CARTER LAKE

Water Quality Management Plan Summary

February 2008

Project Sponsors:

City of Carter Lake

City of Omaha

Prepared by:

Carter Lake Environmental Assessment and Rehabilitation (CLEAR) Council

I. Introduction

Carter Lake is a 315-acre oxbow lake that lies in both Nebraska and Iowa. Carter Lake has a drainage area of 2,722 acres and relies on surface runoff for water. The watershed consists of primarily urban residential and commercial properties.

In 2006, the cities of Carter Lake, Iowa and Omaha, Nebraska requested assistance from environmental agencies in addressing water quality problems at Carter Lake. At that time, a Community Based Planning Process was initiated. As part of the planning process, a voluntary group of interested citizens was formed under the name of Carter Lake Environmental Assessment and Rehabilitation (CLEAR) Council. The CLEAR Council, with assistance of numerous local and state agencies, developed a conceptual plan to address water quality concerns. This summary provides an overview of the major components of the Water Quality Management Plan For Carter Lake. Public input will be sought prior to finalizing the plan in 2008.

II. Water Quality Concerns

Carter Lake is a highly productive lake that exhibits poor water clarity, high nutrient concentrations, frequent algae blooms and periodically high bacteria. Additionally, PCB's in fish tissue has lead to consumption advisories.

Blue green algae and their associated toxins are the primary cause for concern. Over 25 percent of the weekly samples collected from 2004 through 2007 had concentrations of toxins that exceeded beach-posting criteria. Given the nature of the problems at Carter Lake, the focus of corrective measures was on the reduction of phosphorus, which is the driving force behind algae production. Most of the recommended corrective measures are also effective at treating other pollutants such as bacteria.

III. Carter Lake Vision

A visioning exercise was conducted at the second public meeting. Several vision statements developed by the public were combined to produce the following:

"Carter Lake will be the crown jewel of the metropolitan area by being a stable, healthy ecosystem that provides for multi use recreational activities and economic opportunities."

IV. Water Quality Goals

The planning process for Carter Lake was designed to result in a community based management plan that will provide a framework for protecting water quality in Carter Lake. The qualitative goals generated by the stakeholders in the second public meeting became the foundation for quantitative water quality goals developed by the CLEAR Council and Technical Advisory Team (TAT). The goals pertain to protecting aquatic life and the public uses of the lake such as recreation, fish consumption and aesthetics.

Goal 1. Achieve A "Full Support" Status For The Aquatic Life Use

Objective 1: Increase growing season median water clarity from 16 inches to 54 inches to meet the Iowa Lake Restoration Program Goal but not to fall below 30 inches to meet the TMDL Goal.

Objective 2: Reduce growing season in-lake total phosphorus from 153 ug/l to 75 ug/l.

Objective 3: Reduce growing season in-lake total nitrogen from 2,140 ug/l to 409 ug/l.

Objective 4: Decrease growing season median chlorophyll *a* concentrations from 59 mg/m3 to 21 mg/m3.

Objective 5: Maintain water column average dissolved oxygen above 5.0 mg/l throughout the year.

Objective 6: Maintain healthy diverse aquatic habitats that support balanced populations of fish, amphibians, retiles and invertebrates.

Goal 2. Reduce Contaminant Levels In Fish To "Safe" Levels

Objective 7: Reduce and maintain contaminant levels below water quality standards in the Carter Lake inflows.

Goal 3. Maintain A "Full Support" Status For The Recreation Use

Objective 8: Maintain E.coli bacteria concentrations below 235 col./100mls during the recreation season.

Objective 9: Maintain algae toxin concentrations below 7 ppb for all 22 weeks of the recreation season and prevent level of algal toxins above 20 ppb in any measurement.

Objective 10: Provide a sustainable recreational fishery by adopting regulations and management plans jointly recommended by the Iowa Department of Natural Resources and the Nebraska Game and Parks Commission.

Goal 4. Maintain A "Full Support" Status For The Aesthetic Use

Objective 11: Keep the lake and park area free of trash and junk.

Objective 12: Stabilize areas of eroding shoreline.

V. RECOMMENDED CORRECTIVE MEASURES

The CLEAR Council, Technical Advisory Team (TAT), and Olsson Associates conducted a thorough evaluation of techniques that could be used to improve water quality at Carter Lake. The CLEAR Council and TAT were well aware that an aggressive plan would need to be implemented to achieve the desired conditions. In doing so, a holistic approach was taken in accounting for problems and pollutant sources both in the watershed and in the lake itself. It was a priority for the CLEAR Council to include a strong Information and Education program to accompany the treatment alternatives. The Information and Education program is intended to be dynamic to account for needs as the implementation of alternatives progresses.

Water quality alternatives were separated into three categories in this plan: 1) Watershed Alternatives, 2) In-lake Alternatives, and 3) Other Alternative Considerations. Alternatives were evaluated individually based on estimated phosphorus reduction effectiveness and social acceptability, then as a package to determine if nutrient reduction and other water quality goals could be achieved. While the estimated phosphorus reduction for each alternative is reported, the uncertainty around these estimates is high and the cumulative benefits of all the alternatives is unknown. The CLEAR Council and TAT encourage project sponsors to implement all the Watershed and In-lake Alternatives and Information/Education Program as recommended in this plan. The Other Alternative Considerations were either not adopted by the CLEAR Council or were not addressed in the water quality planning process.

The total phosphorus load reduction needed to meet the goal of the Total Maximum Daily Load (TMDL) is 1,704 pounds or a 53.8% reduction from the calculated in-lake and watershed loads. If all the Watershed and In-lake Alternatives recommended were implemented, an estimated reduction of 2,155 pounds (69%) could be realized. While water quality experts were not able to quantify annual reductions for the some of the alternatives, they could cumulatively account for the additional 6% reduction needed to meet the more aggressive reduction goal of 75% established by the CLEAR council.

Where possible, phosphorus loading reductions were reported as an "average annual reduction". Some alternatives, such as the in-lake alum treatment and targeted dredging will provide a significant initial phosphorus reduction in addition to longer term reductions. The initial reductions were reported when applicable.

While treatment cost was not a consideration for the inclusion of a practice into the plan, preliminary cost estimates of each practice is included to provide project sponsors and possible funding sources with additional information for the final selection of alternatives. Estimated costs for each practice are based on initial construction costs and do not account for annual maintenance. Annual maintenance costs are provided in the Estimate of Costs section of this plan.

Watershed Alternatives

Slightly less than 50 percent (1,414 pounds) of the total phosphorus in the lake comes from external sources or the "watershed". Several alternatives were identified to address these pollutant loads. The reduction to the phosphorus load if all the recommended Watershed Alternatives were implemented is estimated to be 796 pounds, which equates to a 56 percent reduction to the external load and a 25 percent reduction to the total load.

Alum Stormwater Injection

This alternative offers very high pollutant removals from stormwater entering Carter Lake. A chemical (alum) is injected into the stormwater system, where it binds with phosphorus and other pollutants and settles to the bottom of a sediment basin near the lake, or within the lake itself. High and relatively certain pollutant reductions are to be expected with this alternative. The injection system would function like a small-scale treatment plant, and would include alum storage facilities (which may be located in the ground), an injection pumping system, an alum feed system to convey alum from the storage tanks to the stormwater system and a contact chamber.

We recommend using an alum injection system to treat flows outleted from the 60-inch concrete outfall and the wet pond at the northwest corner of the lake. If it is feasible to route the 60-inch concrete outfall into the wet detention pond (as described in the section above), these could be treated with one injection system. It is also recommended that an alum injection system be implemented to treat the stormwater that enters the northeast corner of the lake at the intersection of Abbott Drive and Carter Boulevard. The feasibility of this option is uncertain and would have to be investigated in further detail. Water quality data at all three of these locations indicated high phosphorus concentrations. Alum injection would remove 80 to 90 percent of this phosphorus, in addition to very high removals of bacteria, suspended sediment, and heavy metals.

Northwest System

Estimated Phosphorus Reduction	Treatment Cost
437 pounds annually	$506,000

* *The reduction and cost in this table include both the wet detention pond and the alum injection system.*

Northeast System

Estimated Phosphorus Reduction	Treatment Cost
67 pounds annually	$97,000

Wet Detention Pond

Wet ponds offer a moderate to high sediment removal efficiency, and moderate to high phosphorus and bacteria removal. There are limited places to incorporate new wet detention ponds in the Carter Lake Watershed. We would recommend construction of new ponds as part of the overall stormwater system whenever the opportunities arise. There is an existing wet pond that should be retrofitted to increase water quality benefits located at the northwest corner of the lake in Levi Carter Park.

The wet pond at the northwest corner of the lake has historically provided some water quality treatment. However, due to years of filling in with sediment, vegetation, trash, and debris, this pond is no longer functioning well for water quality improvement. There is a dense algae layer at the surface in the summer, and very low water clarity in this pond. Sampling data confirm that outflow from this pond will add to the load of phosphorus and other pollutants to the lake. Our recommendation includes cleaning out and expanding this pond to increase pollutant removal. If feasible, it is suggested that the 60-inch concrete outfall located south of the pond be rerouted to flow into the detention pond to provide additional treatment to the stormwater that would have drained directly to the lake. The feasibility of this option is uncertain and would have to be investigated in further detail. The expansion of the wet pond may offer aesthetic and recreational benefits to the users of the lake and park, as well as additional wildlife habitat and a setting for outdoor education. In addition, this pond may feature multiple basins for increased treatment, and may be used in conjunction with an alum stormwater injection system described later in this plan. Design considerations should include any future park enhancements (e.g. fountains, trails, parking lots).

The golf course pond collects stormwater from a number of pump stations throughout the City of Carter Lake. The frequency of discharges from the pond to the lake is not well documented, but is thought to occur every three to four years. Consequently, in some years, the phosphorus load to the lake from this pond may be zero. The overall impact to the lake when overflow does occur is not as damaging as initially expected. Even if the overflows from the golf course pond with high phosphorus concentrations discharge to the lake once every three years, the load is not significant compared to other more constant sources of pollutants. Dredging or introduction of wetland vegetation would be helpful, but is not a requirement for this plan. Due to the infrequent overflow of the pond, improvement to this feature does not have high priority. Costs were not determined for this alternative because of the low priority.

The practice using the water in the pond to irrigate the golf course should be continued. This provides benefits by recycling stormwater, thus reducing potable water usage, by promoting ground filtration and through nutrient consumption by the turf. The estimated phosphorus reduction and treatment cost is included in the Northwest Alum Stormwater Injection System above.

Bioretention (Rain Gardens),Bioswales, Filter Strips, and Vegetated Buffers
Bioretention features, often referred to as "rain gardens," are a type of structural best management practice (BMP) commonly used for stormwater quality improvement in urban areas. When properly designed and maintained, they can offer highly efficient reduction of phosphorus, as well as other pollutants.

More specifically, rain gardens can be placed next to paved commercial areas, in city right-of-ways, and in other key areas around the lake. We strongly encourage the implementation of rain garden features at the golf course, which can add value to the landscape as well as to water quality. Similarly, we would encourage the promotion of rain gardens as a landscaping technique at private residences. These could be installed individually or as clusters. Development of a cost-share program may make this a more feasible option. Other lower cost options, such as rain barrels exist for homeowners as well. As with other structural BMPs, widespread implementation across the watershed will greatly enhance the overall pollutant reductions achieved by this alternative. The City of Carter Lake has already installed two rain gardens on public property covering approximately 2,000 square feet. It should be noted that the annual removal of dead plant biomass from any vegetated system would decrease the transport of nutrients to the lake.

Vegetated bioswales, filter strips, grass swales, and vegetated buffers are watershed alternatives that function much in the same way, but take slightly different forms. They should be implemented throughout the watershed as improvements to existing ditches, replacements for concrete-lined channels, and substitutes to concrete pipes and channels for future construction. All four alternatives utilize vegetation to improve water quality through filtration, increased infiltration to the ground, and in uptake of nutrients into plant biomass. There are several concrete channels near the lake that could be replaced with one of these methods. In addition, existing swales and ditches in Levi Carter Park could be enhanced with vegetation more suitable for water quality improvement. Two flow routes that run through the golf course and into the lake should be modified to function as vegetated bioswales. Lastly, a vegetated buffer is suggested for locations around the perimeter of the lake.

Estimated Phosphorus Reduction	Treatment Cost
*218 pounds annually	*$1,487,600

* *The reduction and cost in this table include both bioretention and bioswale alternatives and were based upon the quantity and placement suggested by Olsson as seen on Figure 1. This includes 100,000 square feet of bioretention at an estimated $8.00 per square foot and 3,750 linear feet of vegetated bioswale/filter strips at an estimated $120 per linear foot and 32,000 linear feet of vegetated buffer at $1.50 per linear foot.*

Septic Tank Inspections

While there are numerous homes on private septic in the watershed, the contribution of pollutants such as phosphorus and bacteria to the lake is believed to be low because of land slope being minimal (reduced runoff), drainage conveyance being grass, and the low number of homes with potential problems (National failure rate being 2%). While there would be water quality benefits associated with finding and correcting failing septic tanks the cost of this effort is significant. Other more feasible options may include local health agencies conducting the inspections at a reduced cost, providing inspection cost-share to homeowners, educating homeowners on the issue, or replacing private septic systems with a sanitary sewer system.

Estimated Phosphorus Reduction	**Treatment Cost**
49 pounds annually	$50,000

Water Quality Inlets
Water quality inlets are placed in existing storm drains to filter pollutant-laden runoff before it enters the storm sewers, which eventually flow to Carter Lake. These inlet filters do a very good job of removing sediment and grit from runoff, as well as metals, oil, and grease and trash that is carried to the storm drains. Unfortunately their efficiency is not as high for phosphorus removal. However, the pollutants they do remove can contribute to non-algal turbidity in Carter Lake. Also, removing sediment and grit will reduce bacteria, which periodically exceeds acceptable levels for contact recreation. To achieve significant water quality improvement, grate inlets should be retrofitted with filters throughout the drainage area to Carter Lake.

Estimated Phosphorus Reduction	Treatment Cost
25 pounds annually	$45,000*

** Cost based on installing 30 filters at $1,500 per filter.*

Fertilizer Management
Fertilization is the process by which essential nutrients are artificially supplied to plants. In urban areas, lawn fertilizers can be a significant source of phosphorus to surface waters. Problems occur when fertilizers are over applied or when applied to areas that are subject to high runoff such as sidewalks and driveways. While the CLEAR Council does not recommend a phosphorus fertilizer ban, they have focused on this management practice in the Information/Education Program.

Pet Waste Management
Similar to no-phosphorus fertilizer, implementation of a pet waste management program is a simple and inexpensive method of obtaining phosphorus (and other pollutant) load reductions to the lake. Because the cities of Carter Lake and Omaha already have an ordinance that requires pet owners to pick up after their pets, we recommend continuing enforcement of this policy, as well as educating residents in both the Iowa and Nebraska portions of the watershed. An estimated 863 pounds of phosphates are generated in the watershed annually just from dog waste indicating the potential significance of this problem. This component will also be a focus of the Information/Education Program.

In-lake Alternatives

Over 50 percent (1,752 pounds) of the total phosphorus in the reservoir can be attributed to internal sources making the in-lake components an important part of the overall plan. Water quality in Carter Lake has slowly degraded since it first became an oxbow lake. The effects of long-term degradation need to be reversed before loading reductions can be expected to improve water quality in a reasonable period of time. The in-lake alum treatment and targeted dredging will provide a significant amount of short term benefits by removing pollutants like phosphorus and PCB’s that are already in the system. Phosphorus reduction estimates for these alternatives are provided for a one-time (initial) and annual removal of phosphorus from either the bottom sediments or water column.

The total amount of phosphorus that would be initially removed from the lake through the targeted dredging and in-lake alum is 65,800 pounds. This is equivalent to 21 years worth of phosphorus loading. The annual loading reduction from all the in-lake alternatives is estimated to be 1,359 pounds, which is a 78% reduction to the internal load or a 43% reduction to the total load.

In-lake Alum Treatment

Due to the high internal phosphorus load within Carter Lake, even complete control of all external loads would not necessarily result in immediate tangible benefits to the lake. Through modeling the expected impacts of watershed alternatives, it is also apparent that significant in-lake control is required to meet the water quality goals set forth by the TMDL and CLEAR Council. In-lake alum treatment involves the addition of alum to the water column of a lake. After alum is injected just below the water surface, it bonds with phosphates to form a floc, and precipitates (settles) to the bottom of the lake. The alum floc removes phosphorus and other pollutants from the water column as it settles, and forms a thin layer on the top of the sediment. This layer acts as a barrier to prevent the release of phosphorus to the water column from the sediment. The alum is not toxic to plants, animals or humans. Initially, a very high removal rate is to be expected. The lifetime of effectiveness for this alternative is very difficult to estimate, as is it is dependent upon site-specific conditions. It is believed by technical experts that power boating will reduce the duration of alum effectiveness through the re-suspension of bottom sediments.

Estimated Phosphorus Reduction	Treatment Cost
1,938 pounds initially 448 pounds annually	$600,000

Wetland Enhancement/Creation

In addition to creating small "pocket" wetlands as part of the sediment forebays, creation of additional, larger wetlands would be beneficial to water clarity, phosphorus reductions, and benefits associated with fish renovation. For maximum phosphorus removal, we recommend creating a large wetland near the outlet of the drainage ditch that conveys overflow from the golf course pond to the southwest end of the lake. Additionally, wetlands should be established behind the offshore breakwater structures located on the north Omaha shoreline. These large wetlands would contain rooted vegetation that will compete with floating algae for phosphorus uptake. This competition will help reduce the frequency and severity of algal blooms.

In addition to creating the wetlands described above, the large wetland on the shoreline across from Abbott Drive could be enhanced. The goal of the enhancement would be to increase the pollutant removal efficiency from the stormwater that enters this wetland from the east edge of the City. There are currently undesirable plant species along the lake side of this wetland, and the wetland has been "expanding" into Carter Lake. Rehabilitation of this wetland could help address this issue as well. Because this is an existing wetland, any activity impacting it would require permits from the US Army

Corps of Engineers. The permit may require mitigation, which should be satisfied by the creation of the additional wetlands described above.

Estimated Phosphorus Reduction	Treatment Cost
270 pounds annually*	$601,310*

**The reduction and cost are based upon the locations suggested by Olsson as seen on Figure 1. The cost to construct each wetland is highly variable, largely dependant upon the amount of cut/fill required to reach desired elevation.*

Watercraft Management
The impacts of motorized watercraft on water quality have been well documented. These impacts can relate to water clarity, shoreline erosion, bottom sediment re-suspension, and aquatic plant colonization, all of which are targeted for improvement at Carter Lake. Since the longevity of some of the proposed treatment methods will be shortened by wake producing activities the sponsors should give this alternative as much consideration as any other alternative. The CLEAR and Technical councils recommend implementing no-wake boating restrictions to effectively protect a minimum of 100 acres.

Estimated Phosphorus Reduction	Treatment Cost
240 pounds annually	Not Applicable *

** The only direct cost associated with this alternative is in regards to how the no-wake areas are marked. Project sponsors should evaluate options for marking no-wake areas.*

Fish Renovation
The fish population of Carter Lake does not meet state fisheries management goals nor is it conducive for meeting water quality goals stated in this plan. The presence of carp and bullhead can be surprisingly significant contributors to reduced water clarity by stirring up sediments with their feeding habits. Renovating the fishery of the lake will help reduce internal pollutant loads, while at the same time rebalance the species population. Additional fish habitat and angler access structures are also important components of the fish renovation. Increased water quality and fishing opportunities will bring additional patrons to the lake. In addition to increasing water clarity, removal of existing fish tissue that has bio-accumulated PCBs over the years would remove large amounts of this harmful material from the ecosystem and food chain of the lake.

Estimated Phosphorus Reduction	**Treatment Cost**
168 pounds annually	$200,000

Shoreline Stabilization
The protection of the shorelines offers numerous benefits to the lake. First, it reduces erosion along the shore, which increases water clarity. While maintaining near shore water depth, some stabilization techniques also improve the aesthetics and accessibility of the shoreline. These areas can be targeted for fish habitat, which enhances the benefits of the recommended fish renovation. Shoreline stabilization efforts will require more hard

armoring on high boating use areas of the lake. To the extent possible, stabilization will be tailored to the preferences of the CLEAR Council and will address needs of special user groups such as the Creighton Row Team. Several different configurations of shoreline stabilization were considered, including Offshore Breakwaters, Jetties, Rock Riprap Protection, Geotube Protection and Shoreline Regrading. The quantity, location and configuration of shoreline stabilization is highly dependent upon whether no-wake zones are implemented and where they are located.

Estimated Phosphorus Reduction	Treatment Cost
130 pounds annually*	$2,483,455*

**The reduction and cost are based upon the locations suggested by Olsson as seen on Figure 1. The locations and configurations were chosen assuming that no-wake zones will be implemented and includes a combination of the above structures to achieve a total of 13,210 linear feet of protected shoreline.*

Sediment Forebays

Forebays should be constructed at major stormwater outfalls to capture sediment as it enters the lake. This will improve water clarity of the main body of the lake by reducing suspended sediment and will also reduce phosphorus loads by capturing phosphorus that is attached to sediment. Forebays can also reduce bacteria loading, particularly for smaller runoff events. They can be constructed using a number of techniques, including riprap or geotubes filled with sediment dredged as part of the targeted dredging alternative. Establishment of wetland vegetation in these forebays would increase the water quality benefits and offer added aesthetic value.

Estimated Phosphorus Reduction	Treatment Cost
103 pounds annually*	$1,159,200*

**The reduction and cost are based upon the locations suggested by Olsson as seen on Figure 1. This includes four forebays (perimeter length of 1,120 linear feet) at an estimated cost of $900 per linear foot.*

Targeted Dredging

Some areas in Carter Lake have become shallow from inflowing sediment. While some of the sediment is deposited throughout the lake, most of the deposition occurs near stormwater outfalls. Nearly 60 percent of the lake's surface area has a depth of at least 8 feet, which is also the mean depth. Much of the remaining 40 percent includes areas around the shoreline, and a few shallow spots within the main body of the lake. It is recommended that these areas (not including the shoreline) should be dredged to provide 8 feet of depth when the lake is at the desired level (elevation 970.3). Sediment removal in these areas will not only reduce the potential for resuspension but the process will also remove phosphorus and other targeted pollutants such as PCB's from the lake.

Removal of sediment in these areas will do a number of things to help improve the quality of water in Carter Lake. Increased depth in shallow areas will reduce sediment re-suspension and increase water clarity. Targeted dredging will improve fish habitat, thereby increasing the water quality benefits obtained with the fisheries renovation. Targeted dredging will also increase the efficiency and longevity of whole-lake alum application. While direct benefits of targeted dredging may not be apparent, it enhances the performance of a number of other water quality improvements, making this alternative a vital component of the overall plan. The cost provided is based on sediment not containing high levels of pollutants that will require special handling and/or disposal.

Estimated Phosphorus Reduction	Treatment Cost
63,862 pounds initially* Annual Reduction Not Estimated	$1,610,000*

**The reduction and cost are based upon the locations suggested by Olsson as seen on Figure 1. This includes 92,000 cubic yards of excavation at an estimated cost of $17.50 per cubic yard. The phosphorus reduction reported is the amount of phosphorus removed that will no longer be available to be recycled, not removed directly from the water column.*

Targeted Fill

Material removed from targeted dredging will be hydraulically pumped to locations of the lake in which seepage losses may be occurring, such as the deep hole near the island by Abbott Drive. This alternative may help reduce seepage losses from Carter Lake through potential sand layers at deep elevation without adding significant additional costs over and beyond those spent on dredging. To ensure coverage of potential sand lenses the hole must be filled to elevation 954 (several feet above the sand level reported from a boring (adjacent to the hole) taken by the United States Army Corps of Engineers), which would require 35,000 cubic yards of material. The maximum volume the hole could store is approximately 64,000 cubic yards.

Estimated Phosphorus Reduction	Treatment Cost
Not Estimated	Subsidiary to Targeted Dredging

Other Alternative Considerations

Supplemental Water Source

Water quantity has been a long-term issue at Carter Lake. Water quantity and water quality are typically connected in lakes and reservoirs. This seems to be the case at Carter Lake as well. Although a minimal amount of water quantity and water quality data was available, some constituents such as total phosphorus, algae production and water clarity appeared to be influenced by low water conditions. Additionally, the effectiveness of all the water quality alternatives were evaluated based on a full lake pool (Elevation 969.8 to 970.8) so if lake levels were low over an extended period, in-lake loading reduction targets would need to be increased to meet the desired in-lake conditions. The quality of supplemental water entering Carter Lake will play a major role in meeting the goals of this plan. Low phosphorus water would significantly benefit water quality through dilution while high phosphorus water could negate any improvements made from other efforts to reduce phosphorus in the lake.

Estimated Phosphorus Reduction	Treatment Cost
Not Estimated	$2,000,000

Whole Lake Dredging
Sediment removal for the entire lake was deemed as not being cost effective. A crude cost estimate for removing 3 feet of sediment from the bottom is about $26.7 million (approximately 1.5 million cubic yards at 17.50 per cubic yard). Additional concerns arise with the effectiveness of this treatment being unknown and potential risks with creating more seepage than what already exists. To address seepage concerns, a polymer sealant could be applied to the lake bottom after dredging is performed. This would create an additional cost ranging from $1 to $6 million.

Estimated Phosphorus Reduction	Treatment Cost
Not Estimated	$26,700,000

Prefabricated Stormwater Filter
The prefabricated stormwater filter is a passive filtration system that effectively removes pollutants from overland storm water runoff. These systems are constructed underground in concrete vaults and target a full range of pollutants in urban runoff, including sediment, soluble heavy metals, oil and grease, organics and nutrients. The system removes pollutants through mechanical filtration, ion exchange, and absorption. The system does not have high phosphorus removal rates, as some of the other alternatives do. Therefore it was not the recommended alternative in any location. However, if it is discovered past the concept development stage that the recommended alternative in a desired location is not feasible, further investigation around the feasibility/effectiveness of implementing prefabricated stormwater filter(s) is recommended.

Estimated Phosphorus Reduction	Treatment Cost
Dependent Upon Location	$9,350 - $19,550*

**The cost is on a per unit basis and does not include installation expenses.*

Information and Education Program

The Carter Lake Environmental Assessment & Rehabilitation (CLEAR) council formed a sub-subcommittee to develop and promote an educational plan. The education plan is intended to be a dynamic plan that will address educational needs of the watershed residents as defined by the CLEAR Council and sub-committee. The first task of the sub-committee was to establish educational goals. An initial set of action items that support these goals have also been developed. These action items will be the focus of the first year of the project. The educational goals, action items, responsible entity, and project budgetary needs are defined below.

Goal 1. Promote stewardship among the users of public and private recreational areas within the watershed environment.

Action 1. Stencil sidewalks with an awareness message to all users.
Estimated Cost: $500

Action 2. Post signs on the consequence of pet waste and trash.
Estimated Cost: $1,200

Action 3. Solicit volunteers to remove trash from the lake and park areas.
Estimated Cost: Volunteer Time

Goal 2. Promote awareness of Best Management Practices (BMP's) to homeowners and businesses in the Carter Lake Watershed.

Action 4. Promote the installation of rain gardens on public and private land through the development and dissemination of information, workshops, and tours of existing sites.
Estimated Cost: $5,000

Action 5. Promote phosphorus free fertilizers by providing free soil tests and fertilizer for homeowners and holding workshops on lawn care.
Estimated Cost: $18,000

Action 6. Promote existing disposal days for auto waste products and disseminate educational materials on the impacts of these products on water quality.
Estimated Cost: $2,000

Action 7. Educate boat owners on proper fueling of watercraft and impacts of fuels on water quality.
Estimated Cost: $2,000

Goal 3. Inform the public of activities that have been done and will be done to improve the lake.

Action 8. Establishing a web-site that provides photos and continual updates on ongoing or completed components of the project.
Estimated Cost: $1,000

Action 9. Use the blue channel and local media for periodic updates on what has been done or special events related to the project.
Estimated Cost: NA

VI. COST ESTIMATE FOR RECOMMENDED ALTERNATIVES

Olsson Associates determined "preliminary" cost estimates for water quality improvement alternatives targeted for Carter Lake. Estimates of cost are broken into the various alternative categories provided in the Alternative Section of this plan. Costs outlined below include installation/construction cost and maintenance costs where possible. A fifteen percent contingency has been added to each alternative category.

The alternatives recommended by the CLEAR and TA councils total $9,991,620 with contingencies. This includes Watershed Treatment Alternatives, In-lake Treatment Alternatives and the Information and Education Program (Tables 1, 2, 3). Costs identified for alternatives in the "Other Alternative Considerations" category total $33,027,482 (Table 4).

Table 1. Estimated Watershed Treatment Cost

Activity	Installation/Construction Cost	Maintenance Cost
Bioswales/Bioretention	$1,487,600	Not Estimated
Detention/Alum Injection	$603,000	$20,000/yr(a)
Water Quality Inlets	$45,000	$100/yr/inlet
Septic Tank Inspection	$50,000	Not Applicable
Sub-Total	$2,185,600	
15% Contingency	$327,840	
TOTAL	$2,513,440	

(a) Annual maintenance cost based on injection at two locations.

Table 2. Estimated In-lake Treatment Cost

Activity	Installation/Construction Cost	Maintenance Cost
Targeted Dredging	$1,610,000	Not Estimated
Shoreline Stabilization	$2,483,455	Not Estimated
Forebay Enhancement	$1,008,000	Not Estimated
Wetland Creation	$601,310	Not Applicable
In-lake Alum Treatment	$600,000	Not Estimated (a)
Fish Renovation	$200,000	$308,095 (b)
Watercraft Management	$0(c)	Not Applicable
Sub-Total	$6,502,765	
15% Contingency	$975,415	
TOTAL	$7,478,180	

(a) The longevity of this treatment is unknown. Additional treatment needs will be determined from data collected after the first treatment.
(b) Maintenance cost is a one time cost every ten years (fish removal, restocking, vegetation management).
(c) The only direct cost associated with watercraft management is the cost of marking the designated area(s). Options for marking and associated cost should be evaluated by the project sponsors.

Table 3. Estimated Information/Education Program Cost

Activity	Installation/Construction Cost
General WQ Education	$1,500
Pet Waste & Trash Signage	$1,200
Lake Trash Removal	Volunteer Time
Rain Garden Promotion	$5,000
Phosphorus Free Fert. Promotion	$18,000
Waste Disposal Promotion	$2,000
Watercraft Education	$2,000
TOTAL	$29,700

Table 4. Other Alternatives For Consideration

Activity	Installation/Construction Cost
Supplemental Water Source	$2,000,000
Whole Lake Dredging	$26,700,000
Prefabricated Stormwater Filter	$19,550
Sub-Total	$28,719,550
15% Contingency	$4,307,932
TOTAL	$33,027,482

VII. SCHEDULE

Pre-project planning activities will be finalized upon the completion and sponsor approval of the Water Quality Management Plan. It will take several years to fully implement the final package of recommended in-lake and watershed alternatives. Typical project milestones include securing funding, preparing final designs, selecting contractors and construction. The project sponsors will evaluate timeframes for these milestones.

Activity	Timeframe
Final Public Meeting To Present Alternatives	March 11, 2008
Project Sponsors Alternative Approval	April 1, 2008
Complete Written Draft of The Water Quality Plan	April 15, 2008
Develop Funding Applications	To Be Determined
Secure Funding & Develop Contracts	To Be Determined
Begin Final Design	To Be Determined
Begin Construction	To Be Determined