FORGOTTEN RIVER 729 REPORT RECOMMENDATIONS

6.1 Recommendations

All of the Rio Grande's environmental problems identified in this report are inter-related. It is not possible to successfully address the most prominent issue, invasive tamarisk, without simultaneously attending to channel aggradation, sediment transport, soil and water salinity and water management issues. While much information is available with which to guide the implementation of projects, several significant data gaps remain to be filled.

In a reach almost 200 miles in length, the inherent uncertainties and high cost of a full-scale, holistic approach to these issues probably renders wholesale river restoration infeasible at the present time. We recommend initiating an experimental approach, in which local, well-designed and monitored projects are employed. Lessons learned in one sub-reach may then be applied to new project areas, which may eventually result in long-term improvements throughout the Forgotten River. Worthwhile projects, such as the La Junta Tamarisk Control Project, are already underway. These should be continued, expanded when possible and additional components added, toward an ultimate goal of evolving an effective ecosystem management program.

For any suite of projects to have a meaningful impact on the study area, a systematic watershed approach, conceived at both local and landscape scales, will be needed. With the reach serving as an international boundary, this will necessarily involve coordination and cooperation between the two nations. With its location at the bottom of a large irrigation project, cooperation and buy-in from national, international and state regulatory and action agencies, land owners, local governments, environmental groups and upstream water users will also be necessary.

A. General Recommendations:

- Coordination and information sharing- Project proponents should have a mechanism for coordinating activities. This might come from the designation of a lead agency or from a less formal network of stakeholders, meeting regularly.

- Outreach- Local land owners and agencies should be fully-informed of current and future project developments. Elected representatives, especially those involved in appropriations processes, should be kept aware of the latest developments and the desirability of action to restore the Forgotten River. To date, Environmental Defense has done a commendable job in performing this function, and The Rio Grande Institute has conducted outreach tasks for agency stakeholders in Mexico.

- Baseline data collection- The aerial mapping undertaken for this report by the University of Texas Center for Space Research has identified the scope of invasive species and sediment issues. Further aerial data-gathering should be incorporated into the existing database to enable analysis of trends. A similar reach-wide data gathering effort is needed to characterize arroyo discharges of stream flow, sediment and changes in channel morphology. At a minimum, several weather stations should be installed at strategic points within the watershed to enable elaboration of more accurate water, salinity and sediment budgets for the reach. NOAA, USGS or other agency programs may offer resources to assist in placing weather stations within the study area.

- Planning- Individual projects will benefit from the formulation of plans which address the entire suite of desired ecological outcomes, from vegetation, sediment and salinity management to wildlife habitat and river channel functions. Adequate resources should be devoted to monitoring the effects of project activities, so that an adaptive management approach can be implemented. A reach-wide planning effort which would logically follow a successful demonstration project will benefit from continued investigation of sediment, salinity and water budgets. We recommend the addition of these, along with land ownership data, to the existing GIS database.

B. Construction of a Conceptual Model of Forgotten Reach Channel Forms-

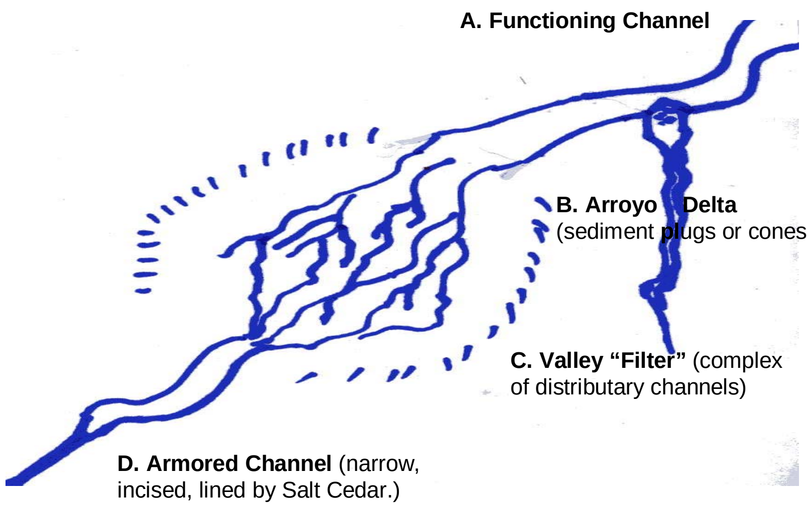
A critical first step to both individual project and reach-wide planning is to improve understanding of the fluvial, and associated ecological, processes at work in the study area. We recommend creation and testing of a conceptual model of the various typical channel types which occur in the Forgotten Reach, both functioning and impaired.

This would consist of sub-dividing the study reach into sub-reaches with similar channel/floodplain morphology and ecologic characteristics, and subsequent ‘target’ ecosystem objectives from which to develop alternative arrays.

For example, the faulted area associated with the ‘cluster’ of sediment cones described earlier in this report (reference *section*) appears to represent a unique set of channel conditions associated with geologic influences.

The tamarisk ‘filters’ (reference *section*) depict another unique channel (or, perhaps more appropriately, non-channel) type. The approaches to these filters could comprise a third type, and the typical incised, narrow channels downstream a fourth (though it would conceivably be possible to group the latter three into one sub-reach type since the characteristics would seem to be related to each other).

Disturbed River Feature Types



From field observations and aerial photographic indicators, it seems that high groundwater conditions in the vicinity of the filters are a major component. It is not clear at this time, however, whether this is more of a cause or effect. On the one hand, it is possible that reduced conveyance within the channel could be inducing transfer of surface flows to the groundwater table and the significant moisture presence in soils near the ground surface observed. On the other hand, it is conceivable that high water tables impose a limit on the ability of the river channel to deepen and achieve higher conveyance capacity. Under this latter hypothesis, any conveyance area adjustment created through incision by the channel would be occupied by essentially static water corresponding to the groundwater table and, thus, would not yield an effective conveyance increase.

Another sub-reach type might be those areas with pronounced vegetative reinforcement of the channel banks, however it is possible that this biologic characteristic could extend over several channel types.

Finally, though there may not be as much discussion within this report of them, some sub-reaches may, in fact, be functioning productively. Inclusion of one or more of these sub-reach categories would go a long way in providing a model of ecosystem function with which to form ‘target’ ecosystem objectives.

C. Project Components-

- Vegetation Management- Non-native tamarisk apparently continues to spread in the study area. While a goal of complete eradication of this species is unrealistic, the science of tamarisk control is rapidly developing in response to the large-scale invasion of this species in river basins throughout the West. A number of alternative land treatments are available for application to this problem. Two types of treatment can be scaled to large areas like the Forgotten River, which contains nearly 40,000 acres of tamarisk: aerial herbicide treatment and bio-control. Broadly applied herbicide potentially impacts desirable vegetation, such as pasture, and sprayed areas may also require extensive re-treatment. Biological control using a natural predator, the tamarisk leaf beetle, may offer an effective, reasonable cost method for tamarisk control in the study area. In native habitats, predation helps prevent tamarisk population from dominating the riparian zone, as it does in the study area. At present insufficient stocks of the Crete sub-species have been propagated at the Agricultural Research Service station at Big Spring, Texas to support a large-scale release in the Forgotten River. When available, additional releases should be considered, with the goal of retarding spread the spread of tamarisk and/or reducing its dominance.   Some projects, which may prescribe removal of vegetation in the river channel, may elect to employ selective mechanical removal of tamarisk. Sites which have little or no presence of desirable native species suggest that, in some projects, employment of active re-vegetation strategies should also be considered.

- Sediment Management- Consistent with its post-dam history, tributary arroyos within the study area continue to introduce large volumes of sediment into the channel. A cursory view of present channel geometries suggests that there is potential to engineer in-channel enhancements that might increase the river’s capacity to transport sediment. Similarly, the construction of retention structures in large sediment-producing arroyos adjacent to a project area offer a further strategy for enhancing equilibrium in the river’s sediment budget. Corps’ authorities and expertise may be available to assist in the design and construction of the sediment management components of projects.

- Channel Improvements- Channel training experiments at project sites should be designed to test the potential for utilizing the river’s current hydrology to enhance water and sediment conveyance. The goal of such project features would be to discover viable strategies for creating new channel forms that are at once diverse, efficient and self-sustaining.

- Groundwater and Wetlands- The role of shallow groundwater in the increasing dominance of tamarisk in the study area deserves additional investigation and monitoring. Projects should include installations of groundwater monitoring wells to track the effects of channel improvement components. Regional groundwater mapping, utilizing project data and other monitoring well data is also a very useful objective. Paradoxically, locally elevated high water tables are at once an economic nuisance and an ecological amenity. If channel improvements are designed to reduce inundation of pastures and farm fields, draining of productive wetlands may also occur. As this effect is probably inevitable, mitigation wetlands should be included in project design. A constructed wetland, as proposed by World Wildlife Fund in an area above Ft. Quitman, could potentially create multiple benefits: polishing saline and nutrient laden waters and serving as a "mitigation bank" for ponds impacted by downstream projects.

- Water Management and Improved Stream Flow- Diminished streamflows are at once the most important organizing principle of the Rio Grande's current condition and its most difficult management problem. If a reliable flood pulse could be provided, great progress might be made in restoring a functioning river. Absent the greatly increased degree of management control that would be required, the potential for restoration is dramatically lower. However, some future potential for attaining the necessary water management control does exist. Two general opportunities for improvement should be vigorously explored; both involve an effort to control the timing of the 200,000 acre-feet of water (on an annual average) passing Ft. Quitman. One possibility is to improve Rio Grande Project water management through acquisition (by lease or purchase from one of the irrigation districts), aggregation by storage and eventual timed release of project water. While the present institutional barriers to this approach are substantial, potential changes in the reservoir operating agreement, coupled with emerging state programs for providing environmental flows may create opportunities to which project proponents should be alert. A second potential project is a possible "conservation dam" project, which might be located at a site above Ft. Quitman. Separately, or in tandem, it is at least remotely possible that water managers may eventually be able to capture, store and release water to work sediment and maintain channels in the Forgotten River. It should be noted that occasional monsoon-season flood events originating below Elephant Butte may continue to adventitiously provide these benefits.

- Research - As the condition of natural rivers continue to decline, the value society places on maintaining and restoring river ecosystems continues to grow. Viewed in this light, the "Forgotten" Rio Grande might have great value as a laboratory for the art and science of rehabilitating perturbed rivers. Just as Sul Ross State University is an enthusiastic participant in the La Junta Project, so might other educational institutions with restoration ecology, environmental engineering and natural resource management programs seize some of the many opportunities for research within the study area. It is possible that the study topics recommended in this section to inform project design and implementation could also benefit by student involvement in research. Certainly, there is more to be learned about the functioning of rivers, knowledge that, if gained, could enhance scientific management of ecosystems and economies in the Rio Grande and beyond.

- Monitoring and Adaptive Management- As project treatments are applied, their outcomes should be monitored and follow-up actions designed, based upon knowledge gained.

D. Design of Demonstration Projects

The following narrative describes possible engineering features that could be used to achieve ecosystem restoration objectives associated with hydraulic and sedimentation behavior. These engineering features would accompany vegetation treatments which utilize some combination of biological control agents and mechanical removal of tamarisk. It is important to note that these are developed from very limited observation of site conditions. More rigorous analysis and design would be necessary to achieve success. Here we illustrate some of the types of engineered facilities that might be incorporated to meet the sponsor's and other stakeholders' objectives.

Completed Demonstration Projects would almost certainly involve partnership among a number of entities who would provide various project components such as: land access, engineering design, construction, vegetative treatments and monitoring.

Of course, no project would proceed without the concurrence and cooperation of the private land owner in the planning for such a project. Considering that the present condition of the lands in the study area are a result of past agency practices, the suggested activities may have limited initial appeal. However, the deteriorating condition of so much of the ranchland in the Forgotten River may provide sufficient incentive for ranchers to commit to participation in what are necessarily long term demonstrations.

Potential Feature Array for Channel improvements (undetermined site):

<Insert Darrel's correction>

The channel would be dredged of its fill to an elevation approximating the elevation of the upstream river bed (above the filter) and the fill removed from the site. An experimental approach would also point to construction of an adjustable sediment detention structure on a proximate upstream arroyo that has been determined to have high sediment transport activity, to evaluate the effect of reducing (or passing) local sediment contributions on the sustainabile conveyance capacity of the constructed channel. The entire channel complex would be re-surveyed after each significant flow event and changes analyzed.

In harmony with the channel training experiment, the most proximate downstream "armored" channel segment could be engineered to harmonize with the expected response to channel training. In this section, vegetation (including roots and boles) would be mechanically removed at various designed distances lateral to the channel and the response of the channel monitored after significant flow events.

Potential Feature Array for IBWC Mitigation site (Cecil's Pond): This potential demonstration project could be located on the periphery of the alluvial fan formed by the upstream left-bank arroyo (FID 35). If the restoration objectives included reducing sediment deposition in the mainstem river channel adjacent to this pilot site, a detention structure on the upstream arroyo would be worth considering. However, this reach is reportedly incised. Assuming the restoration objectives include raising the local groundwater table (*e.g.,* to increase the pond surface area, depth, etc.), a low-head grade-control feature constructed in the river could have enough local influence to achieve this objective. This type of feature would effectively raise the channel bed for some distance upstream of itself, which would increase the width/depth ratio of the river, and increase the frequency of overbank flows (due to decreased channel capacity). It could also add some hydraulic diversity, with a pool/riffle effect. Careful design would be required for such a structure to reduce fish migration issues if this is a concern, in addition to assuring survivability during high flows. Alternatively, a portion of the overly-high overbank could be mechanically lowered by excavation, enhancing the hydrologic connectivity of the river with the floodplain. Either of these approaches could be combined with modification of the channel geometry to achieve desirable aquatic hydrodynamic conditions (*e.g.,* wide, shallow channel form, increased sinuosity, etc.). If freshwater flow-through circulation was desired within the pond (*e.g.,* to increase dissolved oxygen content, reduce temperature), a small distribution channel and return could be created to divert a portion of river flow. This would presumably require some 'hardening' to preclude capture by, or abandonment of, the active river channel. A 'backwater channel' could also be created in the vicinity within the overbank to create low-velocity aquatic habitat, incorporating bankline plantings to moderate water temperatures and enhance stability. Creation of a low-velocity deposition zone in the overbank upstream of the pond could help reduce deposition within the pond during high-flows, thereby reducing maintenance. This could be achieved by planting a dense 'screen' of, for example, willow cuttings which would increase local hydraulic roughness, reducing velocity and sediment transport capacity. Modern planting techniques reportedly have the potential to achieve much higher survival results than those used at the site originally. A much more intensive monitoring effort than undertaken by the original project would also be required.

Conclusion The preceding conceptual approaches are offered to illustrate an array of features potentially available to help achieve desired biological functions at the site. The combination of prudent data collection, careful design and implementation, and watchful monitoring would almost certainly yield insight for application to other sites within the study area. Estimating the cost of such project is difficult vary widely according to the exact details of the treatment, condition of the site(s) selected and the requirements of various cooperators.