Draft Appendix C2 – Habitat Modeling

River Road Aquatic Ecosystem Restoration
Feasibility Study

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1 Introduction

The River Road Aquatic Ecosystem Restoration Feasibility Study or River Road is located in San Antonio, TX (Figure 1). The San Antonio River spans five ecoregions: the Edwards Plateau, Post Oak Savannah, Blackland Prairie, South Texas Plains, and the Gulf Prairies and Marshes. The River Road reach of the San Antonio River lies within the Blackland Prairie and is characterized by deep, black clay soils that historically supported tallgrass prairie plants and animals (San Antonio River Authority [SARA] 2020).

This section of the river has been negatively impacted by urban development and recreational use. Three low water crossings, known as Low Water Crossings (LWCs) 1, 2, and 3, are distributed relatively equally over the 1.5 mile stretch of river within the study area. The low water crossings are impacting natural stream flow and sediment transport processes. Significant pooling caused by LWC 1 at Woodlawn Avenue has resulted in excessive erosion and sedimentation leading to the creation of sand/gravel bars. Erosion along the river has been intensified by recreationalists destroying or removing native vegetation to facilitate pedestrian and vehicular access. These environmental stressors have resulted in a loss of habitat quality due to the loss of the riparian herbaceous vegetation.

Invasive species are a significant contributing factor to the degradation of the study area by inhibiting the growth of native vegetation. The degraded habitat attributed to the modified hydrology and excessive erosion has facilitated the invasion of non-native invasive species further decreasing the habitat quality.

For the purpose of Appendix C2 – Habitat Modeling, alternatives mentioned and described will only include those that were compared during the Cost Effectiveness and Incremental Cost Analysis (CE/ICA). This appendix is limited to the discussion of the modeling and habitat benefits associated with the final array of alternatives. Other measures and alternatives that were considered during early plan formulation will be described in the Integrated Feasibility Report (IFR)/Environmental Assessment (EA). Appendix B – CE/ICA will discuss in detail, the comparison of the plan's benefits and costs and the Tentatively Selected Plan (TSP).

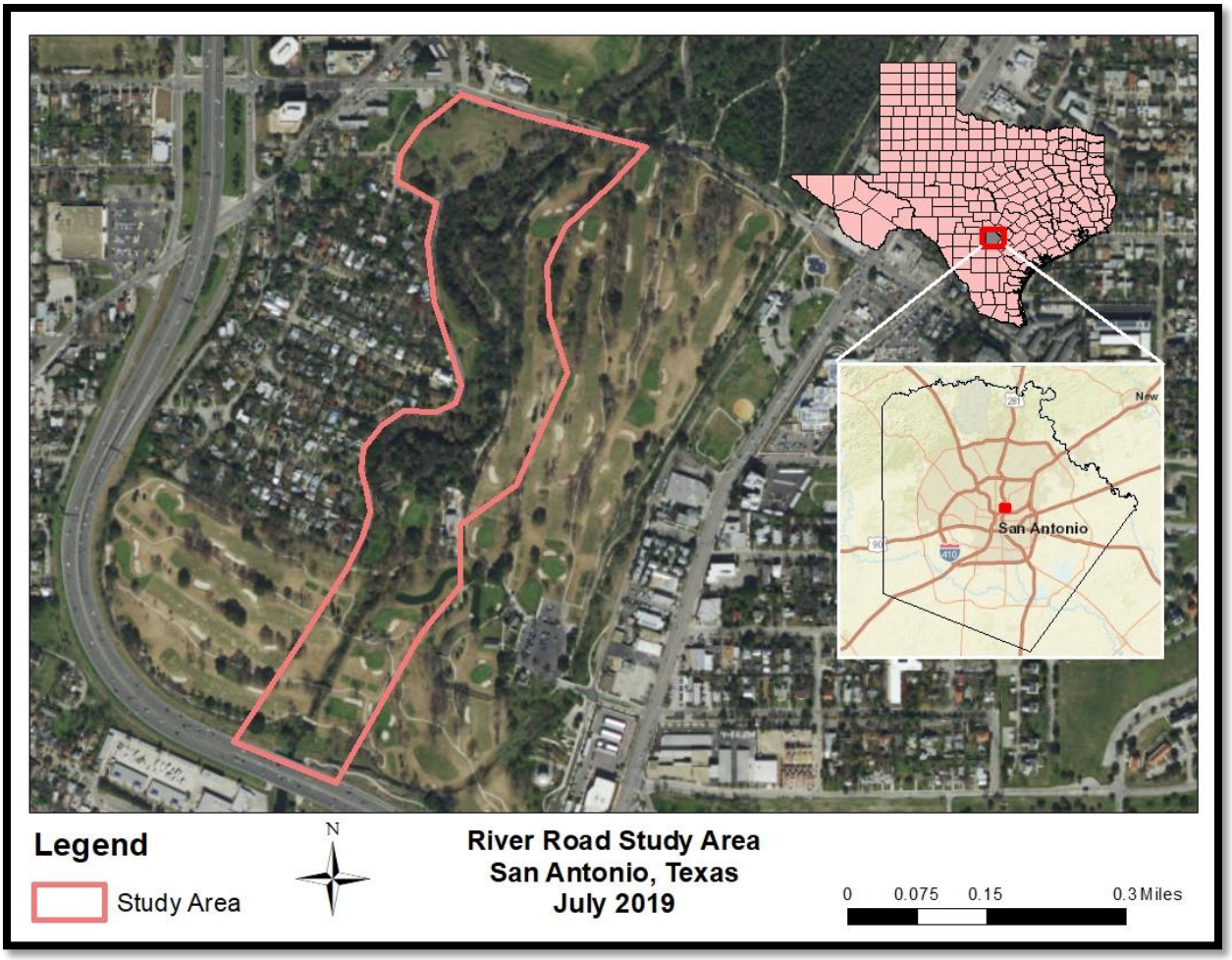

Figure 1. River Road Study Area

1.1 Conceptual Ecological Model (CEM)

A conceptual ecological model (CEM) is a qualitative representation of a system or sub-system that serves as a basis for the organization of processes that can be utilized to understand and communicate the function of that process and the identification of factors impairing the optimal performance of the systems. The models, as applied to ecosystems are simple and qualitative, represented by a diagram which describes general functional relationships among the essential components of an ecosystem.

A resource agency kick-off meeting was held on 11 June 2019 with the U.S. Army Corps of Engineers (USACE), U.S. Fish and Wildlife Service (USFWS), SARA, and the Texas Commission on Environmental Quality (TCEQ) to develop a CEM for the study. The CEM depicts the condition of the existing environment described in Section 4 and identifies factors that have resulted in the degradation of the River Road ecosystem. The resulting CEM is presented in Figures 2, 3, and 4.

The CEM provides a framework enabling the team to characterize the drivers and effects of impediments to ecosystem functions, potential measures to address these impediments, and methodologies to characterize and quantify ecosystem benefits resulting from any restoration actions. The CEM format utilized here follows a top-down hierarchy of information. The River Road CEM does not attempt to explain all possible relationships or include all possible factors

influencing the performance measure targets within natural systems in the study area. Rather, the model attempts to simplify ecosystem function by containing only information deemed most relevant to ecosystem restoration and monitoring goals.

The CEM includes the following components:

- **Drivers:** Includes major external driving forces that have large-scale influences on natural systems. Drivers may be natural (e.g. climate change) or anthropogenic (e.g. hydrologic alteration) in nature. Anthropogenic drivers provide opportunities for finding relevant solutions to problems. Natural drivers, however, cannot be influenced directly by human interference. Some drivers are both anthropogenic and natural in nature. The River Road CEM introduces three drivers: Watershed Modification, Urbanization, and Climate Change.
- **Ecological Stressors:** Includes physical or chemical changes that occur within the natural systems, which are produced or affected by drivers and are directly responsible for significant changes in biological components, patterns, and relationships in natural systems.
- **Ecological Effects:** Includes biological, physical, or chemical responses within the natural system that are produced or affected by stressors. CEMs propose linkages between one or more ecological stressors and ecological effects and attributes to explain changes that have occurred in ecosystems.
- **Attributes:** This component is a prudent subset of all potential elements or components of natural systems representative of overall ecological conditions. Attributes may include populations, species, communities, or chemical processes.
- **Performance Measures**: Includes specific features of each attribute to be monitored to determine the degree to which attribute is responding to projects designed to correct adverse effects of stressors (i.e. to determine success of the project).

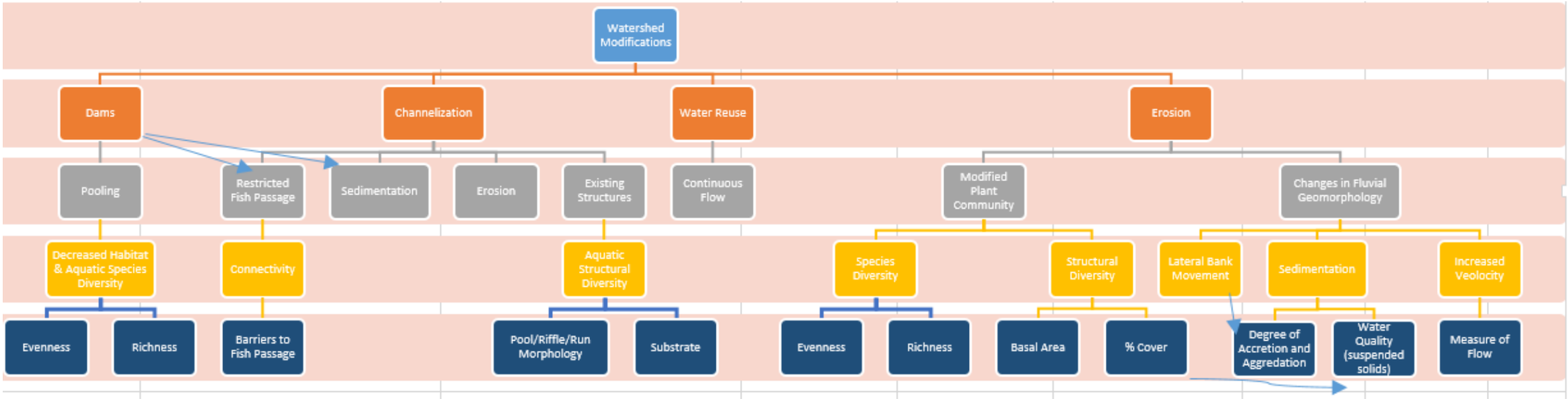

Figure 2. Conceptual Ecological Model - the Watershed Modification Driver (blue) and Its Associated Stressors (Orange), Effect (Gray), Attributes (Yellow), and Performance Measures (Navy)

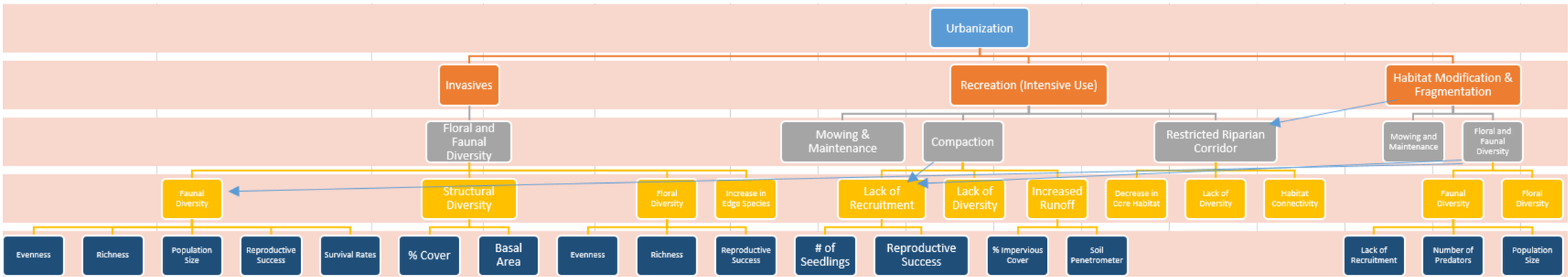

Figure 3. Conceptual Ecological Model - the Urbanization Driver (blue) and Its Associated Stressors (Orange), Effect (Gray), Attributes (Yellow), and Performance Measures (Navy)

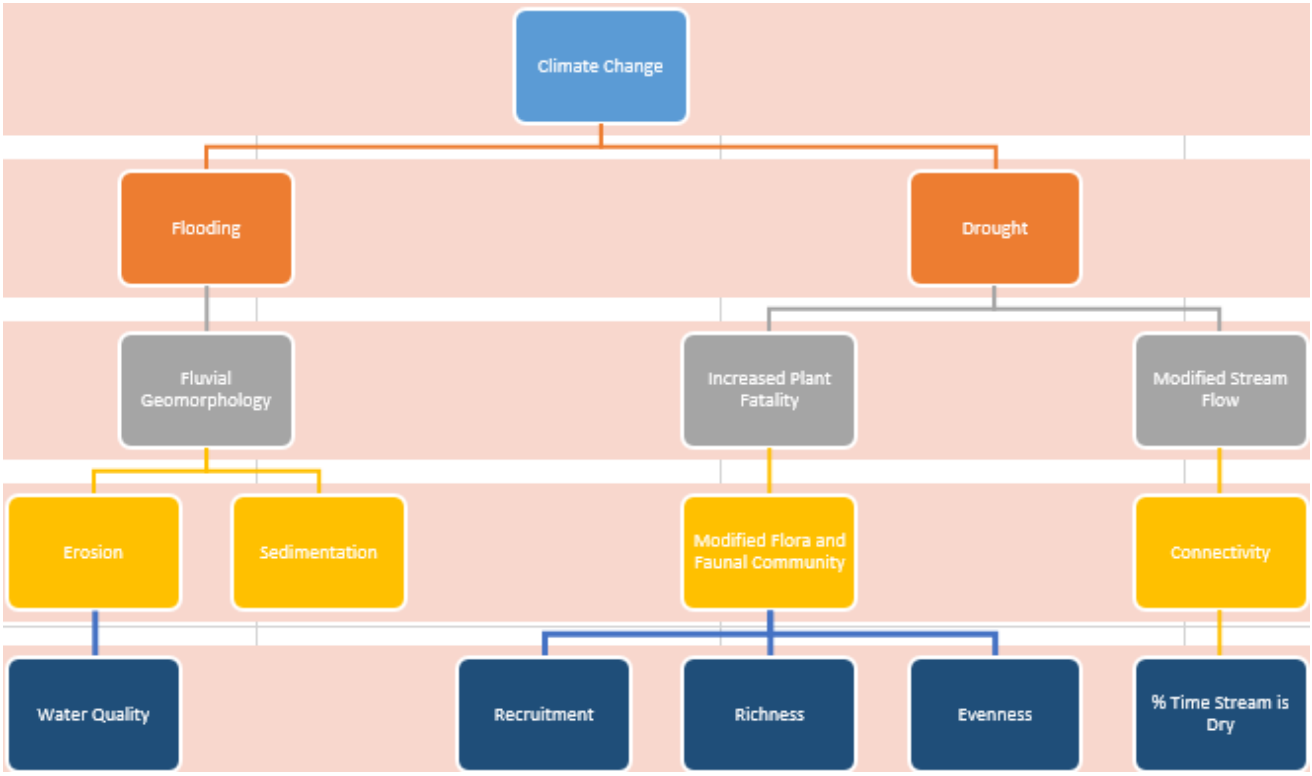

Figure 4. Conceptual Ecological Model - the Climate Change Driver (blue) and Its Associated Stressors (Orange), Effect (Gray), Attributes (Yellow), and Performance Measures (Navy)

2 Habitat Classification

2.1.1 Model Selection and Data Collection

Two habitat types were assessed for the River Road reach of the San Antonio River: Riparian Forest and Riverine. This assessment was based on the historical conditions of the San Antonio River and the ecosystem restoration goals for the feasibility study. The Barred Owl and Gray Squirrel Habitat Suitability Index (HSI) were utilized to assess Riparian Forest habitat (USFWS, 1987a; USFWS 1987b). The Rapid Bioassessment Protocols (RBPs) for Use in Wadeable Streams and Rivers were utilized to assess the ecological integrity and habitat conditions of the river (Barbour et al., 1999). The models were chosen based on applicable studies in the San Antonio, TX area and professional judgment.

The habitat assessments of the San Antonio River within the study area were conducted on June 12, 2019 and August 14, 2019. The data collection points, totaling 19 sites, were selected based on aerial imagery from existing Geographic Information System (GIS) data or were added to further assess site conditions on the day of the survey (Figure 5). See Attachment A for photos of the existing site conditions.

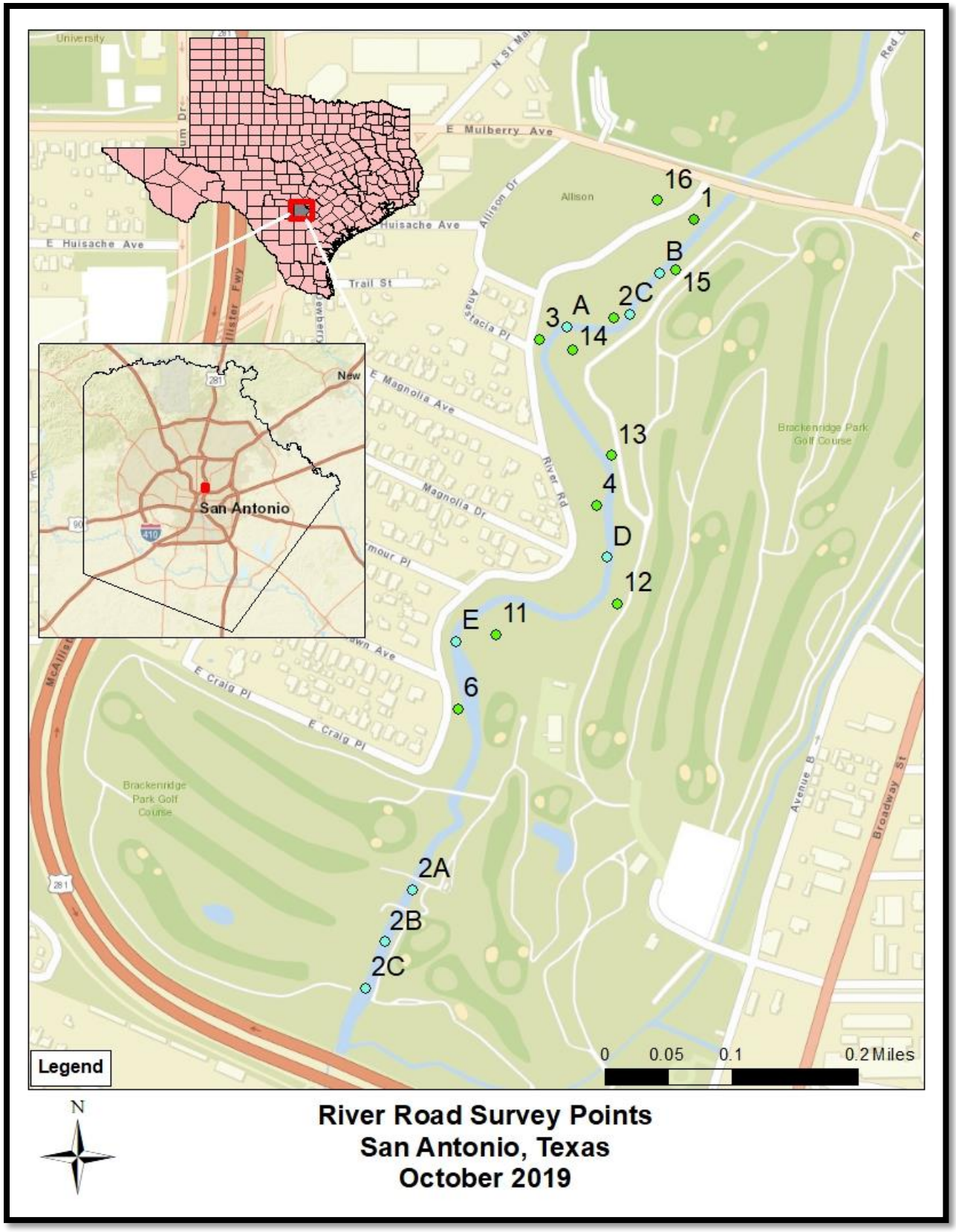

Figure 5. River Road Habitat Assessment Data Collection Sites

2.1.2 Habitat Evaluation Procedure and Habitat Suitability Index

A baseline assessment using the Habitat Evaluation Procedure (HEP) was required before any habitat impacts to the study area could be quantified. See Attachment B for existing conditions as observed through the evaluation. HEP involves defining the study area, delineating habitats (i.e. cover types) within the study area, selecting HSI models and/or evaluation species, and characterizing the study area based on the results of the HEP. HEP was developed by the USFWS in order to quantify the impacts of habitat changes resulting from land or water development projects (USFWS 1980). HEP is based on suitability models that provide a quantitative assessment of the habitat requirements for a species or group of species.

Habitat quality is estimated using the habitat models selected to represent each specific habitat type(s). Each model consists of a list of variables or Suitability Indices (SIs) that are essential to satisfy the life requisites (e.g. reproduction, food, cover, etc.) of a particular species. Each SI can be expressed as a mathematical function with each habitat metric as an independent variable. Each SI ranges from 0.1 to 1.0, with 1.0 representing optimal condition for the variable in question. The SIs for each specific life requisite are then calculated using a mathematical formula to estimate the Life Requisite Suitability Index (LRSI) for each life requisite. The final Habitat Suitability Index (HSI) of the habitat type can then be calculated as a function of the LRSIs.

The HSI methodology and calculations for the barred owl and gray squirrel habitat models are provided in Tables 1 and 2. The barred owl HSI is calculated using the reproduction life requisite (SIR). For the gray squirrel, two LRSIs are calculated (winter food and cover/reproduction; SIWF and SICR, respectively). Because the two gray squirrel life requisites are assumed to be of equal importance, the HSI is equal to the lowest LRSI.

Table 1. Barred Owl Habitat Suitability Index Metrics

Species	**Life Requisite Suitability Indices (LRSI)**	**HSI Formula**
Barred Owl	Reproduction SI (SIR)	$HSI = SIR = \sqrt{SI_1 \times SI_2} \times SI_3$
	Life Requisite Suitability Index Formulas & Variables	
	SI_1	The relationship between the number of trees ≥51 cm dbh/0.4 ha and reproductive habitat quality for barred owls.
	SI_2	The relationship between mean dbh of overstory trees and reproductive habitat quality for barred owls
	SI_3	The relationship between percent canopy cover of overstory trees and reproductive habitat quality for barred owls.
	Suitability Index (SI)	
	Reproduction Suitability Index (SIR)	
	Diameter at Breast Height (dbh)	

Table 2. Gray Squirrel Habitat Suitability Index Metrics

Species	Life Requisite Suitability Indices (LRSI)	HSI Formula
Gray Squirrel	Winter Food Cover/Reproduction	$SIWF = \sqrt{SI_1 \times SI_2} \times SI_3$ $SICR = \sqrt{SI_4 \times SI_5}$ $HSI = \min\{SIWF, SICR\}$

Life Requisite Suitability Index Formulas & Variables	
SI_1	Proportion of the total tree canopy cover that is hard mast producing trees ≥25 cm dbh
SI_2	Number of hard mast tree species
SI_3, SI_4	Percent canopy cover of trees
SI_5	Mean dbh of overstory trees

2.1.3 Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers

The Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers were utilized to evaluate the existing conditions of the San Antonio River within the study area. The RBPs are a synthesis of existing methods that have been employed by various State Water Resource Agencies. The RBPs advocate an integrated assessment comparing habitat (e.g. physical structure, flow regime), water quality, and biological measures with empirically defined reference conditions (Barbour et al. 1999).

The habitat quality evaluation can be accomplished by characterizing selected physiochemical parameters in conjunction with a systematic assessment of physical structure. Through this approach, key features can be rated or scored to provide a useful assessment of habitat quality.

The habitat assessment can be separated into two basic approaches – one designed for high-gradient streams and the other for low-gradient streams. This section of the San Antonio River is classified as a low-gradient stream and was evaluated utilizing the metrics prescribed within that category. Low-gradient streams have substrates or glide/pool complexes prevalent in streams and exist within low to moderate gradient landscapes. Natural low-gradient streams have substrates of fine sediment or infrequent aggregations of more coarse (gravel or larger) sediment particles along stream reaches. The entire sampling reach is evaluated for each parameter.

Reference conditions are used to scale the assessment to the “best attainable” situation. This approach is critical to the assessment because stream characteristics will vary dramatically across different regions (Barbour and Stribling 1991). The ratio between the score for the restoration site and the score for the reference condition site provides a percent comparability measure for each site.

For streams, a system approach to assessing form and function of the stream habitat includes an evaluation of the variety and quality of the substrate, channel morphology, bank structure, and riparian vegetation. Habitat parameters pertinent to the assessment of habitat quality include those that characterize the stream “micro scale” habitat (e.g., estimation of embeddeddness), the “macro scale” features (e.g., channel morphology), and the riparian and bank structure features that are most often influential in affecting the other parameters.

All parameters are evaluated and rated on a numerical scale of 0 to 20 (highest) for each sampling reach. The ratings are then totaled to between 0 and 100 and compared to a reference condition to provide a final habitat ranking. Scores increase as habitat quality increases. The resulting score is defined the Rapid Bioassessment Index or RBI. For the purposes of this project, the representative scores were normalized so that the RBI ranges from 0.0 to 1.0.

Habitat evaluations are first made on instream habitat, followed by channel morphology, bank structural features, and riparian vegetation. The actual habitat assessment process involves rating the 10 parameters as optimal, suboptimal, marginal, or poor based on the criteria below for a low gradient stream:

1. **Epifaunal Substrate/Available Cover**: Includes the relative quantity and variety of natural structures in the stream, such as cobble (riffles), large rocks, fallen trees, logs and branches, and undercut banks, available as refugia, feeding, or sites for spawning and nursery functions of aquatic macrofauna.
2. **Pool Substrate Characterization**: Evaluates the type and condition of bottom substrates found in pools.
3. **Pool Variability**: Rates the overall mixture of pool types found in streams, according to size and depth.
4. **Sediment Deposition**: Measures the amount of sediment that has accumulated in pools and the changes that have occurred to the stream bottom as a result of deposition.
5. **Channel Flow Status**: The degree to which the channel is filled with water.
6. **Channel Alteration**: A measures of large-scale changes in the shape of the stream channel.
7. **Channel Sinuosity**: Evaluates the meandering or sinuosity of the stream.
8. **Bank Stability (Left Bank and Right Bank)**: Measures whether the stream banks are eroded (or have the potential for erosion).
9. **Vegetative Protection (Left Bank and Right Bank)**: Measures the amount of vegetative protection afforded to the stream bank and the near-stream portion of the riparian zone.
10. **Riparian Vegetative Zone Width (Left Bank and Right Bank)**: Measures the width of natural vegetation from the edge of the stream bank out through the riparian zone.

2.1.4 Target Years

Target Year (TY) 0 habitat conditions are represented by the existing, or baseline, habitat conditions. The field and desktop collected data were used to quantify the habitat quality of that baseline condition. Target Year 0 conditions serve as a basis of comparison for both Future Without-Project (FWOP) and Future-With Project (FWP) scenarios.

Additional TYs were identified based on when implemented measures would be expected to elicit community responses represented by changes in the projected habitat variables.

TY 1 is used as a standard comparison year to identify and capture changes in habitat conditions that occur within one year after measures have been constructed. Amount of wetted area, reduction in invasive species, and water regimes are likely variables that may improve within this time period.

TY 5 was selected to capture the increase in habitat quality associated the restoration measures that provide ecological benefits relatively quickly such as natural plant establishment, aquatic vegetative abundance, and plant diversity.

TY 10 is used as a point after the initial growth of vegetation and the likely increase in size and benefits plantings have sustained.

Similarly, TY 25 was selected to capture the growth of aquatic and riparian habitats. Riparian plant abundance and diversity are also key response variables for this target year.

TY 50 is the planning life span of the project and is used as the last projected TY for the study. Restoration measures should produce mature habitat by this target year and represent the habitat types within the study area.

2.1.5 Habitat Units

USACE quantifies the existing, FWOP, and FWP Ecosystem Restoration (ER) benefits using a Habitat Unit (HU) metric. HUs are calculated as the product of the HSI and the number of acres of the habitat of interest. HUs for each FWOP and FWP are then annualized over the 50-year period of analysis utilizing Equation 1 below.

Equation 1: Annualization of Habitat Units for the FWOP and FWP Conditions

$$\int_0^T HU\ dt = (T_2 - T_1)\left[\left(\frac{A_1H_1 + A_2H_2}{3}\right) + \left(\frac{A_2H_1 + A_1H_2}{6}\right)\right]$$

Where:

$\int_0^T HU\ dt = Cumulative\ HUs$

T_1= first target year of time interval

T_2 = last target year of time interval

A_1 = area of available habitat at beginning of time interval

A_2= area of available habitat as the end of time interval

H_1 = Index score at the beginning of time interval

H_2 = Index score at the end of time interval

3 and 6 = constants derived from integration of Index score x Area for the interval between any two target years

This formula was developed to estimate cumulative HUs when either the HSI/RBI and/or area between two time intervals (T_x to T_{x+1}). The sum of these time intervals over the period of analysis divided by the total number of years of that analysis (50 years for this study) provides an Average Annual Habitat Unit (AAHU). This annualization accounts for the temporal shifts in the log rhythmic rate of accumulating ecological benefits that is common when dealing with the unevenness found in nature (USFWS 1980).

As ecological systems are rarely static, The AAHUs for the FWOP may not be equal to the AAHUs of the existing condition. Therefore, the impact of a project is quantified by calculating

the difference between the FWP scenarios and the FWOP. The difference in AAHUs between the FWOP and the FWP represents the net impact attributable to the project in terms of habitat quantity and quality.

Using the habitat models used to establish the existing habitat quality, an interagency team comprised of biologists from the USFWS, TPWD, and TCEQ projected what the future habitat conditions for the FWOP and FWP conditions by consensus based on best professional judgment.

2.1.6 Institute for Water Resources Planning Suite II

The Institute for Water Resources (IWR) Planning Suite II is a water resources investment decision support tool originally built for the formulation and evaluation of ecosystem restoration alternatives; however, it is now more widely used by all USACE business lines for evaluation of actions involving monetary and non-monetary cost and benefits.

The purpose of the IWR Planning Suite II is to assist with the formulation and comparison of plans for Ecosystem Restoration and Mitigation Plans. It has the capability of performing the CE/ICA. The IWR Planning Suite II has an annualization tool to calculate the AAHUs for the FWOP and each FWP plan.

The IWR Planning Suite II Annualizer Tool was utilized to annualize the HUs of each alternative's FWOP and FWP condition for the feasibility study. This is the only USACE certified tool for annualizing NER outputs. In addition to the IWR Planning Suite II, Ecosystem Restoration Planning Center of Expertise (ECO-PCX) annualization spreadsheets were utilized to verify the average annual benefit outputs for each plan as well. All annualization calculations for AAHUs were confirmed by using two separate methods for verification.

3 Array of Measures and Alternatives

3.1.1 Measures

A measure is defined as a means to an end; an act, step, or procedure designed for the accomplishment of an objective. In other words, a measure is a feature that can be implemented at a specific geographic site to address one or more planning objectives. Measures are the building blocks of alternatives and are categorized as structural and non-structural. Equal consideration was given to these two categories of measures during the planning process while conducting this feasibility study.

- Brackenridge Park Golf Course Golf Cart Widening – The Brackenridge Golf Course is adjacent to the project area. A golf cart path runs parallel to Avenue A. This path would be expanded by two feet to accommodate vehicular traffic from the golf course maintenance staff.
- Low Water Crossing Modification – This would include removing existing concrete rip-rap and fill material. One 5'W x 4' H box culvert would be placed in the center of the low water crossing. Suitable fill material would be placed, compacted, and shaped accordingly and 6" of concrete rip-rap would be positioned for appropriate slope.
- Low Water Crossing Removal – Existing low water crossings would be demolished and the materials removed.
- Rerouting River Road – Partial removal of River Road beginning at E Mulberry Avenue and ending at Allison Road. A Texas Department of Transportation approved road would be built within the boundary of the past alignment of Allison Road to the northwest.

- Native Species Plantings – Native aquatic and riparian vegetation would be planted within the specified project area.
- Invasive Species Management – Invasive species would be removed and an invasive species management plan would be implemented within designated sites.
- Boulder Barrier – A barrier consisting of 3’ to 4’ diameter boulders with 7’ centers would be placed along the boundaries of River Road to protect restoration features from recreational vehicle use.
- Gate Installation – This measure would include installation of a gate at the intersection of Avenue A and East Mulberry Avenue to restrict public vehicular access, yet allow the golf course maintenance staff to access the golf course maintenance shed. Depending on the alternatives implemented, a gate could also be installed at the entrance of the Brackenridge Golf Course golf cart path.
- Avenue A Partial Removal – This measure would include the removal of 621 cubic yards of road material and replacing it with native soil.
- Avenue A Full Removal – This would include the complete removal of Avenue A with the removal of 1,921 cubic yards of road material and replacing it with native soil.
- Instream Structures – Placement of instream structures such as j-hooks or rock vanes to create pool/riffle/run features within the San Antonio River. This measure would improve aquatic habitat while also reducing the amount of sheer stress on the banks of the river. The features will also provide quality auditory benefits for the general public.
- Geolifts - This measure will complement the instream structures. They would be used to stabilize the stream bank along the outside of stream meanders and would be placed within an appropriate proximity of the instream structures. Geolifts are basically a series of overlapping soils constructed of erosion control matting and native soils and assist in erosion control.
- Habitat Structures – This measure would include the installation of structural habitat features such as bat boxes, bird boxes, and platforms.
- Bridges – This measure would be dependent upon the low water crossing removal measure. An ADA compliant pedestrian bridge would be necessary for the E Woodlawn Avenue low water crossing while the bridges within the golf course would be utilized mostly for golf cart access.

3.1.2 Alternatives

The final array of management measures were combined into alternatives that would address ecosystem restoration of the riverine and riparian forest habitats, as well as restore structure and function of the study area. Each of the alternatives listed below could be a standalone plan, or be combined with other alternatives to form a suite of plans.

In addition, several scales of the alternatives were developed in order to achieve differing levels of captured and uncaptured benefits. All alternatives listed in Section 4 of this document will include a version of the restoration features: invasive species management, native species planting (aquatic and riparian), and installation of habitat features (platforms, bat boxes, bird boxes). Alternatives that include some modification to Avenue A include the placement of rock barriers or gates. See below for a brief description of the alternatives, a thorough description of each is included in Section 4.2.

- Instream Modification

    - 1A – Restores 16 acres of riverine and riparian habitat through the removal of all three low water crossings.
    - 1B – Restores 16 acres of riverine and riparian habitat through the modification of LWC 1 and the removal of LWCs 2 and 3.
    - 1C – Restores 16 acres of riverine and riparian habitat through the removal of LWC 1 and the modification of LWCs 2 and 3.
    - 1D – Restores 16 acres of riverine and riparian habitat through the modification of all three low water crossings.
- Avenue A Modification
    - 2A – Restores 4.6 acres of riparian habitat through the complete removal of Avenue A.
    - 2B – Restores 2 acres of riparian habitat through the partial removal of Avenue A.
- River Road Modification
    - 3A – Restores 5.1 acres of riparian habitat through the relocation of River Road and planting within Davis Park.
    - 3B – Restores 4.9 acres of riparian habitat through planting within Davis Park.

4 Existing, Future Without- and Future With-Project Conditions

This Section provides the inputs and results of the existing, FWOP, and FWP conditions analyses. Section 4.1 is a description of the justifications, calculations and results of the FWOP conditions. Section 4.2 will describe the likely future conditions in the study area over the 50-year life of each alternative (FWP conditions). Because this is an ecosystem restoration project, the FWP is assumed to provide habitat benefits regarding all alternatives. There will not be any negative impacts due to the FWP. See Attachment C for Future-Without and Future-With Project assumptions for riparian habitat. See Attachment D for Future-Without and Future-With Project assumptions for riverine habitat in the event of low water crossing modification and Attachment E in the event of low water crossing removal.

Analyses involving Avenue A and River Road utilize the two HSI models to calculate the benefits of project implementation. The resulting HUs of the HSI models of each Target Year were then averaged together. The averages of those HUs were entered into the IWR Planning Suite II Annualizer tool. To clarify, HUs of the separate models were not added together, but averaged to avoid duplicating the values analyzed.

4.1 Existing and Future Without-Project Conditions

This section describes the existing conditions for various resources within the study area and the projected conditions of the study area without a project, over the next 50-year period.

Under the FWOP condition there would not be an ecosystem restoration project within the River Road study area; however, it is anticipated that normal activities by the public and natural ecological processes would continue to occur. The San Antonio River is a spring fed system and flows within the river have great variability. The Non-Federal Sponsor (NFS), in agreement with the San Antonio Water System, will ensure a constant of 10 cubic feet per second minimum within the River Road reach of the San Antonio River by supplementing the river flows with re-use water (USACE 2005).

In order to accurately assess the benefits of project implementation, the existing and FWOP conditions are compared to each FWP condition using the same area (acres) and existing values for the model metrics. From there the conditions are projected into the future and annualized over a 50-year period.

Beginning at East Craig Place, the habitat is vastly different compared to the rest of the study area due to the influence of the Brackenridge Park Golf Course (Figures 6 and 7). The southern half of this reach of the San Antonio River has been channelized and has little to no vegetation on its banks because of persistent mowing and herbicide application (Figure 7). It has been negatively impacted by human stressors that have removed the riparian buffer necessary for instream health.

Figure 6. Upstream Portion of the River Road Study Area

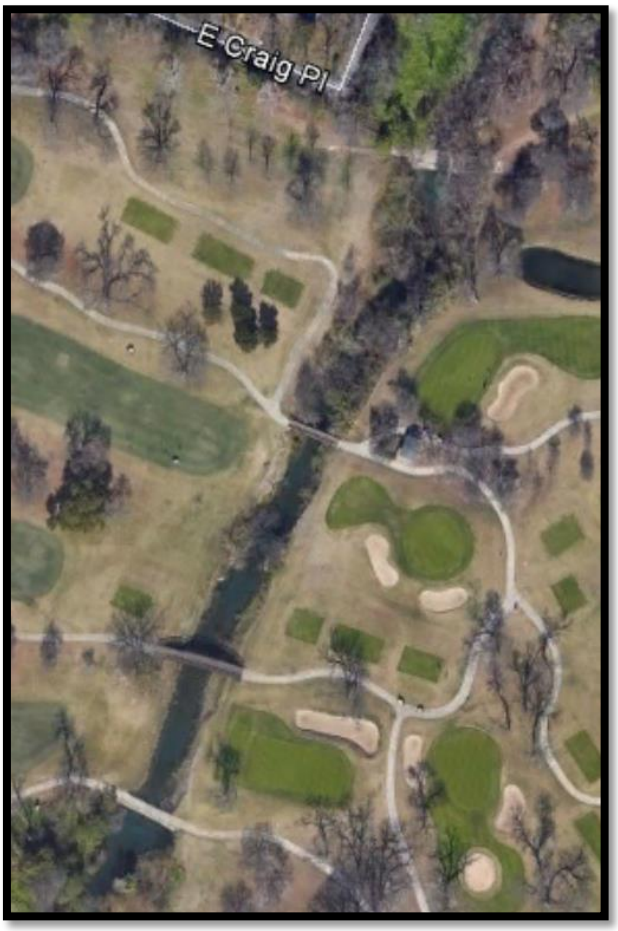

Figure 7. Downstream Portion of the River Road Study Area within the Brackenridge Golf Course

4.1.1 San Antonio River

The Instream Modification alternative was broken into an upstream and downstream evaluation for Low Water Crossing Removal and Low Water Crossing Modification measures. Due to the higher existing habitat quality of the upper section, it was necessary to have separate analyses of the existing conditions in order to accurately assess FWOP and FWP conditions in Section 4.2. The upstream segment of the study area is located north of LWC 1 and up to East Mulberry Avenue. The aquatic habitat for this segment is influenced by significant pooling, erosion, and

sedimentation (Figure 8 and 9). The downstream segment of the study area is associated with the river downstream of LWC 1, which is mostly within the boundaries of the Breckenridge Golf Course (Figure 8, 10 and 11).

The vegetation within the upper segment of the study area includes pecan (*Carya illinoiensis*), poison ivy (*Toxicodendron radicans*), Chinese privet (*Ligustrum sinense*), Chinaberry (*Melia azedarach*), beggar's lice (*Torilis arvensis*), greenbriar (*Smilax* spp.), Virginia creeper (*Parthenocissus quinquefolia*), straggler's daisy (*Calyptocarpus vialis*), giant ragweed (*Ambrosia trifida*), Turk's cap (*Malaviscus arboreus*), and giant cane (*Arundo donax*).

Figure 8. Location of Low Water Crossings 1, 2, and 3 on the San Antonio River

Figure 9. Low Water Crossing 1

Figure 10. Low Water Crossing 2

Figure 11. Low Water Crossing 3

As discussed in Section 2.1.3, there were ten metrics evaluated using the RBPs. The upstream portion of the river, referred to in the table below as LWC 1, has an average of suboptimal conditions for a low gradient stream. Channel flow status and channel alteration are the two metrics that are optimal for this body of water, while channel sinuosity is marginal. The RBI score for the existing and FWOP conditions for the upstream portion of the study area are slightly above average, but will most likely not improve over a 50-year period.

The downstream section of the study area, referred to in the table below as LWC 2 and 3, yield lower scores because of the amount of channelization that has occurred. The lack of vegetative protection and a riparian vegetative zone on both banks leads to a lower overall RBI. The majority of the scores for the downstream segment are poor or marginal resulting in below

average RBI scores. The conditions affecting the AAHUs over a 50-year period are not expected to improve in the future.

Table 3. The Instream Modification Future Without-Project Rapid Bioassessment Index for the Rapid Bioassessment Protocols, Habitat Units for Each Target Year, and the Average Annual Habitat Units for Instream Modification (Scales 1A, 1B, 1C, and 1D)

Alternative	Model	Acres	Target Year												AAHU
			0		1		5		10		25		50		
			RBI	HU	RBI	HU	RBI	HU	RBI	HU	RBI	HU	RBI	HU	
[1]LWC 1 ([2]Removal)	RBP	9.4	0.6	6	0.6	6	0.6	6	0.6	6	0.6	5	0.5	5	5
LWC 2 & 3 (Removal)	RBP	6.6	0.4	2	0.4	2	0.4	2	0.4	2	0.4	2	0.4	2	2
LWC 1 ([3]Modification)	RBP	9.4	0.6	6	0.6	6	0.6	6	0.6	6	0.6	5	0.5	5	5
LWC 2 & 3 (Modification)	RBP	6.6	0.4	2	0.4	2	0.4	2	0.4	2	0.4	2	0.4	2	2

[1]LWC: Low Water Crossing
[2]Removal: RBI and HUs in regards to the complete removal of low water crossings within the study area.
[3]Modification: RBI and HUs in regards to the modification of the low water crossings within the study area.
Combinations of the units above will formulate Scales 1A, 1B, 1C, and 1D in the FWP.

4.1.2 Avenue A

Avenue A provides public access to the study area and is heavily utilized by the public. Avenue A runs parallel to the San Antonio River beginning at East Mulberry Ave and ending near LWC 1 (Figure 12). It is a relatively degraded road that does not have curbs or physical boundaries to signal an edge (see Figures 13 and 14). There is constant human disturbance along the boundaries of Avenue A which have led to compaction and a lack of vegetation. Vegetated areas parallel to Avenue A have species such as poison ivy, giant ragweed, beggar's lice, straggler's daisy, giant cane, Chinese privet, peppervine (*Ampelopsis arborea*), lantana (*Lantana camara*), hackberry (*Celtis occidentalis*), dewberry (*Rubus* spp.), and various oaks (*Quercus* spp.).

The evaluation of the existing and future without-project conditions are separated into two scales: 2A and 2B (Tables 4 and 5). There are two categories for each scale of Avenue A, vegetation and no vegetation. Vegetation represents an area that held a significant amount of vegetation, whether native or invasive. No vegetation represents the areas that had little to no herbaceous, shrub, or tree cover. Because of the measures involved with Avenue A, it was necessary to evaluate the existing conditions and project them to a future with a significant amount of vegetation, whether or not it is existing.

Figure 12. Location of Avenue A within the Study Area

Figure 13. Severely Degraded Road/Non-Existent Habitat at the Avenue A Dead-End

Figure 14. Avenue A Parking Adjacent to the San Antonio River

No Vegetation areas for both 2A and 2B yielded extremely low HSI scores because of the lack of appropriate habitat for Gray Squirrel and Barred Owl HSI metrics. The scales with vegetation generated higher scores for the Barred Owl HSI because of the number of trees, percent canopy cover of trees, and mean dbh of trees within the data collection sites. The Gray Squirrel FWOP HSI scores were low because the species dependency on diversity and the lack of hard mast producing trees is expected to worsen for 2A and 2B. Scale 2A had an AAHU of 1 while 2B had an AAHU of 0. The difference between the two scales is due to the area (acres) that were evaluated, see the explanation in Section 2.1.5 describing the calculations required for AAHUs.

Table 4. The Avenue A Future Without-Project Habitat Suitability Index for Barred Owl and Gray Squirrel, Habitat Units for Each Target Year, Average Habitat Units for Each Target Year between the Models, and the Average Annual Habitat Units for River Road (Scale 2A)

Alternative	Model	Acres	Target Year 0		1		5		10		25		50	
			HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
Avenue A ([1]2A) ([2]No Vegetation)	Barred Owl	1.3	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Gray Squirrel		0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Avenue A (2A) ([3]Vegetation)	Barred Owl	3.3	0.8	3	0.8	3	0.8	3	0.8	3	0.8	3	0.8	3
	Gray Squirrel		0.5	2	0.5	2	0.3	1	0.2	1	0.2	1	0.2	1
AAHU = 1	[4]Average HU		1		1		1		1		1		1	

[1]2A: Refers to the FWP condition of implementing Alternative 2 – Scale 2A. The FWP must be compared to the FWOP, so FWOP was analyzed using the existing conditions.
[2]No Vegetation: Metrics for areas with no existing riparian vegetation will naturally score lower than areas with vegetation.
[3]Vegetation: Areas with existing riparian vegetation
[4]Average HU: The average habitat units between the Barred Owl and Gray Squirrel models
*Total acreage for Average HU is 4.6 (1.3 + 3.3)

Table 5. The Avenue A Future Without-Project Habitat Suitability Index for Barred Owl and Gray Squirrel, Habitat Units for Each Target Year, Average Habitat Units for Each Target Year between the Models, and the Average Annual Habitat Units for River Road (Scale 2B)

Alternative	Model	Acres	Target Year 0		1		5		10		25		50	
			HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
Avenue A ([1]2B) ([2]No Vegetation)	Barred Owl	0.6	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Gray Squirrel		0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
Avenue A (2B) ([3]Vegetation)	Barred Owl	1.4	0.8	1	0.8	1	0.8	1	0.8	1	0.8	1	0.8	1
	Gray Squirrel		0.5	1	0.5	1	0.3	0	0.2	0	0.2	0	0.2	0
AAHU = 0	[4]Average HU		1		1		0		0		0		0	

[1]2B: Refers to the FWP condition of implementing Alternative 2 – Scale 2A. The FWP must be compared to the FWOP, so FWOP was analyzed using the existing conditions.
[2]No Vegetation: Metrics for areas with no existing riparian vegetation will naturally score lower than areas with vegetation.
[3]Vegetation: Areas with existing riparian vegetation
[4]Average HU: The average habitat units between the Barred Owl and Gray Squirrel models
*Total acreage for Average HU is 2.0 (0.6 + 1.4)

4.1.3 River Road and Davis Park

River Road and Davis Park are in the northwestern portion of the study area (Figure 15). Because it is still within the floodplain of the San Antonio River, Davis Park has a moderate risk of flooding (Figure 16). It is heavily maintained parkland and is utilized by the public throughout the year. Davis Park lacks suitable vegetation to appropriately filter and slow down stormwater runoff flowing into the river. Davis Park is dominated by bermudagrass (*Cynodon dactylon*),

isolated green ash (*Fraxinus pennsylvanica*), straggler's daisy, and false mallow (*Malvastrum* spp.) (Figure 17).

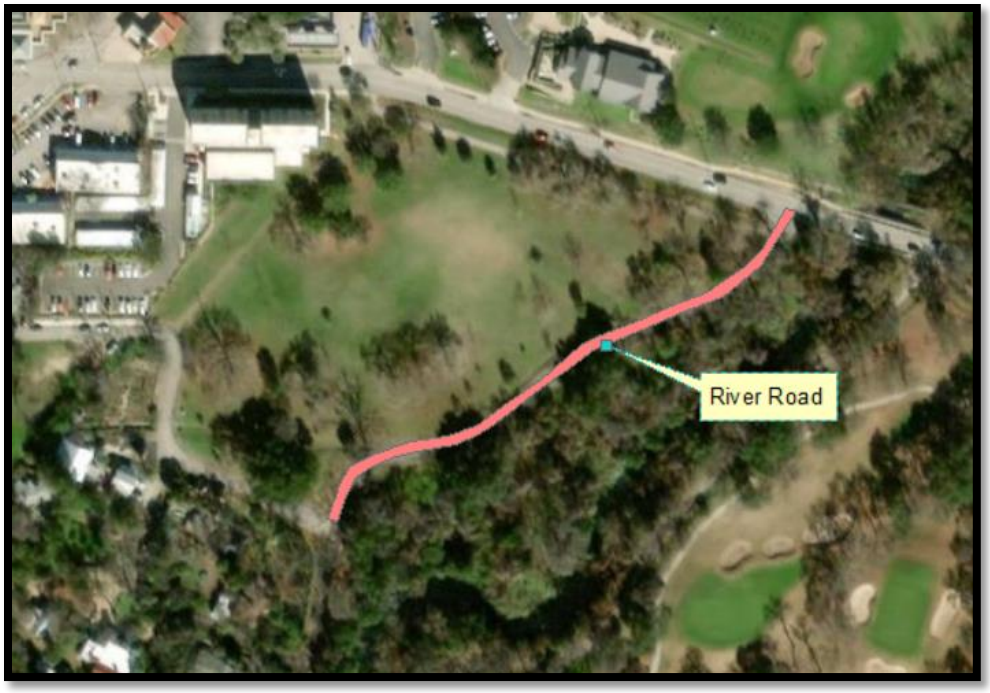

Figure 15. Section of River Road Adjacent to Davis Park

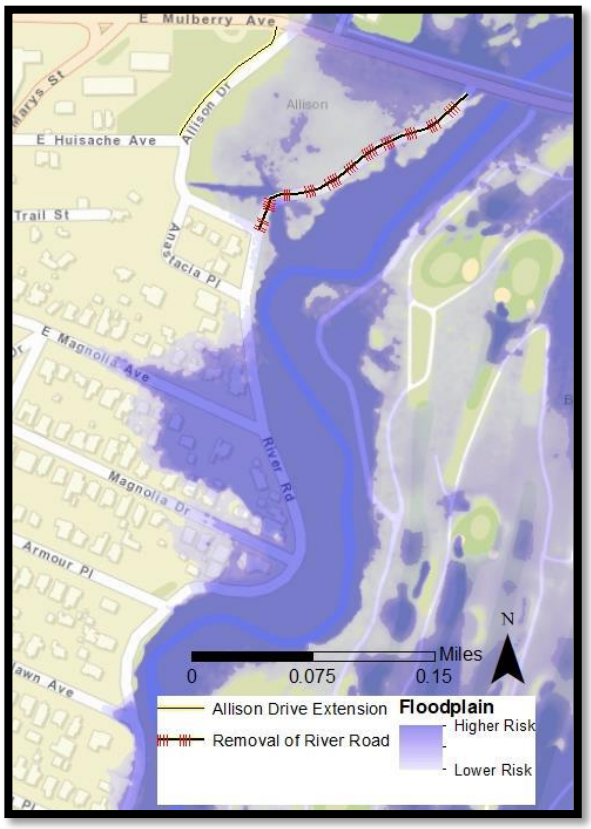

Figure 16. Davis Park and River Road Located within the Floodplain

Figure 17. Davis Park

Because there is not suitable vegetation for riparian habitat within Davis Park, the scores for the Gray Squirrel and Barred Owl HSI for both scales 3A and 3B were 0.0, resulting in an AAHU of 0 for the area (Table 6 and 7).

Table 6. The River Road Future Without-Project Habitat Suitability Index for Barred Owl and Gray Squirrel, Habitat Units for Each Target Year, Average Habitat Units for Each Target Year between the Models, and the Average Annual Habitat Units for River Road (Scale 3A)

Alternative	Model	Acres	Target Year											
			0		1		5		10		25		50	
			HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
River Road ([1]3A)	Barred Owl	5.1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Gray Squirrel	5.1	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
AAHU = 0	[2]Average HU		0		0		0		0		0		0	

[1]3A: Refers to the FWP condition of implementing Alternative 3 – Scale 3A. The FWP must be compared to the FWOP, so FWOP was analyzed using the existing conditions.
[2]Average HU: The average habitat units between the Barred Owl and Gray Squirrel models

Table 7. The River Road Future Without-Project Habitat Suitability Index for Barred Owl and Gray Squirrel, Habitat Units for Each Target Year, Average Habitat Units for Each Target Year between the Models, and the Average Annual Habitat Units for River Road (Scale 3B)

Alternative	Model	Acres	Target Year											
			0		1		5		10		25		50	
			HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
River Road ([1]3B)	Barred Owl	4.9	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
	Gray Squirrel	4.9	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0
AAHU = 0	[2]Average HU		0		0		0		0		0		0	

[1]3B: Refers to the FWP condition of implementing Alternative 3 – Scale 3A. The FWP must be compared to the FWOP, so FWOP was analyzed using the existing conditions.
[2]Average HU: The average habitat units between the Barred Owl and Gray Squirrel models

4.2 Future With-Project Conditions

The FWP conditions will evaluate the ecosystem benefits the restoration measures will have on each alternative. As was done when calculating the FWOP conditions, ecosystem benefits were assessed and projected with the habitat models by USACE, SARA, TPWD, and TCEQ using professional judgment and existing data for each target year. The actions described below are the assumed benefits of project implementation. The alternatives evaluated for this feasibility study include:

- Instream Modification: Scales 1A, 1B, 1C, and 1D
- Avenue A Modification: Scales 2A and 2B
- River Road Modification: Scales 3A and 3B

4.2.1 Instream Modification

FWP benefits vary between the scales of the Instream Modification alternative. All scales would involve native species plantings, invasive species management, instream structures, and geolifts (Figures 18 and 19); however each scale will require either modification or removal to LWCs 1, 2, or 3. The LWC Modification measure does not have a significant increase in benefits in the FWP because the water will only move through a single culvert. A box culvert for LWC 1 would allow for some improved water flow; however, it would be assumed to be less effective than a complete removal. A single culvert allows for some channel flow; however, there would still be residual erosion and pooling due to the constrained conveyance. Combinations of LWC Removal and Modification will yield different results based on the low water crossing it is applied to (upstream vs. downstream), which is how the scales of this alternative were developed. The area analyzed for “downstream” habitat has a significant lack of vegetative cover and riparian width and is severely channelized.

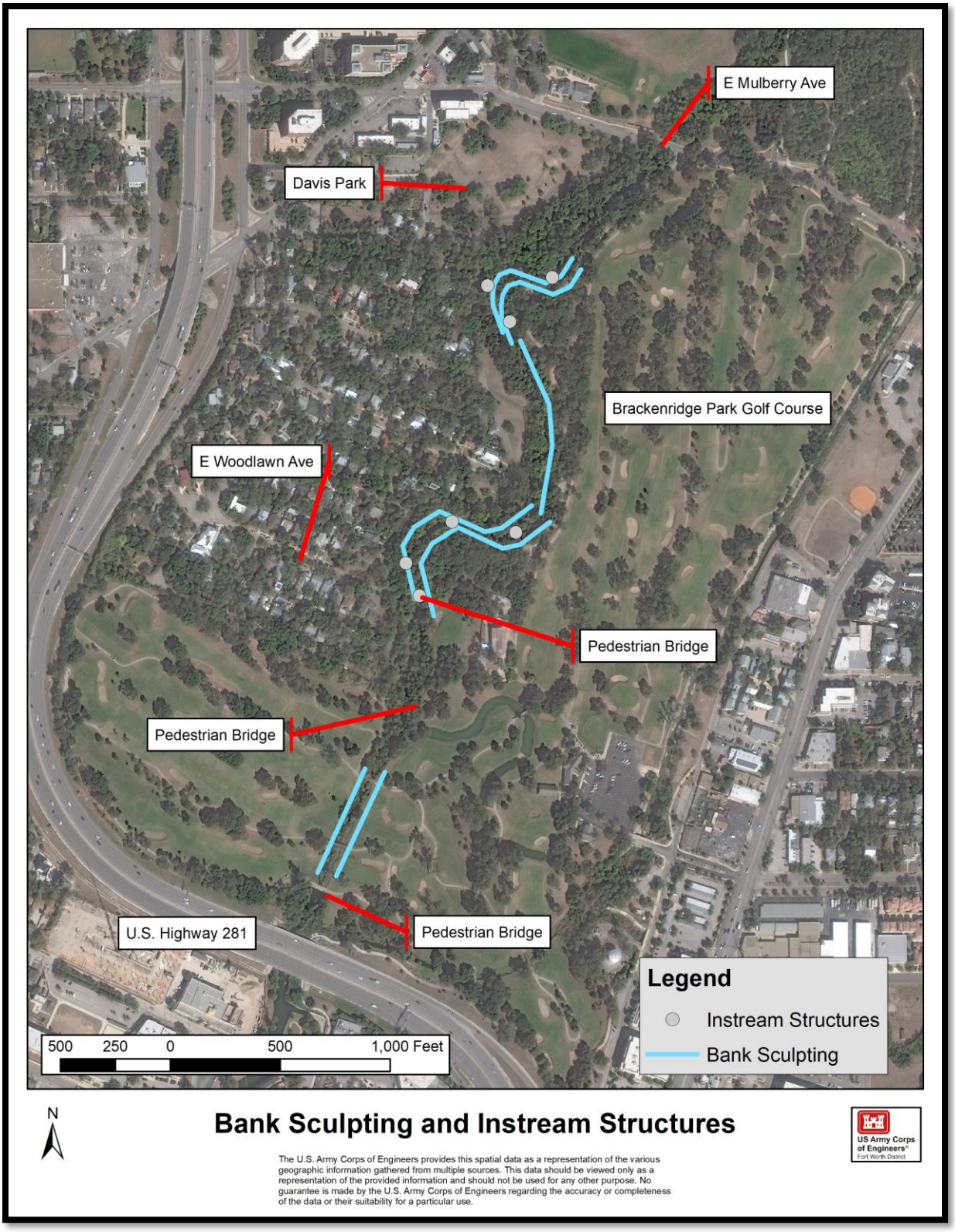

Figure 18. Conceptual Placement of Instream Structures and Bank Sculpting within the San Antonio River

Figure 19. Native Species Plantings and Invasive Species Management Locations for Instream Modification

LWC Removal significantly improves the RBI score over a 50-year period through improved epifaunal substrate/available cover, pool substrate, pool variability, sediment deposition, vegetative protection, and riparian vegetative zone width. Those factors became optimal for LWC 1. The removal of LWCs 2 and 3 increased epifaunal substrate, pool substrate, sediment deposition, channel flow status, vegetative protection to optimal conditions.

LWC Modification yielded slightly lower scores, with increases beginning at TY 5. Vegetative protection and riparian vegetative zone width became optimal for LWC 1, while only vegetative protection increased to optimal for LWC 2 and 3. It was assumed the velocity, pool depth, frequency of riffles, and bank stability would immediately be impacted after construction. Vegetative protection, epifaunal embeddedness, pool substrate metrics would take an extended amount of time to be realized.

Removal of LWC 1 will provide an increase of RBI over a 50-year period from 0.6 to 0.9, resulting in 9 AAHUs. Removal of LWC 2 and 3 will have similar results increasing the RBI score from 0.4 to 0.7, stemming in 4 AAHUs.

Modification of LWC 1 slightly increases the RBI score from 0.6 at TY 0 to 0.7 at TY 50, with 6 AAHUs. LWC 2 and 3 increase from 0.4 RBI to 0.5 RBI and have 3 AAHUs.

The combination of the AAHUs listed in Table 8 can be contributed to the scales listed in Sections 4.2.1.1 – 4.2.1.4

Table 8. The Instream Modification Future With-Project Habitat Suitability Index for the Rapid Bioassessment, Habitat Units for Each Target Year, and the Average Annual Habitat Units for Instream Modification (Scales 1A, 1B, 1C, and 1D)

Alternative	Model	Acres	Target Year												AAHU
			0		1		5		10		25		50		
			RBI	HU	RBI	HU	RBI	HU	RBI	HU	RBI	HU	RBI	HU	
[1]LWC 1 ([2]Removal)	RBP	9.4	0.6	6	0.8	8	0.9	8	0.9	9	0.9	9	0.9	9	9
LWC 2 & 3 (Removal)	RBP	6.6	0.4	2	0.6	4	0.6	4	0.7	5	0.7	5	0.7	5	4
LWC 1 ([3]Modification)	RBP	9.4	0.6	6	0.7	6	0.7	7	0.7	7	0.7	6	0.7	6	6
LWC 2 & 3 (Modification)	RBP	6.6	0.4	2	0.4	2	0.5	3	0.5	3	0.5	3	0.5	3	3

[1]LWC: Low Water Crossing

[2]Removal: RBI and HUs in regards to the complete removal of low water crossings within the study area.

[3]Modification: RBI and HUs in regards to the modification of the low water crossings within the study area.

Combinations of the units above will formulate Scales 1A, 1B, 1C, and 1D in the FWP.

4.2.1.1 Scale 1A

Scale 1A is the removal of all LWCs (i.e. LWC 1 [Removal] + LWC 2 & 3 [Removal]). This will significantly open the stream bed, increase channel flow, and reduce pooling, erosion, and sedimentation. It is assumed that epifaunal substrate, pool substrate, pool variability, sediment deposition, bank stability, and riparian vegetative zone width will dramatically improve within the upstream habitats.

Epifaunal substrate, pool substrate, sediment deposition, bank stability, vegetative protection, and riparian vegetative zone width will dramatically improve within the downstream habitat. This scale would include an additional instream structure underneath the pedestrian bridge in the existing location for LWC 1 for increased habitat for wildlife and auditory benefits for the general public.

Scale 1A of the Instream Modification Alternative includes the following measures:

- LWC Removal,
- Bridges (to mitigate for the loss of community from the removal of the LWC),
- Instream Structures,
- Native Species Plantings,
- Invasive Species Removal,
- Habitat Structures,
- And Boulder Barrier.

4.2.1.2 Scale 1B

Scale 1B incorporates the modification of LWC 1 and the removal of LWC 2 and 3 (i.e. LWC 1 [Modification] + LWC 2 & 3 [Removal]). This scale would include the following measures:

- LWC 2 and 3 Removal,
- LWC 1 Modification,
- Bridges (to mitigate for the loss of community from the removal of the LWC),
- Native Species Plantings,
- Invasive Species Removal,
- Instream Structures,
- And Boulder Barrier.

4.2.1.3 Scale 1C

This scale includes the removal of LWC 1 and the modification of crossings 2 and 3 (i.e. LWC 1 [Removal] + LWC 2 & 3 [Modification]). This scale would include an additional instream structure underneath the pedestrian bridge in the existing location for LWC 1 for increased habitat for wildlife and auditory benefits for the general public.

- LWC 1 Removal,
- LWC 2 and 3 Modification,
- Bridges (to mitigate for the loss of community from the removal of the LWC),
- Native Species Plantings,
- Invasive Species Removal,
- Habitat Structures,
- Instream Structures,
- And Boulder Barrier.

4.2.1.4 Scale 1D

This scale includes the modification of all low water crossings (i.e. LWC 1 [Modification] + LWC 2 & 3 [Modification]).This scale would not include any removals or bridges.

- LWC Modifications,
- Instream Structures,
- Native Species Plantings,
- Invasive Species Removal,
- Habitat Structures,
- And Boulder Barrier.

4.2.2 Avenue A Modification

The Avenue A Modification alternative will limit the amount of vehicular access to the project area. A gate will be installed for both scales of the project, to deter vehicular use along the banks of the river. However, these areas will still be completely open to the public through pedestrian access.

4.2.2.1 Scale 2A

Scale 2A incorporates the complete removal of Avenue A beginning at East Mulberry Avenue until the loop near LWC 1. Upon demolition of this road, native topsoil would be placed in preparation for the planting of native riparian plant species. The Breckenridge Park Golf Course golf cart path would be expanded to maintain access to the maintenance building for their staff. Areas shown in green and yellow (Figure 20) would be managed for invasive species and would be planted with native species. This scale includes the following measures:

- Brackenridge Park Golf Course Golf Cart Path Widening and gate widening for golf course maintenance access,
- and Avenue A Full Removal.

Figure 20. Avenue A Modification Scale 2A Restoration Features

Because Avenue A will be completely lacking vegetation upon project implementation, there is an enormous habitat unit lift from Year 0 to Year 50 for every metric. Areas described as vegetated will also have significant lift, but those scores will mostly result from the Gray Squirrel HSI metrics. It is assumed that there would be an increase in the amount of hard mast trees due to the native species planting measure and invasive species management measure. Mean dbh, percent canopy cover of trees for food and cover/reproduction will significantly increase at TY 50. Barred Owl HSI metrics have slight increases in areas with established vegetation, but the growth was limited to number of trees per acre over 20" dbh. Although Scale 2A has above average HSI scores, the AAHUs are somewhat minor due to the total amount of acreage for this alternative.

Table 9. The Avenue A Future With-Project Habitat Suitability Index for Barred Owl and Gray Squirrel, Habitat Units for Each Target Year, Average Habitat Units for Each Target Year between the Models, and the Average Annual Habitat Units for River Road (Scale 2A)

Alternative	Model	Acres	Target Year											
			0		1		5		10		25		50	
			HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
Avenue A ([1]2A) ([2]No Vegetation)	Barred Owl	1.3	0.0	0	0.0	0	0.0	0	0.0	0	0.3	0	0.7	1
	Gray Squirrel		0.0	0	0.0	0	0.1	0	0.4	1	1.0	1	1.0	1
Avenue A (2A) ([3]Vegetation)	Barred Owl	3.3	0.8	3	0.8	3	0.8	3	0.9	3	0.9	3	1.0	3
	Gray Squirrel		0.5	2	0.7	2	0.7	2	0.8	3	0.8	3	0.8	3
AAHU = 2	[4]Average HU		1		1		1		2		2		2	

[1]2A: Refers to the FWP condition of implementing Alternative 2 – Scale 2A. The FWP must be compared to the FWOP, so FWOP was analyzed using the existing conditions.
[2]No Vegetation: Metrics for areas with no existing riparian vegetation will naturally score lower than areas with vegetation.
[3]Vegetation: Areas with existing riparian vegetation
[4]Average HU: The average habitat units between the Barred Owl and Gray Squirrel models
***Total acreage for Average HU is 4.6**

4.2.2.2 Scale 2B

Scale 2B of the Avenue A Modification alternative would implement the removal of the lower portion of Avenue A while leaving the rest of Avenue A in place for the maintenance staff to access their maintenance building (Figure 21). The areas in green and yellow would be planted with native species and managed for invasive species. The measures for this scale include:

- Gate Installation,
- Native Species Plantings,
- Invasive Species Management,
- Habitat Structures,
- and Avenue A Partial Removal.

Figure 21. Avenue A Modification Scale 2B Restoration Features

Similar to Scale 2A, areas without existing vegetation will drastically increase all metrics for the Barred Owl and Gray Squirrel HSI. Scale 2B will have the same increases to areas with vegetation compared to Scale 2A. The difference between the two scales is the removal and replanting of Avenue A resulting in less acreage associated with Scale 2B and leading to 1 AAHU over a 50-year period (Table 10).

Table 10. The Avenue A Future With-Project Habitat Suitability Index for Barred Owl and Gray Squirrel, Habitat Units for Each Target Year, Average Habitat Units for Each Target Year between the Models, and the Average Annual Habitat Units for River Road (Scale 2B)

Alternative	Model	Acres	Target Year 0		1		5		10		25		50	
			HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
Avenue A ([1]2B) ([2]No Vegetation)	Barred Owl	0.6	0.0	0	0.0	0	0.0	0	0.0	0	0.3	0	0.7	0
	Gray Squirrel		0.0	0	0.0	0	0.1	0	0.4	0	1.0	1	1.0	1
Avenue A (2B) ([3]Vegetation)	Barred Owl	1.4	0.8	1	0.8	1	0.8	1	0.9	1	0.9	1	1.0	1
	Gray Squirrel		0.5	1	0.7	1	0.7	1	0.8	1	0.8	1	0.8	1
AAHU = 1	**[4]Average HU**		**1**		**1**		**1**		**1**		**1**		1	

[1]2B: Refers to the FWP condition of implementing Alternative 2 – Scale 2A. The FWP must be compared to the FWOP, so FWOP was analyzed using the existing conditions.
[2]No Vegetation: Metrics for areas with no existing riparian vegetation will naturally score lower than areas with vegetation.
[3]Vegetation: Areas with existing riparian vegetation
[4]Average HU: The average habitat units between the Barred Owl and Gray Squirrel models
***Total acreage for Average HU is 2.0**

4.2.3 River Road Modification

The River Road Modification alternative will include native plantings in Davis Park, with focus on wildflowers, native grasses, and riparian shrub and tree species.

4.2.3.1 Scale 3A

Scale 3A involves the removal of a portion of River Road and re-establishing the original alignment of Allison Road as another traffic route for the adjacent community (Figures 22 and 23). The River Road section would be replaced with native soil and native vegetative species to expand the riparian zone. The restoration measures included with Scale 3A include:

- Rerouting River Road,
- Native Species Plantings,
- Invasive Species Management,
- and Habitat Structures.

Figure 22. River Road and Davis Park Scale 3A Restoration Features

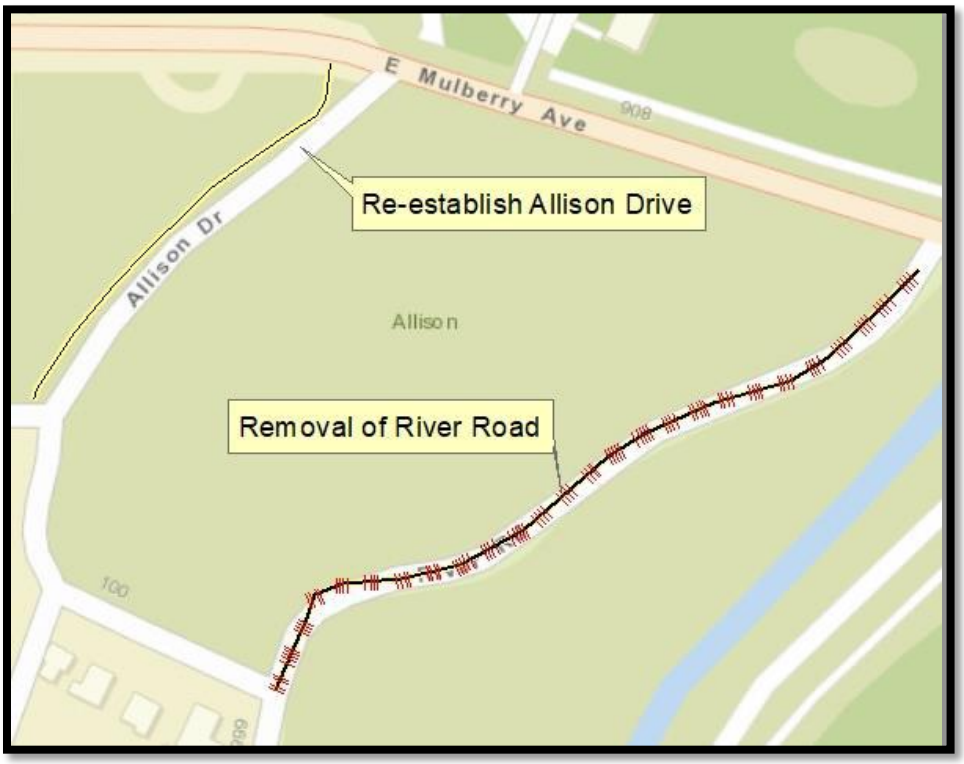

Figure 23. Re-establishment of Allison Drive

The Barred Owl and Gray Squirrel HSI metrics are assumed to significantly increase due to the conversion of Davis Park from a non-native invasive grassland to riparian woodland habitat. Although there are significant increases in the HSI values for this scale, the AAHUs produced are relatively minor (3) due to the acres associated with this alternative.

Table 11. The River Road Future With-Project Habitat Suitability Index for Barred Owl and Gray Squirrel, Habitat Units for Each Target Year, Average Habitat Units for Each Target Year between the Models, and the Average Annual Habitat Units for River Road (Scale 3A)

Alternative	Model	Acres	Target Year											
			0		1		5		10		25		50	
			HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
River Road ([1]3A)	Barred Owl	5.1	0.0	0	0.0	0	0.0	0	0.0	0	0.3	1.5	0.7	4
	Gray Squirrel	5.1	0.1	1	0.0	0	0.1	0	0.4	2	1.0	5	1.0	5
AAHU = 3	**Average AAHU**		**0**		**0**		**0**		**1**		**3**		4	

[1]3A: Refers to the FWP condition of implementing Alternative 3 – Scale 3A. The FWP must be compared to the FWOP, so FWOP was analyzed using the existing conditions.
[2]Average HU: The average habitat units between the Barred Owl and Gray Squirrel models

4.2.3.2 Scale 3B

Scale 2B is limited to native species plantings and invasive species management. The relocation of River Road is not included in this assessment, therefore, all plantings would be limited to existing open park areas (Figure 24).

Figure 24. River Road and Davis Park Scale 3B Restoration Features

Similar to the previous alternative scale, Scale 3B yields better results for Barred Owl and Gray Squirrel HSI metric due to the conversion of non-native invasive grassland to riparian woodland habitat. Scale 3B of River Road Modification yields 3 AAHUs (Table 12).

Table 12. The River Road Future With-Project Habitat Suitability Index for Barred Owl and Gray Squirrel, Habitat Units for Each Target Year, Average Habitat Units for Each Target Year between the Models, and the Average Annual Habitat Units for River Road (Scale 3B)

			Target Year											
			0		1		5		10		25		50	
Alternative	Model	Acres	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU	HSI	HU
River Road ([1]3B)	Barred Owl	4.9	0.0	0	0.0	0	0.0	0	0.0	0	0.3	2	0.7	4
	Gray Squirrel	4.9	0.1	1	0.0	0	0.1	0	0.4	2	1.0	5	1.0	5
AAHU = 3	Average HU		0		0		0		1		3		1	

[1]3B: Refers to the FWP condition of implementing Alternative 3 – Scale 3A. The FWP must be compared to the FWOP, so FWOP was analyzed using the existing conditions.
[2]Average HU: The average habitat units between the Barred Owl and Gray Squirrel models

5 Ecological Benefits of the Alternatives

Overall, Scale 1A of the Instream Modification Alternative has the highest rate of AAHUs. Scale 2B of the Avenue A Modification has the lowest amount of AAHUs gained through project implementation. All AAHUs have a dependency upon Index scores and acreage, which can result in only minor changes of AAHUS between the FWOP and FWP with certain alternatives. The Instream Modification alternative yielded an increase between 26% and 70% from the future without-project and future with-project condition. Avenue A Modification increases 100% to 113% from the future without-project and future with-project condition, while the River Road Modification approximately increases by 2,500-2,600% due to project implementation.

Table 13. Comparison of Future Without-Project, Future-With Project, Average Annual Habitat Units, and Area of All Alternatives

Alternative	Scale	FWOP AAHU	FWP AAHU	AAHU Benefits	Acres
Instream Modification	1A: Removal of Low Water Crossings 1, 2, & 3	7.6	12.9	5.3	16
	1B: Modification of Low Water Crossing 1 and Removal of Low Water Crossings 2 and 3	7.6	10.8	3.2	16
	1C: Removal of Low Water Crossing 1 and Modification of Low Water Crossings 2 & 3	7.6	11.7	4.1	16
	1D: Modification of Low Water Crossings 1, 2, & 3	7.6	9.6	2.0	16
Avenue A Modification	2A: Complete removal of Avenue A	0.8	1.7	0.9	4.6
	2B: Partial removal of Avenue A	0.4	0.8	0.4	2
River Road	3A: River Road Relocation and Planting in Davis Park	0.0	2.6	2.6	5.1

Alternative	Scale	FWOP AAHU	FWP AAHU	AAHU Benefits	Acres
	3B: River Road As-Is and Planting in Davis Park	0.0	2.5	2.5	4.9

6 References

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----------1987b. Habitat Suitability Index Models: Gray Squirrel. Biological Report 82(10.135). July 1987. 16 pp.

7 List of Preparers

Justyss Watson – Biologist, Regional Planning and Environmental Center; 6 years USACE experience.

Daniel Allen – Wildlife Biologist, Regional Planning and Environmental Center, 9 years USACE experience.

Attachment A

1-North

1-East

1-South

1-West

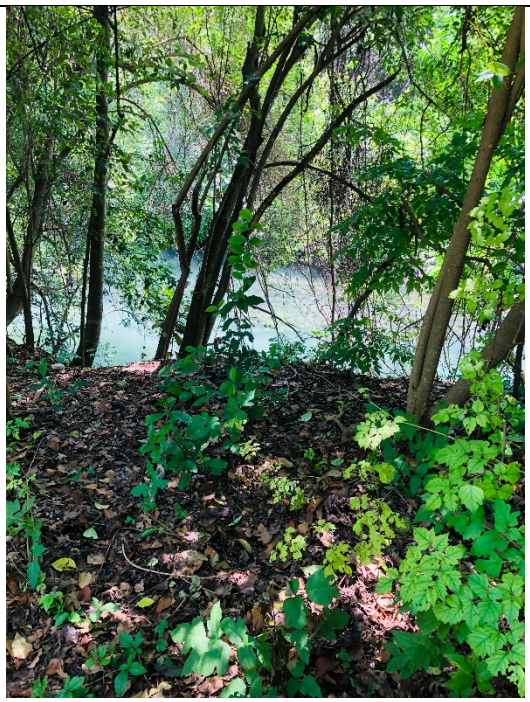
2-North

2-East

2-South

2-West

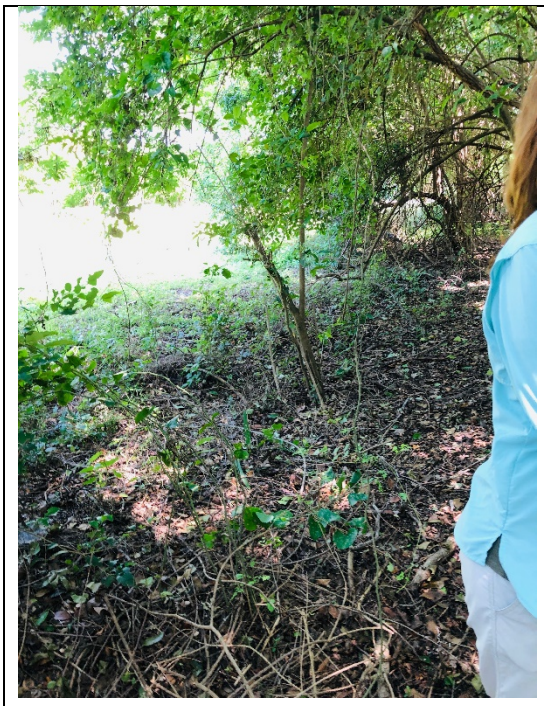
3-North



3-East

3-South

3-West

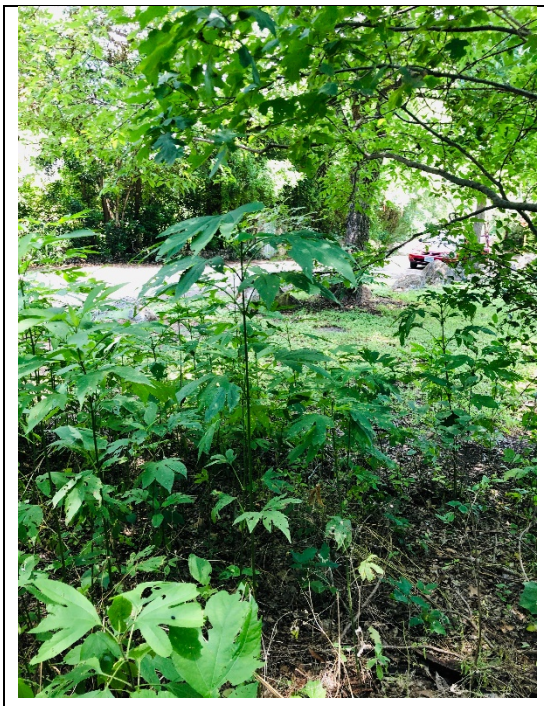


4-North

4-East

4-South

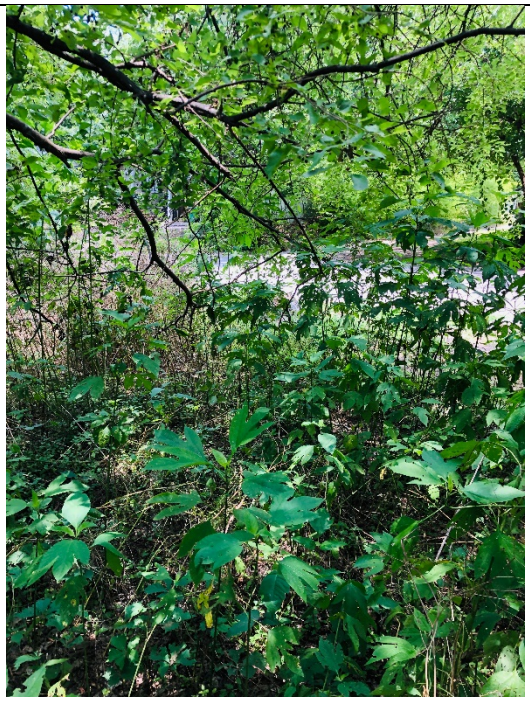
4-West



6-North

6-East

6-South



6-West

11-North

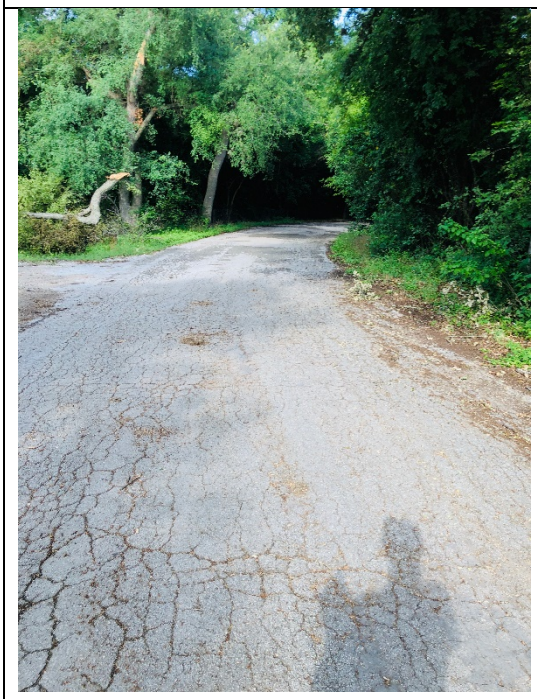
11-East

11-South

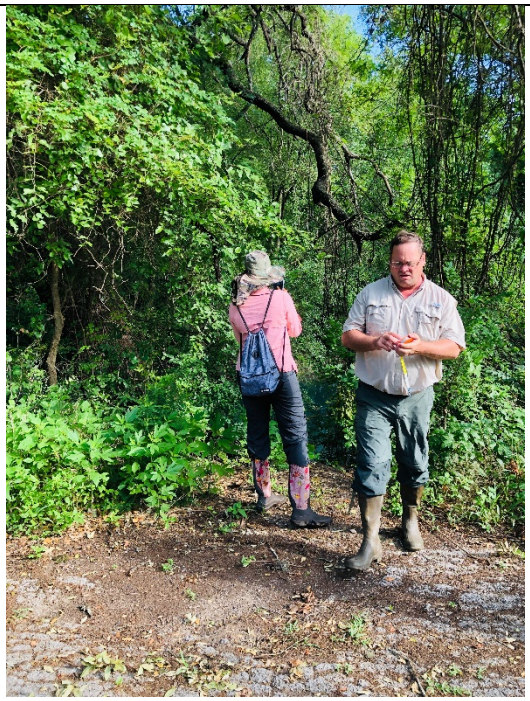
11-West

12-North

12-East



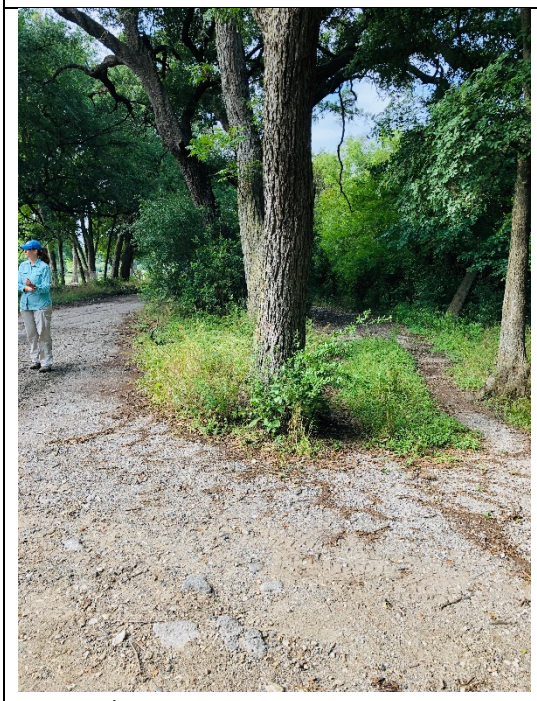
12-South



12-West

13-North

13-East



13-South

13-West

14-North

14-East

14-South

14-West

15-North

15-East

15-South

15-West

16-North

16-East

16-South

16-West

A-Upstream

A-Central

A-Downstream

B-Upstream

B-Central

B-Downstream

C-Upstream

C-Central

C-Downstream

D-Upstream

D-Central

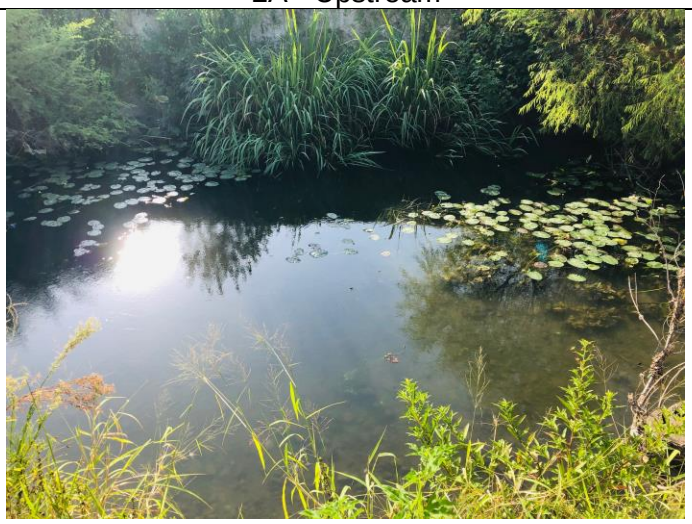
D-Downstream

E-Upstream

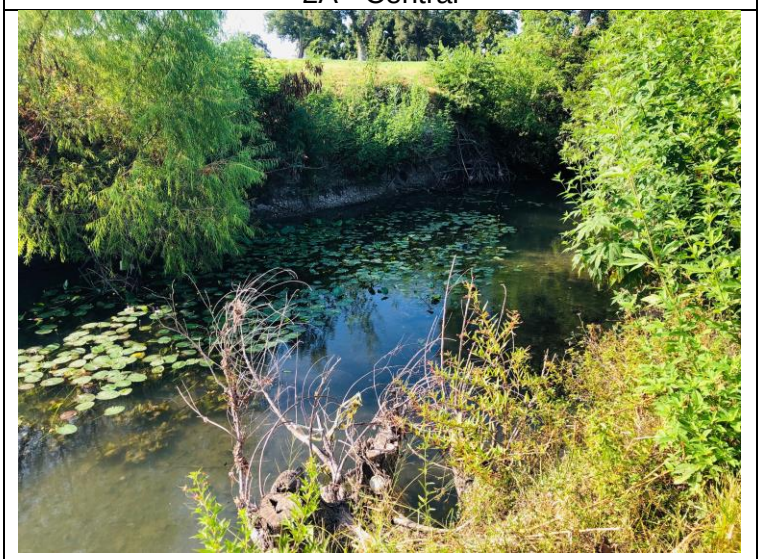
E-Central

E-Downstream

2A - Upstream



2A - Central



2A - Downstream

2B - Upstream

2B - Central

2B - Downstream

2C - Upstream

2C - Central

2C - Downstream

Attachment B

Site	Vegetation
1	Pecan, Poison Ivy, Redbud, Turk's Cap, Hackberry, Greenbriar, Chinese Privet, Palmetto, Donax spp., Peppervine, Straggler's Daisy, Ball Moss, Cheatgrass, Trumpetvine, Mustang Grape, Live Oak, Spiderwort
2	Loquat, Pecan, Chinaberrytree, Hackberry, Texas Palmetto, Poison Ivy, Greenbriar, Giant Cane, Roughleaf Dogwood, Sonchus sp., Turk's Cap, Wild Rye
3	Poison Ivy, Umbrella, Peppervine, Pecan, Chinese Privet, Scrub Oak, Hackberry, Sonchus spp., Bastard Cabbage, Beggar's Tick
4	Pecan, Virginia Creeper, Poison Ivy, Loquat, Palmetto, Chinese Privet, Greenbriar, Turk's Cap, Hackberry, Beggar's Tick, Mustang Grape
6	Straggler's Daisy, Post Oak, Giant Ragwee, Pecan, Hackberry, Beggar's Tick, Peppervine, Virginia Creeper, Turk's Cap, Horseweed, Wild Rye, Poison Ivy
11	Pecan, Live Oak, Green Ash, Poison Ivy, Mulberry, Hackberry, Chinese Privet, Inland Sea Oats, Cyparis spp., Beggar's Tick, Giant Ragwee, Buttonbush, Ball Moss, Greenbriar, Lantana, Carolina Ruellia, Horseweed, Oxalis spp., Dewberry, Cedar Elm, Virginia Wild Rye
12	Poison Ivy, Peppervine, Beggar's Tick, Bermudagrass, Horseweed, Paspalum spp., Lantana, Live Oak, Green Ash, Pecan, Greenbriar, Horsetail, Partridge Pea, Cedar Elm, Giant Ragweed, Mulberry, Ball Moss, Chinese Privet, Hackberry, Cheatgrass, Red Oak
13	Pecan, Greenbriar, Inland Sea Oats, Cedar Elm, Virginia Wild Rye, Common Blue Wood Aster, Giant Ragwee Turk's Cap, Horseweed, Mexican Ruellia, Dewberry, Straggler's Daisy, Carex spp., Chinese Privet
14	Roughleaf Dogwood, Giant Ragweed, Inland Sea Oats, Straggler's Daisy, Virginia Wild Rye, Poison Ivy, Hackberry, Cedar Elm, Dicanthelium spp., Dewberry, Beggar's Tick, Crossvine, Sable Minor, Chinese Privet, Giant Cane
15	Giant Ragweed, Hackberry, Pecan, Live Oak, Straggler's Daisy, Peppervine, Poison Ivy, Cheatgrass, Virginia Wild Rye, Beggar's Tick, Small-leaf Spiderwort, Mexican White Oak, Dewberry, Common Blue Aster, Red Oak, Turk's Cap, Inland Sea Oats, Mexican Ruellia, Three-lobe False Mallow, Virginia Creeper, Chinaberrytree
16	Green Ash, Straggler's Daisy, False Mallow, Bermudagrass
2A	Bermudagrass, Passionflower, Rattlebox, Willow, Giant Ragweed, Pecan, Kitegrass, Bull Nettle, Morning Glory, Dandelion Sedge
2B	Bermudagrass, Rattlebox, Dayflower, Giant Ragwee, Morning Glory, Mustang Grape, Careless Weed
2C	Bermudagrass, Elephant Ear, Willow, Cutgrass

Vegetated Area Averages
1.3
21.75
67.5

1	Barred Owl	HSI	1.18
			Enter Data
# trees >20"	V1	1.00	2
mean dbh	V2	1.40	26
% canopy	V3	1.00	90

2	Barred Owl	HSI	1.03
			Enter Data
# trees >20"	V1	1.00	2
mean dbh	V2	1.07	21
% canopy	V3	1.00	90

3	Barred Owl	HSI	0.74
			Enter Data
# trees >20"	V1	0.55	1
mean dbh	V2	1.00	20
% canopy	V3	1.00	75

4	Barred Owl	HSI	1.34
			Enter Data
# trees >20"	V1	1.00	2
mean dbh	V2	1.80	32
% canopy	V3	1.00	95

6	Barred Owl	HSI	0.25
			Enter Data
# trees >20"	V1	0.10	0
mean dbh	V2	0.63	14.5
% canopy	V3	1.00	60

11	Barred Owl	HSI	1.39
			Enter Data
# trees >20"	V1	1.00	2
mean dbh	V2	1.93	34
% canopy	V3	1.00	65

12	Barred Owl	HSI	0.00

			Enter Data
# trees >20"	V1	0.55	1
mean dbh	V2	1.80	32
% canopy	V3	0.00	15

13	Barred Owl	HSI	0.56
			Enter Data
# trees >20"	V1	0.55	1
mean dbh	V2	0.73	16
% canopy	V3	0.88	55

14	Barred Owl	HSI	0.18
			Enter Data
# trees >20"	V1	0.10	0
mean dbh	V2	0.33	10
% canopy	V3	1.00	75

15	Barred Owl	HSI	0.60
			Enter Data
# trees >20"	V1	1.00	2
mean dbh	V2	0.47	12
% canopy	V3	0.88	55

16	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.55	1
mean dbh	V2	2.33	40
% canopy	V3	0.00	1

Park

Unvegetated Area Averages
0.25
10.50
0.50

2A	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.10	0
mean dbh	V2	0.00	1
% canopy	V3	0.00	0.5

Avian IBI Averages
0.00
0.67
0.33

2B	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.10	0

mean dbh	V2	0.00	1
% canopy	V3	0.00	0.5

2C	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.10	0
mean dbh	V2	0.00	0
% canopy	V3	0.00	0

Enter Condition:	1	Enter Year:	
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	100.0%	1.00
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	4	0.80
SIV_3	Percent canopy cover of trees for food (%)	90.0%	0.88
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	90.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	16	1.00
SI_{WF}	Winter Food Index	-	0.79
SI_{CR}	Cover/Reproduction	-	1.00
	HSI	-	0.79

Vegetated Area Averages
46.3%
2.8
67.5%
67.5%
13

Enter Condition:	2	Enter Year:	
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	10.0%	0.19
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	2	0.20
SIV_3	Percent canopy cover of trees for food (%)	90.0%	0.88
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	90.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	10	0.50
SI_{WF}	Winter Food Index	-	0.17
SI_{CR}	Cover/Reproduction	-	0.71
	HSI	-	0.17

Enter Condition:	3	Enter Year:	
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	60.0%	0.64
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	3	0.50
SIV_3	Percent canopy cover of trees for food (%)	75.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	75.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	9	0.40
SI_{WF}	Winter Food Index	-	0.57
SI_{CR}	Cover/Reproduction	-	0.63
	HSI	-	0.57

Enter Condition:	4	Enter Year:	
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	70.0%	0.73
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	2	0.20
SIV_3	Percent canopy cover of trees for food (%)	90.0%	0.88
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	90.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	12	0.70

SI_{WF}	Winter Food Index	-	0.34
SI_{CR}	Cover/Reproduction	-	0.84
	HSI	-	0.34

Enter Condition:	6	Enter Year:	
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	33.0%	0.40
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	3	0.50
SIV_3	Percent canopy cover of trees for food (%)	60.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	60.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	12	0.70
SI_{WF}	Winter Food Index	-	0.45
SI_{CR}	Cover/Reproduction	-	0.84
	HSI	-	0.45

Enter Condition:	11	Enter Year:	
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	80.0%	0.82
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	2	0.20
SIV_3	Percent canopy cover of trees for food (%)	65.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	65.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	16.8	1.00
SI_{WF}	Winter Food Index	-	0.40
SI_{CR}	Cover/Reproduction	-	1.00
	HSI	-	0.40

Enter Condition:	12	Enter Year:	
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	15.0%	0.24
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	4	0.80
SIV_3	Percent canopy cover of trees for food (%)	15.0%	0.38
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	15.0%	0.38
SIV_5	Mean dbh of overstory trees (inches)	19	1.00
SI_{WF}	Winter Food Index	-	0.16
SI_{CR}	Cover/Reproduction	-	0.61
	HSI	-	0.16

Enter Condition:	13	Enter Year:	
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	20.0%	0.28

SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	2	0.20
SIV_3	Percent canopy cover of trees for food (%)	60.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	60.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	14	0.90
SI_{WF}	Winter Food Index	-	0.24
SI_{CR}	Cover/Reproduction	-	0.95
	HSI	-	0.24

Enter Condition: 14 Enter Year:

Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	1	0.10
SIV_3	Percent canopy cover of trees for food (%)	75.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	75.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	10	0.50
SI_{WF}	Winter Food Index	-	0.10
SI_{CR}	Cover/Reproduction	-	0.71
	HSI	-	0.10

Enter Condition: 15 Enter Year:

Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	75.0%	0.78
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	5	1.00
SIV_3	Percent canopy cover of trees for food (%)	55.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	55.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	12	0.70
SI_{WF}	Winter Food Index	-	0.88
SI_{CR}	Cover/Reproduction	-	0.84
	HSI	-	0.84

Enter Condition: 16 Enter Year:

Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	1	0.10
SIV_3	Percent canopy cover of trees for food (%)	1.0%	0.03
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	1.0%	0.03
SIV_5	Mean dbh of overstory trees (inches)	40	1.00
SI_{WF}	Winter Food Index	-	0.00
SI_{CR}	Cover/Reproduction	-	0.16

Vegetated Area Averages
0.0%
1.0
0.5%
0.5%
11

	HSI	-	0.00

Enter Condition:	2A	Enter Year:	
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	1	0.10
SIV_3	Percent canopy cover of trees for food (%)	0.5%	0.01
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	0.5%	0.01
SIV_5	Mean dbh of overstory trees (inches)	1	0.00
SI_{WF}	Winter Food Index	-	0.00
SI_{CR}	Cover/Reproduction	-	0.00
	HSI	-	0.00

Enter Condition:	2B	Enter Year:	
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	1	0.10
SIV_3	Percent canopy cover of trees for food (%)	0.5%	0.01
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	0.5%	0.01
SIV_5	Mean dbh of overstory trees (inches)	1	0.00
SI_{WF}	Winter Food Index	-	0.00
SI_{CR}	Cover/Reproduction	-	0.00
	HSI	-	0.00

Enter Condition:	2C	Enter Year:	
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	1	0.10
SIV_3	Percent canopy cover of trees for food (%)	0.0%	0.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	0.0%	0.00
SIV_5	Mean dbh of overstory trees (inches)	0	0.00
SI_{WF}	Winter Food Index	-	0.00
SI_{CR}	Cover/Reproduction	-	0.00
	HSI	-	0.00

Avian IBI Averages

0.0%
1.0
0.3%
0.3%
1

Condition:	1		Enter Year:	
Variable	Description	Data	HSI	Comments
V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	40.0%	1.00	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	16	1.00	
V4	Percent tree canopy closure	90	0.63	
V5	Percent shrub crown cover	35	0.91	
	HSI for Winter Food		1.03	
	HSI for Cover-Reproduction		0.83	
	Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.83	

Vegetated Averages	
	34.3%
	800.0
	13.3
	61.0
	12.0

Condition:	2		Enter Year:	
Variable	Description	Data	HSI	Comments
V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	10.0%	0.25	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	10	0.33	
V4	Percent tree canopy closure	10	0.50	
V5	Percent shrub crown cover	15	1.00	
	HSI for Winter Food		0.28	
	HSI for Cover-Reproduction		0.55	
	Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.28	

Condition:	3		Enter Year:	
Variable	Description	Data	HSI	Comments

V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	60.0%	1.00	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	9	0.20	
V4	Percent tree canopy closure	75	0.81	
V5	Percent shrub crown cover	10	1.00	

HSI for Winter Food		1.03
HSI for Cover-Reproduction		0.55
Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.55

Condition: 4 **Enter Year:**

Variable	Description	Data	HSI	Comments
V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	70.0%	0.90	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	12	0.60	
V4	Percent tree canopy closure	90	0.63	
V5	Percent shrub crown cover	15	1.00	

HSI for Winter Food		0.93
HSI for Cover-Reproduction		0.72
Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.72

Condition: 6 **Enter Year:**

Variable	Description	Data	HSI	Comments
V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	33.0%	0.83	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	12	0.60	

V4	Percent tree canopy closure	60	1.00	
V5	Percent shrub crown cover	20	1.00	

HSI for Winter Food		0.86
HSI for Cover-Reproduction		0.84
Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.84

Condition:	11		**Enter Year:**	
Variable	Description	Data	HSI	Comments
V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	80.0%	0.80	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	16.8	1.00	
V4	Percent tree canopy closure	80	0.75	
V5	Percent shrub crown cover	10	1.00	

HSI for Winter Food		0.83
HSI for Cover-Reproduction		0.91
Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.83

Condition:	12		**Enter Year:**	
Variable	Description	Data	HSI	Comments
V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	15.0%	0.38	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	19	1.00	
V4	Percent tree canopy closure	15	0.75	
V5	Percent shrub crown cover	10	1.00	

HSI for Winter Food		0.41
HSI for Cover-Reproduction		0.91

	Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.41	

Condition:	13		**Enter Year:**	
Variable	Description	Data	HSI	Comments
V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	20.0%	0.50	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	16	1.00	
V4	Percent tree canopy closure	60	1.00	
V5	Percent shrub crown cover	2	1.00	
	HSI for Winter Food		0.53	
	HSI for Cover-Reproduction		1.00	
	Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.53	

Condition:	14		**Enter Year:**	
Variable	Description	Data	HSI	Comments
V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	0.0%	0.00	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	10	0.33	
V4	Percent tree canopy closure	75	0.81	
V5	Percent shrub crown cover	1	1.00	
	HSI for Winter Food		0.03	
	HSI for Cover-Reproduction		0.65	
	Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.03	

Condition:	15		**Enter Year:**	
Variable	Description	Data	HSI	Comments

V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	15.0%	0.38	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	12	0.60	
V4	Percent tree canopy closure	55	1.00	
V5	Percent shrub crown cover	2	1.00	

HSI for Winter Food		0.41
HSI for Cover-Reproduction		0.84
Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.41

Condition: 16 **Enter Year:**

Variable	Description	Data	HSI	Comments
V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	0.0%	0.00	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	40	1.00	
V4	Percent tree canopy closure	1	0.05	
V5	Percent shrub crown cover	0	1.00	

HSI for Winter Food		0.03
HSI for Cover-Reproduction		0.37
Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.03

UnVegetated Averages
0.0%
800.0
10.5
0.3
0.5

Condition: 2A **Enter Year:**

Variable	Description	Data	HSI	Comments
V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	0.0%	0.00	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	1	0.00	

Avian IBI Averages
0.0%
800.0
0.7

V4	Percent tree canopy closure	0	0.00	
V5	Percent shrub crown cover	1	1.00	

HSI for Winter Food		0.03	
HSI for Cover-Reproduction		0.00	
Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.00	

0.0
0.7

Condition: 2B **Enter Year:**

Variable	Description	Data	HSI	Comments
V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	0.0%	0.00	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	1	0.00	
V4	Percent tree canopy closure	0	0.00	
V5	Percent shrub crown cover	1	1.00	

HSI for Winter Food		0.03	
HSI for Cover-Reproduction		0.00	
Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.00	

Condition: 2C **Enter Year:**

Variable	Description	Data	HSI	Comments
V1	Percent canopy closure of trees that produce hard mast (e.g., oak, hickory, walnut, pecan, beech) >= 25.4 cm (10 inches) dbh	0.0%	0.00	
V2	Distance to available grain (m)	800	0.10	
V3	Average dbh of overstory trees (in)	0	0.00	
V4	Percent tree canopy closure	0	0.00	
V5	Percent shrub crown cover	0	1.00	

HSI for Winter Food		0.03	
HSI for Cover-Reproduction		0.00	
Overall HSI (lowest HSI for Winter Food/Cover-Reproduction)		0.00	

Attachment C

FWOP - Vegetation

0	Barred Owl	HSI	0.87
			Enter Data
# trees >20"	V1	0.69	1.3
mean dbh	V2	1.12	21.75
% canopy	V3	1.00	67.5

1	Barred Owl	HSI	0.87
			Enter Data
# trees >20"	V1	0.69	1.3
mean dbh	V2	1.12	21.75
% canopy	V3	1.00	67.5

5	Barred Owl	HSI	0.87
			Enter Data
# trees >20"	V1	0.69	1.3
mean dbh	V2	1.12	21.75
% canopy	V3	1.00	67.5

10	Barred Owl	HSI	0.87
			Enter Data
# trees >20"	V1	0.69	1.3
mean dbh	V2	1.12	21.75
% canopy	V3	1.00	67.5

25	Barred Owl	HSI	0.80
			Enter Data
# trees >20"	V1	0.60	1.1
mean dbh	V2	1.07	21
% canopy	V3	1.00	62

50	Barred Owl	HSI	0.84
			Enter Data
# trees >20"	V1	0.64	1.2
mean dbh	V2	1.10	21.5
% canopy	V3	1.00	65

FWOP - Without Vegetation

0	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.21	0.25
mean dbh	V2	0.37	10.5
% canopy	V3	0.00	0.5

1	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.21	0.25
mean dbh	V2	0.37	10.5
% canopy	V3	0.00	0.5

5	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.21	0.25
mean dbh	V2	0.37	10.5
% canopy	V3	0.00	0.5

10	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.21	0.25
mean dbh	V2	0.37	10.5
% canopy	V3	0.00	0.5

25	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.21	0.25
mean dbh	V2	0.37	10.5
% canopy	V3	0.00	0.5

50	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.21	0.25
mean dbh	V2	0.37	10.5
% canopy	V3	0.00	0.5

FWP - Vegetation

0	Barred Owl	HSI	0.87
			Enter Data
# trees >20"	V1	0.69	1.3
mean dbh	V2	1.12	21.75
% canopy	V3	1.00	67.5

1	Barred Owl	HSI	0.80
			Enter Data
# trees >20"	V1	0.60	1.1
mean dbh	V2	1.07	21
% canopy	V3	1.00	66

5	Barred Owl	HSI	0.80
			Enter Data
# trees >20"	V1	0.60	1.1
mean dbh	V2	1.07	21
% canopy	V3	1.00	66

10	Barred Owl	HSI	0.96
			Enter Data
# trees >20"	V1	0.78	1.5
mean dbh	V2	1.20	23
% canopy	V3	1.00	70

25	Barred Owl	HSI	1.13
			Enter Data
# trees >20"	V1	0.87	1.7
mean dbh	V2	1.47	27
% canopy	V3	1.00	75

50	Barred Owl	HSI	1.24
			Enter Data
# trees >20"	V1	1.00	2
mean dbh	V2	1.53	28
% canopy	V3	1.00	76

FWP - Without Vegetation

0	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.21	0.25
mean dbh	V2	0.37	10.5
% canopy	V3	0.00	0.5

1	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.21	0.25
mean dbh	V2	0.37	10.5
% canopy	V3	0.00	0.5

5	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.21	0.25
mean dbh	V2	0.37	10.5
% canopy	V3	0.00	10

10	Barred Owl	HSI	0.00
			Enter Data
# trees >20"	V1	0.21	0.25
mean dbh	V2	0.40	11
% canopy	V3	0.00	20

25	Barred Owl	HSI	0.30
			Enter Data
# trees >20"	V1	0.66	1.25
mean dbh	V2	0.53	13
% canopy	V3	0.50	40

50	Barred Owl	HSI	0.72
			Enter Data
# trees >20"	V1	0.78	1.5
mean dbh	V2	0.67	15
% canopy	V3	1.00	60

FWOP - Vegetation

Enter Condition:		Enter Year:	0
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	46.3%	0.52
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	3	0.50
SIV_3	Percent canopy cover of trees for food (%)	67.5%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	67.5%	1.00
SIV_5	Mean dbh of overstory trees (inches)	13	0.80
SI_{WF}	Winter Food Index	-	0.51
SI_{CR}	Cover/Reproduction	-	0.89
	HSI	-	0.51

Enter Condition:		Enter Year:	1
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	46.3%	0.52
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	3	0.50
SIV_3	Percent canopy cover of trees for food (%)	67.5%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	67.5%	1.00
SIV_5	Mean dbh of overstory trees (inches)	13	0.80
SI_{WF}	Winter Food Index	-	0.51
SI_{CR}	Cover/Reproduction	-	0.89
	HSI	-	0.51

Enter Condition:		Enter Year:	5
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	27.0%	0.34
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	2	0.20
SIV_3	Percent canopy cover of trees for food (%)	67.5%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	67.5%	1.00
SIV_5	Mean dbh of overstory trees (inches)	13	0.80
SI_{WF}	Winter Food Index	-	0.26
SI_{CR}	Cover/Reproduction	-	0.89
	HSI	-	0.26

Enter Condition:		Enter Year:	10
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	20.0%	0.28
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	2	0.20
SIV_3	Percent canopy cover of trees for food (%)	67.5%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	67.5%	1.00
SIV_5	Mean dbh of overstory trees (inches)	12	0.70
SI_{WF}	Winter Food Index	-	0.24
SI_{CR}	Cover/Reproduction	-	0.84
	HSI	-	0.24

Enter Condition:		Enter Year:	25
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	13.0%	0.22
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	2	0.20
SIV_3	Percent canopy cover of trees for food (%)	62.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	62.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	11	0.60
SI_{WF}	Winter Food Index	-	0.21
SI_{CR}	Cover/Reproduction	-	0.77
	HSI	-	0.21

Enter Condition:		Enter Year:	50
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	13.0%	0.22
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	2	0.20
SIV_3	Percent canopy cover of trees for food (%)	65.0%	1.00

FWOP - Without Vegetation

Enter Condition:		Enter Year:	0
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	1	0.10
SIV_3	Percent canopy cover of trees for food (%)	0.5%	0.01
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	0.5%	0.01
SIV_5	Mean dbh of overstory trees (inches)	11	0.60
SI_{WF}	Winter Food Index	-	0.00
SI_{CR}	Cover/Reproduction	-	0.09
	HSI	-	0.00

Enter Condition:		Enter Year:	1
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	1	0.10
SIV_3	Percent canopy cover of trees for food (%)	0.5%	0.01
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	0.5%	0.01
SIV_5	Mean dbh of overstory trees (inches)	11	0.60
SI_{WF}	Winter Food Index	-	0.00
SI_{CR}	Cover/Reproduction	-	0.09
	HSI	-	0.00

Enter Condition:		Enter Year:	5
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	1	0.10
SIV_3	Percent canopy cover of trees for food (%)	0.5%	0.01
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	0.5%	0.01
SIV_5	Mean dbh of overstory trees (inches)	11	0.60
SI_{WF}	Winter Food Index	-	0.00
SI_{CR}	Cover/Reproduction	-	0.09
	HSI	-	0.00

Enter Condition:		Enter Year:	10
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	1	0.10
SIV_3	Percent canopy cover of trees for food (%)	0.5%	0.01
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	0.5%	0.01
SIV_5	Mean dbh of overstory trees (inches)	11	0.60
SI_{WF}	Winter Food Index	-	0.00
SI_{CR}	Cover/Reproduction	-	0.09
	HSI	-	0.00

Enter Condition:		Enter Year:	25
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	1	0.10
SIV_3	Percent canopy cover of trees for food (%)	0.5%	0.01
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	0.5%	0.01
SIV_5	Mean dbh of overstory trees (inches)	11	0.60
SI_{WF}	Winter Food Index	-	0.00
SI_{CR}	Cover/Reproduction	-	0.09
	HSI	-	0.00

Enter Condition:		Enter Year:	50
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	1	0.10
SIV_3	Percent canopy cover of trees for food (%)	1.0%	0.03

SIV_4	Percent canopy cover of trees for cover/reproduction (%)	65.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	11	0.60
SI_{WF}	Winter Food Index	-	0.21
SI_{CR}	Cover/Reproduction	-	0.77
	HSI	-	0.21

SIV_4	Percent canopy cover of trees for cover/reproduction (%)	1.0%	0.03
SIV_5	Mean dbh of overstory trees (inches)	12	0.70
SI_{WF}	Winter Food Index	-	0.00
SI_{CR}	Cover/Reproduction	-	0.13
	HSI	-	0.00

FWP - Vegetation

Enter Condition:		Enter Year:	0
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	46.3%	0.52
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	3	0.50
SIV_3	Percent canopy cover of trees for food (%)	67.5%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	67.5%	1.00
SIV_5	Mean dbh of overstory trees (inches)	13	0.80
SI_{WF}	Winter Food Index	-	0.51
SI_{CR}	Cover/Reproduction	-	0.89
	HSI	-	0.51

Enter Condition:		Enter Year:	1
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	46.3%	0.52
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	5	1.00
SIV_3	Percent canopy cover of trees for food (%)	66.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	66.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	13	0.80
SI_{WF}	Winter Food Index	-	0.72
SI_{CR}	Cover/Reproduction	-	0.89
	HSI	-	0.72

Enter Condition:		Enter Year:	5
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	46.3%	0.52
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	5	1.00
SIV_3	Percent canopy cover of trees for food (%)	70.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	70.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	15	1.00
SI_{WF}	Winter Food Index	-	0.72
SI_{CR}	Cover/Reproduction	-	1.00
	HSI	-	0.72

Enter Condition:		Enter Year:	10
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	55.0%	0.60
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	5	1.00
SIV_3	Percent canopy cover of trees for food (%)	70.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	70.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	15	1.00
SI_{WF}	Winter Food Index	-	0.77
SI_{CR}	Cover/Reproduction	-	1.00
	HSI	-	0.77

Enter Condition:		Enter Year:	25
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	62.0%	0.66
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	5	1.00
SIV_3	Percent canopy cover of trees for food (%)	75.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	75.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	17	1.00
SI_{WF}	Winter Food Index	-	0.81
SI_{CR}	Cover/Reproduction	-	1.00
	HSI	-	0.81

Enter Condition:		Enter Year:	50
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	65.0%	0.69
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	5	1.00
SIV_3	Percent canopy cover of trees for food (%)	76.0%	0.99

FWP - Without Vegetation

Enter Condition:		Enter Year:	0
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	1	0.10
SIV_3	Percent canopy cover of trees for food (%)	50.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	50.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	11	0.60
SI_{WF}	Winter Food Index	-	0.10
SI_{CR}	Cover/Reproduction	-	0.77
	HSI	-	0.10

Enter Condition:		Enter Year:	1
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	5	1.00
SIV_3	Percent canopy cover of trees for food (%)	0.5%	0.01
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	0.5%	0.01
SIV_5	Mean dbh of overstory trees (inches)	11	0.60
SI_{WF}	Winter Food Index	-	0.00
SI_{CR}	Cover/Reproduction	-	0.09
	HSI	-	0.00

Enter Condition:		Enter Year:	5
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	0.0%	0.10
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	5	1.00
SIV_3	Percent canopy cover of trees for food (%)	10.0%	0.25
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	10.0%	0.25
SIV_5	Mean dbh of overstory trees (inches)	11	0.60
SI_{WF}	Winter Food Index	-	0.08
SI_{CR}	Cover/Reproduction	-	0.39
	HSI	-	0.08

Enter Condition:		Enter Year:	10
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	50.0%	0.55
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	5	1.00
SIV_3	Percent canopy cover of trees for food (%)	20.0%	0.50
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	20.0%	0.50
SIV_5	Mean dbh of overstory trees (inches)	12	0.70
SI_{WF}	Winter Food Index	-	0.37
SI_{CR}	Cover/Reproduction	-	0.59
	HSI	-	0.37

Enter Condition:		Enter Year:	25
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	95.0%	0.96
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	5	1.00
SIV_3	Percent canopy cover of trees for food (%)	60.0%	1.00
SIV_4	Percent canopy cover of trees for cover/reproduction (%)	60.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	15	1.00
SI_{WF}	Winter Food Index	-	0.98
SI_{CR}	Cover/Reproduction	-	1.00
	HSI	-	0.98

Enter Condition:		Enter Year:	50
Variable	Description	DATA	HSI
SIV_1	Proportion of total tree canopy that is hard mast producing >= 25 cm dbh	95.0%	0.96
SIV_2	Number of hard mast tree species 1 = hard mast species absent 2 = one species present 3 = two species present 4 = three species present 5 = more than 4 species present	5	1.00
SIV_3	Percent canopy cover of trees for food (%)	60.0%	1.00

SIV_4	Percent canopy cover of trees for cover/reproduction (%)	76.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	18	1.00
SI_{WF}	Winter Food Index	-	0.82
SI_{CR}	Cover/Reproduction	-	1.00
	HSI	-	0.82

SIV_4	Percent canopy cover of trees for cover/reproduction (%)	60.0%	1.00
SIV_5	Mean dbh of overstory trees (inches)	15	1.00
SI_{WF}	Winter Food Index	-	0.98
SI_{CR}	Cover/Reproduction	-	1.00
	HSI	-	0.98

Attachment D

Metric #	Site A FWOP Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/ Available Cover	13	13	13	13	13	13	13
2b	Pool Substrate	12	12	12	12	12	12	12
3b	Pool Variability	11	11	11	11	11	11	11
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	17	17	17	17	16	14	12
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	6	5
8 RB	Bank Stability (Right Bank)	6	6	6	6	5	4	3
9 LB	Vegetative Protection (Left Bank)	7	7	7	7	6	5	4
9 RB	Vegetative Protection (Right Bank)	6	6	6	6	5	4	3
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	4	4	3	2	2
10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	8	8	8	6	5
		0.61	0.61	0.61	0.61	0.59	0.54	0.50

Metric #	FWP Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/ Available Cover	13	13	13	13	13	13	13
2b	Pool Substrate	12	12	12	12	12	12	12
3b	Pool Variability	11	11	11	11	11	11	11
4	Sediment Deposition	6	6	8	8	8	8	8
5	Channel Flow Status	17	17	17	17	17	15	13
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	6	5
8 RB	Bank Stability (Right Bank)	6	6	6	6	5	4	3
9 LB	Vegetative Protection (Left Bank)	7	7	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	6	6	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	10	10	10	10	10
10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	10	10	10	10	10
		0.61	0.61	0.68	0.70	0.69	0.67	0.65

Site B

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/ Available Cover	13	13	13	13	13	13	13
2b	Pool Substrate	12	12	12	12	12	12	12
3b	Pool Variability	11	11	11	11	11	11	11
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	17	17	17	17	16	14	12
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	8	8
8 RB	Bank Stability (Right Bank)	6	6	6	6	6	6	6
9 LB	Vegetative Protection (Left Bank)	7	7	7	7	6	5	4
9 RB	Vegetative Protection (Right Bank)	6	6	6	6	5	4	3
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	4	4	3	2	2
10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	8	8	8	6	5
		0.61	0.61	0.61	0.61	0.59	0.56	0.53

Metric #	FWP Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/ Available Cover	13	13	13	13	13	13	13
2b	Pool Substrate	12	12	12	12	12	12	12
3b	Pool Variability	11	11	11	11	11	11	11
4	Sediment Deposition	6	6	8	8	8	8	8
5	Channel Flow Status	17	17	17	17	17	15	13
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	8	8
8 RB	Bank Stability (Right Bank)	6	6	6	6	6	6	6
9 LB	Vegetative Protection (Left Bank)	7	7	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	6	6	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	10	10	10	10	10
10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	10	10	10	10	10
		0.61	0.61	0.68	0.70	0.70	0.69	0.68

Site C Metric #	FWOP Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/ Available Cover	13	13	13	13	13	13	13
2b	Pool Substrate	12	12	12	12	12	12	12
3b	Pool Variability	11	11	11	11	11	11	11
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	17	17	17	17	16	14	12
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	8	8
8 RB	Bank Stability (Right Bank)	6	6	6	6	6	6	6
9 LB	Vegetative Protection (Left Bank)	7	7	7	7	6	5	4
9 RB	Vegetative Protection (Right Bank)	6	6	6	6	5	4	3
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	4	4	3	2	2
10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	8	8	8	6	5
		0.61	0.61	0.61	0.61	0.59	0.56	0.53

Metric #	FWP Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/ Available Cover	13	13	13	13	13	13	13
2b	Pool Substrate	12	12	12	12	12	12	12
3b	Pool Variability	11	11	11	11	11	11	11
4	Sediment Deposition	6	6	8	8	8	8	8
5	Channel Flow Status	17	17	17	17	17	15	13
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	8	8
8 RB	Bank Stability (Right Bank)	6	6	6	6	6	6	6
9 LB	Vegetative Protection (Left Bank)	7	7	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	6	6	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	10	10	10	10	10
10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	10	10	10	10	10
		0.61	0.61	0.68	0.70	0.70	0.69	0.68

Site D

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50

FWP

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50

1	Epifaunal Substrate/ Available Cover	13	13	13	13	13	13	13
2b	Pool Substrate	7	7	7	7	7	7	7
3b	Pool Variability	11	11	11	11	11	11	11
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	17	17	17	17	16	14	12
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	8	8
8 RB	Bank Stability (Right Bank)	6	6	6	6	6	6	6
9 LB	Vegetative Protection (Left Bank)	7	7	7	7	6	5	4
9 RB	Vegetative Protection (Right Bank)	6	6	6	6	5	4	3
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	4	4	3	2	2
10 RB	Riparian Vegetative Zone Width	8	8	8	8	8	6	5
		0.59	0.59	0.59	0.59	0.57	0.53	0.51

1	Epifaunal Substrate/ Available Cover	13	13	13	13	13	13	13
2b	Pool Substrate	7	7	7	7	7	7	7
3b	Pool Variability	11	11	11	11	11	11	11
4	Sediment Deposition	6	6	8	8	8	8	8
5	Channel Flow Status	17	17	17	17	17	15	13
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	8	8
8 RB	Bank Stability (Right Bank)	6	6	6	6	6	6	6
9 LB	Vegetative Protection (Left Bank)	7	7	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	6	6	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	10	10	10	10	10
10 RB	Riparian Vegetative Zone Width	8	8	10	10	10	10	10
		0.59	0.59	0.65	0.67	0.67	0.66	0.65

Site E

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50

FWP

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50

1	Epifaunal Substrate/ Available Cover	15	15	15	15	15	15	15
2b	Pool Substrate	13	13	13	13	13	13	13
3b	Pool Variability	13	13	13	13	13	13	13
4	Sediment Deposition	3	3	3	3	3	3	3
5	Channel Flow Status	17	17	17	17	16	14	12
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	8	8
8 RB	Bank Stability (Right Bank)	8	8	8	8	8	8	8
9 LB	Vegetative Protection (Left Bank)	9	9	9	9	8	7	6
9 RB	Vegetative Protection (Right Bank)	4	4	4	4	3	3	2
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	4	4	3	2	2
10 RB	Riparian Vegetative Zone Width (Right Bank)	0	0	0	0	0	0	0
		0.59	0.59	0.59	0.59	0.57	0.55	0.53

1	Epifaunal Substrate/ Available Cover	15	15	15	15	15	15	15
2b	Pool Substrate	13	13	13	13	13	13	13
3b	Pool Variability	13	13	13	13	13	13	13
4	Sediment Deposition	3	3	5	5	5	5	5
5	Channel Flow Status	17	17	17	17	17	15	13
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	8	8
8 RB	Bank Stability (Right Bank)	8	8	8	8	8	8	8
9 LB	Vegetative Protection (Left Bank)	9	9	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	4	4	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	10	10	10	10	10
10 RB	Riparian Vegetative Zone Width (Right Bank)	0	0	6	6	6	6	6
		0.59	0.59	0.68	0.70	0.70	0.69	0.68

Site 2A

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50

Metric #	FWP Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50

1	Epifaunal Substrate/ Available Cover	10	10	10	10	10	10	10
2b	Pool Substrate	11	11	11	11	11	11	11
3b	Pool Variability	15	15	15	15	15	15	15
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	20	20	20	20	20	20	20
6	Channel Alteration	6	6	6	6	6	6	6
7b	Channel Sinuosity	0	0	0	0	0	0	0
8 LB	Bank Stability (Left Bank	0	0	0	0	0	0	0
8 RB	Bank Stability (Right Bank)	0	0	0	0	0	0	0
9 LB	Vegetative Protection (Left Bank)	0	0	0	0	0	0	0
9 RB	Vegetative Protection (Right Bank)	0	0	0	0	0	0	0
10 LB	Riparian Vegetative Zone Width (Left Bank)	3	3	3	3	2	2	1
10 RB	Riparian Vegetative Zone Width (Right Bank)	3	3	3	3	2	2	1
		0.37	0.37	0.37	0.37	0.36	0.36	0.35

1	Epifaunal Substrate/ Available Cover	10	10	10	10	10	10	10
2b	Pool Substrate	11	11	11	11	11	11	11
3b	Pool Variability	15	15	15	15	15	15	15
4	Sediment Deposition	6	6	7	7	7	7	7
5	Channel Flow Status	20	20	20	20	20	20	20
6	Channel Alteration	6	6	6	6	6	6	6
7b	Channel Sinuosity	0	0	0	0	0	0	0
8 LB	Bank Stability (Left Bank	0	0	0	0	0	0	0
8 RB	Bank Stability (Right Bank)	0	0	0	0	0	0	0
9 LB	Vegetative Protection (Left Bank)	0	0	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	0	0	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	3	3	5	5	5	5	5
10 RB	Riparian Vegetative Zone Width (Right Bank)	3	3	5	5	5	5	6
		0.37	0.37	0.48	0.50	0.50	0.50	0.50

Site 2B

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50

FWP

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50

1	Epifaunal Substrate/ Available Cover	10	10	10	10	10	10	10
2b	Pool Substrate	11	11	11	11	11	11	11
3b	Pool Variability	15	15	15	15	15	15	15
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	20	20	20	20	20	20	20
6	Channel Alteration	6	6	6	6	6	6	6
7b	Channel Sinuosity	0	0	0	0	0	0	0
8 LB	Bank Stability (Left Bank	0	0	0	0	0	0	0
8 RB	Bank Stability (Right Bank)	0	0	0	0	0	0	0
9 LB	Vegetative Protection (Left Bank)	0	0	0	0	0	0	0
9 RB	Vegetative Protection (Right Bank)	0	0	0	0	0	0	0
10 LB	Riparian Vegetative Zone Width (Left Bank)	3	3	3	3	2	2	1
10 RB	Riparian Vegetative Zone Width (Right Bank)	3	3	3	3	2	2	1
		0.37	0.37	0.37	0.37	0.36	0.36	0.35

1	Epifaunal Substrate/ Available Cover	10	10	10	10	10	10	10
2b	Pool Substrate	11	11	11	11	11	11	11
3b	Pool Variability	15	15	15	15	15	15	15
4	Sediment Deposition	6	6	7	7	7	7	7
5	Channel Flow Status	20	20	20	20	20	20	20
6	Channel Alteration	6	6	6	6	6	6	6
7b	Channel Sinuosity	0	0	0	0	0	0	0
8 LB	Bank Stability (Left Bank	0	0	0	0	0	0	0
8 RB	Bank Stability (Right Bank)	0	0	0	0	0	0	0
9 LB	Vegetative Protection (Left Bank)	0	0	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	0	0	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	3	3	5	5	5	5	5
10 RB	Riparian Vegetative Zone Width (Right Bank)	3	3	5	5	5	5	6
		0.37	0.37	0.48	0.50	0.50	0.50	0.50

Site 2C

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50

FWP

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50

1	Epifaunal Substrate/ Available Cover	10	10	10	10	10	10	10
2b	Pool Substrate	11	11	11	11	11	11	11
3b	Pool Variability	15	15	15	15	15	15	15
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	20	20	20	20	20	20	20
6	Channel Alteration	6	6	6	6	6	6	6
7b	Channel Sinuosity	0	0	0	0	0	0	0
8 LB	Bank Stability (Left Bank	0	0	0	0	0	0	0
8 RB	Bank Stability (Right Bank)	0	0	0	0	0	0	0
9 LB	Vegetative Protection (Left Bank)	0	0	0	0	0	0	0
9 RB	Vegetative Protection (Right Bank)	0	0	0	0	0	0	0
10 LB	Riparian Vegetative Zone Width (Left Bank)	3	3	3	3	2	2	1
10 RB	Riparian Vegetative Zone Width (Right Bank)	3	3	3	3	2	2	1
		0.37	0.37	0.37	0.37	0.36	0.36	0.35

1	Epifaunal Substrate/ Available Cover	10	10	10	10	10	10	10
2b	Pool Substrate	11	11	11	11	11	11	11
3b	Pool Variability	15	15	15	15	15	15	15
4	Sediment Deposition	6	6	7	7	7	7	7
5	Channel Flow Status	20	20	20	20	20	20	20
6	Channel Alteration	6	6	6	6	6	6	6
7b	Channel Sinuosity	0	0	0	0	0	0	0
8 LB	Bank Stability (Left Bank	0	0	0	0	0	0	0
8 RB	Bank Stability (Right Bank)	0	0	0	0	0	0	0
9 LB	Vegetative Protection (Left Bank)	0	0	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	0	0	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	3	3	5	5	5	5	5
10 RB	Riparian Vegetative Zone Width (Right Bank)	3	3	5	5	5	5	6
		0.37	0.37	0.48	0.50	0.50	0.50	0.50

SUMMARY

FWOP							
Existing	**Year 0**	**Year 1**	**Year 5**	**Year 10**	**Year 25**	**Year 50**	

FWP							
Existing	**Year 0**	**Year 1**	**Year 5**	**Year 10**	**Year 25**	**Year 50**	

Upstream	0.60	0.60	0.60	0.60	0.58	0.55	0.52	0.60	0.60	0.67	0.69	0.69	0.68	0.66
Downstrea	0.37	0.37	0.37	0.37	0.36	0.36	0.35	0.37	0.37	0.48	0.50	0.50	0.50	0.50

Attachment E

Metric #	Site A FWOP Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	13	13	13	13	13	13	13
2b	Pool Substrate	12	12	12	12	12	12	12
3b	Pool Variability	11	11	11	11	11	11	11
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	17	17	17	17	16	14	12
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	6	5
8 RB	Bank Stability (Right Bank)	6	6	6	6	5	4	3
9 LB	Vegetative Protection (Left Bank)	7	7	7	7	6	5	4
9 RB	Vegetative Protection (Right Bank)	6	6	6	6	5	4	3
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	4	4	3	2	2
10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	8	8	8	6	5
		0.61	0.61	0.61	0.61	0.59	0.54	0.50

Metric #	FWP Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/ Available Cover	13	13	16	17	19	20	20
2b	Pool Substrate	12	12	12	15	20	20	20
3b	Pool Variability	11	11	20	20	20	20	20
4	Sediment Deposition	6	6	20	20	20	20	20
5	Channel Flow Status	17	17	17	18	18	18	18
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	8	8	8	8	8
8 LB	Bank Stability (Left Bank	8	8	10	10	10	10	10
8 RB	Bank Stability (Right Bank)	6	6	10	10	10	10	10
9 LB	Vegetative Protection (Left Bank)	7	7	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	6	6	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	10	10	10	10	10
10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	10	10	10	10	10
		0.61	0.61	0.83	0.88	0.91	0.92	0.92

Site B

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	13	13	13	13	13	13	13
2b	Pool Substrate	12	12	12	12	12	12	12
3b	Pool Variability	11	11	11	11	11	11	11
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	17	17	17	17	16	14	12
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	8	8
8 RB	Bank Stability (Right Bank)	6	6	6	6	6	6	6
9 LB	Vegetative Protection (Left Bank)	7	7	7	7	6	5	4
9 RB	Vegetative Protection (Right Bank)	6	6	6	6	5	4	3
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	4	4	3	2	2
10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	8	8	8	6	5
		0.61	0.61	0.61	0.61	0.59	0.56	0.53

FWP

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	13	13	16	17	19	20	20
2b	Pool Substrate	12	12	12	15	20	20	20
3b	Pool Variability	11	11	20	20	20	20	20
4	Sediment Deposition	6	6	20	20	20	20	20
5	Channel Flow Status	17	17	17	18	18	18	18
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	8	8	8	8	8
8 LB	Bank Stability (Left Bank	8	8	10	10	10	10	10
8 RB	Bank Stability (Right Bank)	6	6	10	10	10	10	10
9 LB	Vegetative Protection (Left Bank)	7	7	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	6	6	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	10	10	10	10	10
10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	10	10	10	10	10
		0.61	0.61	0.83	0.88	0.91	0.92	0.92

FWOP

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	13	13	13	13	13	13	13
2b	Pool Substrate	12	12	12	12	12	12	12
3b	Pool Variability	11	11	11	11	11	11	11
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	17	17	17	17	16	14	12
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	8	8
8 RB	Bank Stability (Right Bank)	6	6	6	6	6	6	6
9 LB	Vegetative Protection (Left Bank)	7	7	7	7	6	5	4
9 RB	Vegetative Protection (Right Bank)	6	6	6	6	5	4	3
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	4	4	3	2	2

FWP

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	13	13	16	17	19	20	20
2b	Pool Substrate	12	12	12	15	20	20	20
3b	Pool Variability	11	11	20	20	20	20	20
4	Sediment Deposition	6	6	20	20	20	20	20
5	Channel Flow Status	17	17	17	18	18	18	18
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	8	8	8	8	8
8 LB	Bank Stability (Left Bank	8	8	10	10	10	10	10
8 RB	Bank Stability (Right Bank)	6	6	10	10	10	10	10
9 LB	Vegetative Protection (Left Bank)	7	7	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	6	6	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	10	10	10	10	10

10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	8	8	8	6	5
		0.61	0.61	0.61	0.61	0.59	0.56	0.53

10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	10	10	10	10	10
		0.61	0.61	0.83	0.88	0.91	0.92	0.92

Site D

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	13	13	13	13	13	13	13
2b	Pool Substrate	7	7	7	7	7	7	7
3b	Pool Variability	11	11	11	11	11	11	11
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	17	17	17	17	16	14	12
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	8	8
8 RB	Bank Stability (Right Bank)	6	6	6	6	6	6	6
9 LB	Vegetative Protection (Left Bank)	7	7	7	7	6	5	4
9 RB	Vegetative Protection (Right Bank)	6	6	6	6	5	4	3
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	4	4	3	2	2
10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	8	8	8	6	5
		0.59	0.59	0.59	0.59	0.57	0.53	0.51

FWP

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	13	13	16	17	19	20	20
2b	Pool Substrate	7	7	12	15	20	20	20
3b	Pool Variability	11	11	20	20	20	20	20
4	Sediment Deposition	6	6	20	20	20	20	20
5	Channel Flow Status	17	17	17	18	18	18	18
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	8	8	8	8	8
8 LB	Bank Stability (Left Bank	8	8	10	10	10	10	10
8 RB	Bank Stability (Right Bank)	6	6	10	10	10	10	10
9 LB	Vegetative Protection (Left Bank)	7	7	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	6	6	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	10	10	10	10	10
10 RB	Riparian Vegetative Zone Width (Right Bank)	8	8	10	10	10	10	10
		0.59	0.59	0.83	0.88	0.91	0.92	0.92

Site E

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	15	15	15	15	15	15	15
2b	Pool Substrate	13	13	13	13	13	13	13
3b	Pool Variability	13	13	13	13	13	13	13
4	Sediment Deposition	3	3	3	3	3	3	3
5	Channel Flow Status	17	17	17	17	16	14	12
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	7	7	7	7	7
8 LB	Bank Stability (Left Bank	8	8	8	8	8	8	8
8 RB	Bank Stability (Right Bank)	8	8	8	8	8	8	8
9 LB	Vegetative Protection (Left Bank)	9	9	9	9	8	7	6

FWP

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	15	15	16	17	19	20	20
2b	Pool Substrate	13	13	12	15	20	20	20
3b	Pool Variability	13	13	20	20	20	20	20
4	Sediment Deposition	3	3	20	20	20	20	20
5	Channel Flow Status	17	17	17	18	18	18	18
6	Channel Alteration	17	17	17	17	17	17	17
7b	Channel Sinuosity	7	7	8	8	8	8	8
8 LB	Bank Stability (Left Bank	8	8	10	10	10	10	10
8 RB	Bank Stability (Right Bank)	8	8	10	10	10	10	10
9 LB	Vegetative Protection (Left Bank)	9	9	8	10	10	10	10

9 RB	Vegetative Protection (Right Bank)	4	4	4	4	3	3	2
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	4	4	3	2	2
10 RB	Riparian Vegetative Zone Width (Right Bank)	0	0	0	0	0	0	0
		0.59	0.59	0.59	0.59	0.57	0.55	0.53

9 RB	Vegetative Protection (Right Bank)	4	4	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	4	4	10	10	10	10	10
10 RB	Riparian Vegetative Zone Width (Right Bank)	0	0	6	6	6	6	6
		0.59	0.59	0.81	0.86	0.89	0.90	0.90

Site 2A

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	10	10	10	10	10	10	10
2b	Pool Substrate	11	11	11	11	11	11	11
3b	Pool Variability	15	15	15	15	15	15	15
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	20	20	20	20	20	20	20
6	Channel Alteration	6	6	6	6	6	6	6
7b	Channel Sinuosity	0	0	0	0	0	0	0
8 LB	Bank Stability (Left Bank	0	0	0	0	0	0	0
8 RB	Bank Stability (Right Bank)	0	0	0	0	0	0	0
9 LB	Vegetative Protection (Left Bank)	0	0	0	0	0	0	0
9 RB	Vegetative Protection (Right Bank)	0	0	0	0	0	0	0
10 LB	Riparian Vegetative Zone Width (Left Bank)	3	3	3	3	2	2	1
10 RB	Riparian Vegetative Zone Width (Right Bank)	3	3	3	3	2	2	1
		0.37	0.37	0.37	0.37	0.36	0.36	0.35

FWP

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	10	10	16	17	19	20	20
2b	Pool Substrate	11	11	12	15	20	20	20
3b	Pool Variability	15	15	10	10	10	10	10
4	Sediment Deposition	6	6	20	20	20	20	20
5	Channel Flow Status	20	20	20	20	20	20	20
6	Channel Alteration	6	6	6	6	6	6	6
7b	Channel Sinuosity	0	0	0	0	0	0	0
8 LB	Bank Stability (Left Bank	0	0	5	5	5	5	5
8 RB	Bank Stability (Right Bank)	0	0	5	5	5	5	5
9 LB	Vegetative Protection (Left Bank)	0	0	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	0	0	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	3	3	5	5	5	5	5
10 RB	Riparian Vegetative Zone Width (Right Bank)	3	3	5	5	5	5	6
		0.37	0.37	0.60	0.64	0.68	0.68	0.69

Site 2B

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	10	10	10	10	10	10	10
2b	Pool Substrate	11	11	11	11	11	11	11
3b	Pool Variability	15	15	15	15	15	15	15
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	20	20	20	20	20	20	20
6	Channel Alteration	6	6	6	6	6	6	6
7b	Channel Sinuosity	0	0	0	0	0	0	0
8 LB	Bank Stability (Left Bank	0	0	0	0	0	0	0

FWP

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	10	10	16	17	19	20	20
2b	Pool Substrate	11	11	12	15	20	20	20
3b	Pool Variability	15	15	10	10	10	10	10
4	Sediment Deposition	6	6	20	20	20	20	20
5	Channel Flow Status	20	20	20	20	20	20	20
6	Channel Alteration	6	6	6	6	6	6	6
7b	Channel Sinuosity	0	0	0	0	0	0	0
8 LB	Bank Stability (Left Bank	0	0	5	5	5	5	5

8 RB	Bank Stability (Right Bank)	0	0	0	0	0	0	0
9 LB	Vegetative Protection (Left Bank)	0	0	0	0	0	0	0
9 RB	Vegetative Protection (Right Bank)	0	0	0	0	0	0	0
10 LB	Riparian Vegetative Zone Width (Left Bank)	3	3	3	3	2	2	1
10 RB	Riparian Vegetative Zone Width (Right Bank)	3	3	3	3	2	2	1
		0.37	0.37	0.37	0.37	0.36	0.36	0.35

8 RB	Bank Stability (Right Bank)	0	0	5	5	5	5	5
9 LB	Vegetative Protection (Left Bank)	0	0	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	0	0	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	3	3	5	5	5	5	5
10 RB	Riparian Vegetative Zone Width (Right Bank)	3	3	5	5	5	5	6
		0.37	0.37	0.60	0.64	0.68	0.68	0.69

Site 2C

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	10	10	10	10	10	10	10
2b	Pool Substrate	11	11	11	11	11	11	11
3b	Pool Variability	15	15	15	15	15	15	15
4	Sediment Deposition	6	6	6	6	6	6	6
5	Channel Flow Status	20	20	20	20	20	20	20
6	Channel Alteration	6	6	6	6	6	6	6
7b	Channel Sinuosity	0	0	0	0	0	0	0
8 LB	Bank Stability (Left Bank	0	0	0	0	0	0	0
8 RB	Bank Stability (Right Bank)	0	0	0	0	0	0	0
9 LB	Vegetative Protection (Left Bank)	0	0	0	0	0	0	0
9 RB	Vegetative Protection (Right Bank)	0	0	0	0	0	0	0
10 LB	Riparian Vegetative Zone Width (Left Bank)	3	3	3	3	2	2	1
10 RB	Riparian Vegetative Zone Width (Right Bank)	3	3	3	3	2	2	1
		0.37	0.37	0.37	0.37	0.36	0.36	0.35

FWP

Metric #	Metric	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
1	Epifaunal Substrate/Available Cover	10	10	16	17	19	20	20
2b	Pool Substrate	11	11	12	15	20	20	20
3b	Pool Variability	15	15	10	10	10	10	10
4	Sediment Deposition	6	6	20	20	20	20	20
5	Channel Flow Status	20	20	20	20	20	20	20
6	Channel Alteration	6	6	6	6	6	6	6
7b	Channel Sinuosity	0	0	0	0	0	0	0
8 LB	Bank Stability (Left Bank	0	0	5	5	5	5	5
8 RB	Bank Stability (Right Bank)	0	0	5	5	5	5	5
9 LB	Vegetative Protection (Left Bank)	0	0	8	10	10	10	10
9 RB	Vegetative Protection (Right Bank)	0	0	8	10	10	10	10
10 LB	Riparian Vegetative Zone Width (Left Bank)	3	3	5	5	5	5	5
10 RB	Riparian Vegetative Zone Width (Right Bank)	3	3	5	5	5	5	6
		0.37	0.37	0.60	0.64	0.68	0.68	0.69

SUMMARY

FWOP

	Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
Upstream	0.60	0.60	0.60	0.60	0.58	0.55	0.52
Downstrea	0.37	0.37	0.37	0.37	0.36	0.36	0.35

FWP

Existing	Year 0	Year 1	Year 5	Year 10	Year 25	Year 50
0.60	0.60	0.83	0.87	0.91	0.91	0.91
0.37	0.37	0.60	0.64	0.68	0.68	0.69