
APPENDIX A
INTERIM HYDROGEOMORPHIC (HGMI) FUNCTIONAL ASSESSMENT

GIN CITY MITIGATION BANK
HARRIS COUNTY, TEXAS

Interim Hydrogeomorphic (HGMi) Functional Assessment

Permit Application – SWG-2011-01181

Sponsor:

Gin City Restoration, LLC
12417 FM 1960
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1.0 Introduction

Gin City Restoration, LLC (Sponsor) contracted SWCA Environmental Consultants (SWCA) to conduct a theoretical assessment of compensatory mitigation credits based on the hydrogeomorphic (HGMi) approach for riverine, low gradient wetlands developed by the U.S. Army Corps of Engineers (USACE), Southwest Galveston District (USACE, 2010a). SWCA employed the HGMi model to determine the potential post-construction values for the proposed Gin City Mitigation Bank (GCMB) based on the functional lift expected based on the restoration activities described in the Mitigation Banking Instrument (MBI) and the associated Mitigation Work Plan (MWP).

The HGMi classification system provides a mechanism through which generally-defined functions can be quantified for comparative purposes. Within this framework, major classes of wetland functions are described as indices which can be compared to other wetlands. The HGMi approach serves as a means to gauge the performance of the Mitigation Work Plan in accomplishing the goals and objectives of the MBI and will determine the availability of releasable credits.

Based on existing topographic features, the site has been divided into four wetland assessment areas (WAA) of varying size (Table A1 and Figure 6 of the MBI).

Table A1. Proposed acreages and creditable acres for each of the four wetland assessment area (WAA) units.

Units	Acres	Creditable*
		Acres
WAA 1	187.6	175.3
WAA 2	198.3	180.4
WAA 3	90.7	82.9
WAA 4	96.9	75.5
Total	573.5	514.1

* Total acreage less easements, rights of way, berms, and other un-creditable acres.

To estimate the number of mitigation credits that will be available to the bank upon maturation of the mitigation area, SWCA conducted a theoretical post-construction HGMi analysis for each unit. This analysis includes projections of baseline conditions and the expected conditions at years 3, 5, 7, and 10. The purpose of this analysis is to estimate the functional capacity units (FCUs) that will be available as credits within the GCMB if land management activities are conducted according to the MBI and MWP (Appendix D of the MBI).

The above credit projections were developed by the Sponsor for the sake of estimating potential credits and possible "advanced credit" releases based on implementation of mitigation plans. The USACE does not consider this a guarantee of credit production. No guarantee or reliance on the numbers is assumed because credits will be established when earned by the Sponsor as reflected by subsequent functional assessments that are verified by USACE.

2.0 Methods

The HGMi uses multiple variables to evaluate three functions that best describe and measure forested riverine wetlands in this region. The three functional capacity indices (FCI) used to determine credits for each Wetland Assessment Area (WAA) within the bank are based on the Riverine Forested HGMi functional assessment (USACE, 2010a). This assessment examines temporary storage of surface water (TSSW), maintenance of plant and animal communities (MPAC), and removal and sequestration of elements and compounds (RSEC) by the wetland to determine physical, biological, and chemical functions, respectively. These indices are expressed as

$$TSSW = \sqrt{\left[\sqrt{(V_{dur} * V_{freq})} * \left(\frac{(V_{topo} + V_{cwd} + V_{wood})}{3} \right) \right]}$$

$$MPAC = \frac{\left[V_{tree} + V_{cwd} + V_{rich} + \frac{(V_{basal} + V_{density})}{2} + \frac{(V_{mid} + V_{herb})}{2} + V_{connect} \right]}{6}$$

$$RSEC = \frac{\left[V_{wood} + V_{freq} + V_{dur} + \left(\frac{V_{topo} + V_{cwd} + V_{wood}}{3} \right) + \left(\frac{V_{detritus} + V_{redox} + V_{sorpt}}{3} \right) \right]}{5}$$

with the variables

- V_{dur} - Duration of flooding and ponding in an average year.
- V_{freq} - Frequency of flooding and ponding
- V_{topo} - Percent containing topographic features
- V_{wood} - Percent covered by woody vegetation
- V_{mid} - Percent of relative cover between the herbaceous and tree strata
- V_{herb} - Percent of herbaceous cover
- $V_{detritus}$ - Percent of area with detritus at the soil surface
- V_{redox} - Abundance of redox features within the top 12in of soil
- V_{sorpt} - Absorptive properties of the soil
- $V_{connect}$ - Number of habitat types found within 600ft
- V_{cwd} - Number of 3in or greater pieces of woody debris found along a 100ft transect
- V_{tree} - Percent tree canopy cover
- V_{rich} - Number of tree species representing greater than 5% of the stand within the sample plot
- V_{basal} - Basal area of trees in $\text{ft}^2 \cdot \text{acre}^{-1}$
- $V_{density}$ - Number of trees per acre

ranging from 0 to 1 based on site conditions at the time of the assessment. Thus, a wetland scoring closer to 1 for each variable will generate a higher score for each function (TSSW, MPAC, RSEC) than one in which variable values are near 0. Once an FCI has been calculated for each of the WAAs, the individual FCUs can be generated based upon the total acreage to which the FCI applies.

SWCA projected an estimated HGMi based on the improvements in hydrology, afforestation, and implementation of different types of management practices (i.e., adding microtopography, planting, thinning as part of forestry operations, and invasive species removal) based on the Mitigation Work Plan. SWCA judged the potential effect that an integrated management strategy may have on the variables within the HGMi to predict the potential FCUs associated with the WAAs proposed by the Sponsor.

Each WAA was assessed identically based on their contiguity and the projected 10-year FCUs that will be realized from the Mitigation Work Plan. Thus, SWCA estimates that environmental factors associated with the HGMi will be equally influenced for each WAA. An interpretation of the subindex variables follows.

Duration of flooding ($V_{d,10}$) is estimated using hydrology indicators listed in the Corps of Engineers Wetland Delineation Manual (USACE, 1987) and the applicable regional supplement (USACE, 2010b). During the wetland delineation (Attachment C of the MBI), SWCA found no hydrologic indicators along any of the transects sampled except for those in WET 001 and WET 002. However, based on the water budget, the addition of berms and microtopography is likely to improve wetland hydrology on the site. Because >80% of the WAA is expected to be inundated for at least 14 consecutive days during the growing season, SWCA assigned a subindex value of 1.00 for Year 10.

Frequency of flooding ($V_{f,10}$) uses indicators listed from the Delineation Manual (USACE, 1987), the regional supplement (USACE, 2010b), and Federal Emergency Management Agency floodplain maps. GCMB is wholly within the 100-year floodplain, with the majority of the site is located within the floodway. Because the entire bank falls within the 100-year floodplain and is within the mapped floodway or is connected to and at the same elevation as the mapped floodway, the subindex value was predicted to be 1.00.

Topography (V_{topo}) relies on visual estimates conducted in the field to determine what percent of the project site is composed of heterogeneous topographic features. SWCA recorded agricultural ditches on the project site as the only topographic features. However, site preparation activities will involve creation of dips, hummocks, channel sloughs, and other topographic features over at least 30% of the acreage of each WAA. Because these topographic features are unlikely to be lost, SWCA assigned a score of 1.00 for the V_{topo} subindex value for all time periods after site preparation is complete.

Course woody debris (V_{cud}) is measured by the point-intercept method along a 100-foot transect. The planting phase of the project will increase the woody vegetation and tree density on the project. During the 10 years following initial planting, dead trees and managed thinning practices will increase the amount of course woody material found within the WAAs. A subindex value of 1.00 was assigned for Year 10 because SWCA expects that at least seven pieces of course woody debris greater than three inches in diameter will be present along a 100-foot transect within each survey plot.

Woody vegetation (V_{wveg}) can be assessed using aerial imagery, field data, and visual observations. At Year 10, a subindex value of 0.75 was assigned because 67% to 90% of the WAAs are expected to be covered in woody vegetation based on the planting guidelines, estimated growth rates, and selective thinning practices outlined in the MWP.

Tree species (V_{tree}) accounts for the trees in all WAAs that are mast producers. Per the MWP, hard mast species will be managed to compose at least 60% of the dominant forest species throughout each WAA. Therefore, for Year 10, the subindex expected to be 1.00.

Tree richness (V_{rich}) is the diversity of species within the WAAs. Based on the MWP, the stand will be planted with a mixed population of desirable, native tree species including more than five species of hard mast producing trees. Therefore, a subindex value of 1.00 was assigned for Year 10.

Tree basal area ($V_{L_{basal}}$) is the mean basal area per acre of the trees in the WAA. A subindex value of 0.60 was chosen for Year 10 because the planting density, management practices, and species compositions outlined in the MWP are expected to provide the growth rates necessary to produce average basal areas of 60-80ft² per acre for each WAA.

Tree density ($V_{dens.t}$) is based on the number of trees per acre that are at least 3 inches in diameter at breast height (dbh). A subindex value of 1.00 was assumed for Year 10 based on the density of the stand indicated by the management plan in the MBI. If the tree density exceeds 250 trees per acre, GCMB will selectively thin the tree stand to reduce it to optimum levels.

Midstory ($V_{m.s}$) describes the shrub and sapling vegetation layer found between ground level and an upper forest canopy. Based on extensive experience in forested riparian wetlands on the Texas Gulf Coast, SWCA has found that midstory layers are often able to reach cover densities between 11% and 30%. Therefore, a subindex value of 0.50 was chosen for Year 10.

Herbaceous layer (V_{herb}) describes the herbaceous vegetation found on the forest floor. A subindex value of 0.50 was selected for V_{herb} for Year 10 based on the management practices that should be conducive to establishing an herbaceous vegetation layer that would likely cover between 31% and 50% of each WAA.

Detritus ($V_{detritus}$) refers to the presence of the either an O or A horizon associated with wetlands. SWCA projects the site will have an A horizon that is at least 3 inches thick and has a Munsell color value of 4 or less and an O horizon dominated by partially decomposed organic material (Ainslie et al, 1999). Therefore, a subindex value of 1.00 was assigned because at least 85% of the area is likely to possess an acceptable O or A horizon by Year 10.

Redoximorphic process (V_{redox}) is the percent of redox features based on the presence or absence of redox concentrations in the top four inches of the soil profile as determined through field effort. Based on the characterization of the soils during the wetland delineation (Attachment C of the MBI), SWCA determined that redox features comprised at least 20% of the top four inches of the soil profile. Considering that this value is unlikely to decrease in the next ten years as site hydrology is improved, a subindex value of 1.00 was assumed starting in Year 3.

Sorptive soil properties (V_{sorpt}) are determined using the Natural Resource Conservation Service (NRCS) Soil Survey (NRCS, 1976) and data recorded in the field. According to the NRCS Soil Survey, Lake Charles clay (LcA) and Beaumont clay (Ba) are poorly drained with slow surface runoff. Field work revealed a clay texture in all soil pits. Based on the dominance of clay soils for the site, a subindex value of 1.00 was assigned starting in Year 3.

Connectivity to other habitat types ($V_{connect}$) should be assessed using aerial imagery extending 600 feet from the project site. According to the 2010 aerial imagery, the project site is surrounded by shrub and sapling habitat, active agricultural fields, and other wetland habitats. SWCA assigned a subindex value of 0.75 for the connectivity of habitat types within a 600 foot perimeter (wetland plus two habitat types). This variable sub index is unlikely to change within the next 10 years.

3.0 Results

Wetland delineation of the site (Attachment C of the MBI) identified a linear, 1.285 acre palustrine emergent (PEM) wetland (WET001) and a linear 0.75 acre palustrine scrub-shrub (PSS) wetland (WET002). The Riverine Forested HGMi was used to determine the FCUs of these areas (Table A2). These credits will be deducted from the gross FCUs calculated for GCMB.

Table A2. Physical, biological, and chemical FCUs in existing wetlands delineated within the proposed GCMB

Wetland ID	Acres	Physical TSSW	Biological MPAC	Chemical RSEC
WET 001	0.75	0.31	0.18	0.43
WET 002	1.285	0.60	0.47	0.72
Total	2.035	0.91	0.65	1.15

For restored and/or established wetlands within the proposed GCMB, SWCA first created a theoretical baseline from which to determine the potential effects of proposed management practices (i.e., functional lift). The entire site was determined to be prior converted (PC) cropland (Appendix E of the MBI), which lacks any wetland functional value. As such, the baseline value for each WAA was assumed to be 0 for all functional categories.

SWCA used the proposed management actions to predict the potential result of the anticipated land management practices on the WAAs. The MBI and MWP call for the implementation of multiple management actions over several years. As previously stated, the homogeneity of the project site and improvement plan resulted in the projected 10 year FCUs being assessed identically for each unit (Tables A3, A4, A5, and A6).

Table A3. Estimated HGMi values and associated FCUs in WAA 01 of the proposed GCMB.

Wetland Assessment Area 01 (WAA 01)					175.34 Acres
Variable	Baseline	Projected YR3	Projected YR5	Projected YR7	Projected YR10
V _{shrub}	0.00	1.00	1.00	1.00	1.00
V _{herb}	0.00	1.00	1.00	1.00	1.00
V _{emerg}	0.00	1.00	1.00	1.00	1.00
V _{scrub}	0.00	0.10	0.30	0.50	1.00
V _{emerg}	0.00	0.10	0.25	0.50	0.75
V _{shrub}	0.00	1.00	1.00	1.00	1.00
V _{herb}	0.00	1.00	1.00	1.00	1.00
V _{emerg}	0.00	0.10	0.40	0.40	0.60
V _{scrub}	0.00	0.40	0.40	0.60	1.00
V _{shrub}	0.00	0.10	0.25	0.50	0.50
V _{herb}	0.00	1.00	0.50	0.50	0.50
V _{emerg}	0.00	0.30	0.50	1.00	1.00
V _{scrub}	0.00	1.00	1.00	1.00	1.00
V _{emerg}	0.00	1.00	1.00	1.00	1.00
V _{scrub}	0.00	0.75	0.75	0.75	0.75
TSSW FCI	0.000	0.632	0.719	0.816	0.957
MPAC FCI	0.000	0.608	0.638	0.708	0.842
RSEC FCI	0.000	0.653	0.720	0.833	0.933
					FCU Uplift
TSSW FCU	0.000	110.895	126.034	143.165	167.875
MPAC FCU	0.000	106.665	111.779	124.199	147.578
RSEC FCU	0.000	114.555	126.245	146.117	163.651

Table A4. Estimated HGMi values and associated FCUs in WAA 02 of the proposed GCMB.

Wetland Assessment Area 02 (WAA 02)				180.42 Acres		
Variable	Baseline	Projected YR3	Projected YR5	Projected YR7	Projected YR10	
V _{dist}	0.00	1.00	1.00	1.00	1.00	
V _{freq}	0.00	1.00	1.00	1.00	1.00	
V _{topo}	0.00	1.00	1.00	1.00	1.00	
V _{scd}	0.00	0.10	0.30	0.50	1.00	
V _{wood}	0.00	0.10	0.25	0.50	0.75	
V _{flow}	0.00	1.00	1.00	1.00	1.00	
V _{rich}	0.00	1.00	1.00	1.00	1.00	
V _{total}	0.00	0.10	0.40	0.40	0.60	
V _{diversity}	0.00	0.40	0.40	0.60	1.00	
V _{bird}	0.00	0.10	0.25	0.50	0.50	
V _{large}	0.00	1.00	0.50	0.50	0.50	
V _{detritus}	0.00	0.30	0.50	1.00	1.00	
V _{rock}	0.00	1.00	1.00	1.00	1.00	
V _{small}	0.00	1.00	1.00	1.00	1.00	
V _{connect}	0.00	0.75	0.75	0.75	0.75	FCI Uplift
TSSW FCI	0.000	0.632	0.719	0.816	0.957	0.957
MPAC FCI	0.000	0.608	0.638	0.708	0.842	0.842
RSEC FCI	0.000	0.653	0.720	0.833	0.933	0.933
						FCU Uplift
TSSW FCU	0.000	114.108	129.685	147.312	172.739	172.739
MPAC FCU	0.000	109.756	115.018	127.798	151.854	151.854
RSEC FCU	0.000	107.049	119.077	150.350	168.392	168.392

Table A5. Estimated HGMi values and associated FCUs in WAA 03 of the proposed GCMB.

Wetland Assessment Area 03 (WAA 03)				82.87 Acres		
Variable	Baseline	Projected YR3	Projected YR5	Projected YR7	Projected YR10	
V _{dist}	0.00	1.00	1.00	1.00	1.00	
V _{freq}	0.00	1.00	1.00	1.00	1.00	
V _{topo}	0.00	1.00	1.00	1.00	1.00	
V _{scd}	0.00	0.10	0.30	0.50	1.00	
V _{wood}	0.00	0.10	0.25	0.50	0.75	
V _{flow}	0.00	1.00	1.00	1.00	1.00	
V _{rich}	0.00	1.00	1.00	1.00	1.00	
V _{total}	0.00	0.10	0.40	0.40	0.60	
V _{diversity}	0.00	0.40	0.40	0.60	1.00	
V _{bird}	0.00	0.10	0.25	0.50	0.50	
V _{large}	0.00	1.00	0.50	0.50	0.50	
V _{detritus}	0.00	0.30	0.50	1.00	1.00	
V _{rock}	0.00	1.00	1.00	1.00	1.00	
V _{small}	0.00	1.00	1.00	1.00	1.00	
V _{connect}	0.00	0.75	0.75	0.75	0.75	FCI Uplift
TSSW FCI	0.000	0.632	0.719	0.816	0.957	0.957
MPAC FCI	0.000	0.608	0.638	0.708	0.842	0.842
RSEC FCI	0.000	0.653	0.720	0.833	0.933	0.933
						FCU Uplift
TSSW FCU	0.000	52.412	59.567	67.663	79.342	79.342
MPAC FCU	0.000	50.413	52.830	58.770	69.749	69.749
RSEC FCU	0.000	49.170	54.694	69.058	77.345	77.345

Table A6. Estimated HGMi values and associated FCUs in WAA 04 of the proposed GCMB.

Wetland Assessment Area 04 (WAA 04)				75.50 Acres	
Variable	Baseline	Projected YR3	Projected YR5	Projected YR7	Projected YR10
V _{det}	0.00	1.00	1.00	1.00	1.00
V _{hwa}	0.00	1.00	1.00	1.00	1.00
V _{det}	0.00	1.00	1.00	1.00	1.00
V _{sed}	0.00	0.10	0.30	0.50	1.00
V _{wood}	0.00	0.10	0.25	0.50	0.75
V _{uv}	0.00	1.00	1.00	1.00	1.00
V _{hwh}	0.00	1.00	1.00	1.00	1.00
V _{total}	0.00	0.10	0.40	0.40	0.60
V _{detrit}	0.00	0.40	0.40	0.60	1.00
V _{nut}	0.00	0.10	0.25	0.50	0.50
V _{hwh}	0.00	1.00	0.50	0.50	0.50
V _{detrit}	0.00	0.30	0.50	1.00	1.00
V _{nut}	0.00	1.00	1.00	1.00	1.00
V _{sed}	0.00	1.00	1.00	1.00	1.00
V _{total}	0.00	0.75	0.75	0.75	0.75
TSSW FCI	0.000	0.632	0.719	0.816	0.957
MPAC FCI	0.000	0.608	0.638	0.708	0.842
RSEC FCI	0.000	0.653	0.720	0.833	0.933
					FCU Uplift
TSSW FCU	0.000	47.750	54.269	61.645	72.286
MPAC FCU	0.000	45.929	48.131	53.479	63.546
RSEC FCU	0.000	44.797	49.830	62.917	70.467

Based on this analysis, GCMB bank anticipates a potential for 492.24 physical (TSSW), 432.73 biological (MPAC), and 479.86 chemical (RSEC) FCUs (credits) to be generated throughout this phase of the bank. After accounting for existing wetland functions on the site (WET001 and WET 002), the net credits anticipated at year 10 are 491.33 physical, 432.08 biological, and 478.71 chemical credits. These estimates are subject to verification and are based upon acreages that may increase or decrease based on site improvement activities.

These results are based on the estimated conditions that are predicted to occur as a result of the afforestation processes. Although reasonable estimates of the improvement in the functional categories have been provided, these values may vary from the expected based on environmental conditions. Therefore, the bank asks that the USACE and IRT members review and verify the scores used in this estimation and any subsequently provided HGMi calculations that are provided. Should the USACE or IRT find a discrepancy, the Sponsor will work to remedy the error as soon as possible.

4.0 Literature Cited

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APPENDIX B
CREDIT RELEASE SCHEDULE

GIN CITY MITIGATION BANK
HARRIS COUNTY, TEXAS

Credit Release Schedule

Permit Application – SWG-2011-01181

Sponsor:

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March 19, 2013

Upon execution of Mitigation Banking Instrument (MBI) for Gin City Mitigation Bank (GCMB), the United States Army Corps of Engineers (USACE) grants the Gin City Restoration, LLC (Sponsor) the proposed wetland credits as described in the credit release schedule (Table B1). It is the purview of the USACE to allow the adjustment of these quantities downward if ecological performance standards are not met or upward if the ecological performance standards are significantly exceeded. Credit releases are guided by the attainment of performance standards and fulfillment of administrative requirements specified in the MBI. The credit release schedule described herein will facilitate the permanent operation of the bank by ensuring that the long-term financial assurances are funded as quickly as possible.

Baseline values were calculated and projections of functional lift were made using the Interim Forested Riverine Hydrogeomorphic (iHGM) model with subindex values based on the expected conditions following the execution of the Mitigation Banking Instrument (in particular, Section 4.0) and the Mitigation Work Plan documented in Appendix A of the MBI. The iHGM approach provides a means to rapidly quantify the current functional baseline of a site and provides insight for developing management prescriptions that facilitate functional lift. In particular, the Riverine Forested iHGM model focuses management efforts on achieving functional lift for hardwood forested wetlands by identifying variables that can be improved to provide increased physical, biological, and chemical wetland functions. Additionally, the iHGM provides a tool by which relative wetland function can be quantified to substantiate mitigation actions and justify credit releases.

Future credit availabilities were projected (3, 5, 7, and 10 years after MBI approval) to estimate the accrual of wetland functions for each Wetland Assessment Area (WAA) based on the planned improvements. Expected iHGM variables were derived from in-house knowledge, published information of hydrologic function, and the development of forest regimes in east and southeast Texas. The 10-year projection is an estimate of the climax community functions and, therefore, serves as the basis for initial credit releases. Validation of projected scores will serve to demonstrate the efficacy of site improvements and will justify future adjustments in credit availability.

Table B1. Credit release schedule for Gin City Mitigation Bank based on 10 year projections of functional lift.

Action	Task	Functional Capacity Units		
		TSSW	MPAC	RSEC
Administrative (15%)				
	Cessation of farming and development activities	73.7	64.8	71.8
	Authorization and signature of the MBI			
	Establishment of conservation easement			
	Establishment of financial assurance mechanism			
Construction (10%)				
	Berm construction	49.1	43.2	47.9
	Install low-water crossings			
	Establishing microtopography			
Site Preparation/Planting (10%)				
	Subsoiling	49.1	43.2	47.9
	Tree planting			
	Install monitoring stations			
Functional Uplift (65%)				
	Subsequent credit releases will be based on functional uplift determined through iHGM calculations.	319.4	280.9	311.2
	Total	491.3	432.1	478.7

Initial credit releases will be based on administrative, construction, and initial afforestation activities, whereas subsequent credit releases will be based on functional improvements of each WAA as documented through ecological surveys. The quantitation of functional capacity units (FCUs) beyond the initial release will be based on iHGM calculations derived from field surveys and will be conducted for each WAA a minimum of five times

(at approximately years 1, 3, 5, 7, and 10) following approval of the MBI. Release of these credits will be approved following USACE verification of the Sponsor's determinations in years 3, 5, 7, and 10 (and subsequent years, if necessary).