CHAPTER 6: POTENTIAL RIVER RESTORATION

The term “channel restoration” can be used to define changes to the river to promote natural function of the river corridor. It can include any or all of the following options:

1. Physical modifications,
2. Restoration of biological function, or
3. Improvement of the chemical water quality.

Physical improvements (Option 1) to the channel are the subject of this report. However, *restoration* of the Dolores River through Rico certainly could also focus on chemical and biological improvements to correct impacts from mining and associated activities. This type of restoration could be termed “environmental” remediation, which is beyond the scope of the study.

Restoration of the physical channel characteristics and planform usually requires heavy earthmoving equipment and includes stabilization measures to “hold” the river in-place once construction is complete. This sort of work is not warranted in many of the reaches of the Dolores River in and around Rico, and the temporary impact of “restoration” to the natural wetlands may be greater than the natural impacts of instability. However, there are certainly some areas experiencing erosion or lateral channel migration that could be stabilized to protect infrastructure and property, and improve the health and function of the river corridor. These areas are shown on Exhibits 6.1 and 6.2.

CHANNEL STABILIZATION

Channel stabilization and restoration reestablishes a river’s pattern and geometry to resist long-term erosion or sediment deposition which can alter habitat and land use along a river corridor. Channel stabilization protects both the environment and development from the inherent flood hazards associated with changes in a stream system. Restoration implies the use of stabilization techniques to return the river to natural configuration as it may have existed prior to “disruption” of the channel equilibrium. Restoration efforts may involve stabilizing a river by adjusting the channel slope, strengthening the banks and removing confining levees to restore the connection to the natural floodplain.

The key is to work with and accelerate a river’s natural tendency to achieve equilibrium and regain balance with new conditions.

Restoration implies returning the stream to a natural condition. To do this, the natural plan view pattern, termed “planform” must be understood. Channels can be straight, meandering, or have multiple branches. Mankind tends to want to put all rivers into a scenic meandering, single thread channel. A confined meandering pattern is easier for adjacent property owners to co-exist with the river, rather than contending with wider, multiple channels. However, the natural pattern may not be the most desirable pattern for adjacent land use. Although a river may create multiple channels, this many not be a sign of instability that must be “restored” and put back into a single channel. **The natural planform for the Dolores River through Rico is primarily a braided channel** with longitudinal and transverse bars often having a very wide channel with eroding banks. However, there are some reaches with more tendencies toward meandering or straight patterns. This relates to a ***Rosgen Classification*** of Type D with some Type C or B.

In the past, man felt he had the power to control rivers. However, as can be seen along the Dolores River valley, **controlling structures will fail without regular maintenance**, given enough time. Nature will find the weak point and continually work to overcome the control and reestablish equilibrium. Man-made structures, such as rock lining, gabion baskets, tires, concrete blocks, steel plates, car bodies, have all failed to withstand the river's forces over a range of flows. They diminish the natural beauty of the river corridor, and when they fail, they need to be cleared from the channel.

Native materials can be used to stabilize a river over a range of flows by modifying the hydraulic geometry of the channel. With careful attention to flow depth, channel width, channel slope, flow velocity and the stability of the bed material, the hydraulic parameters can be designed below the sediment transport thresholds at which channel instability would result. Improvements to the channel should allow for flooding to over-top channel banks and spread out across broad floodplains. Otherwise, concentrating the river's energy solely within the channel will result in high sediment transport during future flooding and lead to further channel instability.

Hard controls, such as rock riprap along the banks, as seen adjacent to the St. Louis Ponds and mine tailings caps, should only be used when necessary to protect critical infrastructure. Hard controls should be in compliance with a regional stream corridor plan to avoid pushing problems onto adjacent properties.

APPROACHES TO RIVER RESTORATION

Any structure, whether it is a dam in the river or riprap to stabilize the banks, impacts the dynamics of the stream, including its flow and its configuration. The goal is to use structures that work with the stream's natural dynamics to enhance the waterway for wildlife habitat and flood control. Accomplishing this goal requires planning, expert assistance and a maintenance program. The following features occur in naturally in rivers over a long period of time, and should be protected to promote stability.

Floodplains - Allow overbank flooding to occur and maintain broad floodplains to dissipate a flood's energy. Remove levees and confining structures which concentrate energy into the channel and result in the river becoming one long riffle section. The transport capacity for flood flow which erodes the channel can be reduced by spreading the water over broad floodplains, thereby dissipating the available energy of the river. Floodplains promote variations in the river and allow pools to become established. Maintaining building setbacks protects natural floodplains.

Meanders - Allow the river to meander by removing confining structures. River meanders are nature's effort to achieve a gentler channel slope thus reducing stream power and instability. It is the same principle as skiing straight down a hill rather than skiing in a slalom pattern. Meanders reduce the slope by increasing the distance a river must travel over a fixed drop in elevation. Channel straightening with levees along the banks destroys streambanks and fish habitat. As a remedy in these reaches where land use has confined a river from meandering, drop structures can be constructed to control the channel slope.

Resistance - Maintain vegetation and debris along a channel to increase the resistance and slow floodwaters. A rough river channel will help dissipate a flood's energy and improve channel stability. Minimize the use of riprap banks which are relatively smooth to a river and, therefore, allow water to flow fast by the banks. Where the riprap (hard control) is discontinued, the fast moving river will have available energy to scour the bed and banks.

Armoring -	Avoid excavating through the armor layer in the river. Armoring is a natural action by the river to stabilize a channel by removing the fine particles and leaving the coarser fraction of cobbles to shield the bed and banks against scour. Breaking this armor layer by using heavy equipment in the river will lead to some short-term channel instability.
Planforms -	Understand the natural river classification (Rosgen 1996) such as braided, anabranched or meandering regime. Promote the stable characteristics of the specific river classification (width/depth ratios, sinuosity, meander amplitude, radius of curvature, etc.).

Each restoration project must be site specific. Stream characteristics, such as channel configuration, velocity of water flow, slope of beds and bank, and channel material, are unique. The Dolores River cobble bed channel is the result of high stream power and channel bed armoring.

TYPES OF STABILIZATION

Streambank stabilization options are available that are generally divided into two groups:

"**Hard**" or highly engineered treatments, and
"**Soft**" or bioengineered treatments.

Examples of hard engineering treatments include the use of rock riprap, grouted riprap (rock and concrete), and concrete revetments. These treatments have worked well in a variety of locations and under widely fluctuating flow conditions to stabilize riverbanks. These techniques are utilized where it is critical to control the river so that impacts to infrastructure or property are minimized.

While hard controls can work well hydraulically, they do not offer the functional biological benefits provided by soft bioengineered treatments. They can also detract from the aesthetic appeal of the river. Bioengineering (also known as biotechnical engineering or soil bioengineering) is the practice of using natural, native and living plant materials to vegetate and stabilize disturbed land such as streambanks and hill slopes. It brings together biological, ecological and engineering concepts. A major goal of bioengineered slope protection treatments is to stabilize highly eroding streambanks with native plant root structure. Bioengineering techniques and treatments are especially appropriate along degraded, slumping, and eroding streambanks where there is increasing interest in restoring the multiple environmental benefits and functions associated with fully-vegetated riparian corridors. Examples of soft bioengineered treatments include brush layering, wattling (live facines), brush layering/wattling combinations, terracing, compacted soil, vertical bundles, and many variations of these basic types.

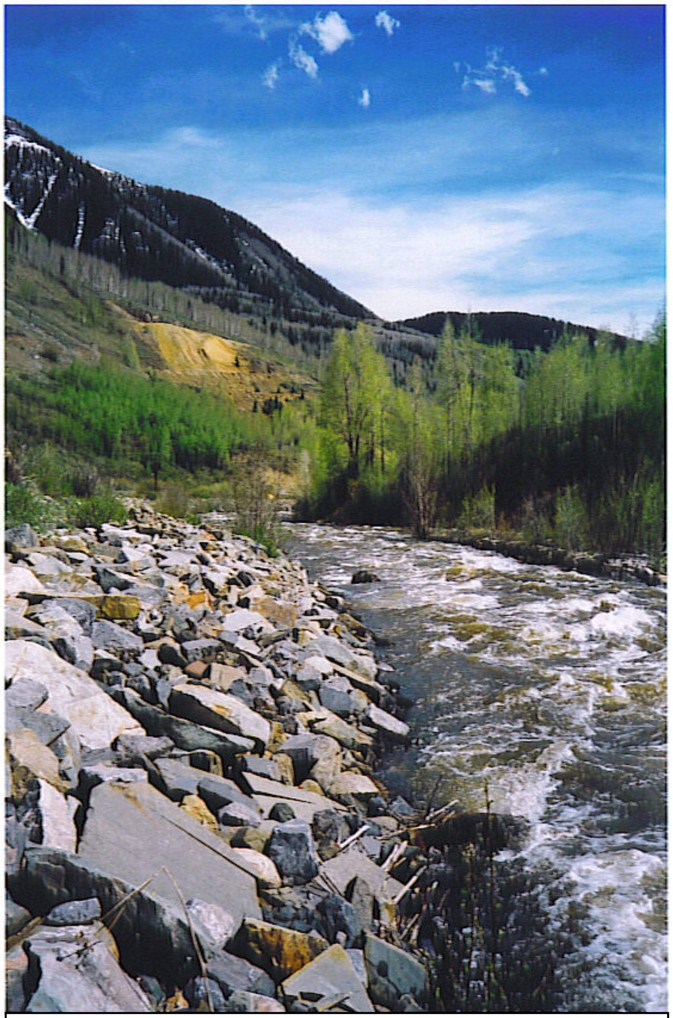
A hybrid of these streambank stabilization treatments called "**Native Material Revetment**" has been utilized on the Dolores River and is suitable for rivers with fluctuating flows (Rosgen 1996). Native strong materials are used to provide a hard control, along with vegetation and other natural stabilization measures to control rivers. The basic implementation plan for native material revetment includes placement of very large trees that are pushed into banks leaving portions of the tree and root wads extending along the bank. Large boulders weighting several tons are placed on and around the trees to hold them in place. Willow clumps are often transplanted along the immediate restored bank and seeding and other plantings further up the slope. The treatment can work well for eroded banks. Natural materials do not hold up as well against a major flood as concrete or steel, but they offer a reasonable amount of protection where failure of the stabilization structure can occur without threatening human life and safety.

HARD CONTROLS

Rock Riprap

Riprap is rock placed on the riverbank to prevent erosion where a hard control is necessary for protection of roadways or other critical infrastructure. Hand-placed large, angular stones set close together provide the best protection and require less maintenance. Loose rocks or rocks placed on steep slopes are not effective because they will tumble into the stream during high water or be washed away by floods. The rocks must be carefully installed during low water levels, not as emergency measures during flooding. Riprap must extend to the bottom of the bank and be securely anchored at the base. Riprap must be large and heavy enough to stay in place during flooding.

The riverbank should be regraded at a 3:1 slope or flatter for stability. Granular bedding material ¾” to 3” diameter should be placed under the riprap to prevent erosion behind the stones. The shape of the riprap always should fit in with that of the adjacent banks and should reach above the highest floodwater level so vegetation can be planted. Vegetation should be planted on top of the bank to prevent the river from cutting behind the riprap. The rock layer should be at least two stone diameters thick, with a greater thickness at the toe of the slope. The hand-placed (carefully placed, not dumped) stones should extend to the bottom of the bank and be on a solid foundation. The entire installation should be inserted into the bank at each end to prevent scour. These types of stabilizing hard controls are seen along the river banks adjacent to mine tailings caps and mine seep settling ponds.



Riprap revetment has been placed along the river bank to prevent floods from eroding into the St. Louis Ponds. Hard controls, as seen here, have little biological function, but are used when it is critical to armor the river bank.

Spurs, Dikes, Deflectors, Hardpoints, Groins, Vanes

These stabilizing structures project into the river and are used to create pools, divert the flow of water from an eroding bank, and to guide a stream into a more meandering pattern or away from critical structures. These structures have been used globally for flood control and erosion river problems. They can be constructed of rocks or logs to slow the water along the bank and direct the flow back into the center of the channel. All of these designs must be anchored sufficiently into the bank to prevent outflanking and be placed deep enough into the channel bed to prevent scouring. Although they have many names, their permeability, material, and type of construction define each of the categories. These projecting structures are classified mainly into three categories: retardance, retardance/diverter, and diverter spurs.

Retardance Spurs

Retardance spurs are perpendicular to the bank of the river, permeable, and are designed to reduce the flow along the bank line and create sedimentation between the structures. When placed on both sides of a streambank, spurs can be used to deepen the stream by narrowing a channel and increasing the velocity of flow. The spur is attached to the bank rigidly in the lateral direction and vertical direction. These spurs have been made of a variety of materials such as wood fencing or chain meshing, but boulders and root wads are more appropriate on the Dolores River. Hardpoints extend a short distance into the channel along straight sections of the river to halt erosion of the bank.

Retardance/Diverter Spurs

Retardance/diverter spurs affect the river by retarding flows along the bank and deflect the flow away from the bank. They are short, permeable and are usually angled downstream.

Diverter Spurs

Heavy diverter spurs are the most permeable of the spur types, allowing water to seep through the structure as water is diverted. Transverse dike spurs are similar to hardpoints, but they extend farther into the river to change the direction of flow. Vanes are a diverter spur to guide a river around a bend. The structures can be angled upstream or downstream. When constructed out of riprap, the rock must be carefully sized to resist the flow of the river. Diverter spurs work best where the water levels does not fluctuate much.

These seven diverter spurs angled downstream were constructed along the east bank of the Dolores River near the town bridge to keep the river back in the existing main channel location and prevent it from creating a flow path around the bridge.

River Placement of Spur Dikes

Spur dikes, like riprap described above, should be placed upstream of channel bends or bridges a distance of one channel width and downstream a distance of 1.5 times the width. These figures could vary due to irregular flows, bridge abutments, and site-specific factors. The area needing protection can be visually determined on actively eroding river by scars left in the bank. Generally spurs should be placed one river width upstream of the scars and an extra allowance downstream as a factor of safety. If placed improperly, spurs actually can increase erosion and cause failure of the opposite bank. In addition, an incorrect angle or length of a deflector can cause problems downstream. Deflectors may cause opposing banks to erode, so care should be taken to observe their effects.

Another factor to analyze in the spur layout is the general river dynamics of the channel. The channel will produce high currents on the upstream section of bends during periods of low flow, and high currents on the downstream portion of the bends during high flow, possibly strong enough to remove the materials in the bank and transport them downstream.

Length of Spurs into the River

The standard lengths of spur dikes are 10 to 20 percent of the rivers full width. The length of the spurs should be considered by looking at the permeability of the spur. Impermeable spurs ordinarily are not as long as permeable spurs.

The length of spurs projecting into a river is generally measured from the streambank to a point in the river perpendicular to the flow of the river. The exception to this rule is made when the purpose of the spurs is to rebuild an extremely eroded section of the river. In such a case the spur length should be measured from the desired bank of the river.

Angle between the Spur and Bank

The angle recorded between spurs and the bank is commonly noted as the angle between the downstream bank and the dike. Thus, spurs projecting upstream have angles ranging from 90 to 180 degrees, and spurs projecting downstream have angles of 0 to 90 degrees.

Spurs angled upstream combat "**secondary currents**" which spiral into a bend, erode banks and flow across the channel bed. A designer must think in three-dimensions to understand the function of these spurs. Spurs pointing upstream must be low enough to allow water to flow over the top back and created a downstream scour hole into the center of the channel. Upstream angled spurs will create bigger scour holes in the streambed, which may be ideal for creating trout habitat, but very large boulders are required to prevent the structure from failing. Spurs angled upstream are prone to accumulating sedimentation, trash, and ice, and therefore it is critical that water be allowed to flow over the structure.

Spur dikes angled downstream extend above the water surface and direct the ***streamlines*** (flow lines) into the center of the channel. Turbulence and scour depths are less when the dike is angled downstream.

Across Europe and Asia spurs are generally angled slightly upstream. Yet in the United States, most spurs are built angled perpendicular to the bank or slightly downstream at an angle of 75 degrees. Spurs angled upstream have been used successfully on mountain streams. It is commonly agreed that if the spur is to be completely submerged, it should be angled slightly upstream. The angle selection must be specific for the application.

Grade Control Drop Structures

In order to provide vertical stability for a river, drop structures can be installed. Drop structures are used for erosion control, grade control, and energy dissipation. The drops are designed to provide a hard control to keep the river from incising. They can also be instrumented in creating pool – riffle sequences for trout habitat.

Boulder drop structure on the Blue River, Colorado.

The basic design principles adequate for the Dolores River are shown on the adjacent pictures. The structures should be angled into a “V” pattern pointing upstream to focus the river’s energy into the center of the channel and away from the banks to reduce bank erosion. The downstream angle inside the “V” should be 120° to 180°.

The water surface drop height should be less than 18 inches to allow fish migration and safe boating passage. This shallow drop will minimize the amount of scour occurring downstream which can undermine the structure.

This picture of a drop structure on the Blue River near Breckenridge shows the primary upstream drop and the downstream control drop which forms the plunge pool.

A second minor drop installed downstream from the first primary drop is designed to back-up water and create a pool between the structures. The pool dissipates the energy of the river over the first drop and minimizes the chances the structure will be undercut by scour. The angle of the second drop should be 135° to 180°, though frequently the second structure is constructed at 180° (straight across the river). The spacing of the pair of drop structures is typically 0.3 to 0.6 times the channel width. The drop of the downstream structure is less significant.

For aesthetics and availability of material, the Dolores River is well suited for drop structures constructed of rock boulders, although they are also frequently built of concrete and/or sheet piling. Boulders work best where the river is small enough to control.

The primary causes of failure in rock drop structures are piping, sliding, and undermining. Piping occurs when the water upstream of the structure seeps through the foundation and the upstream side of the structure develops a sinkhole. As this continues the water can work its way under the drop structure and create a tunnel effect until the structure collapses. This can be avoided by constructing a watertight foundation under the structure. Sliding develops when the river moves the rocks in the downstream direction. To avoid sliding, the rock in the structure should be heavy enough to counter the drag forces due to the water flow. Also, a firm foundation attached to the structure will counter sliding. Undermining occurs when a scour hole on the downstream side of the drop structure forms and the boulders roll into the hole. This can be avoided by armoring the downstream bed of the drop structure.

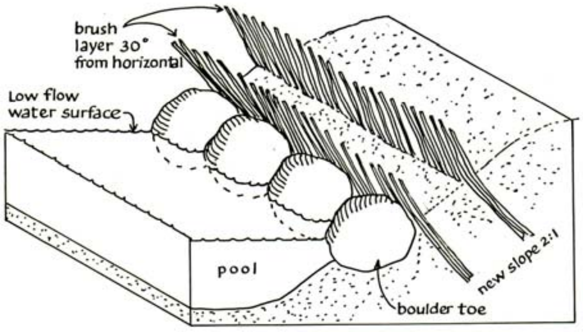
SOFT CONTROLS - BIOENGINEERED TREATMENT FUNCTIONS

Bioengineered streambank treatments provide a host of assets recognized as important in an environmentally sensitive, multi-objective approach to stream corridor and watershed management. Plant materials reduce erosion by causing friction and drag during high overbank flows while forcing the thalweg flow toward the center of the channel. Stream shading during the growing season months maintains lower water temperature, provides overhead cover for fish, limits aquatic weed growth, provides an organic food supply for benthic invertebrates, and creates habitat for a great variety of wildlife. A major function of healthy vegetated streambanks and riparian corridors is sediment entrapment that improves water quality and decreases non-point source pollution inputs. The below-ground root structure serves to bind and stabilize streambank soils. Most importantly, bioengineered treatments result in restored ecosystem function instead of unaesthetic riprap or concrete.

Stream Stabilization Alternatives

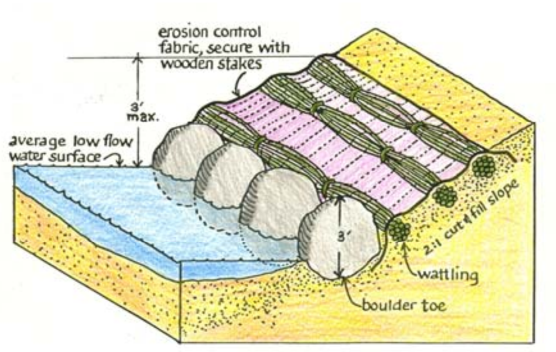
Brush Layering Treatment

Brush layering with toe protection works well along eroded streambanks ranging between 2 and 7 feet in height. More highly eroded banks subjected to highly fluctuating flows such as spring snowmelt and storm water runoff can be treated with a double terrace or other types of treatments. The installation of the brush layering treatment involves five successive steps: 1) placement of boulders at the toe of the slope, 2) planting willow stems, 3) placement of the fabric, 4) balancing the cut and fill of the vertical eroded bank, and 5) pruning the willows.



Wattling Treatment (or live facines)

A wattle is formed by tying overlapping willow stems end to end into a long cable or snake like form that equals the length of the eroded bank. Twine, wire, or both can be used as the tying material. The diameter of the wattle can range from four to six inches too as much as one and one-half to two feet. The installation of wattles requires four steps including: 1) placement of the boulders at the toe of the slope, 2) adding fabric, 3) laying the wattle in a half trench, and 4) stretching and staking the fabric in place.



Selecting the Best Alternative Bioengineered Treatment

Planning a streambank stabilization project requires adequate field work and data collection so that the appropriate treatment can be fitted to each specific site. Basic data collection includes: 1) measuring the length and height of the eroded bank, 2) determining the slope or gradient, and 3) selecting the specific location relative to straight or curved reach. Once the basic information is collected, the appropriate treatment can be chosen.

Effectiveness of Treatments

Bioengineered “soft” stabilization treatments compare favorably in terms of cost with the more traditional “hard” engineered treatments. Both types of treatments can be damaged by extremely high flood flows over the course of their usable life and may require repair and maintenance. Although hard treatments usually require no maintenance during the first year, they provide little biological function to fish and wildlife and are considered highly unaesthetic in a natural setting. While soft treatments may require watering and weed control maintenance during the first several years when root structure is developing, biological function is provided and they are considered highly aesthetic. However, there is more risk of failure if rock is not buried into the bank with the plantings.

Maintenance of Bioengineered Treatments (Watering and Weed Control)

Bioengineered streambank stabilization treatments characteristically require maintenance during at least the first full growing season to facilitate maximum root growth and to reduce competition from weeds.

Watering

The regular application of water to the bioengineered treatments can make the difference between success and failure. Therefore, an ambitious daily or alternate day watering maintenance plan is strongly recommended.

Weed Control

Construction disturbance of streambank, riparian and wetland habitat provides optimum conditions for the invasion of weed species. Common herbaceous weed species include: Canadian thistle, leafy spurge, diffuse knapweed, field knapweed and purple loosestrife. Common woody invaders include Russian olive, salt cedar (Tamarix ramosissima), and Chinese tamarisk (Tamarix chinensis).

Hand pulling is the most successful and least environmentally harmful method of noxious weed removal. Best results can be attained in the spring and after storms when the soils are soft and moist. In some situations cutting and mowing can be effective. In other situations, as a last resort, it may be necessary to apply herbicides and other types of chemical treatments.

PREVIOUSLY PROPOSED IMPROVEMENTS

Reach D, through the Town of Rico, was previously studied and subdivided into 5 sub-reaches by Corey Sue Derfus of Aqua-Hab, Inc. in a report titled, “Report of Biological and Aquatic Surveys along the Dolores River Corridor at Rico,” dated January 2001. These sub-reaches, originally labeled Reach 1 through Reach 5, are now labeled Reach D1 through Reach D5 for this report.

The purpose of the 2001 report was to promote/protect wetlands, riparian habitat and aquatic habitat. The report did not address water quality, but rather focused on natural bank stabilization improvements. Exhibit 6.1 is an aerial map of Rico which summarizes those proposed improvements. Those improvements primarily included:

1. Removing berms and levees,
2. Adding boulder structures in the river for habitat,
3. Planting wetlands, and
4. Installing a new stream gage.

The 100-year floodplain has been overlain on this exhibit for information and for an understanding of how low flow controls may be impacted by flood flows.

INSERT EXHBIT 6.1

Implementing the 2001 study improvements may be premature without additional study. For example, if the stream sediments contain unusually high metals loading that impacts water quality, wetlands and boulders alone will not improve trout populations. Also, planted bank vegetation could be destroyed by floods or earthmoving equipment used for restoration activities.

ADDITIONAL PROPOSED IMPROVEMENTS

Exhibit 6.2, titled “Utopia Map” or “Possible River Improvements” describes restoration activities within the Town of Rico which may help to stabilize the river corridor and preserve its natural function. The term “Utopia” is used to describe improvement that could be implemented without constraints. This list is only a brainstorming of possible proposed improvements, and may not be desirable or practical in all instances. These restoration activities have not been evaluated by the stakeholder group, and this map should not imply consensus as to the desire of the Town to implement this list.

There are at least 8 action items which could be implemented to improve the overall stream health:

1. Eliminate (or minimize) elevated metals loading and mine seeps
2. Implement engineering controls to address point source discharges
3. Remove sediments containing elevated metals from the river corridor
4. Stabilize the river channel with natural controls to the extent possible
5. Establish and preserve the natural character of the river channel riparian zone
6. Provide public river access for fishing and recreation
7. Establish a “river walk” to allow the community to embrace the river
8. Improve the Dolores River fishery to Gold Medal designation

Specific recommendations are noted on the aerial map of Rico in Exhibit 6.2. They have been broken down into 3 main categories:

1. Redevelopment/Construction (red)
2. Wetlands/Stabilization (green)
3. Flood-prone structures (blue)

The redevelopment/construction recommendations (red) include:

1. Develop the brownfields’ site north of Rico near the St. Louis Mine adit for light industrial purposes.
2. Treat or eliminate the seepage from the St. Louis Mine adit.
3. If the seepage is treated, re-activate the water treatment plant
4. The St. Louis Ponds should be reconfigured to give the river back its natural floodplain.
5. Pipe to use or treat the geothermal discharge from the well near the St. Louis Ponds that is currently discharging into the Dolores River untreated.
6. Redevelop the brownfields’ site around the town maintenance shed

The wetlands/stabilization recommendations (green) include:

1. Remove fill in the historic river floodplain by reconfiguring the St. Louis Ponds and the armored riprap along the banks.
2. Remove fill in the historic river floodplain by removing the road embankment and forcing access to occur on the alternate route higher up on the slope. Restore the wetlands in the area to calm floodwaters before they enter the Town of Rico. Wetlands in this area would create a natural deposition area to drop out suspended sediment from the high energy flows upstream.
3. Stabilize the river banks with buried riprap and wetland plantings

INSERT EXHBIT 6.2

4. Remove fill in the historic river floodplain for the engineered cap of the Columbia Tailings Pile and remove the barren armored riprap along the banks. Restore the wetlands in the area and provide a wider floodplain.

The flood-prone structures shown in blue are structures currently located in known flood hazard areas. Recommendations include either removing or relocating buildings outside the regulatory floodplain, floodproofing the structures, or armoring and berming the river banks. Armoring the banks with hard controls to protect these structures eliminates the natural functions of the floodplains, causes instability to propagate downstream, destroys riparian habitat, and reduces natural vegetation along the banks.

IMPLEMENTATION

Public Involvement

Public involvement can make a project a success by involving stakeholders and the public early in the planning process. The following is a summary of steps for involving the public:

> <u>Educating the public</u>, landowners, ranchers and businesses is the key to gaining support for a river project. Citizens can play an important role in stream restoration and protection. This can be accomplished by educating the community about the need to restore and protect streams and by getting diverse stakeholders together to plan for a restoration/stabilization project. The important thing is to involve as many partners as possible early on in a project and to treat those partners respectfully to keep it progressing forward and reduce future opposition during implementation.
>
> <u>Involve citizens</u> by talking about the river and potential restoration. Contact people with a particular interest in the Dolores River, such as elected officials, government agencies, landowners, conservation organizations like the Trout Unlimited, and local groups. Begin getting grassroots support by making the public aware of some of the land uses affecting the waterway as well as possible solutions. Invite guest speakers or hold a community forum and invite residents to express their views and concerns. Ask people to bring photos, videos or displays that illustrate the river's values and problems. Consider issues such as accessibility and willingness of public and private landowners to participate in the project.
>
> <u>Form a watershed committee</u> or an association that will have advocacy power and better chances to obtain grant money for stream restoration projects. Connect with an existing organization to help obtain funds. Forming a committee of people with diverse interests will help create a vision for the waterway and set realistic goals. Clearly define the relationship between the committee and the duly elected local government.
>
> <u>Examine community opportunities for the river</u>. Citizens may decide that they would like to plan for bike paths or nature trails along the river. Bringing people to the river and creating more opportunities for enjoyment and recreation may be the most important way to get participation from diverse interests.

Enlisting Expertise

A person does not need to be an expert to initiate a stream restoration project – but they do need to know how to bring required expertise to the restoration project. The more complex the method, the more technical assistance, planning and materials will be required. A stabilization project may require an integrated approach where more than one technique, and perhaps more than one discipline, is necessary. Engineering a stabilization project will be necessary to prevent overlooking critical information and creating a project that only demonstrates that restoration does not work. Experts should assist in implementation to ensure design specifications are followed and installation techniques are appropriate.

The following is a list of technical expertise that may be required for work on the river:

- Civil Engineers
- Hydrologists
- Computer modeling experts
- Geomorphologists
- Landscape architects
- Biologists
- Soil scientists
- Botanists

Funding

Cost is always a consideration. If the project team cannot afford to complete the entire project, it may be better off doing nothing. Do not start a project that does not include adequate planning or ongoing maintenance funds. Leveraging funds can help stretch available dollars. Obtaining loans or grants can make a project more affordable.

Acquire land only as a last resort to save costs. Acquisition of land can involve a huge potential cost for a restoration project. It is often better to leave the land under private ownership and management to keep organizations out of the business of maintenance. Also, preserving private land ownership means the land stays on the tax rolls. Creative land protection strategies may include:

- Acquiring Development Rights,
- Initiating Conservation Easements,
- Land Exchanges, or
- Clustering Development to provide more open space along the river.

Next Steps

Stakeholders of the Dolores River Watershed should gather and organize themselves to complete the following tasks:

1. Develop a core technical team for design of restoration and watershed protection improvements.
2. Identify a list of stakeholders and citizen committee, and include them in regular progress meetings.
3. Clearly define “Goals and Objectives” for proposed stream improvements.
4. Define the extent of the river corridor to be improved. This may match the 7-mile limits of this study, or it may be refined to a smaller area. Conversely, it could include a larger geographic region, particularly if the stakeholder group includes entities outside of Rico.
5. Review Exhibits 6.1 and 6.2 as a starting point and develop a “Community Consensus” map for proposed restoration/improvement activities. It is often very difficult to get unanimous support for a project, but at a minimum, there should be a consensus to move forward.
6. Sample and analyze stream sediments to characterize metals loading within the stream corridor. Determine if the bed material must be removed and replace, which will certainly impact the magnitude and extent of restoration activities.
7. Once a “vision” for the river has been established by the team, develop a list of improvement activities and estimate costs for those improvements.
8. Apply for grants to design and construct the proposed improvements.