them to identify important areas of work and finding support in the public to help them move forward still seems like the best approach. Demonstration projects are popular because volunteers like to do hands-on work. That can be a useful hook, but we should make sure we keep the objectives clear and focus on projects that further outreach, education, and the opportunities for conversation on natural resource issues.*

## **Monitoring and Critical Information Gaps**

### **Validate Existing Forest-Aquatic Conceptual Model**

#### **CFLRP PIBOXGRAIP**

See the discussion under **Focus Restoration**, *New Tools* and associated references above. Through our collaboration with The Wilderness Society and ties to agency scientists across the Northwest, substantial work has been funded through the CFLRP and the Great Northern Landscape Collaborative to develop a novel approach to the road-stream habitat issue. That work supports the general conceptual model linking roads, erosion and in-channel sediment in the Southwest Crown, but it also shows that the specific effect of roads (i.e. in channel fine sediment), that was the focus of the original concern and debate, is narrowly constrained to a small part of the network (Cissell et al. 2014). Erosion rates are low compared to other geologies and landscapes and the connectivity between roads and streams is low as well. That information should provide a real opportunity to focus restoration in critical areas rather than simply attempting to mitigate road densities in general (Al Chokhachy et al., In Press). It also suggests that road erosion and sediment delivery to streams may not be as important as originally anticipated. In general erosion and the annual delivery of sediment appears to be a small portion of the total base erosion in the study watersheds.

Several important questions remain: The work to date shows that road use can have a major influence and current levels of use are moderate or low. Heavy traffic could generate important increases in erosion. Erosion plots to test this are being installed in 2015 as part of continued work funded through CFLRP.

There are other hydrologic, geomorphic, and ecological effects of roads that have not been the addressed in this work. The focus was on the most contentious issues surrounding erosion, sediment, and in channel substrates. The road-stream questions have focused on a relatively coarse fraction of “eroded sediment” that is deposited in the stream substrate. Suspended sediments can have an important influence on other measures of water quality such as nutrient export (Rieman and Wallenburn 2014). We have good evidence that tightly connected roads associated with small streams can have an important influence on suspended sediment, turbidity and ultimately downstream phosphorous loading. GRAIP erosion estimates are not strongly correlated with the suspended load in our study streams, perhaps because the GRAIP analytical approach does not address the very fine sediments carried in the water column (Rieman and Wallenburn 2015).

### Annual Workshops

Over the course of the CFLRP-GNLCC work on roads and sediment we have helped sponsor, fund and coordinate five 1-2 day workshops with scientists and managers. The workshops were used to discuss, design, and coordinate the monitoring work.

### **Discussion**

*See the discussion under **Focus Restoration** above. The work with CFLRP supports the conceptual model linking roads and sediment in stream channels, but with important caveats. The final draft conclusions from the last workshop in March 2015 are as follows:*

- *Evidence from three years of intensive aquatic monitoring across the SW Crown show that roads have an influence on suspended fine sediments within stream systems.*
- *The most important impacts are concentrated within a small portion of the existing road networks.*
- *Under current conditions, most basins in the SW Crown are not currently feeling a strong impact from roads because they have:*
  - *Low levels of traffic*
  - *Closed roads tend to be well vegetated*
  - *Geology is less erosive and tends to produce finer materials than other landscapes.*
- *When strongly connected to stream segments, roads can have much more significant effects on channel conditions and water quality (suspended sediment and nutrients) with:*
  - *high traffic, and*
  - *episodic failure of poorly installed or poorly maintained stream crossings.*
- *The effects of roads on streams may be amplified with hydrologic events, such as:*
  - *fire,*
  - *large thunderstorms, and*
  - *rain-on-snow events.*
- *That means that the risks posed by roads to aquatic ecosystems within the SW Crown can be mitigated through:*
  - *thoughtful/strategic replacement/up-grade of problem crossings,*
  - *relocation of some tightly connected road segments, and*
  - *road closures and complete road obliteration.*
- *Application of new geospatial tools like GRAIP/ GRAIP Lite can help managers focus attention on the critical places in the road network.*



- *Continued monitoring of both road and in-stream conditions could further illuminate the effectiveness of more intensive management and restoration, as well as impacts from higher road traffic and large disturbance events.*

*The CFLRP has committed to further work testing the road use question by installing and monitoring additional erosion plots in watersheds where intensive logging and road obliteration is already scheduled. It is not clear whether CFLRP will pursue the other questions. So far the new information has not had much influence on management or even the discussion within the aquatic monitoring group. We seem incapable of finding a message that doesn't threaten someone's credibility or power, so the conclusions and recommendations remain muddled (see discussion above).*

### Evaluate CFLRP restoration

No work has occurred here, though the road erosion, channel condition and water quality protocols and baseline information are now available in several watersheds.

### **Discussion**

*The restoration objectives established by the original CFLRP have been put on hold and new planning effort has been started. It is virtually impossible that any new restoration projects will be implemented within the remaining window of the original CFLRP funding. It does appear that one or the original projects where a baseline has been established will go forward. Although the project does not take advantage of the strategic planning made available through GRAIP it will provide a test of the road use question (see discussion above).*

### Critical Analysis of Lake Status

Completed (See **Identify Key Watersheds** above)

### Identify Key Nutrient Sources

This work has been started (See **Identify Key Watersheds** and *Nutrient Sampling* under **Community Based Monitoring** above).

### **Discussion**

*Our work with the CFLRP, the Schools, and volunteers through the Adopt-a-Stream project provide an important starting point to identify the most important tributary nutrient sources (and locations within those watersheds). We have shown that citizen based monitoring can be an effective way of gathering new information, of detecting differences among watersheds, and even potential new sources within those watersheds (e.g. N loading in Morrell Creek below the High School). We have the knowledge and methods worked out to find important source areas and to monitor those long term. We have some funding from the Lolo Forest to continue the nutrient work but that will support adequate sampling in only a handful of streams (10-12). It would be most effective, however, to find additional support allowing a full synoptic survey of all tributaries within the Clearwater. Given the importance of the lakes to fisheries and other values we are discussing a collaborative effort to find the funding and other resources for such work. That effort should involve the major landowners in the Basin (TNC, MT FWP, USFS) at a minimum. It should also involve MT DEQ, State Lands, and the County, but Bruce is too grouchy and stubborn to put any more effort into those groups. Progress will likely depend on having a new face lead the discussions.*

## Estimate Baseline Flow Availability

From our work with the schools and Morrell Creek we have made crude estimates of total water availability and consumption in the Clearwater basin. Aaron Fiascshetti (MT DNRC) provided estimates of water use (water actually lost from the system) based on all known water rights and standard assumptions of water lost vs. consumption. We estimated the total annual water yield from the basin based on the old Clearwater gage near the mouth. Estimated total annual loss was about 0.6% of total annual available. However, if we make several assumptions regarding seasonal use (more occurs during summer) and availability (most leaves in spring based on the High School gage) the estimated loss becomes almost 20% of available. This assumes an average water year, as water availability in summer declines in low water years or with climate change, the relative importance of human use could be substantially greater.

## **Discussion**

*Water availability and use has not been a topic of discussion in the basin with the exception of issues linked to the larger Blackfoot Watershed. The entire Blackfoot is a “closed basin” and currently no new surface water rights can be granted; domestic groundwater development is not restricted. In 2014 the MT FWP was granted a minimum lake level and minimum in-stream flow in the Clearwater River based on the need for lake volume and flushing to mitigate oxygen deficits and the potential for continued eutrophication (the application and justification was based on analysis of the information we have generated in the lake work). The Seeley Lake Water District has sought additional water rights, anticipating continued growth in the community. Those are not likely unless the town becomes incorporated. If that happens the “City” could be at odds with the State and with the community interest in the lakes. These issues have not been linked in any discussion, though the notion that climate change may threaten both the lakes and water availability are part of our work with schools and lake volunteers. This may be an important issue to consider in further work, particularly as the discussion on climate change begins to mature. The new sewer could open the door to discussion about more efficient water use and even reuse in irrigation (local golf course) or other ways.*

## Identify Key Lands for Water Supply

No work has been done under this strategy. It could become an important topic in forest management in the future if CFLRP and other attempts at broader collaboration continue and with a more refined discussion of potential climate effects.

## Evaluate Effects of Climate Change

We have done some limited work under this strategy. Climate change has become an important issue in Forest Service planning discussions and with new planning efforts under the CFLRP. The aquatic monitoring committee has participated in discussions on a strategic approach to restoration that uses stream habitat and climate models (NorWest) to anticipate where important native fishes are most likely to persist in the future. Those models could eventually support an evaluation of key lands for water supply.

We have done work to begin a discussion about climate change in the community. We now mention the issues associated with climate change in many if not most public and class presentations and articles. It is mentioned in our upcoming outreach video on water quality. We were funded through the Crown Roundtable AMI (see *Primary and Secondary Education* above) to develop a network of stream



monitoring sites that could enhance the discussion and networking among schools and local communities. That included the completion of a new curriculum/lesson on Climate Change. It also includes student-produced video on their work with water and the implications of climate change as a means to broaden the discussion among students and with the community. That video focuses on issues with bull trout, water availability and irrigation and local food and is available online through the Montana Stories from the Big Sky: <https://www.youtube.com/watch?v=k3JIW0u1vNE>.

## References

- Al-Chokhachy, R., T. A. Black, C. Thomas, C. H. Luce, B. Rieman, R. Cissel, A. Carlson, S. Hendrickson, E.K. Archer, and J. L. Kershner. (In Press) Linkages between unpaved forest roads and streambed sediment: why context matters in directing road restoration. *Restoration Ecology* 00:000-000.
- Caton, E., C. Davis, and B. Rieman. 2015. Engaging communities in ecosystem monitoring and promoting regional discussions on climate change impacts. Final Report to Roundtable on the Crown of the Continent for the 2014-2015 adaptive management initiative. <http://www.swcrown.org/wp-content/uploads/2014/12/SWCC-AMI-final-report-2015.pdf>
- Cissel, R., T. Black, N. Nelson, and C. Luce. 2014. Southwest Crown of the Continent GRAIP roads assessment: Center Horse and Morrell/Trail project area, Poorman Creek, and Cold Creek Lolo, Helena, and Flathead National Forests, Montana. Rocky Mountain Research Station Boise Aquatic Sciences Lab Report to Southwestern Crown Collaborative. <http://www.swcrown.org/monitoring/aquatics-monitoring/>
- CRC (Clearwater Resource Council). 2012. Final Report 319 Grant #209066. Clearwater Resource Council, Seeley Lake, MT. Available online: [www.crcmt.org](http://www.crcmt.org).
- CRC (Clearwater Resource Council). 2015. Stream flows, water quality, and nutrient export in Morrell Creek: Seeley Swan High School students in action monitoring results 2015. Internal Report, Seeley Lake, MT.
- CRC (Clearwater Resource Council). 2014. Stream flows, water quality and nutrient export in Morrell Creek: Seeley Swan High School students in action monitoring results 2011-2013. Internal Report, Seeley Lake, MT. [crcmt.org](http://www.crcmt.org)
- Davis, C., B. Rieman, G. Burnett, and E. Caton. 2014. Engaging communities in ecosystem monitoring and promoting regional discussions on climate change impacts. Final Report to Roundtable on the Crown of the Continent. <http://www.swcrown.org/wp-content/uploads/2014/12/SWCC-AMI-final-report-2014.pdf>
- ESI (Earth Systems Institute). 2011. Analysis of roads in support of restoration planning in the Clearwater River, Western Montana using NetMap. Report to the Clearwater Resource Council, Seeley Lake, MT.
- Haufler, J. and B. Rieman. 2011. Integration of terrestrial and aquatic in the Clearwater Valley, Northwestern Montana. Proceedings of the NA Wildlife and Natural Resources Conference, Kansas City, Missouri 2011.
- Mehl, C., J. Haufler, S. Yeats, and B. Rieman. 2012. Southwestern Crown of the Continent Landscape Assessment. Report to Southwestern Crown of the Continent Collaborative Forest Landscape Restoration Project, Agreement 11-CS-11011600-034, Seeley Lake, MT.
- Niederost, G., and B. Rieman. 2014. Dissolved oxygen analysis in Seeley Lake for 2013. Internal report Clearwater Resource Council, Seeley Lake, MT. [www.crcmt.org](http://www.crcmt.org)



Rieman, B. and J. Wallenburn. 2014. Water quality monitoring to determine the influence of roads and road restoration on turbidity and downstream nutrients: a pilot study with Citizen Science. Report for the Southwest Crown CFLRP, supplemental project agreement #12-PA-11011600-039.

<http://www.swcrown.org/wp-content/uploads/2014/07/2014ContractCompletionWaterQualityMonitoring050114-1.pdf>

Rieman, B., and J. Wallenburn. 2015. Water quality monitoring to determine the influence of roads and road restoration on turbidity and downstream nutrients: a pilot study with citizen science. Addendum 1 to final report for the Southwest Crown CFLRP, Agreement #14-PA-11011600-031.

<http://www.swcrown.org/wp-content/uploads/2014/11/Addendum-to-Water-Quality-Report-Final.pdf>

Rieman, B., J. Wallenburn, G. Niederoest, C. Harrits, and J. Harrits. (2015). Adopt-A-Lake monitoring 2014 progress report. Internal report, Seeley Lake, MT. [www.crcmt.org](http://www.crcmt.org).

Rieman, B.E., and P.F. Hessburg. 2011. Restoring resilient forests, native fish populations and aquatic habitats: relevant contexts and linkages. Proceedings of the North American Wildlife and Natural Resources Conference, Kansas City, Missouri 2011.