LOWER COLORADO RIVER WATERSHED QUALITY UPDATE

JANUARY 2009

FINAL

Prepared for

COLORADO RIVER REGIONAL SEWER COALITION

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Executive Summary

The Colorado River and its tributaries drain portions of seven states and Mexico. Growth in Arizona, California, and Nevada, along the Lower Colorado River (LCR) Basin, is occurring at an unprecedented rate. The population explosion is creating significant challenges for public officials and agencies that are tasked with providing the resources and infrastructure necessary to support the expanding region. Contamination of LCR water increasingly threatens the livelihood of millions of Americans. The health of this river system, the only perennial flowing river in the Southwest, is vital to the well-being of over 25 million people in Arizona, California, and Nevada. In April 2004, the American Rivers organization and its partners designated the Colorado River as the nation's "most endangered river," citing mounting problems with radioactive, human, and toxic waste contaminating groundwater to levels unsafe for humans, fish, and wildlife.

Nitrates and other man-caused pollutants, which pose a threat to both human well-being and wildlife, are accumulating rapidly in groundwater formations adjacent to the LCR main stem and reservoirs. A 2001 study conducted on the aquifer immediately tributary to Lake Havasu estimated that nitrates in just this limited area are accumulating at a rate of about 300,000 pounds per year, with an annual rate of accumulation having increased about seven-fold in the past 20 years. Since groundwater migrates relatively slowly, the impact to the down-gradient water bodies is delayed but certain.

Forty-six states currently identify septic tanks as a source of nitrate pollution to their groundwater with nine states identifying septic tanks as a primary source of pollution to their groundwater.

Arizona Governor Janet Napolitano signed a bill into law in the spring of 2006 requiring nitrates be included in groundwater testing and recognizing septic tanks as a significant contributor to groundwater, pollution. Recently, studies have been completed in Washington and Texas that concluded that septic tanks in proximity to a water body contribute significantly to the degradation of the water quality and the potential for lake eutrophication.

In addition to existing threats along the LCR, renewed efforts to reduce the nation's dependence on foreign oil has seen a significant increase in mining claims for uranium, drilling for natural gas, and renewed efforts to extract oil within the Colorado River Basin. A recent article in the San Diego Union Tribune newspaper (published December 21, 2008) indicted that in the past six years, claims for uranium mines within five miles of the Colorado River have increased from

395 to 1,195. These efforts not only add a significant additional strain to a dwindling supply of available water, but they also increase the potential for introduction of harmful pollutants into the river system.

If climate prediction models can be believed, the current drought, which has brought the river flows at Lee's Ferry to the lowest level since measurements began 85 years ago, may become more the rule than the exception. Aside from the considerable economic disorder resulting from reduced supplies, significantly diminished flows will accelerate and worsen the water quality impacts from man-induced contaminants. Pollutants accumulating in groundwater that flows toward the river and reservoirs will migrate more rapidly with steepened gradients. Reduced flows mean less assimilative capacity and greater concentrations of nitrates, phosphates, and other pollutants of concern including endocrine disrupting compounds (EDCs). Lowered lake levels and warmer waters with greater concentrations of nitrates promote algal blooms resulting in toxic "dead zones."

A new study, published by Kentucky State University scientists in Environmental Science and Technology (ES&T), entitled "*Eutrophication of U.S. Fresh Water – Analysis of Potential Economic Damages,*" highlighted the economic implications of nutrient overloading, which is occurring in the LCR system. They evaluated four factors:

1) loss of waterfront property values;

2) reduced fishing and other recreational values;

3) cost of biodiversity loss; and

4) cost of purifying drinking water.

Potential losses in fresh waters of the U.S. were estimated at more than $4.3 billion per year. In particular, the economies of the LCR communities are dependent on recreation and tourism and would be greatly impacted by increasing and recurrent water quality disruptions.

Pharmaceuticals and personal care products (PPCPs) now being detected in receiving waters are of increasing concern to health officials and environmentalists. Although the long term effects of human consumption are still being researched, there is cause for concern about their carcinogenic and endocrine-disrupting potential. Also, the effects on fish and wildlife are of great concern, particularly as a large number of EDCs have been detected in the LCR system. With the prevalence of septic systems and older-technology treatment plants along the LCR, PPCPs are accumulating, along with nitrates, in the adjacent formations and are present in the wells and river system. A recent study titled "*Effects of Human Pharmaceuticals on Aquatic Life: Next Step*" (ES&T, June 1, 2006), documents the potential environmental threat of PPCPs.

Invasive non-native species, like the Quagga mussel, adapt more rapidly to new environments than can native species, and can quickly proliferate by feeding on the increased food sources (nutrient overloading) in the water, and alter chemical balances to adversely affect water quality. Quaggas are multiplying at an alarming rate in the LCR system and, according to Metropolitan Water District of Southern California (MWDSC) testimony, they "…pose an immediate threat to water and power systems serving more than 25 million people." In addition to the economic impact, any alteration of the natural environment, whether by nutrient overloading, toxic chemicals, EDCs, or indirectly by invasive species such as the Quagga mussel, will have

detrimental impacts on the fish population, water fowl, raptors, and other native species along the LCR. Protection of native natural resources is not only important to the local LCR communities, but mandated by law through the Federal Endangered Species Act, the Clean Water Act, and the Migratory Bird Treaty Act.

According to the *Wastewater Treatment Needs Along the Lower Colorado River* report, prepared by the U.S. Department of the Interior, Bureau of Reclamation in 2007, approximately $2.1 billion, in escalated dollars, is needed over a 20-year period to convert septic systems to wastewater collection systems and for improvement of treatment processes.

Small communities such as Bullhead City and Lake Havasu City in Arizona have been burdened to date with the entire cost of nitrate mitigation. These two river communities alone have committed to completing over $617 million in infrastructure improvements through 2013 but, due to limited funding capability, they are struggling to meet those commitments and the economic impact to them is substantial. Completion of projects such as these will have a significant impact in reducing nitrates and other contaminants from leaching into the LCR water system because they address concentrated impacts created by the larger populations in these areas, but the projects do not address the entire contamination problem.

In addition to septic tank contamination, other pollutants such as perchlorate, uranium, and chromium have been identified as serious threats to the river system. Private enterprises have helped to mitigate some of these concerns along the river.

A variety of programs exist that may provide assistance to fund needed projects, but most require diligent and persistent efforts by the affected agencies that can benefit from the funding, as well as cooperation from state and local officials who must enact legislation for these programs. Examples of possible funding sources include:

- Clean Water State Revolving Fund Loan programs, both managed by the individual states where the work will occur as well as jointly enacted multi-state loan programs
- State Loan Programs funded and managed by each state
- Loan and Grant programs administered through Federal Government offices
- Participation in the upcoming, and as yet not defined, Federal Economic Stimulus program
- Creation of a specifically designated program by the Federal Congress
- Creation of a multi-state foundation to protect the LCR

Competition for the limited money earmarked for these programs is intense. With the proper assistance of staff and lobbyists, CRRSCo could pursue one or more of the programs to offset or reduce the amount of money needed to protect the watershed. Because of the complexity of these programs, it may take several years to properly define and fund these programs. However, the results will be long lasting and protect the water quality for many generations.

Benefits to investing in mitigation measures to reduce contamination and improve environmental quality along the LCR include:

- **Water Quality Protection:** Reducing nutrients and other contaminants protects against the degradation of the safety, taste and odor of a principal water source for millions of people; reduces treatment costs; and reduces food sources for organisms that support invasive species such as the Quagga Mussel. It also decreases the likelihood of recurrent algae blooms.
- **Water Conservation:** Collecting, treating, and reusing effluent is critical to maintaining sustainable water supplies.
- **Protection of Irreplaceable River Ecosystem:** Preservation of fish and wildlife habitat is not only mandated by law, but is essential to the economic wellbeing of the LCR communities and reservations. Failure to protect this sensitive environment would essentially forfeit the extensive investment already made.
- **Economic Security:** Improvement programs can reduce contaminants in the water supply for the essential winter crop industry in the Southwest and allow for safe public use of the river and reservoirs, which are major attractions for tourists from throughout the United States. They can also contribute to need employment of the local workforce.

Section 1
Introduction

The Colorado River and its tributaries drain portions of seven states and Mexico. The river is over 1,400 miles in length with a watershed area of 246,000 square miles. Benefits derived from the Colorado River and its dams and reservoirs include not only a vast water supply and environmental enhancements, but also flood control for river communities. Over 25 million people in Arizona, California, and Nevada rely on the river system for drinking water and other needs. River-derived economic benefits are in the billions of dollars annually and include a significant portion of the nation's crop production and non-polluting hydroelectric power generation. In addition, the primary livelihood for thousands of local residents is directly related to the Colorado River.

Growth in Arizona, California, and Nevada, along the LCR Basin is occurring at an unprecedented rate. The population explosion is creating significant challenges for public officials and agencies that are tasked with providing the resources and infrastructure necessary to support the expanding region. In anticipation of the impacts of this growth on the river and ecosystem, the Colorado River Regional Sewer Coalition (CRRSCo) is proactively updating the needs and priorities necessary to facilitate the protection and enhancement of the Colorado River.

This report reiterates and builds on relevant findings from the following two (2) reports:

- *Regional Watershed Planning Document, Final Report for CRRSCo*, dated August 1999 and prepared by Burns and McDonnell; and
- *Wastewater Treatment Needs Along the Lower Colorado River*, dated March 2007 and prepared by U.S. Department of the Interior, Bureau of Reclamation.

Additionally, this report presents updated information on water quality and environmental threats, mitigation measures, research and funding needs affecting the LCR, and the projects needed to improve water quality along the LCR.

1.1 Background

CRRSCo is a non-profit organization of river communities, local governments, Indian tribes, and other entities in the LCR Basin. Formed in 1997, CRRSCo's purpose is to protect and enhance Colorado River water quality and the LCR environment, and to help assure high quality water for all users. Communities and water interest groups along the Colorado River below the Hoover Dam have organized themselves into a cohesive unit to address wastewater management and water quality maintenance issues on the lower river. Members of CRRSCo include:

- Buckskin Sanitary District
- Central Arizona Project
- Chemehuevi Indian Tribe
- City of Blythe
- City of Bullhead City

- City of Lake Havasu City
- City of Needles
- City of Tucson
- Colorado River Sewage Systems – Joint Venture
- La Paz County Board of Supervisors
- Los Angeles County Department of Public Works
- Metropolitan Water District of Southern California (MWDSC)
- Mohave County
- Southern Nevada Water Authority (SNWA)
- Town of Parker
- Town of Quartzsite

1.2 Regional Watershed Planning Document, Final Report

Burns & McDonnell completed the *Regional Watershed Planning Document for the Colorado River Regional Sewer Coalition* in August 1999. This report focused on existing conditions, needs, and priorities from Davis Dam (north of Bullhead City) to the Mexico Border. The report's prime objective was to stress the seriousness of LCR watershed needs to state and federal legislators and to provide information supporting efforts towards obtaining funding for the identified need. The report's core was a watershed-prioritized, multi-year phased program of recommended sewer system improvements with corresponding construction costs. The program addressed needs for all entities residing in the CRRSCo planning area. The report was envisioned to be a "living" strategic road map for CRRSCo with the proposed multi-year phased program being revisited over time based on actual funding secured and other events that could impact priorities.

1.3 Wastewater Treatment Needs Along the Lower Colorado River

The 1999 study, coupled with persistence and leadership by CRRSCo, led to the additional study *Wastewater Treatment Needs Along the Lower Colorado River*, published in draft form by the Bureau of Reclamation in February 2005. This report updated and expanded the information provided in the 1999 report with an additional objective of evaluating the effects of municipal growth along the river and wastewater facilities needed through 2025. Although less than decade has passed since the original study and update, many things have changed. Significant sewer expansion activity has occurred in several of the highly-populated communities along the river; growth projections have exceeded forecasts; and federal funding, planning requirements, and permitting requirements have changed. After several reviews and input from multiple stakeholders, the report was finalized and issued in March 2007.

1.4 Findings and Conclusions

This report updates the significant efforts the LCR communities have made to help insure the protection of an endangered and precious water source that serves approximately 25 million people from Southern Nevada to Southeast Arizona and Southern California. PBS&J met with the CRRSCo members to capture both the progress the agencies are making on addressing previous issues but also to ascertain and document current challenges facing the river. Some of the issues, such as the invasion of the Quagga mussels has, and will continue to have significant financial impacts to both the water purveyors and the energy companies who rely on the river to produce power for a multi-state region.

Each of the communities provided PBS&J with updates on the progress of the CIP projects to reduce impacts to the LCR, and projected future programs that have been incorporated into this report. Septic tanks have been identified in 46 states as a major source of groundwater pollution. Since the 2007 BOR report was issued, both Lake Havasu City and Bullhead City have made significant progress in removing septic tanks within their communities. Septic tanks have been reduced by approximately 58% in these two communities combined. Even though this is a significant accomplishment for these two communities, it only represents a 28% reduction along the LCR. The number of remaining septic tanks is estimated to be in excess of 36,000, which will require significant effort and cost to remove. The progress to date comes at a significant cost to these communities who are now facing inflated sewer fees and debt repayment. It has been estimated that the cost to retrofit an average resident from septic to conventional sewer is approximately $12,000 per household, or about 50% higher than the cost of installing a sewer collection system in a new development. This does not include any cost for treatment, disposal or reuse. In addition to this additional debt, the residents also incurred the cost of installing their original septic system which has burdened a population having a significantly lower than average per annum income, with paying almost three times the cost for a sewer system than what is typically expected. These costs are not due to failing systems that have outlived their normal expected life, but due to increased regulations and concerns with the impacts of septic tanks on the environment after the systems were permitted according to state and federal regulations and installed meeting all requirements.

This report also documents some of the latest research regarding environmental impacts to the river. Specifically, information is included about the harmful impacts of biological organisms, the impacts of pharmaceuticals on both groundwater and river systems, challenges the river faces in both supply and quality due to increased mining interests, and alternative sources for energy resources. It is clear that the issues affecting the Lower Colorado River require additional attention and studies on the continued impacts of growth and the potential to impacts to 25 million people that rely on the LCR for their quality of life. State and federal funding will be critical to insure the viability of projects that protect the water quality, a debt currently shouldered by the small local populations adjacent to the rivers. A regional, multi-state, approach should be considered as well as an environmental tax credit to those residents who have been burdened with the debt to date. The political climate in these communities has been very turbulent due to these costs, and the staggering financial impact to the residents. The community of Lake Havasu City has been under considerable pressure to stop projects until funding is secured that more fairly allocates the costs to all those who benefit from these improvements.

Section 2 provides detailed information on updated costs for the relevant CIP projects along the LCR as well as an updated priority for construction of the projects. Section 3 updates the environmental issues and concerns and the impacts caused to the water quality of the LCR. Section 4 recaps the financial programs available to fund projects and describes financing models that have been successfully implemented throughout the country.

Section 2
Update of Capital Improvements Along the Lower Colorado River

2.1 Capital Improvements Unit Costs

As part of this planning effort, the cost estimates originally developed by Burns & McDonnell and later updated by the United States Bureau of Reclamation (BOR or USBR) in 2007 were reviewed and compared with relevant cost information currently available. These reports identified a total of $1.6 billion worth of projects in current dollars. The costs were indexed at a 3% annual inflation rate through 2025, resulting in an estimated $2.1 billion of work. The projects were divided into four phases of five years each based on a prioritization ranking.

Because Lake Havasu City has recently completed a substantial number of sewer projects associated with their 2001 wastewater bond program, their current cost data was used to compare and update the cost forecasts from the previous reports (see Table 1).

Table 1
Lake Havasu City Improvements
(For Program Years 1-6)

Improvement	Cost ($)	Quantity	Unit Cost	Use
Collection Systems	$111,355,044	171 miles	$651,199/mile	$660K/mile
Treatment, Re-use and Disposal	$82,603,329	4.6MGD	$18.0M/MGD	$18.5M/MGD

Previous studies increased costs by 25% for those entities that did not have a wastewater plan in place. Additional cost associated with planning, design, regulatory and public involvement account for this increase. Applying this same rationale, the costs for those communities with no approved wastewater master plan is estimated in Table 2.

Table 2
Estimated Costs for Communities with No Wastewater Plan

Improvement	Unit Cost
Collection Systems	$825K/mile
Treatment, Re-use and Disposal	$23M/MGD

The cost information provided on the priority list was based on the unit costs shown in Table 3.

Table 3
Collection System and Treatment Unit Costs

Improvement	With Plan Unit Cost	Without Plan Unit Cost
Collection System (Pipe)	$660K/mile	$825K/mile
Treatment, Re-use, Disposal	$18.5M/MGD	$23M/MGD

From the information provided by member and non-member agencies, this update to previous reports includes a current estimate of the septic tanks remaining and wastewater treatment and improvements needed to serve Lower Colorado River communities.

The 2007 BOR report estimated over 50,000 existing septic systems along the Lower Colorado River. Current data shows that, while there are still over 36,000 septic tanks remaining, this represents a 30% decrease from the 2007 BOR report.

This decline comes from the work done in Reach 2, primarily by Lake Havasu City and Bullhead City. The BOR report estimated nearly 44,000 (88% of the total) septic tanks in Reach 2 alone. Through an aggressive capital improvement program, Lake Havasu City and Bullhead City have added wastewater treatment capacity and extended collection systems to existing neighborhoods. Specifically, Lake Havasu City has reduced the number of septic tanks by 47%, from 24,600 to 13,000 and Bullhead City has reduced the number of septic tanks by 78%, from 8,900 to 2,000.

Table 4 compares current information on the number of septic tanks remaining by reach with the 2007 BOR Report, which presented information gathered by Burns & McDonald in 2004. In some reaches, additional septic systems were identified and included in this summary.

Table 4
Identified Septic Tanks Remaining

Reach	2007 BOR Report	2008 Update	Reduction
2	43,812	28,812	15,000
3	2,700	2,700	0
4	2,654	2,754	-100
5	1,298	1,798	-500
Totals	**50464**	**36064**	**14400**

Previous reports identified other uses, primarily recreational users and seasonal visitors, as sources contributing to the water quality problem in the river, however, no attempt were made to quantify their impact. While this update does not quantify them either, a cursory scan of river frontage indicates there are thousands of additional users along each reach in the form of

campsites, RV sites, trailers, recreational facilities and other users, producing waste and whose treatment and disposal methods are not known. In addition to other pollutants, these uses likely account for hundreds of thousands of pounds of nitrates leaching into the Lower Colorado River watershed annually.

While considerable progress has been made, clearly the further elimination of septic systems remains an important and primary objective in reducing pollutants in the Lower Colorado River.

2.2 Prioritization Criteria

After discussion with the CRRSCo Technical Advisory Committee, it was recommended that the capital improvement priority list be evaluated using the following three criteria:

Overall Needs Ranking: This criterion examined the septic tanks remaining and treatment needs remaining and combined them into an overall ranking. The communities were ranked in order from most to least for both number of septic tanks remaining and treatment needs remaining. The septic tank ranking was weighted at 60% and remaining treatment needs ranking was weighted at 40% to determine the overall needs ranking.

Overall Cost Ranking: This criterion considered the cost to each community. It examined both the estimated cost remaining and the cost incurred to date by the community. The communities were ranked highest to lowest in order of cost for both cost remaining and cost expended to date. An 80% weight was assigned to the remaining cost and 20% weight assigned to the cost to date ranking to determine the overall cost ranking.

Administrative Ability Ranking: This criterion considers the community's ability to administer a wastewater program. It assigns a value from 1 to 3, depending on whether the community has a governing body that can manage a program, including ability to enter contracts, incur debt and assess/collect associated costs. Numbers were assigned as follows:

1 = Incorporated body exists to administer the project

2 = Unincorporated body exists with a governing board/agency

3 = Unincorporated body exists without centralized governing body

2.3 Prioritization of CIP

Twenty seven (27) communities/locations are identified in Table 5. For each criterion, the communities were ranked from 1 to 27 with "1" being highest priority and "27" being the lowest. A score was tabulated for each community by combining the Overall Needs Ranking, Overall Cost Ranking and Administrative Ability Ranking and assigning each an equal weighting of one-third (33.3%). The final priority was then determined from this combined score. The lower the score, the higher the funding priority.

Table 5
Priorities List

Reach	Community	Septic Tanks Remaining	Septic Ranking	Treatment Needs Remaining (MGD)	Treatment Ranking	Overall Needs Ranking (60%Septic, 40%Treat.)	Estimated Remaining Cost (million)	Remaining Cost Ranking	Cost-to-Date (millions)	Cost to Date Ranking	Overall Cost Ranking (80%Remain, 20%Spent)	Administrative Ability Ranking	Score	Priority
2	**Lake Havasu City***	13,000	1	3.5	3	1.8	$381.6	1	$236.0	1	1	1	1.27	**1**
2	**Bullhead City***	2,000	4	6	2	3.2	$162.5	4	$145.9	1	3.4	1	2.53	**2**
5	**Yuma***	1,000	8	9	1	5.2	$265.5	2		2	2	1	2.73	**3**
2	**Mohave Valley**	6,000	2	1.15	7	4	$191.5	3		2	2.8	3	3.27	**4**
4	**Blythe***	1,750	5	2.8	4	4.6	$74.9	6		2	5.2	1	3.60	**5**
3	**Parker Strip (Buckskin Sanitary Dist.)***	1,542	7	1.9	5	6.2	$38.5	7		2	6	1	4.40	**6**
2	**Crystal Beach/Desert Hills**	1,750	5	0.39	11	7.4	$13.1	12		2	10	3	6.80	**7**
3	**Big River/Earp**	1,000	8	0.36	12	9.6	$11.6	13		2	10.8	1	7.13	**8**
4	**Ehrenberg**	540	13	0.35	13	13	$24.6	9		2	7.6	1	7.20	**9**
5	**San Luis**	0	23	1.5	6	16.2	$102.2	5		2	4.4	2	7.53	**10**
2	**Needles***	200	18	0.4	10	14.8	$23.9	10		2	8.4	1	8.07	**11**
4	**Quartzsite***	300	15	0.45	9	12.6	$11.6	13		2	10.8	2	8.47	**12**
2	**Fort Mohave Indian Res.**	3,500	3	0	23	11	$10.7	15		2	12.4	2	8.47	**12**
3	**Parker/Col. River Tribe (CRRSJV)***	0	23	0.9	8	17	$22.6	11		2	9.2	1	9.07	**14**
5	**Somerton**	0	23	0.3	14	19.4	$30.0	8		2	6.8	3	9.73	**15**
4	**Cibola**	64	21	0.2	15	18.6	$9.6	16		2	13.2	1	10.93	**16**
5	**Gadsden**	798	10	0	23	15.2	$6.6	18		2	14.8	3	11.00	**17**
2	**Havasu Lake, CA**	300	15	0.2	15	15	$6.3	19		2	15.6	3	11.20	**18**
2	**Golden Shores**	700	11	0.18	19	14.2	$5.8	21		2	17.2	3	11.47	**19**

Table 5
Priorities List
Continued

Reach	Community	Septic Tanks Remaining	Septic Ranking	Treatment Needs Remaining (MGD)	Treatment Ranking	Overall Needs Ranking (60%Septic, 40%Treat.)	Estimated Remaining Cost (million)	Remaining Cost Ranking	Cost-to-Date (millions)	Cost to Date Ranking	Overall Cost Ranking (80%Remain, 20%Spent)	Administrative Ability Ranking	Score	Priority
3	**Poston/Col. River Ind. Res.**	158	19	0.11	22	20.2	$8.3	17		2	14	1	11.73	**20**
2	**Topock**	700	11	0.17	20	14.6	$5.6	22		2	18	3	11.87	**21**
2	**Havasu Landing, etc (Chemehuevi Ind. Res.)**	300	15	0.2	15	15	$0.0	25	$3.5	1	20.2	1	12.07	**22**
5	**Winterhaven**	0	23	0.2	15	19.8	$6.3	19		2	15.6	3	12.80	**23**
2	**Black Meadow Landing**	350	14	0.14	21	16.8	$3.2	24		2	19.6	3	13.13	**24**
2	**Laughlin***	12	22	0	23	22.4	$3.3	23		2	18.8	1	14.07	**25**
4	**Palo Verde, CA**	100	20		23	21.2	$0.0	25		2	20.4	1	14.20	**26**
5	**Cocopah Indian Reservation**		23		23	23	$0.0	25		2	20.4	3	15.47	**27**
	Totals:	**36,064**		**30.4**			**$1,419.8**		**$385.4**					

*Community with Wastewater Master Plan

Notes: All costs are in 2008 dollars

Minor (small) users with no available data are not included

The following text describes the headings in Table 5.

Reach: A segment of the river between defined points. In this report, the LCR between Hoover Dam and the Southern International Border (SIB) has been divided into five (5) reaches, the first beginning at Hoover Dam. These 5 reaches as referenced in this report correspond to the same reaches identified in previous reports by Burns & McDonnell in 1999 and by the Bureau of Reclamation in 2007.

Reach 1 – Hoover Dam to Davis Dam

Reach 2 – Davis Dam to Parker Dam

Reach 3 – Parker Dam to Pal Verde Diversion Dam

Reach 4 – Palo Verde Diversion Dam to Imperial Dam

Reach 5 – Imperial Dam to the Southern International Border

Community/Member: The organization, community or stakeholder identified along the river. The table includes several communities that are not members of CRRSCo, but have an interest or impact on water quality along the river.

Septic Tanks Remaining: The estimated number of septic tanks that are still in use. These numbers were taken from the 2007 BOR report unless more current data was provided.

Septic Ranking: Prioritizes communities in order of which has the most septic tanks remaining in service.

Treatment Needs Remaining (MGD): Estimated volume of wastewater treatment capacity still needed to meet year 2025 projections.

Treatment Ranking: Prioritizes communities in order of which has or will have the greatest waste treatment needs.

Overall Needs Ranking (60%Septic, 40%Treat.): Combines septic tanks ranking, weighted at 60% and the remaining treatment needs, weighted at 40%. The 60/40 Needs weighting recognizes that existing septic tanks leach a majority of nitrates and other contaminants into the ground and new development will be required to meet higher construction standards. So expanded treatment facilities or newer septic systems will have less impact on groundwater quality than the existing septic tanks. Therefore, these remaining septic tanks have a slightly higher priority (weighting).

Estimated Remaining Cost (million): Estimated cost (in millions of dollars) to provide the treatment and infrastructure improvements to meet year 2025 needs, based on typical unit costs as identified in the report. Unit costs are assumed to be higher if a community does not have an approved wastewater plan. (*The increase accounts for the planning and regulatory efforts required.)*

Remaining Cost Ranking: Prioritizes communities in order of which has the most cost remaining in wastewater infrastructure needs.

Cost-to-Date (millions): The cost incurred by the Community/Member to provide wastewater treatment facilities to date, in millions of dollars.

Cost to Date Ranking: Prioritizes communities in order of which has expended the most capital to date in wastewater infrastructure improvements.

Overall Cost Ranking (80%Remain, 20%Spent): Combines Remaining Cost needs, weighted at 80% and the cost already expended (Cost to Date), weighted at 20%. The 80/20 cost split gives most of the preference to future needs (80%) since that is where the remaining investment needs lie, while still modestly recognizing (20%) the costs already incurred by some communities and the associated financial burden to their constituents.

Administrative Ability Ranking: Considers the Community/Member ability to administer a wastewater program. Numbers were assigned as follows:

1 = Incorporated body exists to administer the project

2 = Unincorporated body exists with a governing board/agency

3 = Unincorporated body exists without centralized governing body

Score: Combines the Overall Needs Ranking, Overall Cost Ranking and Administrative Ability Ranking and assigns them all equal weighting of one-third (33.3%).

Priority: The recommended order of funding based on Score. The lower the score, the higher the funding priority.

2.4 Results and Recommendations

Current data show over 36,000 septic tanks remaining, which represents a 28% decrease from the 2007 BOR report. The bulk of these septic tanks are in Reach 2. That is the only reach to have a decline in septic systems. Others have either held steady or more systems have been identified since the 2007 BOR report. Table 6 compares the total identified septic tanks within the LCR reaches.

Table 6
Identified Septic Tanks Remaining Comparison with 2007 Report

Reach	Community	2007 BOR Report	2008 Update
2	Lake Havasu City		13,000
2	Bullhead City		2,000
2	Mohave Valley		6,000
2	Crystal Beach/Desert Hills		1,750
2	Needles		200
2	Fort Mohave Indian Res.		3,500
2	Havasu Lake, CA		300
2	Golden Shores		700
2	Topock		700
2	Havasu Landing, etc (Chemehuevi Ind. Res.)		300
2	Black Meadow Landing		350
2	Laughlin		12
	SUBTOTAL	**43,812**	**28,812**
3	Parker Strip (Buckskin Sanitary Dist.)		1,542
3	Big River/Earp		1,000
3	Parker/Col. River Tribe (CRRSJV)		0
3	Poston/Col. River Ind. Res.		158
	SUBTOTAL	**2,700**	**2,700**
4	Blythe		1,750
4	Ehrenberg		540
4	Quartzsite		300
4	Cibola		64
4	Palo Verde, CA		100
	SUBTOTAL	**2,654**	**2,754**
5	Yuma		1,000
5	San Luis		0
5	Somerton		0
5	Gadsden		798
5	Winterhaven		0
5	Cocopah Indian Reservation		
	SUBTOTAL	**1,298**	**1,798**
	TOTAL	**50,464**	**36,064**
	Estimated from Other Uses/Users	0	2,650

The updated cost for the identified capital improvements needed to protect the LCR is $1.805 billion (2008 dollars), of which $385 million has been completed as shown in Table 7. The costs have increased from the $1.6 billion (in 2004 dollars) identified in the BOR 2007 report because of additional projects that have been identified as well as inflationary increases in labor and material costs. The top five communities, Lake Havasu City, Bullhead City, Yuma, Mohave

Valley and Blythe, have a combined need of approximately $1.1 billion, which accounts for about three-fourths of the remaining CIP needs identified.

Efforts should be focused on completing these projects early on because they will have the largest impact on improving water quality in the LCR since they address the concentrated impacts created by the larger populations in these areas.

Table 7
Cost of Projects Completed to Date

Member Organization	Project Name	Year of Work	Cost
Bullhead City	Sewer Improvement District #1	2000	$ 42,000,000
Bullhead City	Soccer Field Sewer Line	2000	$ 15,000
Bullhead City	Sierra Force Main	2001	$ 365,000
Bullhead City	Sun Ridge Sewer Extension	2002	$ 478,590
Bullhead City	Rainbow Drive Sewer Extension	2002	$ 240,000
Bullhead City	Goldrush and Ramar LS By-Pass	2003	$ 5,000
Bullhead City	Tierra Grande WWTP By-Pass	2003	$ 370,254
Bullhead City	Highway 95 & Arcadia Line Extension	2003	$ 1,887,812
Bullhead City	Havasupi Line Extension	2003	$ 201,705
Bullhead City	Chaparral Country Club WWTP Abandonment	2003	$ 25,000
Bullhead City	Chaparral Country Club LS Abandonment	2003	$ 19,214
Bullhead City	Tierra Grande WWTP Abandonment	2003	$ 50,000
Bullhead City	Riverview LS Abandonment	2008	$ -
Bullhead City	Section 10 Plant Expansion	2005	$ 7,200,000
Bullhead City	Sewer Improvement District #2	2005	$ 25,000,000
Bullhead City	Sewer Improvement District #3	2007	$ 47,650,000
Bullhead City	16" Force Main (Silver Creek Rd to Merrill Ave)	2007	$ 600,000
Bullhead City	Original Bullhead City Phase I	2007	$ 480,000
Bullhead City	Section 18 Plant Expansion	2007	$ 17,000,000
Bullhead City	Fire Station #3	2008	$ 13,469
Bullhead City	Ramar and Arcadia LS Abandonment	2008	$ 10,000
Bullhead City	16-2 Sierra LS Expansion	2008	$ 2,247,000
Bullhead City	Sun Ridge 1 & 3 LS Abandonment	2008	$ 20,000
Bullhead City	Club House LS Abandonment	2008	$ 9,642
Bullhead City		Sub-total	$ 145,887,686
Chemehuevi Indian Tribe	Treatment Plant	2008	$ 3,500,000
Lake Havasu City	Wastewater System Expansion (WWSE)	2002-2008	$ 236,000,000
	Total Cost of CIP Projects Complete to Date	**Total**	**$ 385,387,686**

Section 3
Water Quality in the Lower Colorado River

3.1 Environmental Issues and Background

The health of the LCR, the only perennial flowing river in the southwest, is vital to the wellbeing of over 25 million residents in Arizona, California, and Nevada, and to the valuable fish and wildlife habitat that it provides.

The 1922 Colorado River Compact and subsequent agreements dealt primarily with allocation of flows, storage and flood control to facilitate urban and agricultural development in the Basin states. Typical of that era, water quality and environmental protection were not addressed. However, that strategy "…was undertaken at great cost to the environment, and…environmental concerns now beset the Colorado River."[20] While these concerns are now being addressed to some degree, there is broad consensus that much is yet to be done.

In April 2004, the American Rivers organization and its partners designated the Colorado River as the nation's "most endangered river," citing mounting problems with radioactive, human and toxic waste that are contaminating groundwater in some areas along the river to levels unsafe for humans and detrimental to fish and wildlife.[1] Three categories of pollutants are at the heart of the contamination threat: nitrates and other nutrients, uranium, and heavy metals such as chromium and mercury. Salinity, pesticide residues and emerging contaminants, such as pharmaceuticals and other EDCs, are also increasing concerns. In addition, biological issues, particularly pathogens and the invasive Quagga mussel, exacerbate degradation of the river environment. A 2005 Sanitary Survey indicates that uranium, chromium, and most other contaminants of concern are well within drinking water standards in the river itself but are serious threats if not properly monitored and mitigated. In particular, the degradation of tributary groundwater needs to be addressed. Compounded by rapid population growth, outdated wastewater technology and septic tanks cannot treat wastewater adequately to remedy these contamination problems.

The pollution threat is exacerbated by drought conditions such as the current severe dry period, and the very real prospect of an increasingly arid future, featuring generally diminished snowpack, river flows and lake levels as a result of climate change.

Another major concern is the increase in exploration and mining activity in the Colorado River Basin related to our quest for increased domestic energy production. These efforts not only result in increased competition for limited water supply, but also increase the potential for pollution of the river.[23]

Adverse impacts from development along the LCR are occurring to the human environment as well as the native environment. For years, due to its isolation and low population levels, the use of septic systems for waste disposal in this region was considered to be adequate. Approximately 20 years ago, early signs began appearing suggesting that contamination from septic systems could and would eventually affect the water quality of the LCR. Today, concerns have heightened that contamination is a ticking time bomb, which seriously threatens the long-term health of the LCR environment and all those dependent on water from the river. A recent death of a Lake Havasu recreationist in August 2007 from an infection caused by an amoeba called Naegleria Fowleri, has galvanized local concern, both for the physical health of the

residents as well as for the health of tourism that provides the main economic driver in many of the local communities. This does not even begin to address downstream effects on the ecosystem and on the millions of users that receive LCR water.

As mentioned in the introduction, Congress requested in 2004 that the U.S. Bureau of Reclamation prepare a study to investigate steps that must be taken to protect the LCR. This study concentrated on contamination issues associated with septic systems operating along the LCR. Numerous pollution sources were identified: organic and inorganic contaminants, disinfection byproducts, pharmaceuticals, industrial chemicals, household cleaning agents, antibiotics, and EDCs. The study concluded that these contaminants are polluting the underlying groundwater that is a useable source of water to the various communities along the LCR, and that the polluted groundwater is seeping into the river. A top remedial priority, centralized wastewater treatment plants are needed to replace the septic tank systems that can no longer handle the increase in sewage generated by the LCR communities. Since the LCR is an interstate stream located in three states (Nevada, Arizona, and California), the need to address the contamination of tributary groundwater and the LCR must be comprehensively addressed. This includes not only water quality issues affecting the health of the various communities along the river and the large population dependant on Colorado River supplies, but also the natural habitats and wildlife found along the river.

The Clean Colorado River Alliance, established by Arizona Governor Janet Napolitano, issued a comprehensive report in 2006, "*Recommendations to Address Colorado River Water Quality*," detailing the threats of most concern to the Colorado River.[2] Recognizing that there are many potential threats to the river system, the Alliance decided to focus on what it perceived to be the seven most significant threats: nutrient loading, metals, EDCs, perchlorate, pathogens/bacteria, salinity/total dissolved solids (TDS), and sedimentation. The report also highlights the need for better understanding of the interactions between the river and human activities through monitoring, data sharing, education programs, federal funding for mitigation, and interstate communications. Since the final report was published, there has been progress in addressing some of these threats, such as a reduction in perchlorate loading into the system as a result of continuing remediation efforts in Nevada.

However, another onerous threat has since emerged: the infestation of Quagga mussels, which are already having operational impacts and costing millions of dollars in control efforts. Quagga mussels have the potential to alter the ecological balance in the river/reservoir system. Some scientists also speculate that the Quagga infestation could indirectly exacerbate the threat from pathogens/bacteria and more directly alter the threat of chemical contaminants through bio-concentration up the food chain.[14]

Other potential threats, largely unstudied, are the long-term effects of pharmaceutical chemicals and personal care products on human health and wildlife[20], and the impacts of hydrocarbons from recreational water craft in the river/reservoir system. According to the American Rivers report: "…Colorado River water is used to irrigate crops – trace amounts of toxic chemicals can be measured in produce on supermarket shelves across the country."[1] Each threat is significant and of great concern to the population dependent on the LCR water supply and to the native environment, requiring investment in pollution control measures and in further study of ramifications and remediation potentials.

3.2 Water Quality Problems, if Unmitigated, Will Worsen with Time and Be Exacerbated by Climate Change

Nitrates and other man-caused pollutants, which pose a threat to both human well-being and wildlife, are accumulating rapidly in groundwater formations adjacent to the LCR main stem and reservoirs. A 2001 study conducted in the alluvial aquifer immediately tributary to Lake Havasu estimated that nitrates in just this limited area are accumulating at a rate of about 300,000 lbs/year, with the annual rate of accumulation having increased about seven-fold in the past 20 years.[13] Since groundwater migrates relatively slowly, the impact to the down-gradient water bodies is delayed but certain.

Climate change, whether a result of natural cycles or man-influenced, will exacerbate the LCR water quality problems. Some climate prediction models and studies of historic precipitation patterns indicate that the current drought, which has brought the river flows at Lee's Ferry to the lowest level since measurements began 85 years ago, may be more the rule than the exception. A recent news piece in the July, 2008, issue of *Leadership and Management in Engineering*, entitled *"The Future is Drying Up – The Other Water Problem*", stated: "The latest research effort, published in the *Journal Geophysical Research Letters* in May, 2008, identified the existence in the past of an 'epochal Southwestern mega-drought.'"[4] Most scientists agree that the current drought is an indication that we are indeed encountering a drier climate, which means typically reduced snowpack and river flows. Aside from the considerable economic impact resulting from reduced supplies, significantly diminished flows will accelerate and worsen the water quality impacts from man-induced contaminants. Pollutants accumulating in the groundwater formations tributary to the river and reservoirs will migrate more rapidly with steepened gradients. Reduced flows means less flushing and assimilative capacity and greater concentrations of nitrates, phosphates, and other pollutants of concern, including EDCs. Lowered lake levels and warmer water with greater concentrations of nitrates and phosphates promote algal blooms, resulting in toxic "dead zones." Drought related water quality impacts in the LCR system are further pointed out in a study of the effects of drought and diminished water levels in Lake Mead,[5] which indicates that the year 2000 to year 2004 decline in storage from about 24 million acre feet to 14 million acre feet resulted in large increases in the concentrations of bromide and TDS.

3.3 Salinity

Salinity or TDS are terms used to describe the sum of the inorganic cations and anions dissolved in water. Sodium, calcium, magnesium, carbonates, sulfates, chlorides, and nitrates are common constituents comprising the TDS of the Colorado River. Sources of dissolved solids in the LCR include natural saline sediments and eroded/dissolved sedimentary rocks, irrigated agriculture return flows, municipal runoff, wastewater discharges, and development of energy resources.

Salinity in the Colorado River has long been recognized as a major issue, as it impacts agricultural, municipal and industrial users. Excess salinity negatively affects crop production, and this is a major economic issue for the nearly 1.8 million acres of irrigated agriculture that the river supports. Salinity also affects the palatability of drinking water and the useful life of system facilities and appliances.

Colorado River water, delivered through the MWDSC Colorado River Aqueduct and the Central Arizona Project, is conveying millions of tons per year of salts to users in Southern California and Central Arizona. Each acre foot exported from Lake Havasu at current salinity levels carries approximately one ton of dissolved minerals. These salts are accumulating in receiving groundwaters and thus contributing to salt imbalance issues which must eventually be dealt with at considerable cost.

Another issue is the impact of salinity on the feasibility of recycling, which is being counted on to provide a significant portion of growing demands in these regions. Municipal wastewater used for recycling typically contains approximately 300 mg/l greater concentration of TDS than the municipal water source. Recycled water derived from 700 mg/l Colorado River water would thus have a TDS of about 1000 mg/l, which is marginal for many landscape and agricultural plant species, and unacceptable in certain soil types. This issue is exacerbated in Southern California by the recent court ruling which limits the amount of low TDS water from Northern California which can be exported from the Delta through State Water Project (SWP) facilities. A greater proportion of the higher TDS Colorado River supplies will alter the blend ratio in several MWDSC facilities.

Salinity issues are being addressed in a Salinity Control Program spearheaded by the Colorado River Basin Salinity Control Forum, a partnership involving the seven Colorado River Basin states and including federal and agricultural interests. The Forum is a working group providing interstate and interagency coordination and guidance on project prioritization and funding. Most of the remediation efforts have been toward source control in the upstream areas. The Department of Interior reported in its 2003 Progress Report that the Salinity Control Program had succeeded in controlling 800,000 tons/year of salts of the year 2020 target of 1.8 million tons/year.[2] However, according to the Alliance report, a recent study by MWDSC and the BOR concluded that salinity damage in Arizona, California and Nevada currently amounts to nearly $200 million per year (at the 1999 salinity level of 669 mg/l), so LCR salinity even at present levels is a major concern.[2]

3.4 Nitrates

Nitrates in potable water sources cannot exceed 10 mg/L based on federal standards. But aside from the potential human health hazard, accumulation of nitrates beyond normal levels can cause “nutrient overloading,” with indirect negative consequences to the natural ecosystem. The primary source of nitrate contamination in the LCR system is the number and density of septic tanks utilized for wastewater treatment. Even well designed and properly maintained septic systems have limited value in reducing the total nitrogen content of wastewater. Other non-point sources of nitrates include applied fertilizers in agricultural areas and golf courses located adjacent or tributary to the river.

The 1999 “Regional Watershed Planning Document” by Burns & McDonald included an assessment of septic tank densities from Bullhead City to Yuma, Arizona. The largest concentration of septic tanks is along the Colorado River, generally north of Interstate 10. In some instances, septic tank densities are three to four times greater than typically associated with current regulations in place for permitting septic systems. An update conducted in 2004 and included in the Bureau of Reclamation’s March 2007 report on the river found that the

number of septic systems increased over the five-year period despite the addition and augmentation of some centralized collection systems.

Due to past limits on funding and staff, county regulators in California have been able to address septic system problems primarily only when pollution was visible on the surface. However, the State is now taking a strong interest in septic systems because of fecal bacteria and nitrates leaking into surface water and groundwater. Nitrate levels exceeding state and federal standards have been recorded in several locations where septic systems are prevalent. With greater numbers of septic systems introduced, more nitrates are added to the adjacent aquifers, which are part of the connected hydrogeology of the Colorado River. California Regional Water Quality Control Board members are concerned that in fast growing desert areas developers are proposing septic systems despite the risk of aquifer contamination. The Board estimates that only a small fraction of these tanks are regulated by the Board. However, the State is moving to put into effect new rules to regulate home septic systems. By 2010, as mandated by AB 885, all septic systems will be required to be inspected at least every five years. Hearings currently being held indicate that rural residents are very concerned over the cost they will bear for the inspections and the prospects of having to replace failing systems.

Based on population information and septic tank data for the LCR, CRRSCo estimates greater than seven million gallons per day (MGD) are being discharged to the LCR portion of the aquifer system on both sides of the river. This is a disproportionate value considering the limited land area involved along the LCR.

On the Arizona side of the river, two communities with the highest septic tank densities, Lake Havasu City and Bullhead City, have each taken the lead to mitigate nitrate loading by expanding their sewer collection systems. Prior to these efforts, the number of pounds of nitrates accumulating in the aquifer adjacent to the river increased dramatically from 1981 to about 2005, particularly with the construction boom from 2000 to 2005. Nitrate values recorded in monitoring wells in both areas over this period reflect increases and indicate a down-gradient migration toward the Colorado River and Lake Havasu. Monitoring wells tested indicate increases from 4.3 mg/L to as much as 40 mg/L, moving down-gradient.

Arizona Department of Environmental Quality studies in 1995 and 1999 in the Bullhead City and Mohave Valley areas noted that local geology is a controlling factor in the hydrology and the water quality of the area, particularly correlating elevated nitrate concentrations with high-density population areas using subsurface, on-site septic systems. Discharged wastewater migrates down gradient toward the Colorado River. In the January/February 2006 issue of *Southwest Hydrology*, the New Mexico Environmental Secretary is quoted as attributing more groundwater pollution to septic than all other sources combined. Representatives of the California State Water Resources Control Board have recently reported that septic wastewater plumes can travel much farther than previously thought. Data developed for the Lake Havasu City area indicates over 4000 feet of lateral migration in a year's time.[13]

Although Lake Havasu City and Bullhead City have taken large strides in the past few years in reducing the number of septic systems (over 19,000 as of November, 2008), many more are still in place within these communities and in surrounding unincorporated areas.

3.5 Other Nutrients

Nutrients in addition to nitrogen, such as phosphorous, organic carbon, and sulfur, are important in plant metabolism and are common in the environment. Of these, phosphorous in concentrations above 1.0 mg/l can facilitate algae blooms, which can result in eutrophication of standing water, anaerobic conditions and fish kills. Concentrations of phosphates along the LCR are generally well below this range, and only Nevada's Department of Conservation and Natural Resources has mandated phosphate standards in the LCR system (0.05 mg/l).[2] However, algal blooms have occurred in some areas---detrimental to both wildlife and recreation. Organic carbon and sulfates are generally found in modest quantities in LCR surface and groundwaters. Elevated sulfate levels, above the secondary maximum containment level (MCL) of 250 mg/l have been recorded in some groundwaters, but are considered to be primarily an aesthetic issue. Dissolved organic carbon in surface waters may react with chlorine disinfectants to form harmful byproducts. However, LCR water users report very low levels of such organic compounds.

Nationwide, economic damages from nutrient pollution are creating what is referred to as a "toxic debt." A new study published in ES&T *"Eutrophication of U.S. Fresh Water – Analysis of Potential Economic Damages"* spearheaded by Kentucky State University scientists, highlighted the economic implications of nutrient overloading such as that which is occurring in the LCR system.[12] The four factors evaluated are: 1) loss of waterfront property values; 2) reduced fishing and other recreational values; 3) cost of biodiversity loss; and 4) cost of purifying drinking water. Potential losses attributed to nutrient pollution in fresh waters of the U.S. were estimated at more than $4.3 billion per year. As previously emphasized, the economies of the LCR communities are dependant on recreation and tourism and would be greatly impacted by increasing and recurrent water quality disruptions.

Recent studies of nutrient and associated pollution in fresh waters have established a strong correlation between septic systems and lake eutrophication. An evaluation of 30 lakes in the Seattle region[24] presented evidence that urban development contributed greatly to the overloading of nutrients, namely nitrogen and phosphorous, and that those lakes with shoreline septic systems "…had concentrations of hypolimnetic phosphorous that were 108% higher than lakes with sewer systems." The study concluded that "…septic lakes tended to have higher levels of all measured indicators of eutrophication (phosphorous, chlorophyll-a, and the proportion of inedible algae) than lakes with sewer systems and undeveloped lakes."

3.6 Uranium

The Atlas Minerals Corporation's uranium mill tailings pile sits on the west bank of the Colorado River near Moab, Utah. This pile contains approximately 16 million tons of uranium mill wastes over a 130-acre site. In 1995, Atlas placed an interim cover on the site and soon after, filed for bankruptcy. Leachate from the pile has impacted the local groundwater and seeps towards the river. A portion of the pile is within the 100-year floodplain of the Colorado River, which poses the biggest threat to the river should a significant flood event occur. Levels of uranium in the pile are several orders of magnitude above drinking water standards. Ammonia, salinity, and other constituents are also present in very high levels.

A 1998 report by the Oak Ridge National Laboratory calculated that even if Atlas' proposed control plan were implemented, the uranium-contaminated liquid would leak into the Colorado River for approximately the next 270 years. Uranium is a regulated radioactive element with significant health concerns associated with it. The Environmental Protection Agency (EPA) states that uranium can cause toxic damage to the kidneys and increases the risk of bone and liver cancer and blood diseases such as leukemia.

The U.S. Department of Energy (DOE) took ownership of the site in 2001 and assumed responsibility for its remediation. In September 2005, DOE completed its Environmental Impact Statement which indicated that the 16 million tons of radioactive waste will be moved via rail from the banks of the Colorado River to a site at Crescent Junction, Utah, more than 30 miles to the northwest. Movement of the tailings pile is scheduled to begin in the spring of 2009 with a projected project completion date of 2028. The process could be accelerated and completed as early as 2019 if sufficient funding is available. DOE has also implemented interim measures for groundwater remediation at the Moab tailings site and are developing their long-term remediation plan. Continued Congressional appropriations will be vital to eliminate the threat to the Colorado River posed by this large tailings pile.

3.7 Chromium VI

Residents along the Colorado River have growing concerns regarding chromium VI and the potential for surface and groundwater contamination.

The pollution began decades ago when the Pacific Gas & Electric Company (PG&E), which serves central and northern California, used hexavalent chromium (chromium VI) to control corrosion and mold in water-cooling towers at an isolated natural gas compressor station south of Needles. From 1951 to 1964, PG&E dumped untreated wastewater into percolation beds and into a wash across from its Topock Natural Gas Compressor Station.

Chromium VI is considered to be a human carcinogen when inhaled or ingested. It is highly soluble and therefore easily transported in groundwater. Chromium VI is currently regulated under the 50 ppb California drinking water standard for total chromium. A groundwater plume contaminated with chromium VI from past disposal practices at the PG&E site was discovered on the California side of the Colorado River near PG&E's Topock site. The California Department of Toxic Substances Control (DTSC) is the primary regulatory agency responsible for the site cleanup. A similar chromium VI plume occurs in Lake Havasu City, approximately one half mile from Lake Havasu, which originated from subsurface disposal of waste from a metal plating shop.

3.8 Perchlorate

Perchlorate contamination, detected in the river in 1997, was traced to Lake Mead and the Las Vegas Wash, and eventually to a Kerr McGee Chemical Company (Kerr McGee) plant in Henderson, Nevada.[2] The United States Environmental Protection Agency (EPA), the Nevada Division of Environmental Protection (Nevada) and Kerr McGee have executed measures to control the source and reduce perchlorate releases to the Las Vegas Wash. Containment, control and cleanup efforts being implemented are reducing the concentrations and the potential risk of perchlorate in and to the Colorado River. The concentrations in the Colorado River are

currently below published health standards, do not pose any known threat to public health and, provided that remedial activities continue at these levels, the concentrations should not be a future threat.[2]

3.9 Quagga Mussel

The Quagga and related Zebra mussel infestation problem was recently aired in extensive hearings conducted before the Committee on Natural Resources (subcommittee on Water and Power, U.S. House of Representatives). The hearings, appropriately named *"The Silent Invasion: Finding Solutions to Minimizing the Impacts of Invasive Quagga Mussels on Water Rates, Water Infrastructure, and the Environment"*, took place on June 24, 2008. Testimony was received from representatives of numerous affected/concerned entities including CRRSCo members SNWA and MWDSC, as well as from the USBR and others. Brief excerpts from several of those statements, highlighting the gravity of the mussel problem, are presented in the following paragraphs:

- **USBR, by Karl Wirkus**[6] – The USBR has been monitoring the Quagga and Zebra mussel invasion since their appearance in the Great Lakes in 1988. They are now spreading in the West. They affect the USBR facilities by flow restriction and chemical degradation and can cause destruction of habitat and reduction of native mussels. They can impair water quality and potentially accumulate toxic materials. The USBR spent $800,000 in fiscal year 2008 for research on the mussels and are anticipating spending $1.5 million in 2009. U.S. Geological Survey's budget is $2.9 million for aquatic invasive species work. The Fish and Wildlife Service is spending $5.3 million, of which $1.8 million is dedicated to western waters.
- **National Aquatic Nuisance Species Clearinghouse, by Charles R. O'Neill, Jr.**[7] – Zebra and Quagga mussels have had profound physical and economic impacts on surface water-dependant infrastructure. Rapid proliferation and layers of millions of mussels cause the impacts on infrastructure. A synopsis of the testimony given by the National Aquatic Nuisance Species Clearinghouse indicates a revised fiscal impact from 1989 to 2007 of $1 to $1.5 billion across 23 states, with one half of the costs being borne by the electric generation industry and a third borne by the drinking water industry. The testimony also includes a brief statement that "…mussel infiltration of water may be increasing the proportion of cyanobacteria versus green algae in the water, potentially resulting in the production of waterborne neurotoxins that must be filtered from drinking water to prevent public health impacts." The net result is increased water treatment costs. Emphasis is placed on the fact that it is less costly to prevent pollutants than to treat for them.
- **CRRSCo Quagga Mussel Report, submitted by Representative Grijalva**[8] – Quagga mussels are thriving in Lake Havasu, Mojave, and Mead in the LCR system; with local observed populations as great as 40,000 or more per square meter. Nutrient relationships are detailed, along with other impacts on water quality and the ecological implications of these invasive organisms. The mussels may accumulate organic pollutants within their tissues to concentrations of more than 300,000 times greater than those in the surrounding environment, resulting in a potential threat to fish and birds that prey on them. A concluding statement: *"The above-presented research indicates a relationship between Driessena mussel feeding habitats,*

nutrient loading and cycling, ecological shifts, and the bioaccumulation of contaminants, all of which result in changes of water quality and a potential threat to the health of the ecosystem, including humans."

- **Southern Nevada Water Authority by Ronald E. Zegars**[10] – The written statement details the recent discovery of Quagga mussels in Lake Mead and the MWDSC intake structure 150 miles downstream at Lake Havasu. Populations of Quagga mussels typically expand exponentially, and in the LCR they are growing even more rapidly than some predicted. The statement is made that *"The Zebra/Quagga mussel has become arguably the most serous non-indigenous biofouling pest ever to be introduced into North America fresh water systems."* Impacts on the power industry in the U.S. from 1993 to 1999 are estimated at $3.1 billion, with other impacts exceeding $5 billion. Recommendations are made for assistance from the U.S. Department of Interior, including additional research. Key points include anticipation of over $20 million in infrastructure improvements to combat the mussels. A collaborative workshop funded by the American Water Works Association research foundation that included 34 experts on mussel research and control and 140 attendees, recommended funding for $20 million in research projects.
- **Metropolitan Water District of Southern California, by Ric De Leon**[10] – The presence and spawning of Quagga mussels in the LCR system pose an immediate threat to water and power systems serving more than 25 million people. If not controlled, the entire Western U.S. could be affected. The MWDSC has undertaken rapid actions for control, but federal government involvement/ funding is critical to an effective plan to combat the invasion of mussels in the West. MWDSC expects to spend $10 to $15 million annually to address the Quagga invasion.
- **New York State Education Department/Museum, by Denise A. Moyer**[11] – As Senior Research Scientist, Moyer has a long history of study of sensitive aquatic ecosystems and their susceptibility to invasive species. She is the lead scientist in development of a promising non-chemical toxic treatment to control Quagga and Zebra mussels. This bacterial product, designated Pf-CL145A, is currently being assessed in its effectiveness against mussel larvae in open waters. The research was done at the request of the North American Power Generation Industry. Recently, the USBR allied with this group, and the States of Arizona, California, and Nevada have expressed interest in teaming with them to expedite field trials. Pf-CL145A is believed to be the only non-chemical method being developed that could be used in both raw-water infrastructure and open waters with minimal ecological impact.

3.10 Pathogenic Organisms

Bacterial pathogens are the leading cause of water quality improvements in the nation, and the estimated cost of waterborne illness nationwide ranges from $309 million to $913 million per year.[22] The two most likely pathogens found in recreational waters are Cryptosporidium and Giardia. Potential causes of bacteria and pathogens in the Colorado River include the high density of on-site wastewater systems in river communities, storm water run-off and the improper design or inadequate maintenance of sanitary facilities in recreational areas along the

Colorado River. Bacterial contamination can result whenever there are high concentrations of people or animals.[2]

Nutrient overloading contributes to the proliferation of parasitic organisms such as the Naegleria amoeba (*Naegleria fowleri*), a free swimming amoeba that has caused a total of six deaths nationwide in 2007, including one recreational user swimming in the LCR (Havasu Magazine, October 2007, and the Center for Disease Control and Prevention statistics). Identifying and controlling these biological threats to human health is imperative and needs to be addressed in a comprehensive study.

3.11 Pharmaceutical and Personal Care Products

In the last decade, an entirely new water pollution problem has become a concern to the managers of our nation's water supply: the introduction and persistence in the environment of harmful chemicals originating from the myriad of pharmaceutical and personal care products (PPCPs). In particular, the large number of septic systems contributing to groundwater and surface water contamination render the PPCP threat more acute in the LCR. The primary concern with PPCPs is their potential to interfere with the reproductive systems of fish and mammals. EDCs occur at minute levels in waters associated with domestic and municipal sources. These chemicals originate in common household products and over-the-counter drugs and then find their way, via sewage systems and dumping, into the ground water. They include pain relievers, hormone replacement drugs, pesticides, steroids and surfactants (found in soaps and polish). Rather than poisoning an organism, EDCs interfere with the hormone activity of the body. U.S. health agencies are struggling to understand the extent of the threat to human health, but its impact on wildlife communities is well documented.[15]

Aquatic wildlife is especially vulnerable because they not only consume the chemicals but are literally surrounded by the contaminants. Sex change (feminization) and deformed sex organs have occurred in wild populations of fish, frogs, gastropods, alligators and gulls exposed to EDCs. Reproductive failure even in mammals (sheep) has been tied to high levels of estrogen in the pasture. Because the natural endocrine levels in an organism are at such minute levels, they are affected by small amounts of externally originating hormonally active substances. The timing of exposure is also presumed to be critical, since different hormone pathways are active during different stages of development. Rather than causing death to the exposed organism, its ability to breed or develop properly is impaired. Thus, the impact of EDCs on populations is subtle and difficult to document.[16]

CRRSCo must now include PPCP pollution considerations and focus on the approach that this is a new but growing health and environmental concern. The federal and some state governments are steadily moving towards regulating EDC pollution in natural waters. Endocrine disruption was not specifically named in any U.S. legislation until 1995, when amendments to the Safe Drinking Water Act and Food Quality Protection Act mandated the screening of chemicals and formulations for potential endocrine activity before manufacture or use in certain processes where drinking water or food can become contaminated. To meet the requirements of this recent legislation, the EPA formed a task force to recommend a conceptual framework, priorities, and screening and testing methodologies for EDCs. The committee's final report in 1998 recommended that human and wildlife impacts be considered and that estrogen, androgen, and thyroid endpoints be examined.

At present, the Food and Drug Administration requires ecological testing and evaluation of a pharmaceutical only if an environmental concentration in water or soil is expected to exceed one microgram per liter. While extensive monitoring programs are underway, toxicological studies conducted at environmentally relevant concentrations are necessary to establish reasonable regulations. California is considering establishing regulations based on the potential impacts of EDCs, especially where municipal wastewater effluent is recycled for indirect potable reuse. A recent modification to California's draft regulations for indirect potable reuse states, "Each year, the PGRRP (planned groundwater recharge reuse project) shall monitor the recycled water for endocrine disrupting chemicals and pharmaceuticals specified by the Department…" This interest by regulatory agencies will strengthen the case that EDCs negatively impact wild populations of fish and wildlife.[18]

Several treatment technologies have been found to be effective in reducing PPCP residuals in municipal wastewaters, but they are dependent on centralized treatment facilities.[17]

3.12 Other Contaminants

A number of other contaminants –- both organic and inorganic –- further contribute to pollution on the LCR.

Organic contaminants are usually carbon-based chemicals, such as solvents and pesticides, which can get into water through runoff from cropland or discharge from factories. Municipal wastewater discharge from treatment plants and stormwater runoff frequently contain numerous organic contaminants stemming from the use of pesticides, pharmaceuticals and personal care products, petroleum derivatives, cleaning agents and other household products. As previously mentioned, some organic constituents can also lead to disinfection byproducts when treated at drinking water plants.

The emergence of organic compounds in streams is a relatively recent phenomenon, and there are many uncertainties regarding their effects. Most are not regulated by the EPA. According to a recent article in *Tri-state Online* (December 8, 2008), low levels of many organic waste compounds have been detected in the LCR including pharmaceuticals, synthetic estrogenic hormones, personal care products, flame retardants, insect repellants, nicotine and caffeine.

Pesticide residues have been detected in the LCR at Imperial Dam and the Northern International Boundary. In 1968, the Federal Water Pollution Control Administration concluded that the use of pesticides on irrigated lands was causing contamination problems. A 1973 EPA analysis concluded that pesticide contamination was not a problem on the LCR. Nonetheless, fish tissues collected there exceeded California's maximum tissue residue level for several pesticide constituents.

Industrial contaminants include compounds such as polychlorinated biphenyls (PCBs) and polyaromatic hydrocarbons, which once were used as coolants and lubricants in transformers, capacitors and other electrical equipment. PCBs, which the EPA has identified as carcinogens and priority pollutants, do not readily break down in the environment and may remain there for very long periods of time.

Inorganic contaminants are compounds that typically do not contain the element carbon in their structure. They can become dissolved in water from natural sources or as the result of human activity. Though they occur naturally, they are regulated in public water supplies due to their ability to cause acute poisoning, cancer and other health effects.

3.13 Water Quality Issues Summary

From the above paragraphs, it is seen that the health of this vital waterway is threatened by a variety of pollutants from numerous sources, and that water quality degradation has serious and costly consequences for both the human and native environments. Water quality threats include salinity degradation, nutrient overloading, heavy metals such as chromium and mercury, uranium, organic contaminants such as perchlorates, pathogens, and invasive species such as the Quagga mussel. Also, an emerging concern is the introduction of chemical compounds from a variety of personal care products, which are demonstrated to have endocrine-disrupting and perhaps other serious health consequences.

A primary source of pollutants is development along the LCR, which has occurred at an astonishing pace, and in particular, the thousands of septic systems which are discharging into the underlying groundwater formations. These formations are themselves a source of drinking water and also are tributary to the river and its associated reservoirs. Other pollutant threats, which are not presently causing problems but which would have very severe consequences if not successfully mitigated, include the huge uranium stockpile adjacent to the river near Moab, Utah, and the perchlorate wastes near Henderson, Nevada.

Water quality issues, if not dealt with, will become increasingly serious with time. The rapid development along the river and the associated accumulation of contaminants in the adjacent groundwaters will increasingly contribute to nutrient overloading and other water quality impairments. Climate change, predicted by most scientists to result in a more arid environment in the southwest, will exacerbate water quality degradation in the LCR. Also, the increasing level of energy development activities in the upper basin states will create an additional pollution threat.

Although this report documents that significant progress has been made in improving the general level of awareness and in mitigation of certain water quality problems, the “needs” summary in Section 2 makes it clear that a much greater investment is needed to deal with the known issues and to better understand the newly identified and emerging threats to this most valuable river system.

Section 4
Review and Update of Funding Sources

The Regional Watershed Planning Document dated August 1999 lists many potential funding sources. The following sections identify a few of the more promising funding and grant programs and also review their applicability to finance capital improvements to improve the water quality along the LCR. Competition for the programs described below is intense. Relatively few new funding sources have materialized since the completion of the 1999 report.

4.1 Clean Water State Revolving Funds (CWSRF)

Each state has different agencies to manage the CWSRF program. The Water Infrastructure Financing Authority (WIFA) manages the program for the State of Arizona. For 2009 WIFA had $36 million to loan and received applications requesting $209 million showing how intense the competition is for this loan program.

The California State Water Resources Control Board (SWRCB) manages the program for California. The Average loan ranges from $15 million to $22 million, and some are as large as $300 million. Roughly $200 million to $300 million is disbursed annually. The application process is cumbersome and requires a project to be identified and placed on a priority list at least one year in advance. Additionally, environmental clearances are required as part of the funding process.

The Nevada Division of Environmental Protection (DEP) – Office of Financial Assistance manages the program for Nevada. The Nevada DEP expects to fund $244 million worth of projects for the 2009 fiscal year. Loans range from $400 thousand to $46.5 million. The draft intended use plan states that the short term goals are to make loans in excess of $20 million as well as to give three loans annually to communities with less than 10,000 people. This same intended use plan ranks projects in classes from class A to class H, with class A having the highest priority. The definition of class A projects is as follows:

> Treatment works or pollution control projects necessary to eliminate documented public health hazards in unsewered communities as evidenced by a finding of violation which has been issued in writing by the public health authority having jurisdiction over the area and by an official action which has been taken to halt or restrict construction of individual sewerage disposal systems, eliminate or restrict the discharge from a non-point source or treatment works necessary to eliminate documented public health hazards in sewered communities where existing facilities have exceeded their useful live and have deteriorated to the point that public health hazards exist.

At this time, no known projects within the LCR have been identified that meet these criteria.

4.2 Multi-State CWSRF Financing

CRRSCo could create a multi-state CWSRF financing approach by coordinating the California, Nevada and Arizona SRF programs. This approach was mentioned in a memorandum by the Assistant Administrator for the Office of Water, EPA, in regards to options to address the Nation's water infrastructure funding gap. The memorandum suggested that states should "[e]valuate new institutional approaches including providing states with the option to merge and expand their revolving fund programs as well as environmental SRFs with multi-media eligibilities, and allow states to create basin-wide, multi-state revolving funds[16]."

As mentioned in the 1999 Regional Watershed Planning Document, the Kansas and Missouri CWSRF programs negotiated joint funding of a wastewater treatment plant in Fort Smith, Kansas whose effluent will impact Missouri. CRRSCo must contact each state's program to coordinate the SRF programs. The LCR provides a common purpose for which multi-state CWSRF financing would be very appropriate.

4.3 Other State Loan Programs

In Arizona, the Greater Arizona Development Authority (GADA) assists local and tribal governments and special districts with the development of public infrastructure. GADA leverages its approximate $20 million fund to lower the costs of financing and help accelerate project development for public facilities owned, operated and maintained by a political subdivision, special district or Indian tribe. GADA has both financial and technical assistance programs. Information on the average project funding could not be found.

In California, the California Infrastructure and Economic Development Bank (I-Bank) finances public infrastructure and private development that promote economic growth, revitalize communities, and enhance quality of life for Californians. I-Bank has extremely broad statutory powers to issue revenue bonds, make loans, and provide credit enhancements for a wide variety of infrastructure and economic development projects and other government purposes. I-Bank has financed nearly $30 billion for various projects. Loans range from $250,000 to $10 million for projects. Sewage collection and treatment projects are eligible for funding via I-Bank.

4.4 Federally Funded Programs

U.S. Department of Agriculture: Loans are available to cities and towns with populations of 10,000 or less for water and waste disposal systems for rural communities. In fiscal year 2003, $797 million was available for direct loans, $425 million was available for grants and $75 million was available for guaranteed loans.

U.S. Department of Commerce: The Economic Development Administration awards grants. In FY 2007, grants ranged from $12,500 to $3.2 million. The average grant amount was $1.2 million. Generally grants do not exceed 50% of the project cost.

U.S. Department of Interior: The Reclamation and Water Reuse Grant Program selects only projects that are not eligible for funding under other federal programs. Construction funding is limited to 25% of the total project cost or $20 million, whichever is less.

U.S. Environmental Protection Agency: The EPA offers several programs, three of which are listed below:

- Nonpoint Source Implementation Grants – these grants fund about $100 million worth of projects annually.
- Sustainable Development Challenge Grants – this grant program has two categories of grants: 1) grants from $30,000 to $100,000; and 2) $100,000 to $250,000. Twenty percent matching funds are required. Approximately one thousand applications were received in 1997 for $5 million in funding. In 2000 $9.4 million was available.
- Wetlands Protection and Development Grants – In 2005 this program funded $1.8 million in grants. Normally, six to 15 grants are made ranging from $50,000 to $300,000 each in Region 9, which includes Arizona and California.

Federal Economic Stimulus Plan: President Elect Barack Obama has been discussing a plan to invest tax dollars in our national infrastructure at a rate unseen since the creation of the federal highway system in the 1950s. The details of the program, currently estimated to infuse from $500 to $700 billion into the US economy, are being developed for implementation starting in early 2009. The program will require states to identify projects, with the assistance of the counties, cities, and local communities, and act quickly to secure the funding for these projects. Mayors and county officials should be in contact with the appropriate state authorities to identify and prioritize the infrastructure projects. Mayors and county officials should ensure that they have the procurement resources needed to issue contracts in a timely manner, which may include drawing on A/E firm services. Lack of current final design documents should not be used as an excuse for avoiding project funding requests. Final design can be done on an expedited basis using either traditional or alternative delivery methodologies. CRRSCo members should identify projects that are designed or nearly completed in design for consideration in the economic stimulus program and submit the projects and estimated construction amounts to the proper officials in each respective state.

4.5 Designation as a Federal Program

CRRSCo could also try to elevate the wastewater improvement program to a federal program level administered by a federal agency such as the EPA. CRRSCo's goal of maintaining a safe river ecosystem for humans, fish and wildlife is not unlike that of the Great Lakes Program administered by the EPA. The goal of the Great Lakes Program is to restore and maintain the chemical, physical, and biological integrity of the Great Lakes Basin Ecosystem. The Great Lakes National Program Office, along with the EPA, leads a consortium of programs, agencies and institutions in actions to reduce contaminants, restore habitat, and protect all living resources.

The Great Lakes Strategy 2002, developed by EPA in conjunction with other Federal, State, and Tribal agencies (available at http://www.epa.gov/glnpo/gls/index.html), guides the activities of these organizations towards the Great Lakes Water Quality Agreement goal. Funding priorities include: Contaminated Sediment Assessment and Remediation; Pollution Prevention and Reduction; Ecological (Habitat) Protection and Restoration; Invasive Species; Strategic and Emerging Issues; Contaminant Monitoring of Lake and tributary waters and biota; information management; and the development and implementation of Remedial Action Plans and Lake

Wide Management Plans. For FY 2004, the President's Budget included new Great Lakes funding of $15 million. Financial assistance ranges from $100,000 to $3 million. Applicant and beneficiary eligibility includes state water pollution control agencies, interstate agencies, other public or nonprofit private agencies, institutions, organizations, Indian tribes and individuals.

Another successful example is the federally program to protect the Everglades in southern Florida, which represents the largest single marsh system in the United States and hosts a diverse spectrum of aquatic birds, mammals, reptiles, and amphibians, including 56 federally listed endangered or threatened species and 29 candidate species. In the first half of the twentieth century, more than half of the everglades has degraded and become unable to support the native species and animals. In the 1970's, the Federal government began a program to radically alter the natural water regime that will have the greatest impact on the Everglades. The federal government has financed 80 percent of the cost of constructing the Central and South Florida Project, which provides drainage and flood control for agriculture. Increasingly agricultural land is converted to or encroached upon by residential development, which also benefits from the drainage and flood control program. Agricultural programs and incentives to residential development have led to the filling of wetlands, and greatly increased the pressure for Federal flood control and drainage efforts. Funds for highways and airports have helped to establish the infrastructure for expanded residential development.

The Great Lakes Strategy 2002 program is an excellent prototype for CRRSCo to model for the LCR. Creating a similar program would help focus funding on the critical issues impacting the watershed and improve the water quality. To create such a program requires sponsorship by federal congressional members, and federal oversight and reporting requirements will be mandatory elements.

4.6 Establishment of a Multi-State Foundation

Independent 501(c) (3) organizations have been established among states with the cooperation of the federal government to protect vital watersheds and environmentally sensitive habitat throughout the United States. CRRSCo members could work together to form a charitable foundation with the sole purpose of restoring and protecting the Colorado River. A successful example of a multi-state is the Chesapeake Bay Foundation (CBF), which was formed 40 years ago. CBF has been a very effective means for protection of the Chesapeake Bay along the Eastern Seaboard in Maryland. CBF represents interests in the key states of Maryland, Pennsylvania, and Virginia, and on a more minor basis the states of New York, West Virginia, and Delaware as well as the District of Columbia.

CBF works closely with federal agencies and Congress to ensure that as much federal and state assistance as possible is allocated each year to saving the Chesapeake Bay watershed. 2007 operating results published in CBF's annual report shows funding from grants comprises over half of the $22 annual million operating budget. In 2007, state and federal leaders responded to lobbying efforts for Bay-saving funding with the following results:

- In Pennsylvania, Governor Edward Rendell signed the landmark Resource Enhancement and Protection Act (REAP), one of the most innovative conservation laws in recent history. REAP helps farmers who plan and

implement proven water-quality measures by providing $10 million in transferable state tax credits.

- The Maryland General Assembly voted to create a fund that will deliver $50 million annually to reduce pollution and restore the Bay and Maryland rivers.
- Virginia built on 2006's historic clean-water funding with an additional $250 million in new bonds for wastewater treatment plant improvements.
- In July, the U.S. House of Representatives voted to include an additional $100 million in conservation funding annually for five years in the re-authorized Farm Bill. This assistance will help farmers re-establish natural filters, plant forested and grassy streamside buffers to remove contaminants from runoff, and sow winter cover crops—all proven, cost-effective practices to clean receiving waters.

A similar foundation could be created to promote Colorado River water quality and lobby for similar funding measures from the federal and state governments in the form of federal and state income tax credits for pollution control and direct financial support for capital projects. This effort would require working cooperatively with local, regional, and state officials who could collectively lobby the appropriate federal Senate and House of Representatives legislators to develop a multi-state program to protect and improve the water quality of the Lower Colorado River.

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