7.0 WATERSHED MILESTONES

7.1 MEASURABLE MILESTONES

Due to the dynamic nature of watersheds and the countless variables governing landscape processes across scales of time and space, some uncertainty is to be expected when a Watershed Protection Plan is developed and implemented. As the recommended restoration measures of the Lake Granbury Watershed Protection Plan are put into action, it will be necessary to track the water quality response over time and make any needed adjustments to the implementation strategy. As efforts continue, incorporation of new data will improve the understanding of watershed conditions and will drive a more efficient implementation process.

Adaptive management will allow initial results to guide future restoration strategies as stakeholders learn through experience. By tracking water quality trends, stakeholders will be able to evaluate whether plan execution is successful and will determine the need for new action or refocusing of existing programs (Table 34). This adaptive approach relies on constant input of watershed information and the establishment of intermediate and final water quality targets. Stakeholders plan to have bi-annual meetings to discuss implementation progress and strategies. Additionally, stakeholders have requested a full review with the potential to revise and modify the WPP once every five years, in case redirection or alternative management measures need to be included.

Table 34. Adaptive Management Review Schedule

Year	Review Type
2011	Bi-annual Stakeholder Review of Implementation Status
2012	Bi-annual Stakeholder Review of Implementation Status
2013	Bi-annual Stakeholder Review of Implementation Status
2014	Bi-annual Stakeholder Review of Implementation Status
2015	Revise WPP if Stakeholders Determine Necessary
2016	Bi-annual Stakeholder Review of Implementation Status
2017	Bi-annual Stakeholder Review of Implementation Status
2018	Bi-annual Stakeholder Review of Implementation Status
2019	Bi-annual Stakeholder Review of Implementation Status
2020	Revise WPP if Stakeholders Determine Necessary
2021	Bi-annual Stakeholder Review of Implementation Status
2022	Bi-annual Stakeholder Review of Implementation Status
2023	Bi-annual Stakeholder Review of Implementation Status
2024	Bi-annual Stakeholder Review of Implementation Status
2025	Revise WPP if Stakeholders Determine Necessary

Pollutant concentration targets were developed based on complete implementation of the Watershed Protection Plan and assume full accomplishment of pollutant load reductions by the end of the 20-year project period (Tables 35). While some of the less complex management measures recommended here will be relatively simple to implement early in the process, implementation of other measures will require more time, energy, and funding. For this reason, reductions in pollutant loads and associated concentrations initially may be gradual. However, it can be assumed that reductions in the loading of bacteria and nutrients will be tied to the implementation of management measures throughout the watershed. Thus, these projected pollutant targets will serve as benchmarks of progress, indicating the need to maintain or adjust

planned activities. While water quality conditions likely will change and may not precisely follow the projections indicated here, these estimates serve as a tool to facilitate stakeholder evaluation and decision-making based on adaptive management.

Milestones relate to achievement of bacteria goals in priority areas. Milestones consider timing and implementation of management measures in important areas. Short-term and long-term checkpoints in time may be used to indicate progress towards implementation, used to indicate level of effectiveness of implemented management measures, and may relate to implementation of additional measures if needed. It is understood that bacteria reductions are not achievable in all years. Other measures of progress and success in achieving stakeholder goals may include active pursuit of funding for priority management measures and enactment of HOA rules or local ordinances.

Table 35. *E. coli* bacteria targets at selected intervals through implementation.

Year	Oak Trail Shores	Sky Harbor	Port Ridglea East	Indian Harbor	Long Creek	Walnut Creek
2011	70	63	73	71	156	124
2015	65	55	65	60	100	100
2020	60	53	60	55	75	75
2025	53	53	53	53	53	53

7.2 SCHEDULE FOR IMPLEMENTATION

Implementation of management measures will generally commence in order of stakeholder-identified priority for each area; however, implementing many measures depends upon securing appropriate resources which may become available.

Implementation of some of the recommended management measures is already being undertaken by stakeholders. Because of awareness and collaboration among WPP stakeholders, grant assistance has been provided by the Texas Department of Rural Affairs (formerly the Office of Rural and Community Development, ORCA to the Hood County Health Department for replacement of 25 malfunctioning septic systems owned by disadvantaged citizens within the project area.

For each of the last 3 years, AMUD has filed an Intended Use Plan with the TWDB under the CWSRF to provide first time sewer service for residents of Port Ridglea East, Port Ridglea West, Nassau Bay II and Holiday Estates – all within a single project. Unfortunately, AMUD was not successful in receiving funding for the entire project but has secured funding to extend a sewer main into the area. This extension will be the first step in connecting these areas to the AMUD collection and treatment system.

Texas AgriLife Research and Extension continues to put on educational events in Hood County. These trainings have been extremely successful in motivating homeowner's to alter their behavior regarding property management. In late September, after a septic system maintenance training targeted at the communities on the northwest shore of the lake, Oak Trail Shores had a homeowner who lived on the worst canal in the development perform maintenance on their system. Since that time bacteria concentrations in the canal have been dramatically reduced and

AgriLife hopes to use this example to encourage more homeowner's around the lake to perform routine maintenance on their systems.

This schedule is developed considering year 1 begins in late 2011, with the exception of implementation projects already under way, after final approval of this WPP document.

7.2.1 Implementation of education and non-structural management measures

Lake-wide educational measures, commencing within the first year and continuing into the future, will be open to any community member within the area covered by this WPP (Table 36). Where resources are limited, educational and advertising focus will be directed towards priority areas.

Years 1 and 2

- Funding should be pursued for a dedicated Watershed Coordinator to help stakeholders implement strategies and identify funding as well as coordinate and facilitate stakeholder involvement and decision making.
- Funding should be pursued to develop, implement and continue the educational components, including post-education follow-up surveys. Educational programs should begin in year 1, and may include a dedicated Education Coordinator staff member.
- Educational programs are developed for water fowl and wildlife feeding.
- Adopt/update county order to require pump-out records be submitted annually to the Hood County Health District for all holding tanks in the Lake Granbury flood plain.
- Health District can establish and maintain a database of inspections and activities.
- Funding should be pursued to implement structural management measures.

Long-termContinue education efforts and pursuit of funding until goals are achieved.

7.2.2 Implementation of structural management measures

Management measures resulting in structural improvements (e.g, construction projects like installation of sewage collection systems, watershed best management practices, drainage projects, etc.) will be implemented as funding becomes available for each measure. Table 36 presents a schedule for implementation based on permitting and construction timelines regardless of funding needs. This schedule may need to be adjusted based on the status of funding for different projects. Beginning immediately within the first year, funding will be investigated according to stakeholder-identified priority areas and priority management measures. While it is not anticipated that the schedule of implementation of management measures will strictly follow the order of priorities, it is anticipated that the priorities will be used as a guide identifying funding opportunities for measures having the best value in terms of efficiency in achievement of bacteria goals.

Table 36. Implementation Schedule for Educational and Non-Structural Management Measures

Management Measure	Number Events per Year				
	Year				
	1	2	3	4	5+
Stakeholder Meetings	2	2	2		
Executive Committee Meetings	12	12	12		
Update Lake Granbury WPP Web-page	2	2	2		
Bi-monthly Email Newsletter	6	6	6		
Maintain Stakeholder List and General Public Notification List	2	2	2		
Track Implementation of Non-Point Source Management Measures	4	4	4		
Identification of Funding Sources linked to each non-point source management measures	1	1	1		
Assist Stakeholders in Grant Writing and Preparing Funding Requests	2	2	2		
Train Stakeholders to Find and Apply for Funding	4	4	4		
Evaluate Watershed Knowledge and Awareness	1				
County Order Requiring Special Data Submittals to the Hood County Health Department for residents in the 100-yr Floodplain in Rolling Hills Shores	1				
County Order Prohibiting Feeding of Wildlife within 1 mile of Lake Granbury	1				
Outreach to Local Governments	4				
Outreach to Homeowners Associations	5	5			
Develop Educational Program and Materials for Home Inspectors	1				
Develop Educational Program and Materials for Wildlife/Waterfowl	1				
Deliver Educational Programs	24	24	24		
Track Implementation of Education and Outreach Management Measures	4	4	4		
Evaluate Targeted Outreach Effectiveness	4	4	4		
Press Releases	4	4	4		
Public Service Announcements	4	4	4		
Maintenance of Hood County Health Department OSSF Database	4	4	4		
Area Conservation Plans for Long Creek Microwatershed		1	1	1	1
Area Conservation Plans for WalnutCreek Microwatershed	1	1	1	1	1

7.2.3 Implementation of structural management measures

Management measures resulting in structural improvements (e.g, construction projects like installation of sewage collection systems, watershed best management practices, drainage projects, etc.) will be implemented as funding becomes available for each measure. Table 37 presents a schedule for implementation based on permitting and construction timelines regardless of funding needs. This schedule may need to be adjusted based on the status of funding for different projects. Beginning immediately within the first year, funding will be investigated according to stakeholder-identified priority areas and priority management measures. While it is not anticipated that the schedule of implementation of management measures will strictly follow

the order of priorities, it is anticipated that the priorities will be used as a guide identifying funding opportunities for measures having the best value in terms of efficiency in achievement of bacteria goals.

Years 1 and 2

- Funding opportunities should be pursued for structural implementation measures, with concentration given to priority areas.
- Funding opportunities should be pursued specifically for priority areas, to allow for mid-term implementation.
    - Port Ridglea East
    - Oak Trail Shores
    - Sky Harbor
- Conduct field evaluation to identify or rule out sources of bacteria near Blue Water Shores.

Years 3 through 5

- Implementation of structural measures in priority area Port Ridglea East to compliment existing funded measures.
- Outline a plan for implementation of structural measures in priority areas surrounding Oak Trail Shores and priority areas surrounding Indian Harbor. The plan should identify responsible or sponsoring entities (e.g., utility district, non-profit corporation or private corporation) and should include preliminary drawings, specifications and cost estimates as appropriate. Pursue funding for these plans.
- Implementation of range and acreage landowner management initiatives, particularly in Sky Harbor, Long Creek and Walnut Creek watersheds.

Long-term

- Continue pursuit of funding for any un-implemented measures.
- Implementation of structural measures in areas surrounding Port Ridglea East.
- Implement sewage collection and treatment in all priority areas.

Hypothetical load reductions and concentration reductions of *E. coli* in coves of Lake Granbury that can be expected as a result of full implementation of the Lake Granbury Watershed Protection Plan are presented in Figures 48 and 49. Precise estimates of attainable load reductions are difficult to determine and may change over time due to significant changes in land use and pollutant sources. Additionally, estimates of implementation costs for the recommended management measures have been calculated and a tentative schedule has been developed, assuming funding will be available at each critical step of the implementation process. These estimates can be used to demonstrate expected improvement toward target water quality goals for the watershed and what reductions can be anticipated with each expenditure and type of management measure implemented (Figure 50). With active stakeholder engagement and participation in plan implementation and continued support from cooperating groups and agencies, the activities outlined here will make significant progress toward improving and protecting water quality in Lake Granbury and its coves.

Table 37. Implementation Schedule for Structural Management Measures

Management Measure	Number Implemented Year			Equivalent Annual Cost Index	Cost/Reduction Benefit Ratio
	1-5	5-10	10+		
Regional Wastewater Treatment and Collection – Port Ridglea East	1	3		0.65	0.66
Regional Wastewater Treatment and Collection – Port Ridglea West, Nassau Bay II, Sandy Beach, and Holiday Estates		1	3	0.65	0.66
Cove Circulation for Sky Harbor	5			0.25	0.64
Cove Circulation for Indian Harbor		5		0.21	0.65
Cove Circulation for Blue Water Shores		5		0.20	0.54
Regional Wastewater Treatment and Collection – Sky Harbor		1		0.30	2.37
Catchment Basins for Sky Harbor/Bee Creek Watershed	1			0.82	1.25
Catchment Basins Walnut Creek Watershed		1		0.16	7.88
Catchment Basins Rolling Hills Shores			1		
Drainage Re-Routing Oak Trail Shores	1	1	1	0.07	0.14
Dredge Coves in Oak Trail Shores		1		0.84	1.29
Dredge Coves in Rolling Hills Shores			1	0.91	1.06
Dredge Coves in Blue Water Shores		1		0.96	2.13
Vegetative Filter Strips for Rolling Hills Shores	1	1	1	0.05	0.90
Regional Wastewater Treatment and Collection – Long Creek		1	1	0.59	0.59
Regional Wastewater Treatment and Collection – Arrowhead Shores			1	0.26	0.42
Regional Wastewater Treatment and Collection – Oak Trail Shores			1	0.26	0.48
Regional Wastewater Treatment and Collection – Rolling Hills Shores			1	0.26	0.42
Regional Wastewater Treatment and Collection - Indian Harbor			1	0.60	0.61

7.3 IMPLEMENTATION MONITORING PLAN AND ADAPTIVE MANAGEMENT

Twice every year, stakeholders will have the opportunity to provide input on the achievement of milestones. At each input opportunity, the stakeholders will evaluate achievement and adapt the plan. Stakeholders could choose to re-evaluate the list of priority areas, re-evaluate priority management measures (including consideration of additional measures) and/or re-evaluate the bacteria goal.

Throughout the year, it is anticipated that the Watershed Coordinator will provide updates to the stakeholders on relevant stakeholder activities, provide quarterly updates and maintain a website. The Watershed Coordinator will work with the Executive Committee on a more frequent basis to assist with the implementation of recommended management measures.

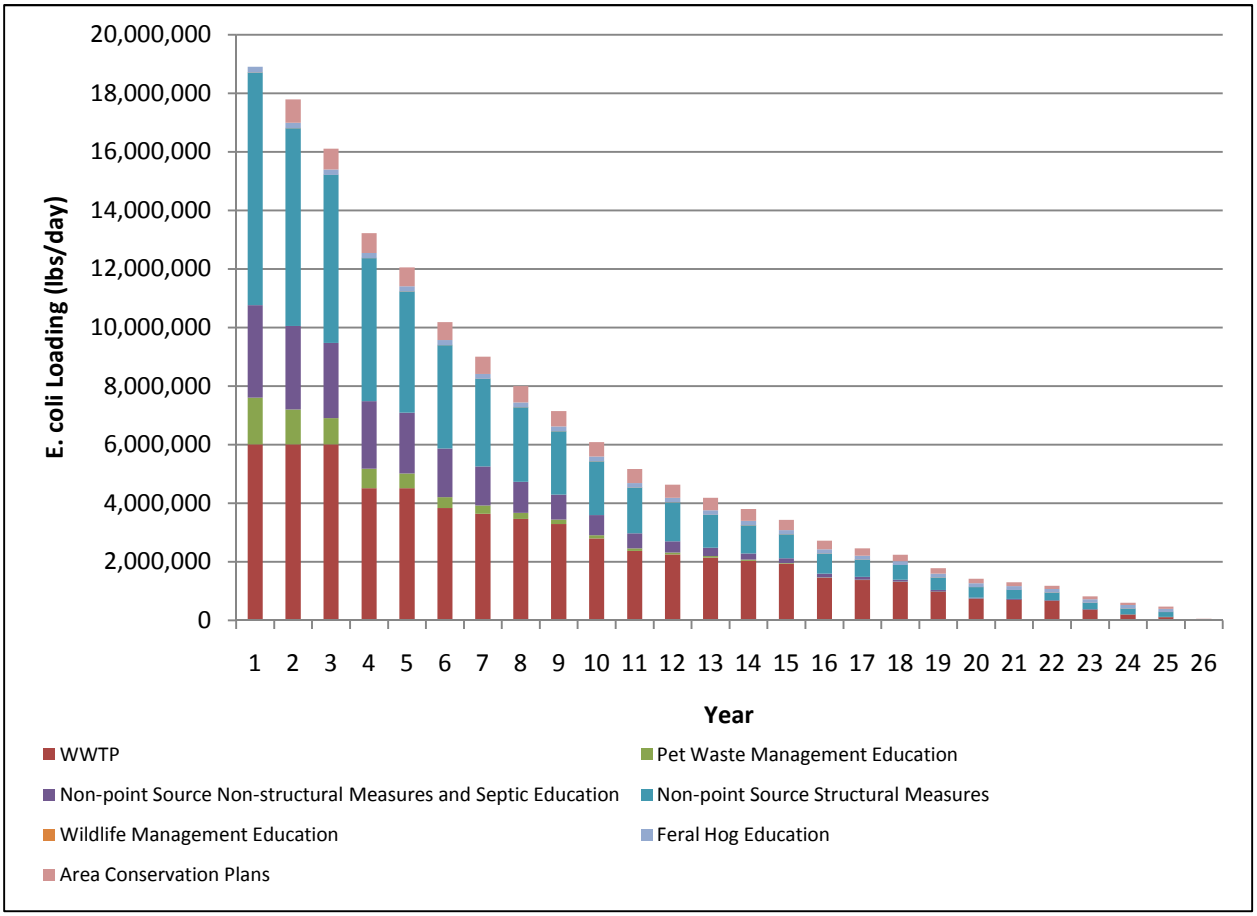

Figure 48. Hypothetical *E. coli* Loading and Reductions Due to Management Measure Implementation

7.3.1 Implementation Monitoring Plan

Watershed and landscape processes are dynamic and variable across scales of time and space, so some uncertainty is to be expected when a Watershed Protection Plan is developed and implemented. As the management measures recommended in the Lake Granbury Watershed Protection Plan become implemented and water quality response is tracked, strategies may need to be adapted to help achieve goals. Adaptive management will allow initial results to guide stakeholders in making informed decisions on future restoration strategies; those adaptions may include new action or refocusing of existing programs.

The purpose of this water quality monitoring plan is to outline the monitoring strategy that will be used to track water quality conditions through the implementation of the Lake Granbury WPP. The goal of this monitoring plan is to provide a means to document water quality improvements in Lake Granbury and its adjacent canals as a result of implementation of recommended management measures.

While some of the less complex management measures recommended here will be relatively simple to implement early in the process, full implementation of the management measures will require more time, energy and funding. For this reason, reductions in pollutant loads and

concentrations initially may be gradual since reductions are assumed to be tied to the implementation of management measures throughout the watershed.

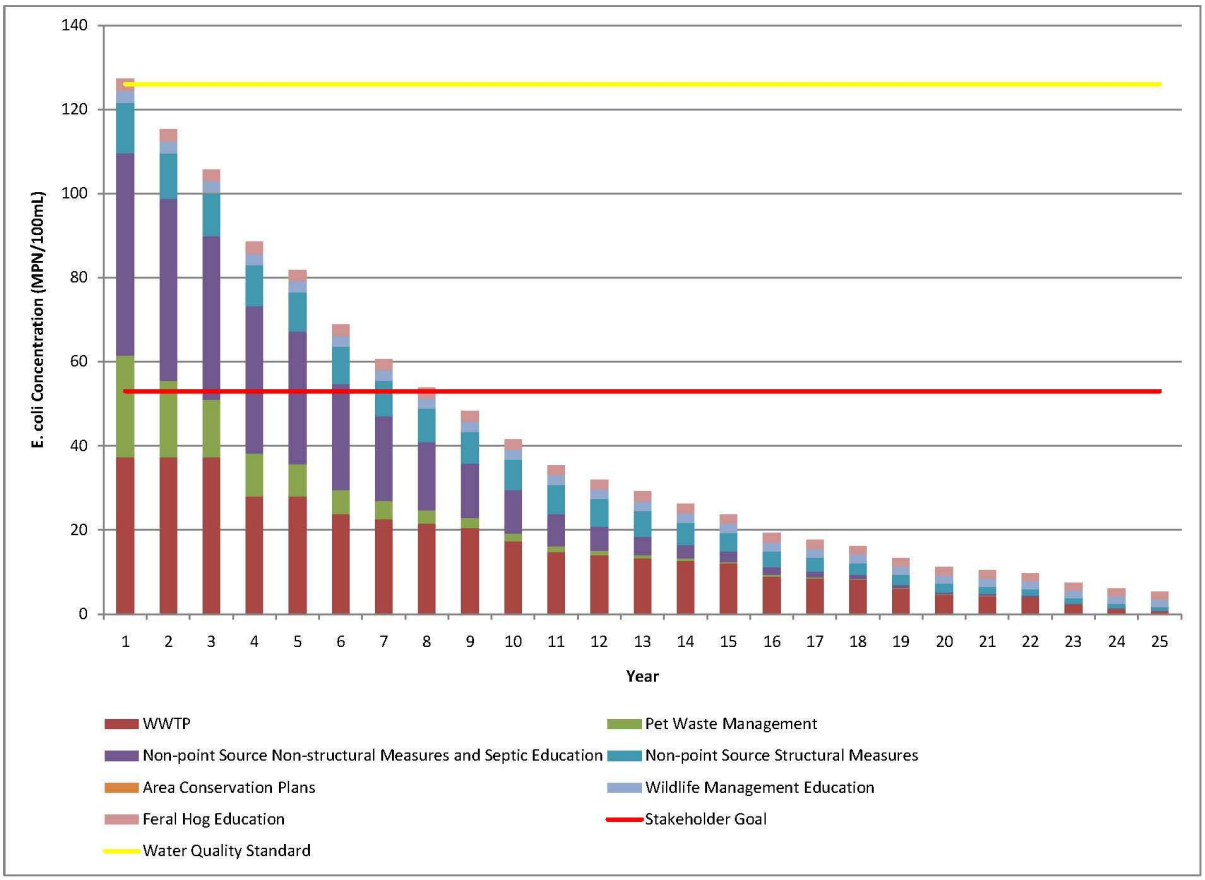

Figure 49. Hypothetical *E. coli* Concentration Reductions Due to Management Measure Implementation

Because most of the construction-based management measures require design, engineering and then construction, these will be long-term multiyear implementation projects. Some of the construction-based management measures, such as the Port Ridglea East sewer expansion, are only waiting funding to implement; therefore, success could be observed here rather quickly if funding is attained. The construction-based management measures related to eliminating the aging OSSFs/OWTFs and replacing them with regionalized wastewater treatment are estimated to reduce bacteria loading into the canals of Lake Granbury from 62 to 99%. The construction-based management measures related to altering drainage patterns and cove dynamics are estimated to reduce bacteria loading or concentrations into the canals by 30 to 60%.

To assess bacteria trends, water quality data will be compiled and a 7-year geometric mean for *E. coli* bacteria will be computed every six months to examine trends in the main body and the coves. Additionally, parameters including, but not limited to, dissolved oxygen, water temperature and nutrients will also be evaluated by the stakeholder committee every six months. These values will be compared to historical data to (1) determine the effectiveness of monitoring measures in reducing bacteria concentrations, (2) determine achievement of stakeholder goals and (3) determine the need to adjust implementation.

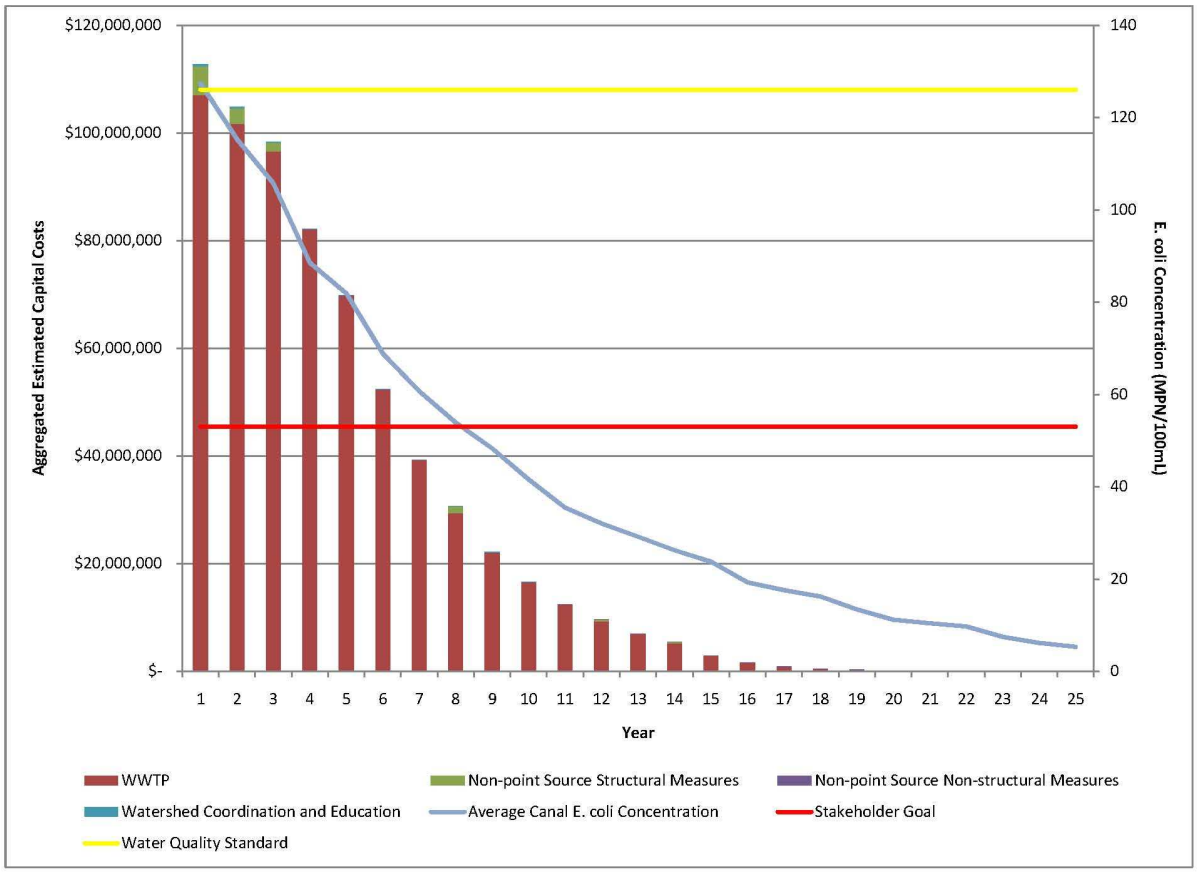

Figure 50. Hypothetical Funding Needs for Implementation of Management Measure and Hypothetical *E. coli* Concentration Reductions in the Canals of Lake Granbury as Management Measures are Implemented

Current water quality monitoring efforts in the watershed consists of existing long-term monitoring sites on the main body of the reservoir, plus monitoring of 38 canals and 6 tributary streams. As funding is being sought and design, engineering and construction plans are being developed for implementation measures, interim-baseline monitoring will consist of monthly monitoring of three sites on the main body of the lake, eight cove sites in the most problematic areas and five tributary streams (Table 38 and Figure 51).

Though not all of these measures coincide with current impairments or concerns, continued monitoring for a wide array of parameters will detect the development of additional water quality problems, in addition to measuring progress towards the WPP water quality goal.

As construction-based management measures are implemented, the number of monitoring sites in the affected area will be increased to include all impacted coves in the area for a two-year period to assess the effectiveness of the management measure in reducing bacteria concentrations.

An example of increased monitoring efforts is the Port Ridglea East area. Currently, Acton Municipal Utility District (AMUD) is working on a five-phase project to connect the area to its

wastewater collection and treatment system. Phase 1 is currently funded and being constructed and will extend a necessary sewer main to the area. Once complete a limited number of households will be connected to the new sewer main. When this phase of the project is complete the BRA will increase its monitoring in the area of Port Ridglea East affected by this upgrade to document if the implementation and removal of OSSFs improved water quality. BRA will add an additional monitoring site on the canal that will be affected and will collect monthly data at this site for a two-year period (Figure 52). As the project moves through all five phases the BRA will continue to adjust and increase monitoring in the affected areas of Port Ridglea East.

However, AMUD is pursuing funding for phases 2-5 in one large block. If successful in obtaining funding for the remaining phases at one time, AMUD will disregard the phased approach and construct and implement the project in its entirety. If this occurs, Figure 53, reveals how the BRA would adjust its Interim Monitoring Plan for Port Ridglea East once construction is completed for two years to document success.

Assessment of interim and implementation monitoring data will occur on three levels. In the first level of assessment each individual canal will be assessed to show improvement, this will be particularly valuable to show improvements in areas where regional wastewater treatment expansions projects will be phased over a long period of time. The individual canals in the immediate vicinity of the improvement will most likely show water quality improvement before the entire community or larger area of the lake.

The next assessment level will be by community or tributary; here the data from all of the canals in a community will be composited into one data set to assess the overall water quality for the canals in the community. This will hopefully assess both the effectiveness of education programs in altering land management practices by lakeside residents and the long-term, community-wide impact of the implementation of larger management measures. For the tributaries, this level of assessment will allow us to determine the effectiveness of agricultural management measures such as the development and implementation of area conservation plans and individual property water quality management plans.

The final assessment level will be the mainbody of the lake. However, this level of assessment may be of little value in determining the effectiveness of management measure implementation aimed at rectifying water quality concerns in the canals and tributaries. Historically, while the canals and tributaries have shown varying levels of water quality impairment, the mainbody of lake has never indicated a concern for elevated bacteria concentrations.

Table 38. Monitoring Sites, Parameters and Annual Monitoring Frequency for Interim-Baseline Monitoring

Site Description	Station ID	E. coli	$N)_3$	PO_4	Cl^-	SO_4	Temperature	Conductivity	Dissolved Oxygen	pH	Salinity
Lake Granbury Near Dam	11860	12	12	12	12	12	12	12	12	12	12
Lake Granbury Upstream of Business US 377	20307	12	12	12	12	12	12	12	12	12	12
Lake Granbury at FM 51	11862	12	12	12	12	12	12	12	12	12	12
Unnamed canal at the low-water crossing on Bedford Drive	18004	12	12	12	12	12	12	12	12	12	12
Unnamed canal at 3709 Greenbrook Drive	18010	12	12	12	12	12	12	12	12	12	12
Unnamed canal east of the intersection of Apollo Court and Sky Harbour Drive	18015	12	12	12	12	12	12	12	12	12	12
Unnamed canal east-southeast of intersection of Hartwood Drive and East Fernwood Court	18038	12	12	12	12	12	12	12	12	12	12
Unnamed canal west of the intersection of Kruse Court at Blue Water Circle	18741	12	12	12	12	12	12	12	12	12	12
Unnamed canal northwest of the intersection of Mallard Way and Mallard Court	18018	12	12	12	12	12	12	12	12	12	12
Unnamed canal north east of the intersection of Dakota Trail and Conejos Court	20216	12	12	12	12	12	12	12	12	12	12
Contrary Creek	20218	12	12	12	12	12	12	12	12	12	12
Long Creek	20220	12	12	12	12	12	12	12	12	12	12
Robinson Creek	20227	12	12	12	12	12	12	12	12	12	12
Strouds Creek	20228	12	12	12	12	12	12	12	12	12	12
Walnut Creek	20229	12	12	12	12	12	12	12	12	12	12
Brazos River at Turkey Creek Confluence	20230	12	12	12	12	12	12	12	12	12	12

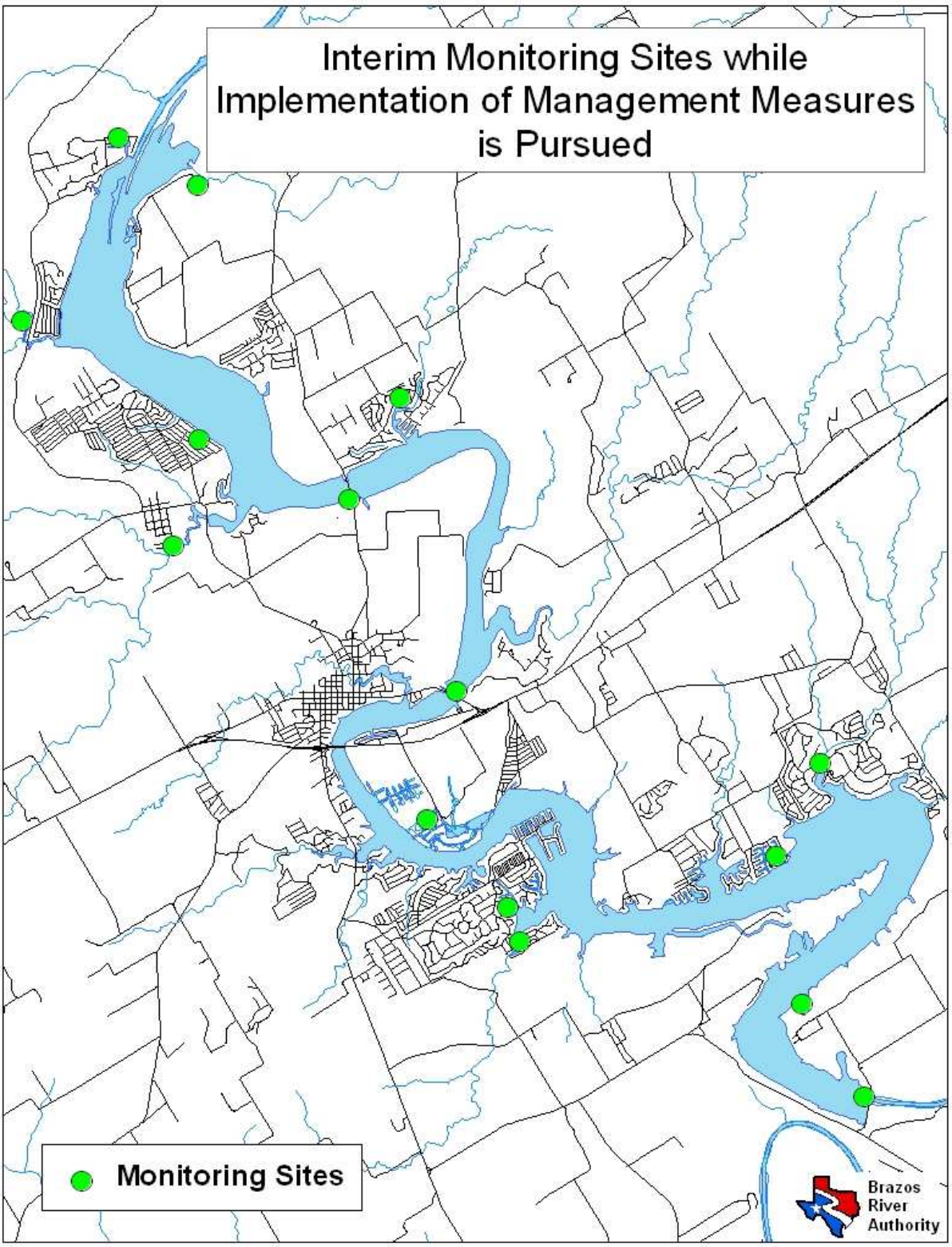

Figure 51. Interim monitoring sites

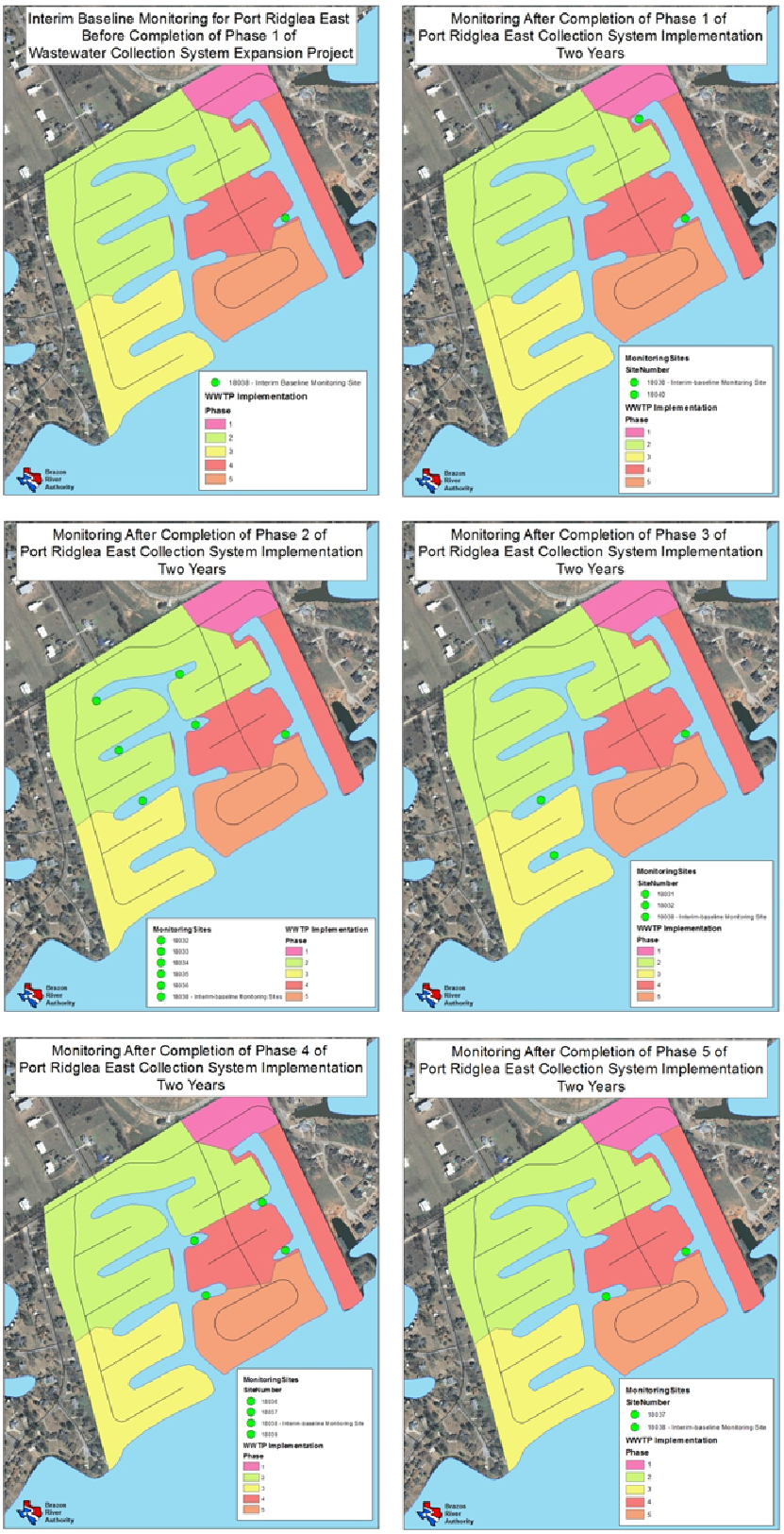

Figure 52. Hypothetical adjustments to Interim Monitoring Plan as wastewater collection management measure is implemented in Port Ridglea East.

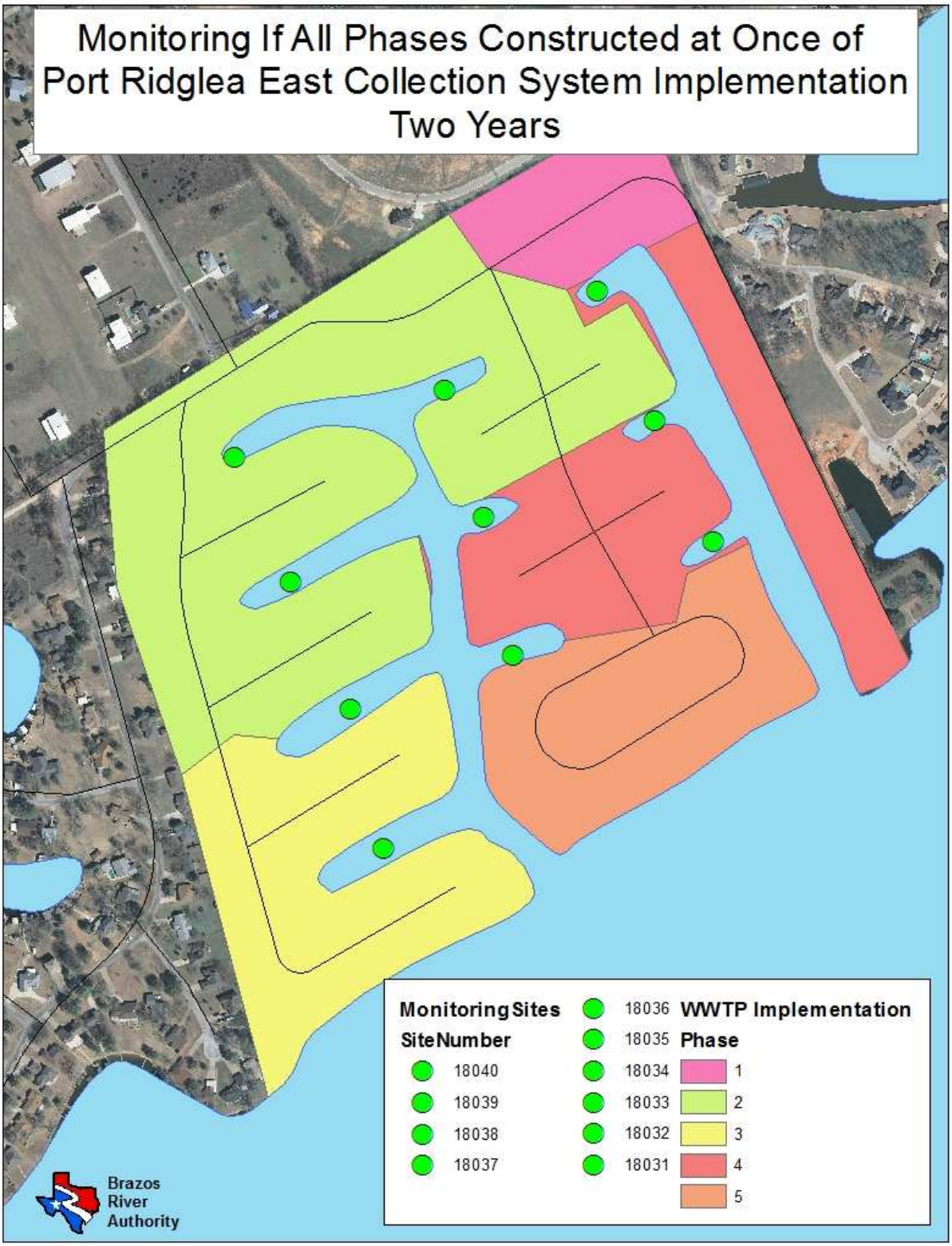

Figure 53. Implementation monitoring if all phases of WWTP expansion implemented at once.