## Appendix A: GIS Analysis and Potential Load Calculations

A GIS analysis was used to estimate potential bacteria loads in the watershed and subwatersheds. This approach estimates potential loads by subwatershed and allows stakeholders to consider results for prioritizing management implementation. This geospatial approach provides an easy method to understand relative contributions and spatial distribution across the watershed without relying on data intense (and expensive) modelling approaches. The GIS analysis distributes inputs across the watershed based on land use and land cover attributes using Geographic Information Systems. The bacteria loadings are calculated from published bacteria production data. The loadings are then spatially distributed across the watershed based on appropriate land cover.

### Agriculture Bacteria Loading Estimates

The first step to calculate potential bacteria loads from cattle is to develop cattle population estimates. Stakeholder input was critical to develop livestock population estimates across the watershed. Because watershed-level livestock numbers are not available, livestock populations were estimated using the USDA NASS (2017) census counts and the ratio of nonurban county land in the watershed to the ratio of nonurban land in the county. The assumptions used in this method are documented in Wagner and Moench (2009) and Borel et al. (2015) (Table 1)

*Table 1 Bacteria loading assumptions for livestock*

| **Assumptions** | | | |
|---|---|---|---|
| | **Total in watershed** | **Animal Unit Conversion** | **Fecal coliform production rate** |
| **Cattle** | 2,899 | 1 | $8.55 \times 10^{9}$ cfu/animal-day† |
| **Goats** | 40 | 0.17 | $2.54 \times 10^{10}$ cfu/animal-day† |
| **Sheep** | 17 | 0.2 | $2.90 \times 10^{11}$ cfu/animal-day† |
| **Horses** | 98 | 1.25 | $2.91 \times 10^{8}$ cfu/animal-day† |
| **Fecal coliform to E. coli conversion rate** | | 0.63 E. coli per cfu fecal coliform† | |

† Wagner and Moench 2009

Using cattle population estimates, we estimate potential loading across the watershed and for individual subwatersheds. The annual load from cattle was calculated as:

$$PAL_{cattle} = AnU \times FC_{cattle} \times \ Conversion \times 365 \frac{days}{year}$$

Where:

$PAL_{cattle}$ = Potential annual *E. coli* loading attributed to cattle

$AnU$ = Animal Units of cattle (~1,000 lbs of cattle)

$FC_{cattle}$ = Fecal coliform rate of cattle

$Conversion$ = Estimated fecal coliform to *E. coli* conversion rate

The estimated potential annual loading across all subwatersheds due to cattle is: $5.7 \times 10^{15}$ cfu *E. coli*/year.

Using population estimates of other livestock in the watershed, the annual load from goats, sheep, and horses were individually calculated as:

$$PAL_{livestock} = AnU \times FC_{livestock} \times\ Conversion \times 365\,\frac{days}{year}$$

Where:

$PAL_{livestock}$ = Potential annual *E. coli* loading
$AnU$ = Animal Units conversion (~1,000 lbs of cattle)
$FC_{livestock}$ = Fecal coliform rate
$Conversion$ = Estimated fecal coliform to *E. coli* conversion rate

The estimated potential annual loading across all subwatersheds due to all other livestock is: $2.75 \times 10^{14}$ cfu *E. coli*/year. Collectively, we estimated the potential loading across the watershed from livestock as $5.97 \times 10^{15}$ cfu *E. coli*/year.

## Dog Bacteria Loading Estimates

The dog population in the watershed was estimated using American Veterinary Medical Association (AVMA, 2018) statistics for average number of dogs per household and an estimate of number of households derived from Census block data.

*Table 2 Bacteria loading assumptions for dogs*

| **Assumptions** | |
|---|---|
| Average dogs per home | 0.614 (AVMA 2018) |
| Number of homes | 18,045 |
| Estimated number of dogs | 11,080 |
| Fecal coliform production rate for dogs | $5.0 \times 10^9$ cfu/animal-day (EPA 2001) |
| Fecal coliform to *E. coli* conversion rate | 0.63 *E. coli* per cfu fecal coliform† |

† Wagner and Moench 2009

Using the assumptions listed in Table 2, the annual potential bacteria load from dogs is estimated as:

$$PAL_d = N_d \times FC_d \times\ Conversion \times 365\,\frac{days}{year}$$

Where:

$PAL_d$ = Potential annual *E. coli* loading attributed to dogs
$N_d$ = Number of dogs
$FC_d$ = Fecal coliform loading rate of dogs
$Conversion$ = Estimated fecal coliform to *E. coli* conversion rate

Therefore, the estimated potential annual loading attributed to dogs is: $1.27 \times 10^{16}$ cfu *E. coli*/year. A 12% annual load reduction would remove $1.53 \times 10^{15}$ cfu *E. coli*/yr from the waterbody.

## OSSF Bacteria Loading Estimates

Using the OSSF estimates, potential E. coli loading across the watershed and for individual subwatersheds was estimated. Methods to estimate OSSF locations and numbers are described in Chapter 4 of this WPP.

*Table 3 Bacteria loading assumptions for OSSFs*

| **Assumptions** | |
|---|---|
| Estimated Number of OSSFs in watershed | 2,835 |
| Failure rate | 30% (per Nacogdoches County DR) |
| Average number of people per household | 2.49 (USCB 2010) |
| Assumed sewage production rate | 70 gallons per person per day (Borel et al. 2015) |
| Fecal coliform concentration in sewage | $1.0 \times 10^6$ cfu/100mL (EPA 2001) |
| Fecal coliform to *E. coli* conversion rate | 0.63 *E. coli* per cfu fecal coliform† |

† Wagner and Moench 2009

Using the assumptions listed in Table 3, the annual potential bacteria load from OSSFs is estimated as:

$$PAL_{ossf} = N_{ossf} \times N_{hh} \times \ Production \ \times Failure\ Rate \ \times FC_s \times Conversion \times 3{,}578.2 \ \frac{mL}{gallon} \times 365 \frac{days}{year}$$

Where:

$PAL_{ossf}$ = Potential annual *E. coli* loading attributed to OSSFs
$N_{ossfs}$ = Number of OSSFs
$N_{hh}$ = Average number of people per household
$Production$ = Assumed sewage discharge rate
$Fail\ Rate$ = Assumed failure rate
$FC_s$ = Fecal coliform concentration in sewage
$Conversion$ = Estimated fecal coliform to *E. coli* conversion rate

Therefore, the potential annual loading attributed to OSSFs from the estimated 30% failure rate is $1.02 \times 10^{13}$ cfu *E. coli*/year.

## Feral Hog and Wildlife Bacteria Loading Estimates

Feral hog populations were estimated based on an assumed population density of 33.3 ac/hog, this number was chosen based on stakeholder input, and 39,574 ac of available habitat identified in the NLCD. Potential bacteria loadings from feral hogs were estimated using GIS analysis and the assumptions in Table 4.

*Table 4 Bacteria loading assumptions for feral hogs*

| **Assumptions** | |
|---|---|
| Number of feral hogs in the watershed | 1,188 |
| Animal Unit conversion factor for feral hogs | 0.125† |
| Fecal coliform production rate for feral hogs | $1.21 \times 10^{9}$ cfu fecal coliform per animal† |
| Fecal coliform to *E. coli* conversion rate | 0.63 *E. coli* per cfu fecal coliform† |

† Wagner and Moench 2009

Using the assumptions listed in Table 4, the annual potential bacteria load from feral hogs is estimated as:

$$PAL_{fh} = N_{fh} \times AnUC \times FC_{fh} \times Conversion \times 365 \frac{days}{year}$$

Where:

$PAL_{fh}$ = Potential annual *E. coli* loading attributed to feral hogs
$N_{fh}$ = Number of feral hogs
$AnUC$ = Animal Unit Conversion
$FC_{fh}$ = Fecal coliform loading rate of feral hogs
$Conversion$ = Estimated fecal coliform to *E. coli* conversion rate

Therefore, the estimated potential annual loading attributed to feral hogs is: $4.13 \times 10^{13}$ cfu *E. coli*/year.

White-tailed deer estimates for the watershed are not available, therefore estimates from the TPWD RMU 21 were used. The estimated deer density for RMU 14 and 15 is 56.49 acres per deer. Applying this density to pasture, cultivated crops, rangeland, and forest resulted in an estimated 701 deer in the watershed. Potential bacterial loadings were estimated using a GIS analysis and the assumptions in Table 5.

*Table 5 Bacterial loading assumptions for white-tailed deer.*

| **Assumptions** | |
|---|---|
| Number of white-tailed deer in the watershed | 701 |
| Animal Unit conversion factor for white-tailed deer | 0.112 † |
| Fecal coliform production rate for white-tailed deer | $1.5 \times 10^{10}$ cfu fecal coliform per animal † |
| Fecal coliform to *E. coli* conversion rate | 0.63 *E. coli* per cfu fecal coliform † |
| † Wagner and Moench 2009 | |

Using the assumptions listed in Table 5, the annual potential bacterial load from white-tailed deer is estimated as:

$$PAL_{wtd} = N_{wtd} \times AnUC \times FC_{wtd} \times Conversion \times 365 \frac{days}{year}$$

Where:

$PAL_{wtd}$ = Potential annual *E. coli* loading attributed to white-tailed deer
$N_{wtd}$ = Number of white-tailed deer
$AnUC$ = Animal Unit Conversion
$FC_{wtd}$ = Fecal coliform loading rate of white-tailed deer
$Conversion$ = Estimated fecal coliform to *E. coli* conversion rate

Therefore, the estimated potential annual loading attributed to white-tailed deer is $2.71 \times 10^{14}$ cfu *E. coli*/year.

## WWTP Bacterial loading Estimates

Potential loadings from wastewater treatment plants (WWTP) were calculated as maximum permitted discharges of the City of Nacogdoches' WWTP multiplied by the maximum permitted *E. coli* concentration. The other permitted discharger, Cal-Tex Lumber, is not included because it only discharges cooling, storm, and wash water from their milling facility.

*Table 6 Bacterial loading assumptions for City of Nacogdoches WWTP*

| **Assumptions** | |
|---|---|
| Maximum permitted daily discharge | 12.88 million gallons per day (MGD; EPA 2021) |
| *E. coli* concentration of effluent | 1.26 *E. coli* per cfu fecal coliform (Wagner and Moench 2009) |

Using the assumptions listed in Table 6, the annual potential bacterial load from WWTFs is estimated as:

$$PAL_{wwtf} = Discharge \times Concentration_{max} \times 3{,}785.2\ \frac{mL}{gallon} \times 365\,\frac{days}{year}$$

Where:

$PAL_{wwtf}$ = Potential annual *E. coli* loading attributed to WWTFs
$Discharge$ = Maximum permitted daily discharge from each WWTF
$Concentration_{effluent}$ = *E. coli* concentration of effluent

Therefore, the estimated potential annual loading attributed to WWTFs is $2.24 \times 10^{13}$ cfu *E. coli*/year.

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## Appendix B: Calculations for Potential Bacteria Load Reductions

Estimates for bacteria load reductions in the La Nana Bayou watershed are based on the best available information regarding the effectiveness of management measures agreed upon by local stakeholders. Real world conditions based on where implementation is completed will ultimately determine the actual load reduction achieved and might differ from estimated values. Stakeholders determined the types and numbers of management measures to be implemented over a 10-year period based on perceived local acceptability, effectiveness, and available resources.

### Agricultural Nonpoint Source Load Reductions

The potential load reductions that are achieved through conservation planning will depend on the specific management practices implemented by landowners. The load reduction will vary based on the type of practice, existing land condition, number of cattle in each operation and proximity to water bodies. Substantial research has been conducted on bacteria reduction efficiencies of practices. We reviewed literature to assess the median effectiveness of practices likely to be used in the watershed (Table 7) and used a mean 62.8% load reduction effectiveness rate for conservation planning. Assumptions used in bacteria load reduction calculations are provided in Table 8.

*Table 7 Estimated effectiveness of conservation practices*

| **Effectiveness** | | | |
|---|---|---|---|
| **Conservation Practice** | **Low** | **High** | **Median** |
| Exclusionary Fencing[1] | 30% | 94% | 62% |
| Prescribed Grazing[2] | 42% | 66% | 54% |
| Watering Facility[3] | 51% | 94% | 73% |

[1] Includes the following sources: (Brenner et al. 1996; Cook, 1998; Hagedorn et al. 1999; Line 2002, 2003; Lombardo et al. 2000; Meals 2001; Peterson et al. 2011)

[2] Includes the following sources: (Tate et al. 2004; EPA 2010)

[3] Includes the following sources: (Byers et al. 2005; Hagedorn et al. 1999; Sheffield et al. 1997)

*Table 8 Bacteria load reduction assumptions for livestock*

| **Assumptions** | |
|---|---|
| Number of operations in the watershed | 48.8 estimated |
| Head of cattle per operation | 59.4 estimated |
| Fecal coliform production rate for cattle | 8.55 x $10^9$ cfu per animal unit per day † |
| Fecal coliform to *E. coli* conversion rate | 0.63 *E. coli* per cfu fecal coliform † |
| Conservation practice effectiveness rate | 62.8% |
| Proximity factor | 25% |

† Wagner and Moench 2009

Potential bacteria load reductions for livestock management measures were calculated based on the assumed average number of cattle per operation, average fecal coliform production rates, standard conversions, conservation practice effectiveness and proximity factor of practice to water body. The proximity factor is an estimated impact factor that accounts of an assumed stream impact factor based on the location of a practice to the stream. Practices closer to the stream are assumed to have a higher potential load reduction impact while those further away are assumed to have a lower impact. Since actual practices and locations are unknown and proximity factor of 25% was assumed, similar to proximity factors used in other watershed protection plans.

Using the above assumptions, the potential annual load reduction was estimated by:

$$LR_{cattle} = N_{plans} \times \frac{AnU}{Plan} \times FC_{cattle} \times Conversion \times 365\,\frac{days}{year} \times Efficacy \times Proximaty\ Factor$$

Where:

$LR_{cattle}$ = Potential annual load reduction of *E. coli*
$N_{plans}$ = Number of WQMPs and conservation plans, 25 are proposed in this WPP
$\frac{AnU}{Plan}$ = Animal Units of cattle (~1,000 lbs of cattle) per management plan, 32.65
$FC_{cattle}$ = Fecal coliform loading rate of cattle
$Conversion$ = Estimated fecal coliform to *E. coli* conversion rate
$Efficacy$ = Median BMP efficacy value
$Proximity\ Factor$ = Percentage based factor based on the assumed proximity of the management measure to the water body

The WPP recommends the implementation of 25 WQMPs or conservation plans across the watershed, resulting in a total potential reduction of $3.77 \times 10^{14}$ cfu *E. coli* per year. Additionally, nutrient reductions can be anticipated with each WQMP or conservation plan. The Tres Palacios Watershed Protection Plan and Carancahua Bay Watershed Protection Plan estimated annual load reductions ranging from 733 to 983 pounds of nitrogen and 276 to 511 pounds of phosphorus per WQMP or conservation plan depending on presumed size and type of agricultural operation (Schramm et al. 2017; Schramm et al. 2019).

## Feral Hog Load Reductions

Loading reductions for feral hogs assume that existing feral hog populations can be reduced and maintained by a certain amount on an annual basis. Removal of a feral hog from the watershed is assumed to also completely remove the potential bacteria load generated by that feral hog. Therefore, the total potential load reduction is calculated as the population reduction in feral hogs achieved in the watershed.

Based on GIS analysis, 1,188 feral hogs were estimated to exist across the La Nana Bayou watershed (see Appendix A for details). The established goal is to reduce and maintain the feral hog population 10% below current population estimates, thus resulting in a 10% reduction in potential loading that is attributable to feral hogs. Assumptions used in bacteria load reduction calculations are provided in Table 9.

Table 9 Bacteria load reduction assumptions for feral hogs

| Assumptions | |
|---|---|
| Number of feral hogs removed per year | 118.8 (10% of total estimated population) |
| Animal Unit conversion factor | 0.125 (Wagner and Moench 2009) |
| Fecal coliform production rate for feral hogs | $1.21 \times 10^9$ cfu per animal unit per day (Wagner and Moench 2009) |
| Fecal coliform to *E. coli* conversion rate | 0.63 *E. coli* per cfu fecal coliform (Wagner and Moench 2009) |
| Proximity factor | 25% |

Using the above assumptions, the potential annual load reduction was estimated by:

$$LR_{fh} = N_{fh} \times AnUC \times FC_{fh} \times Conversion \times 365\frac{days}{year} \times Proximaty\ Factor$$

Where:

$LR_{fh}$ = Potential annual load reduction of *E. coli* attributed to feral hog removal
$N_{fh}$ = Number of feral hogs removed
$AnUC$ = Animal Unit conversion factor (~1,000 lbs of cattle)
$FC_{fh}$ = Fecal coliform loading rate of feral hogs
$Conversion$ = Estimated fecal coliform to *E. coli* conversion rate
$Proximity\ Factor$ = Percentage based factor based on the assumed proximity of the management measure to the water body

The estimated potential annual loading across the La Nana Bayou watershed based on reducing and maintaining the population by 10% (118.8 feral hogs) is $1.03 \times 10^{12}$ cfu *E. coli* annually. Additionally, nutrient reductions can be anticipated for each feral hog removed. The Tres Palacios Watershed Protection Plan and Carancahua Bay Watershed Protection Plan estimated annual load reductions 6 pounds of nitrogen and 2 pounds of phosphorus per hog removed (Schramm et al. 2017; Schramm et al. 2019).

## Pet Waste Load Reductions

Potential load reductions for pet waste depend on the number of pets that contribute loading and the amount of pet waste that is picked up and disposed of properly. Assessing the number of dog owners who do not pick up waste or who would change behavior based on education or availability of pet waste stations is inherently difficult. It is estimated that 12% of dogs in the watershed will have their waste picked up and disposed of (Swan, 1999). Assumptions used in bacteria load reduction calculations are provided in Table 10.

*Table 10 Bacteria load reduction assumptions for dogs*

| **Assumptions** | |
|---|---|
| Number of dogs in the watershed | 11,080 |
| Percent of dogs managed | 12% (Swan 1999) |
| Fecal coliform production rate for dogs | $5.0 \times 10^9$ cfu per animal per day (EPA 2001) |
| Fecal coliform to *E. coli* conversion rate | 0.63 *E. coli* per cfu fecal coliform (Wagner and Moench 2009) |
| Practice efficiency | 75% |
| Proximity factor | 5% |

Using the above assumptions, the potential annual load reduction was estimated by:

$$LR_d = N_d \times DM\% \times FC_d \times Conversion \times 365 \frac{days}{year} \times Practice\ efficiency \times Proximity\ Factor$$

Where:

$LR_d$ = Potential annual load reduction of *E. coli* attributed to proper dog waste disposal
$N_d$ = Number of dogs
$DM\%$ = Percent of dogs managed
$FC_d$ = Fecal coliform loading rate of dogs
$Conversion$ = Estimated fecal coliform to *E. coli* conversion rate
$Practice\ Efficiency$ = Assumption of efficiency of proper dog waste disposal
$Proximity\ Factor$ = Percentage based factor based on the assumed proximity to the waterbody that the management measure is being implemented

If we assume that 5% of the removed dog waste would have entered the actual waterbody had it not been removed and that 75% of the waste was disposed of properly, the estimated potential load reduction attributed to this management measure in the watershed is $5.73 \times 10^{13}$ cfu *E. coli* annually. Additionally, nutrient reductions can be anticipated for every additional dog managed. The Tres Palacios Watershed Protection Plan and Carancahua Bay Watershed Protection Plan estimated annual load reductions between 0.8 and 1.0 pounds of nitrogen and 0.2 pounds of phosphorus per additional dog managed (Schramm et al. 2017; Schramm et al. 2019).

## OSSF Load Reductions

OSSF failures are factors of system age, soil suitability, system design and maintenance. The Nacogdoches County Designated Representative (DR) estimated a 30% failure rate in the watershed. Given the difficulty and cost of replacing 15% of the total OSSF systems in the watershed, stakeholders decided to target 30 failing systems for repair or replacement. Load reductions can be calculated as the number of assumed failing OSSFs replaced. Assumptions used in bacteria load reduction calculations are provided in Table 11.

*Table 11 Bacteria load reduction assumptions for OSSFs*

| **Assumptions** | |
|---|---|
| Number of OSSFs repaired/replaced | 30 |
| Average number of people per household | 2.49 (USCB 2010) |
| Assumed sewage production rate | 70 gallons per person per day (Borel et al. 2015) |
| Fecal coliform concentration in sewage | 1.0 x $10^6$ cfu/100mL (EPA 2001) |
| Fecal coliform to *E. coli* conversion rate | 0.63 *E. coli* per cfu fecal coliform (Wagner and Moench 2009) |

Using the above assumptions, the potential annual load reduction was estimated by:

$$LR_{ossf} = N_{ossf} \times N_{hh} \times \ Production \ \times FC_s \ \times Conversion \times 3{,}578.2 \ \frac{mL}{gallon} \times 365 \frac{days}{year}$$

Where:

$LR_{ossf}$ = Potential annual load reduction of *E. coli* attributed to OSSF repair/replacement
$N_{ossf}$ = Number of OSSFs repaired/replaced
$N_{hh}$ = Average number of people per household
$Production$ = Assumed sewage production rate
$FC_s$ = Fecal coliform concentration in sewage
$Conversion$ = Estimated fecal coliform to *E. coli* conversion rate

In the watershed, it is assumed that 85 (~10%) failing OSSFs will be remediated which results in a potential reduction of 1.29 × $10^{15}$ cfu *E. coli* annually. Additionally, nutrient reductions can be anticipated for every OSSF replaced. The Tres Palacios Watershed Protection Plan and Carancahua Bay Watershed Protection Plan estimated annual load reductions between 11.6 and 20.5 pounds of nitrogen and 2.9 and 4.8 pounds of phosphorus per additional OSSF repaired or replaced (Schramm et al. 2017; Schramm et al. 2019).

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## Appendix C: Elements of Successful Watershed Protection Plans

EPA's Handbook for Developing Watershed Plans to Restore and Protect Our Waters (EPA 2008) describes the nine elements critical for achieving improvements in water quality that must by sufficiently included in a WPP for it to be eligible for implementation funding through the Clean Water Act Section 319(h) funds. These elements do not preclude additional information from being included in the WPP. This Appendix briefly describes the nine elements and references the chapters and sections that fulfill each element.

### A: Identification of Causes and Sources of Impairment

An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan). Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed. Information can be based on a watershed inventory, extrapolated from a subwatershed inventory, aerial photos, GIS data or other sources.

### B: Estimated Load Reductions

An estimate of the load reductions expected for the management measures proposed as part of the watershed plan.

### C: Proposed Management Measures

A description of the management measures that will need to be implemented to achieve the estimated load reductions and identification (using a map or description) of the critical areas in which those measures will be needed to implement the plan. Proposed management measures are defined as including BMPs and measures needed to institutionalize changes. A critical area should be determined for each combination of source BMP.

### D: Technical and Financial Assistance Needs

An estimate of the amounts of technical and financial assistance needed, associated costs and/or the sources and authorities that will be relied upon to implement this plan. Authorities include the specific state or local legislation that allows, prohibits, or requires an activity.

### E: Information, Education and Public Participation Component

An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the appropriate nonpoint source pollution management measures.

## F: Implementation Schedule

A schedule for implementing the nonpoint source pollution management measures identified in the plan that is reasonably expeditious.

## G: Milestones

A description of interim, measurable milestones for determining whether nonpoint source pollution management measures or other control actions are being implemented. Milestones should be tied to the progress of the plan to determine if it is moving in the right direction.

## H: Load Reduction Evaluation Criteria

A set of criteria that can be used to determine whether loading reductions are being achieved over time and if substantial progress is being made toward attaining water quality standards. If not, it is also the criteria for determining if the watershed-based plan needs to be revised. The criteria for the plan needing revision should be based on the milestones and water quality changes.

## I: Monitoring Component

A monitoring component to evaluate the effectiveness of the implementation efforts over time that is measured against the evaluation criteria. The monitoring component should include required project-specific needs, the evaluation criteria and local monitoring efforts. It should also be tied to the state water quality monitoring efforts.

*Note: This table will be completed after chapters are finalized.*

| | |
|---|---|
| **Name of Water Body** | La Nana Bayou and Banita Creek (not currently monitored) |
| **Assessment Units** | 0611B_01, 0611B_02, and 0611B_03 |
| **Impairments Addressed** | Bacteria |
| **Concerns Addressed** | Nitrate, total phosphorus |

| **Element** | **Report Section(s) and Page Number(s)** |
|---|---|
| **Element A: Identification of Causes and Sources of Impairment** | |
| 1. Sources identified, described and mapped | |
| 2. Subwatershed sources | |
| 3. Data sources are accurate and verifiable | |
| 4. Data gaps identified | |
| **Element B: Expected Load Reductions** | |
| 1. Load reductions achieve environmental goal | |
| 2. Load reductions linked to sources | |
| 3. Model complexity is appropriate | |
| 4. Basis of effectiveness estimates explained | |
| 5. Methods and data cited and verifiable | |
| **Element C: Proposed Management Measures** | |
| 1. Specific management measures are identified | |
| 2. Priority areas | |
| 3. Measure selection rationale documented | |
| 4. Technically sound | |
| **Element D: Technical and Financial Assistance Needs** | |
| 1. Estimate of technical assistance | |
| 2. Estimate of financial assistance | |
| **Element E: Information, Education, and Public Participation Component** | |
| 1. Public education/information | |
| 2. All relevant stakeholders are identified in outreach process | |
| 3. Stakeholder outreach | |
| 4. Public participation in plan development | |
| 5. Emphasis on achieving water quality standards | |
| 6. Operation and maintenance of BMPs | |
| **Element F: Implementation Schedule** | |
| 1. Includes completion dates | |
| 2. Schedule as appropriate | |
| **Element G: Milestones** | |
| 1. Milestones are measurable and attainable | |
| 2. Milestones include completion dates | |
| 3. Progress evaluation and course correction | |

| | |
|---|---|
| 4. Milestones linked to schedule | |
| **Element H: Load Reduction Evaluation Criteria** | |
| 1. Criteria are measurable and quantifiable | |
| 2. Criteria measure progress toward load reduction goal | |
| 3. Data and models identified | |
| 4. Target achievement dates for reduction | |
| 5. Review of progress towards goals | |
| 6. Criteria for revision | |
| 7. Adaptive management | |
| **Element I: Monitoring Component** | |
| 1. Description of how monitoring is used to evaluate implementation | |
| 2. Monitoring measures evaluation criteria | |
| 3. Routine reporting of progress methods | |
| 4. Parameters are appropriate | |
| 5. Number of sites is adequate | |
| 6. Frequency of sampling is adequate | |
| 7. Monitoring tied to QAPP | |
| 8. Can link implementation to improved water quality | |

## References for Appendix C

EPA. 2008. Handbook for Developing Watershed Plans to Restore and Protect Our Waters. Washington, DC: EPA Office of Water, Nonpoint Source Control Branch. EPA 841-B-08-002. https://www.epa.gov/sites/production/files/2015-09/documents/2008_04_18_nps_watershed_handbook_handbook-2.pdf