APPENDIX E: CERTIFIED WVA MODELS AND ASSUMPTIONS

CONTENTS

WVA Approval Memorandums

DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS
441 G STREET, NW
WASHINGTON, DC 20314-1000

REPLY TO
ATTENTION OF

CECW-P 7 November 2017

MEMORANDUM FOR Director, National Ecosystem Restoration Planning Center of Expertise (ECO-PCX)

SUBJECT: Regional Certification for the Wetland Value Assessment, Coastal Marsh Models, Version 2.0

1. The HQUSACE Model Certification Panel has reviewed the Wetland Value Assessment (WVA) – Coastal Marsh Models Version 2.0 in accordance with EC 1105-2-412, and has determined that the model and its accompanying documentation are sufficient to approve the model for regional use in the Gulf Coast of Texas and Louisiana, as defined by USEPA Level IV Ecosystem Region. The HQUSACE panel considered the assessments of the ECO-PCX in making this determination.

2. Version 2.0 of the WVA Coastal Marsh Models is based on multiple levels of review. The Battelle Memorial Institute conducted a review of all the WVA community models and associated spreadsheets to assess the technical quality, system quality, and usability of the models in 2010. The model review panel included six individuals with expertise in Habitat Evaluation Procedures, planning, hydraulic engineering, coastal wetland ecology, coastal ecosystems, and software programming/spreadsheet auditing. The recommendations provided during the Battelle review were adopted and incorporated into Version 2.0 of the WVA Coastal Marsh Models. That version underwent further review in 2017 and is the subject of this recommendation memorandum. A final independent review was managed by the ECO-PCX in accordance with the model approval review plan to evaluate the degree to which the WVA Coastal Marsh Models Version 2.0 incorporated the Battelle recommended changes appropriately within the model documentation and the application spreadsheets. The review concluded that the changes recommended by Batelle were incorporated appropriately into the model. The ECO-PCX has determined that the WVA Coastal Marsh Models Version 2.0 has sufficient technical quality, system quality and usability.

3. The model meets the certification criteria contained in EC 1105-2-412.

PAYNES.WILBERT.V.1230824769

Digitally signed by PAYNES.WILBERT.V.1230824769
DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=PAYNES.WILBERT.V.1230824769
Date: 2017.11.07 09:15:19 -05'00'

WILBERT V. PAYNES
Deputy Chief, Planning and Policy Division
Directorate of Civil Works

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, MISSISSIPPI VALLEY DIVISION
P.O. BOX 80
VICKSBURG, MISSISSIPPI 39181-0080

CEMVD-PDP 06 December 2018

MEMORANDUM FOR

Commander, Fort Worth District, Regional Planning and Environmental Center, U.S. Army Corps of Engineers (Attn: Mr. Rob Newman, CESWF-PEC)

Commander, New Orleans District, Regional Planning and Environmental Division South, U.S. Army Corps of Engineers (Attn: Mr. Troy Constance, CEMVN-PD)

Commander, St Paul District, Regional Planning and Environmental Division North, U.S. Army Corps of Engineers (Attn: Mr. Terry Birkenstock, CEMVP-PD)

SUBJECT: Regional Use Re-approval of the Wetland Value Assessment (WVA) Coastal Barrier Headland, Barrier Island, Bottomland Hardwood, Coastal Chenier and Swamp Models

1. References:
   a. Engineer Circular 1105-2-412: Assuring Quality of Planning Models, 31 March 2011.

   b. Planning Bulletin 2013-02, Assuring Quality of Planning Models (EC 1105-2-412), 31 March 2013.

   c. Memorandum to Directors of National Planning Centers of Expertise – Subject: Modification of the Model Certification Process and Delegation of Model Approval for Use, 04 December 2017.

   d. Memorandum to Director of the National Ecosystem Restoration Planning Center of Expertise - Subject: Recommend Regional Use Re-approval of the Wetland Value Assessment (WVA) Coastal Barrier Headland, Barrier Island, Bottomland Hardwood, Coastal Chenier and Swamp Models, 03 December 2018. (Encl 1)

2. The National Ecosystem Restoration Planning Center of Expertise evaluated the results of an independent review managed by a team of experts from the New Orleans District for the subject models. The models are used to evaluate and compare alternatives for habitat restoration or other civil works project activities.

3. The models are re-approved for regional use within the range of applicability defined for each model. Independent technical review of the tools is complete and the models meet the criteria contained in References 1.a. and 1.b. There are no

unresolved issues stemming from the review. This re-approval will expire on 06 December 2025.

YOUNG.GARY.LAWRENCE.1229597511 Digitally signed by YOUNG.GARY.LAWRENCE.1229597511 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=USA, cn=YOUNG.GARY.LAWRENCE.1229597511 Date: 2018.12.06 10:00:31 -06'00'

Gary L. Young
Chief, MVD Planning and Policy and Director, National Ecosystem Restoration Planning Center of Expertise

Encl

CF
CEMVD-PDP (Lawton, Mallard, Miller)
CEMVP-PD (Birkenstock)
CEMVP-PD-F (Knollenberg, Mesko, Richards, Sparks)
CEMVP-PD-P (Creswell, McCain, Runyon)
CEMVP-PD-C (Johnson, Jordan)
CEMVN-PD (Constance)
CEMVN-PM-P (Inman)
CEMVN-PM-W (Broussard)
CEMVN-PD-P (Axtman)
CEMVN-PDN (Harper)
CEMVN-PDN-CEP (Klein, Smith)
CEMVN-PDN-UDP (Meden)
CELRH-PX-NC (Cade)
CENAD-PD-X (Cocchieri)
CESAM-PD-D (Otto)
CESPD-PDS-P (Thaut)

Comprehensive Wetland Value Assessment Project Information Sheet

Maurepas Swamp Project

Wetland Value Assessment

Project Information Sheet

Prepared by:

Ronald Paille

and

Cathy Breaux

U. S. Fish and Wildlife Service
Lafayette, LA Ecological Services Field Office

November 2, 2021

Introduction

This Project Information Sheet on the benefits and impacts of the Maurepas Swamp Project consists of the following parts:

RECEIVING AREA WVA

WVA Model Version

The WVA Swamp Community Model for Civil Works Version 2.0 (Swamp WVA which is approved for regional use on U.S Army Corps of Engineers [USACE] Civil Works projects) was used to assess swamp benefits and impacts. Further information on this model may be obtained from the USACE, New Orleans District, Regional Planning and Environmental Division South (RPEDS), Point of Contact: Patrick Smith (USACE), Phone: 504-862-1583. The WVA was utilized to determine the environmental benefits of the Maurepas Swamp Project (MSP and assess whether the MSP would be a viable mitigation project to compensate for unavoidable impacts to baldcypress (*Taxodium distichium*) – water tupelo (*Nyssa aquatica*) swamp habitat (hereinafter referred to as cypress and tupelo, respectively) associated with construction and implementation of the West Shore Lake Pontchartrain Hurricane and Storm Damage Risk Reduction Project (WSLP). Given that WSLP impacts were calculated for the Intermediate Sea Level Rise scenario, the below discussions are also associated with the same Intermediate Sea Level Rise scenario.

Project Area Benefit Polygons

United States Fish and Wildlife Service (USFWS) Mitigation Policy requires that a mitigation project must provide benefits as long as project impacts occur. Assuming that the effects of relative sea level rise (RSLR) and increasing salinities will reduce future MSP benefits to swamps near Lake Maurepas, a smaller benefit area closer to the conveyance channel discharge site (Figure 1) was identified to include an area where benefits would be more certain to occur throughout the 50-year project life.

Primary, Secondary, and Tertiary Benefit areas for this WVA were estimated with the objective of determining a potential mitigation project area to mitigate WSLP swamp impacts. The extents of the benefit areas were based on results of Delft3D hydrodynamic and water quality model modeling contracted by the CPRA to FTN and Associates, Inc. Previous research has found that an increase in nutrients could stimulate plant growth and improve forest health in the Maurepas Swamp (Effler et al., 2006, and Shaffer et al., 2016). The Primary Benefit area was determined using model-generated contours of total nitrogen (TN) during summer, and the future with-project water surface elevation (WSE) increase relative to no action (for 2,000 cfs steady state discharge). It was assumed that the zone of more rapid WSE drop would be where flow through the swamps was strongest, and would carry dissolved oxygen and nutrients through that portion of the swamp before being consumed in more remote regions where the flow rates were slower.

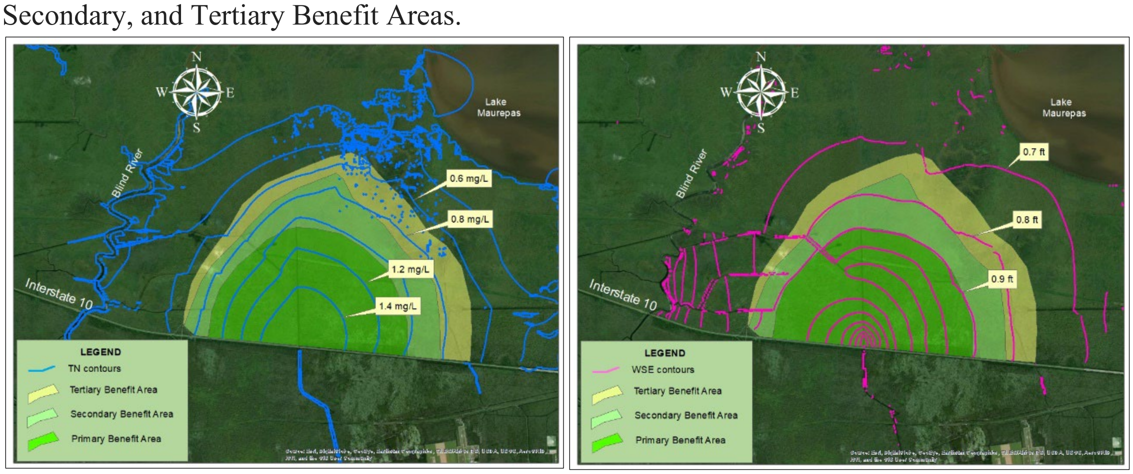
Therefore, the eastern portion of the project area follows the 0.9 ft WSE difference contour counterclockwise until it reaches an oilfield canal (Figure 2b). Because the contours south of that oilfield canal become widely spaced, indicating slower velocities within the swamps, the Primary Benefit area boundary was shifted to run midway between the 1.0 and 0.8 mg/L TN contours (Figure 2a). The eastern and central portions of the Secondary Benefit area boundary stays generally within the 0.8 ft WSE and 0.8 mg/L TN contours and does not extend past Mississippi Bayou. Near Hope Canal, the boundary was extended northward beyond those contours as more exchange is expected to occur between the Canal and the adjoining swamps. Continuing counterclockwise, the

0.8 ft WSE contour was followed until reaching the oilfield canal, after which it was located roughly between the 0.6 and 0.8 mg/L TN contours.

Swamps within these benefit areas consist of Transitional Canopy forest and Closed Canopy forests as described by Keim et al. (2010). Separate WVAs were calculated for each canopy type zone within the Primary Benefit Area. WVAs were not conducted for the Secondary Benefit Area. Instead Primary Benefit Area Average Annual Habitat Unit benefits (AAHUs/ac) were determined, and 75% of those benefits were assumed to occur on a per acre basis within the Secondary Benefit area. The basis for that assumption is discussed below.

Figure 1. Map showing the locations of the Primary, Secondary, and Tertiary WVA Benefit Areas.

Figure 2a and 2b. TN contours (left) and WSE difference contours (right) used to establish the Primary, Secondary, and Tertiary Benefit Areas.



Assuming that the magnitude of benefits gradually decrease with distance from the discharge point at I-10 and Hope Canal, it was assumed that a Tertiary Benefit Area would exist beyond the Secondary Benefit area. Since the 0.7 ft WSE elevation contour is irregular, it was decided that the 0.6 mg/L TN contour would be a better estimate of the approximate outer limit of the Tertiary Benefit Area (this Tertiary boundary was shaped similar to that of the Secondary Benefit area). It was also assumed that the center of the Primary Benefit area would be on the 1.3 mg/L contour (assumed to be midway between the 1.4 and 1.2 mg/L contours). Hence, the proportion of Primary Area Benefits occurring in the Tertiary Area would be 0.6/1.3 = 0.46 of the Primary Area benefits, on a per acre basis. The 46% value was rounded off to 45%.

Keim et al. (2010) created a GIS database of project area habitat types including marsh, water, transitional canopy forest and closed canopy forest. Forest acreage totals from that database are provided in Table 1. Using a variety of other data sources, Patrick Smith (New Orleans Corps of Engineers) determined marsh areas as the Kiem data did not identify known marsh areas. Those habitat type data include acreages within both publicly-owned land and public-plus-private lands (i.e., all lands).

Table 1. Forest type acres within the Primary, Secondary, and Tertiary Benefit Areas from Keim et al. (2010).

	Primary Benefit Area		Secondary Benefit Area		Tertiary Benefit Area	
	Public + Private Lands	Public ONLY Lands	Public + Private Lands	Public ONLY Lands	Public + Private Lands	Public ONLY Lands
Closed Canopy Swamp	2,743.2	1,900.4	856.0	816.4	796.6	780.8
Trans. Canopy Swamp	2,089.2	1,750.2	2,145.9	2,022.5	1,849.2	1,543.2
Marsh*	262.2	208.2	251.5	244.0	288.0	283.6

Values rounded to nearest whole number

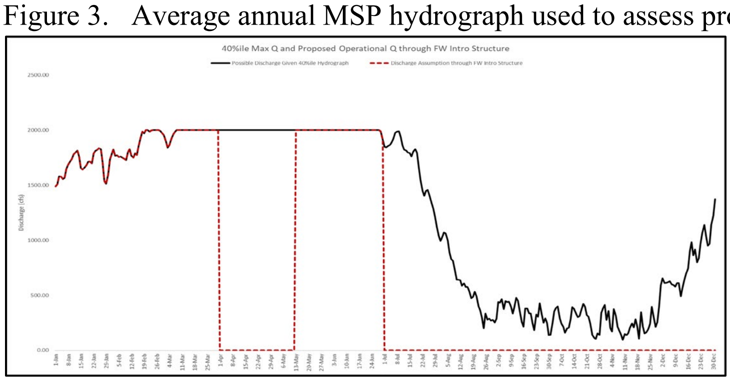
Project Life

This WVA analysis was conducted assuming a 50-yr project life from 2025 to 2075 (2025 as the baseline year). Coastwide Reference Monitoring System (CRMS) data used in the WVA (data currently available through 2018 or 2020) was projected forward to 2025, and then continued forward for the 50 year project life.

Assumed MSP Operation Plan

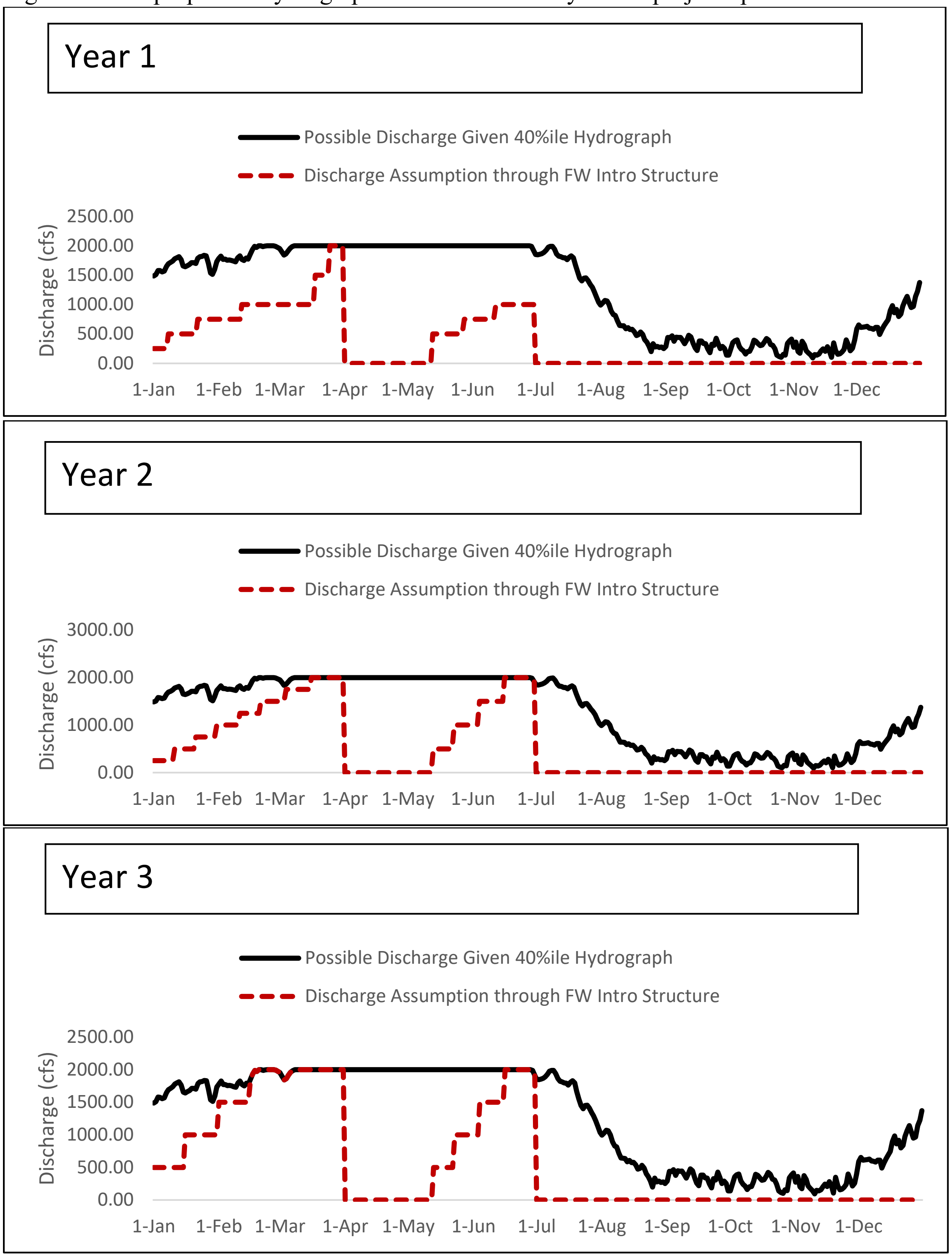
The CPRA provided a generic average annual MSP hydrograph (solid black line) based on an average to below average (40th percentile) Mississippi River discharge year (Figure 3). Actual MSP operations (dashed red line) would include non-flow periods to reduce flooding stress, allow for occasional swamp floor dewatering, and permit pulsing of high discharge events to maximize delivery of nutrients and sediments (all events thought to improve swamp health). While the assumed operations are in a format that is useful within this analysis, actual discharges will vary based on environmental conditions in the Mississippi River and Maurepas swamp. Operations will be determined within an adaptive management approach that is capable of responding to real time conditions as necessary as well as being optimized over time.

Figure 3. Average annual MSP hydrograph used to assess project benefits.



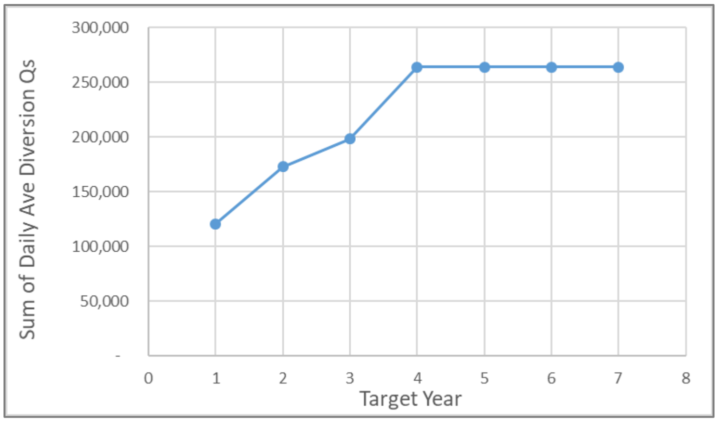
The CPRA has also proposed that the first 3 years of MSP operation consist of gradually increasing flow duration and magnitude (i.e., a “ramp-up” period). This ramp-up period is intended to reduce the initial shock to the system and enable adaptive management based upon observed water flow and environmental responses. See Figure 4.

Figure 4. Ramp-up MSP hydrographs for the first three years of project operation.



The annual sum of the daily average MSP discharges is proportional to the total annual volume of discharge. Assuming that this sum also is a proxy measure of project related benefits, the plot of these sums over the first few years of MSP operation provides an estimate of relative benefits during the ramp-up period (Figure 5). That plot suggests that MSP benefits would increase gradually over the first three years and would achieve maximum benefits at year 4. Consequently, target years (TYs) of 1 and 4 would capture effects of the ramp-up operations.

Figure 5. Sum of the daily average project discharge by year.



Benefits to the swamp associated with seasonal flushing and delivery of nutrients/sediment are assumed to occur at maximum or near maximum discharges when introduced water is able to inundate the entirety of the benefit areas. The number of days at various moderate to high discharge during the ramp-up period were compared to normal operation days (Table 2). Based on that data, the 1750 cfs discharge provides the most conservative number of days (and hence ramp-up benefit estimates) when compared to normal post ramp-up operations. Those ramp-up percent days were applied to WVA Variable 2 estimates as explained below.

Table 2. Days of ramp-up discharges compared to post ramp-up discharges.

Diversion Discharge	**# Days @ Normal Ops**	**3-Year Discharge Ramp-Up Period**					
		TY1 # days	TY1 % of Normal Ops	TY2 # days	TY2 % of Normal Ops	TY3 # days	TY3 % of Normal Ops
>= 1000 cfs	139	67	48%	99	71%	114	82%
>= 1500 cfs	138	14	10%	66	48%	86	62%
>= 1750 cfs	115	7	6%	43	37%	59	51%
>= 2000 cfs	77	7	9%	29	38%	43	56%

CRMS Data

No project specific data were gathered for determining the benefits of the MSP. However, CRMS stations are located within the Primary and Secondary Benefit Areas and data from those stations were used for this WVA analysis. For the Transitional Canopy Forest WVA, CRMS0063, 0079, and 5414 were considered appropriate for use and representative of the project area. In some cases, other CRMS data was used as explained below. For the Closed Canopy Forest WVA, the only nearby CRMS station is CRMS0039. This station is located south of I-10 and west of Hwy 641. CRMS data indicate this station is 100% inundated and consists entirely of baldcypress and water tupelo. Because of its impounded condition, it is not well suited to represent the project area non-impounded Closed Canopy Forest area. Yet certain parameters from site were used as discussed below. Under the future-with-project (FWP) conditions, Mississippi River flows would be re-introduced into the area. Because no Pontchartrain Basin CRMS stations experience such expected conditions, CRMS stations in the lower Atchafalaya Basin were used to inform tupelo and cypress dbh growth rates for the FWP analysis (Appendix C) since the Atchafalaya/Mississippi River hydrology/flooding regime is common to both.

RSLR, Inundation and Target Years

Relative sea level rise (RSLR) under the intermediate sea level rise (SLR) scenario was determined using the USGS West End Lake Pontchartrain gage (Figure 6) and per USACE protocols (USACE EC-1165-2-212). Subsidence at that gage is 7.1 mm/yr. CRMS accretion measurements from the three stations within or adjacent to the project area were examined (Table 3). The value from CRMS0063 was exceptionally high and was considered an outlier (since most other CRMS swamp values range from 2 to 7 mm/yr). The average project area accretion rate of 5.65 mm/yr was calculated based on CRMS0097 and CRMS5414. Future projections used a 2025-2075 RSLR value of 1.96 feet (NAVD88) as a basis to run long-term simulations and compare FWP and FWOP. The RSLR data accounts for subsidence, accretion, and SLR.

Figure 6. RSLR under the intermediate SLR scenario for the West End gage (from Corps web site).

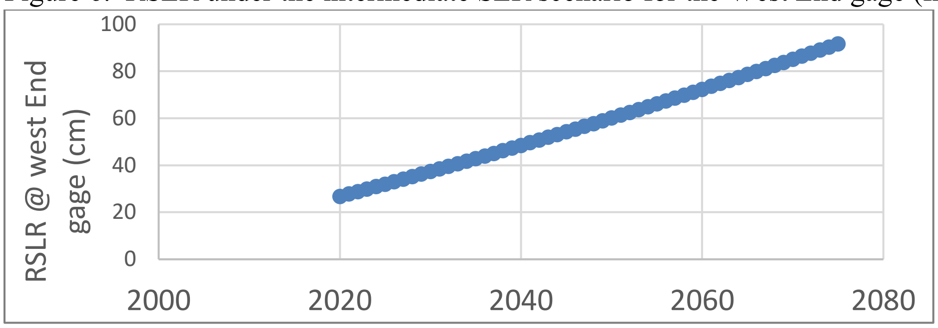


Table 3. Calculation of the average project area accretion rate.

	cm/yr	mm/yr	
CRMS 63	2.61	26.1	← *outlier value not to be used*
CRMS 97	0.49	4.9	5.65 mm/yr ave.
CRMS 5414	0.64	6.4	

For each of the three project-area CRMS stations, substrate elevation and average daily 2015-2020 water level data were acquired. The RSLR data were applied to those elevations to forecast the future depths relative to substrate elevation for each station. The station specific water depths were then averaged to obtain the average future-without-project (FWOP) water depth across the benefit areas over the project life.

For each project area CRMS station, instances when the 2015-2020 daily average water elevation was below the substrate elevation were determined and the highest 99th percentile elevation difference (i.e., substrate exposure value) was recorded. The 100th percentile (maximum) substrate exposure value was not used because of several apparent outlier values at one station. The 99th percentile value is assumed to be the maximum extent that the water level was below the swamp floor. The average water elevation increase which would equal or exceed the 99th percentile substrate exposure value was determined for each CRMS station, and then averaged over the three CRMS stations to obtain an average FWOP 100% inundation depth of 1.37 ft, which would occur at TY37 (Appendix A). Therefore, TY37 was selected as a target year when the area would become permanently inundated.

When average area inundation of 1.0 ft, occurs, the corresponding year (TY19) was also selected as a target year to apply non-baldcypress growth rate change. An additional FWOP target year occurs for Transitional Forest at TY45 because at that year, the canopy coverage decreases to 33%, which is the WVA Swamp Model threshold for conversion of swamp to marsh. This threshold is never reached in the Closed Canopy WVA, hence, the FWOP TY45 is not applied in the Closed Canopy WVA.

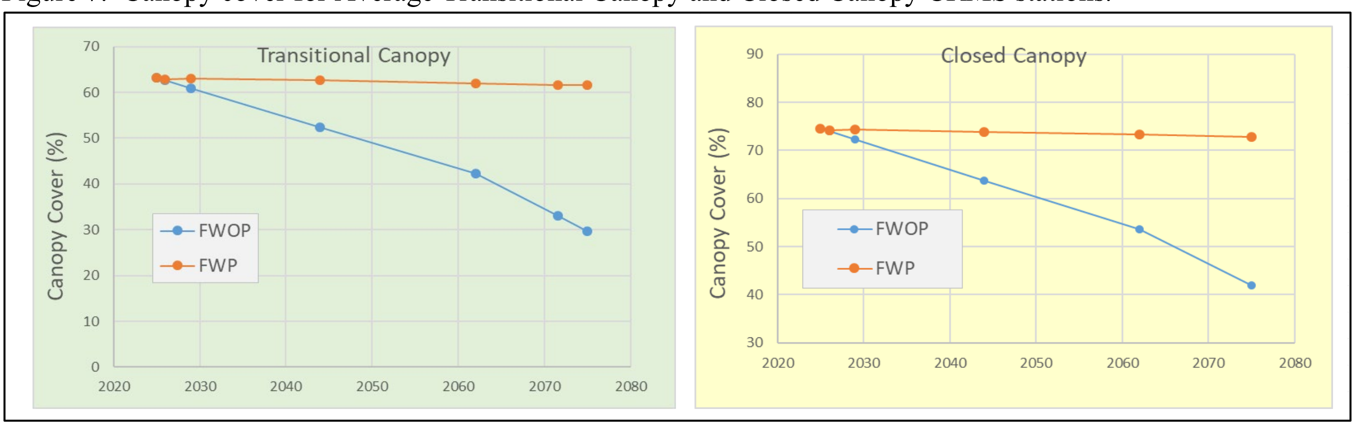
Under normal FWP discharges, it is assumed that an additional 5 mm/yr accretion would occur consisting of mineral sediment deposition and organic production/deposition (based on CRMS117 accretion in the Caernarvon Freshwater Diversion outfall area and mid-Barataria Sediment Diversion Project modeling). To account for reduced ramp-up period accretion, the additional FWP accretion amount (5.0 mm/yr) is reduced to the percentages shown in Table 2 (6% of 5.0 mm in TY1, 37% in TY2, and 51% in TY 3).   Because of FWP accretion, neither the 1.0 ft inundation level, the 100% inundation level, nor the conversion of swamp to marsh threshold is reached for either the Transitional or Closed Canopy swamp areas.

Primary Benefit Area

V1 – Stand Structure

Canopy cover data from CRMS0063, 0097, and 5414 were averaged and then projected forward to obtain canopy values for the Transitional Canopy Forest (Figure 7). Based on those stations, canopy cover would decrease at a rate of 0.567 %/yr. It was assumed that when the 100% submergence year is reached (TY37 = 2062), the rate would increase to that of the more deeply and permanently flooded Closed Canopy Forest at CRMS0039 (-0.893%/yr).

Figure 7. Canopy cover for Average Transitional Canopy and Closed Canopy CRMS stations.



The Closed Canopy Forest is assumed to be healthier than the Transitional Canopy, but the high canopy decrease rate is not consistent with that assumption. Hence, it was decided to use the Transitional Canopy rate (-0.567 %/yr) for the Closed Canopy WVA rather than the higher Closed Canopy decrease rate (which might have been higher due to the deep flooding at CRMS0037). The TY0 Closed Canopy value was generated using the CRMS0039 trend line equation in order to capture the more dense initial canopy condition. FWOP Transitional Canopy loss rates were then applied to this predicted TY0 value to obtain canopy cover values for the Closed Canopy swamps.

The FWP canopy values were assumed to decrease at 75% the rate of decrease in the FWOP rate for all years (Table 4). The 75% value reflects expected improved growth/productivity and health of trees minus the loss of some less flood tolerant species. Given time constraints for conducting this WVA, midstory and herbaceous cover percentages were determined using best professional knowledge as informed by predicted submergence and salinity changes. It was assumed that RSLR-related FWOP flooding depths would decrease herbaceous cover even though the swamp canopy was opening up and the system converting to attached and floating marsh.

Table 4. V1 values for Transitional Canopy and Closed Canopy swamps*.

FWOP Transitional Canopy				FWP Transitional Canopy				FWOP Closed Canopy				FWP Closed Canopy			
TY	Canopy	Mid-Story	Herb.	TY	Canopy	Mid-Story	Herb.	TY	Canopy	Mid-Story	Herb.	TY	Canopy	Mid-Story	Herb.
0	63	15	60	0	63	15	60	0	75	13	25	0	75	13	25
1	63	15	60	1	63	15	61	1	74	13	25	1	74	13	27
4	61	16	58	4	63	17	62	4	72	12	25	4	74	15	28
19	52	16	53	19	63	17	58	19	64	11	23	19	74	13	25
37	42	14	47	37	62	15	55	37	54	10	20	37	73	11	23
45	33	11	42	45	62	13	51	50	42	8	16	50	73	9	20
50	0*	8	38	50	62	11	47								

* *Zero value reflects conversion of swamp to marsh and is not predicted by the trendline*

V2 – Stand Maturity (dbh)

Weighted average diameters at breast height (dbh) of existing trees > 6 inches dbh at 2018 were calculated from project area CRMS stations (Table 5). Dbh growth rates of trees > 6 inches dbh were also calculated for baldcypress and other non-baldcypress trees using available CRMS data (2007-2018). A weighted average dbh growth rate was then calculated and applied to the weighted average 2018 dbh values, to predict future dbh values (Table 6). The resulting dbh values were then converted to inches for input into the WVA spreadsheets.

Table 5. Weighted average 2018 dbh calculated from project area CRMS stations.

Transitional Canopy				
CRMS	2018 Cypress dbh (cm)	n	2018 Tupelo dbh (cm)	n
63	42.81	13	32.29	37
97	40.64	17	20.59	31
5414	26.28	5	23.00	37
		35		105
Wt. Ave.	**39.40**		**25.56**	

Closed Canopy				
CRMS	2018 Cypress dbh (cm)	n	2018 Tupelo dbh (cm)	n
39	**32.31**	48	**34.37**	30

Table 6. Average dhb growth rates from project area CRMS stations.

FWOP Transitional Canopy		
	Cypress dbh Growth (cm/yr)	n
CRMS 63	0.362	13
CRMS 97	0.211	17
CRMS 5414	0.647	5
		35
Wt. Ave. =	**0.330**	

FWOP Transitional Canopy		
	Tupelo dbh Growth (cm/yr)	n
CRMS 63	0.183	37
CRMS 97	0.116	31
CRMS 541	0.122	37
		105
Wt. Ave. =	**0.142**	

FWOP Closed Canopy		
	Cypress dbh Growth (cm/yr)	n
CRMS 39	**0.296**	50

FWOP Closed Canopy		
	Tupelo dbh Growth (cm/yr)	n
CRMS 39	**0.275**	35

For FWOP Transitional Canopy cypress, the weighted average growth rate 0.330 cm/yr (CRMS0673, 0097, 5414) was applied until the 1.0 ft inundation was reached (TY19). At TY19, the weighted average growth rate for the lowest 3rd of Pontchartrain Basin CRMS stations was used (0.226 cm/yr). At the 100% inundation year (TY37), increased flooding and salinities are assumed to reduce the cypress dbh growth rate to zero. See Appendix B for Pontchartrain Basin CRMS dbh growth rates.

For FWOP Transitional Canopy tupelo (and other non-baldcypress species), the weighted average project area CRMS non-baldcypress growth rate of 0.142 cm/yr was used until the 1.0 ft inundation point was reached (TY19). Thereafter, a dbh growth rate of zero was applied as flooding and salinities are assumed to be stressful for tupelo and other non-baldcypress species. Table 7 provides a summary of dbh growth rates used.

Table 7. Summary of dbh growth rates (Transitional Area rates = Closed Canopy Area rates).

FWOP dbh Growth Rates		
	Cypress (cm/yr)	Tupelo (cm/yr)
TY 0-18	0.330	0.142
TY 19-36	0.226	0.000
TY 37-50	0.000	0.000

FWP dbh Growth Rates		
	Cypress (cm/yr)	Tupelo (cm/yr)
TY 0-37	0.842	0.342
TY 38-50	0.586	0.242

Trees in the Closed Canopy area would normally be expected to be more healthy than in the more degraded Transitional Canopy area. However, the CRMS0039 cypress dbh growth rate of 0.296 cm/yr is less than that of the Transitional Canopy cypress rate of 0.330 cm/yr. Hence, the FWOP Transitional Canopy growth rate of 0.330 cm/yr was used for the Closed Canopy dbh rate, assuming that because of increased competition, the Closed Canopy area rate was not greater than the Transitional Canopy rate. That rate was used until the 1.0 ft inundation point in TY19. The growth rate was then reduced to the weighted average baldcypress rate of lowest 3rd Pontchartrain Basin CRMS stations (0.226 cm/yr). At 100% inundation (TY37), the growth rate was decreased to zero. It was assumed that the increased competition for the more densely forested Closed Canopy swamp results in dbh growth equal to that of the less healthy Transitional Canopy swamp. Consequently, FWOP growth rates used for the Closed Canopy tupelo are the same as for the FWOP Transitional Canopy area. Dbh values were calculated in cm, and then converted to inches for use in the WVA (Table 8).

Table 8. Dbh values for Transitional and Closed Canopy areas.

Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	16	10
1	17	11
4	17	11
19	19	11
37	20	11
45	20	11
50	0	0

Transitional Canopy		
TY	FWP Cypress dbh (inches)	FWP Tupelo dbh (inches)
0	16	10
1	17	11
4	17	11
19	22	13
37	28	15
45	30	16
50	31	17

Closed Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	14	14
1	14	14
4	14	14
19	16	15
37	18	15
50	18	15

Closed Canopy		
TY	FWP Cypress dbh (inches)	FWP Tupelo dbh (inches)
0	14	14
1	14	14
4	15	14
19	20	16
37	25	19
50	28	20

Under FWP, the project area would experience flowing oxygen and nutrient rich river water. Given no such Pontchartrain Basin CRMS stations exhibit such conditions, CMRS stations in the lower Atchafalaya Basin were considered (Appendix C). Examination of data from those stations reveals that tree densities are low. Tree growth rates are often enhanced under low-density conditions where light and resource availability are greater than in more densely forested areas (Ewel et al. 1988). For this reason, the Atchafalaya CRMS dbh growth rates were sorted, and the lowest third cypress dbh rate of 0.842 cm/yr was used at TY1 for FWP Transitional Canopy areas. This rate is 2.55x greater than the FWOP rate. Because the 1.0 ft submergence point is never reached, and because average salinity would remain low due to the introduction of fresh water, this rate was assumed to continue till TY37. Thereafter, increased flooding associated with RSLR would reduce the river to receiving area head differential and associated freshwater flows through the receiving area. Hence, the with-project growth rate increase (relative to FWOP) was assumed to decrease 50% to 0.586 cm/yr (TY38-50). For Transitional Canopy non-cypress, the Atchafalaya CRMS data were also examined. Very rapid black willow (*Salix nigra*) growth at some stations was responsible for rapid non-baldcypress dbh growth rates. Because black willows are not present within the project area, use of those CRMS data were avoided. Therefore, the CRMS non-baldcypress growth rates were sorted and the weighted average of the lowest half of Atchafalaya Basin growth rates (0.342 cm/yr) was used beginning at TY1 for FWP Transitional Canopy tupelo. Because the 1.0 ft submergence point was never reached, this rate was used through TY37. Thereafter, increased flooding associated with RSLR would reduce freshwater flows within the receiving area. Consequently, future with-project growth rate increase (relative to FWOP) was assumed to decrease 50% to 0.242 cm/yr (TY38-50). The FWP rates described above for the Transitional Canopy areas were applied to the FWP Closed Canopy forest. See Appendix D for dbh calculations. During the first three years FWP (operation ramp-up period), the dbh growth rates were calculated as the TY4 dbh growth rates reduced by the percents highlighted in Table 2.

<u>V2 – Stand Maturity (basal area)</u>

CRMS 2018 basal area (BA) data for Transitional and Closed Canopy areas were used as the starting point for future BA projections (Table 9). Post-2019 BA changes were calculated by applying the annual percent change in dbh (relative to 2018) to the weighted average 2018 BA values.

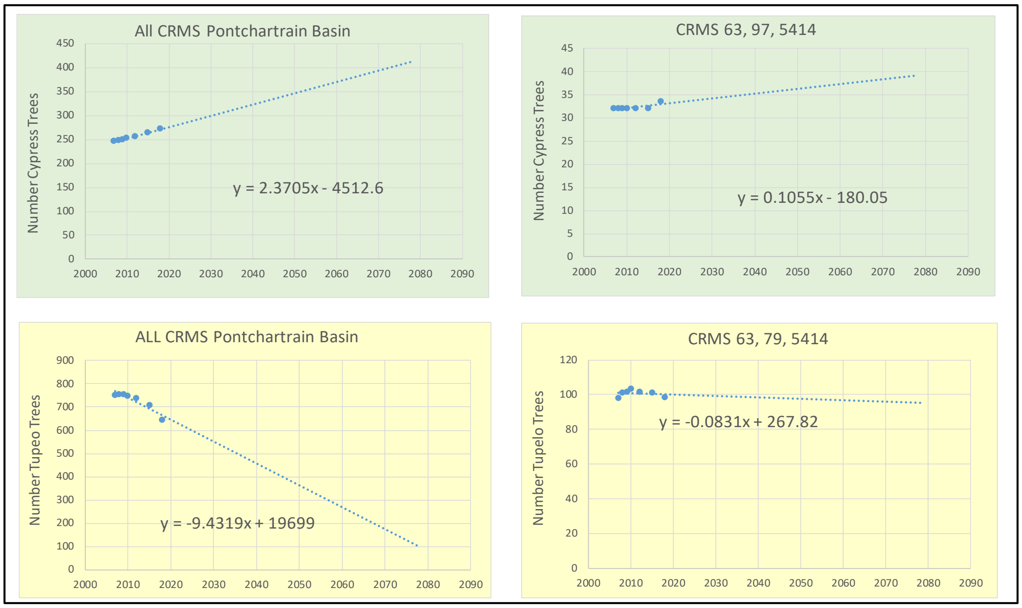
Table 9. CRMS project area weighted average basal area for cypress and tupelo (all non-baldcypress).

	Transitional Canopy								Closed Canopy	
Year	crms63 ft^2/ac Cypress	crms97 ft^2/ac Cypress	crms5414 ft^2/ac Cypress	**Weighted Average ft^2/ac Cypress**	crms63 ft^2/ac Non-Cyp.	crms97 ft^2/ac Non-Cyp.	crms5414 ft^2/ac Non-Cyp.	**Weighted Average ft^2/ac Non-Cyp.**	Basal Area Cypress (ft^2/ac)	Basal Area Non-Cyp (ft^2/ac)
2007	63.1	73.2	8.2	**60.1**	123.0	85.2	100.1	**103.8**	213.3	201.7
2008	64.0	72.7	8.6	**60.3**	126.5	87.4	101.5	**106.2**	137.4	110.7
2009	66.6	73.5	8.9	**61.7**	133.5	87.6	106.2	**110.3**	135.6	110.5
2010	66.1	73.1	9.1	**61.4**	125.1	87.6	108.9	**108.3**	138.3	110.6
2012	69.8	76.3	10.1	**64.4**	137.7	90.9	95.5	**109.0**	147.0	116.8
2015	82.2	78.8	12.2	**70.6**	131.9	91.3	96.6	**107.5**	155.2	120.8
2018	85.8	84.6	14.8	**75.1**	137.8	82.7	89.9	**104.6**	161.7	122.6

The use of dbh change (calculated for trees > 6 inches dbh) to estimate BA change has limitations since dbh values are recorded only for living trees. As young trees grow they are tagged and dbh measurements for those trees appear in the data set. Trees less than 6 inches dbh exist in the data set but were not used in dbh and dbh growth rate calculations. As existing trees die, dbh measurements of those trees cease. In some cases, monitoring staff may miss a tree during annual sampling, but record dbh in the subsequent sampling event. However, when dbh shrinks for one or more years, and no dbh measures follow, it is assumed that mortality had occurred. In this manner, the number of trees for which dbh was recorded was used, along with BA changes to guide assumptions regarding changes to BA over time.

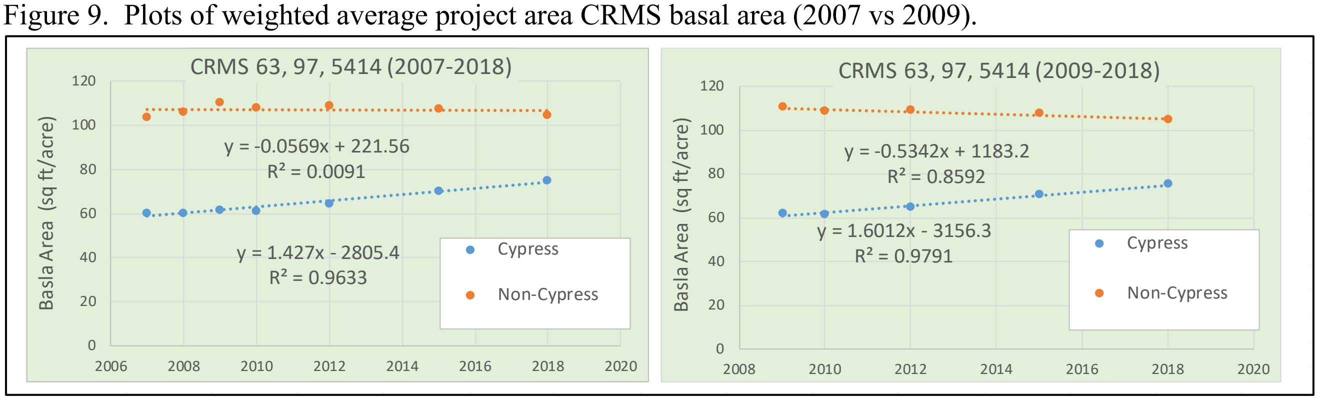
The project area and the Pontchartrain Basin show increasing numbers of cypress trees, and decreasing numbers of tupelo and other species over time (Figure 8). These data suggest that tupelo and other species have suffered stress and mortality with increasing inundation and salinity (along with insect defoliation and other stressors). The increasing number of baldcypress indicate that they are not only able to tolerate those conditions, but increase in numbers. Because the CRMS dbh values themselves do not provide any indication of recruitment and survival, the BA values calculated from dbh change would also not include effects of recruitment and survival. Therefore, BA values derived from dbh change were adjusted to include recruitment/survival effects as explained below.

Figure 8. CRMS tree numbers data illustrating effects of recruitment and survival.



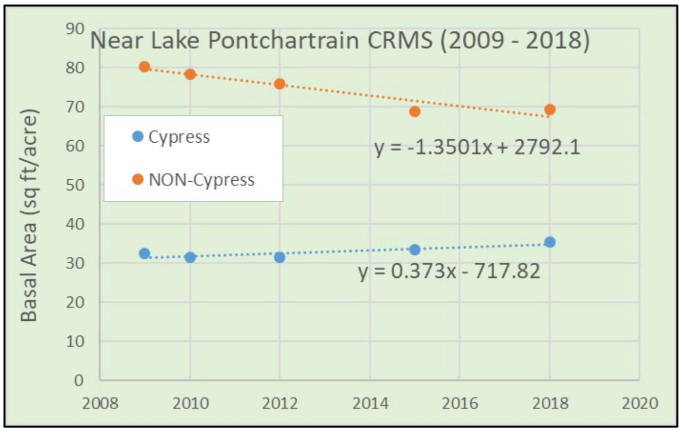
Because the number of trees monitored at each CRMS stations varies, weighted averages of BAs from CRMS 63, 97, and 5414 were calculated to determine the average project area BA (m^2/ha). Those weighted averages were converted to ft^2/acre and plotted (Figure 9). Because R^2 for the 2009 to 2018 data were higher than for the 2007 to 2018 data, the 2009 to 2018 data were used, along with the associated BA change rates. These data illustrate that baldcypress BA has increased while tupelo BA growth has decreased. This supports that tupelo and other non-baldcypress species are more sensitive to salinity than baldcypress and that tupelo and other species have suffered stress and mortality with increasing inundation and salinity (along with insect defoliation and other stressors). Because no Maurepas swamp CRMS stations exhibited decreasing baldcypress BA, as is expected to occur in the future, the project area 2009 – 2018 Transitional Canopy tupelo BA reduction rate of -0.534 ft^2/ac was applied at TY37-TY50 (post 100% submergence point and salinity >= 1.40 ppt) to simulate expected salinity-related baldcypress mortality in the future. Before applying this value however, it had to be converted to a per tree basis, then applied to the total number of baldcypress trees at CRMS0063, 0097, and 5414 which resulted in a value of -0.1787 ft^2/acre.

Figure 9. Plots of weighted average project area CRMS basal area (2007 vs 2009).



The FWOP Transitional Canopy tupelo basal area change was determined using percent dbh change adjusted by the 2009 – 2018 project area rate of -0.534 ft^2/ac from TY0 to TY18 (period prior to the 1.0 ft submergence point). To estimate impacts of more hostile conditions at TY19 (1.0 ft submergence) and beyond, the greater 2009-2018 rate associated with near-Lake Maurepas CRMS stations (0058, 0090, and 5255) of -1.350 ft^2/ac was used (Figure 10). Because the 70 trees at those lakeshore stations were fewer than the 105 tupelo at the project area stations, the -1.350 ft^2/ac value was converted to a per tree rate of -0.019 ft^2/ac, then multiplied by the 105 trees in the project area to yield a project area basal area change rate of -2.025 ft^2/ac. This rate was applied to the dbh-determined tupelo basal areas for TY37-TY50 (post 100% submergence point).

Figure 10. Near-Lake Maurepas CRMS (stations 0058, 0090, and 5255) weighted average basal area (2009-2018).



The adjustments described above for the Transitional Canopy forests were also applied to the Closed Canopy forest dbh-determined BA values. A summary of basal area rate adjustments is provided in Table 10. Given that FWP salinities remain low and that the 1.0 ft submergence point is never reached, no adjustment was applied to reduce FWP basal area growth. Therefore, FWP basal area values for both the Transitional Canopy and Closed Canopy areas were determined solely based on percent FWP dbh change. FWOP and FWP basal area values are shown in Table 11. See Appendix E for BA calculations.

Table 10. Summary of basal area growth rate adjustment factors (Transitional Area & Closed Canopy Area).

FWOP Basal Area Growth Rate Adjustments						FWP Basal Area Growth Rate Adjustments				
	Cypress (ft2/ac)			Tupelo (ft2/ac)			Cypress (ft2/ac)			Tupelo (ft2/ac)
TY 0 -36	0.000		TY 0-18	-0.534		TY 0 -50	none		TY 0 -50	none
TY 19-50	-0.178		TY19-50	-2.025						

Table 11. WVA basal area values for the Transitional Canopy and Closed Canopy areas.

Transitional Canopy			Transitional Canopy			Closed Canopy			Closed Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)	TY	FWP Cypress BA (ft^2/ac)	FWP Tupelo BA (ft^2/ac)	TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)	TY	FWP Cypress BA (ft^2/ac)	FWP Tupelo BA (ft^2/ac)
0	79	105	0	79	105	0	173	122	0	173	122
1	80	105	1	80	106	1	175	122	1	175	123
4	82	105	4	84	109	4	180	122	4	185	126
19	91	104	19	108	129	19	204	120	19	248	143
37	98	67	37	137	153	37	223	83	37	324	165
45	97	51	45	146	161	50	221	57	50	362	176
50	0	0	50	151	166						

V3 – Flooding Duration and Water Exchange

Based on RSLR and accretion data discussed above, under FWOP, the project area substrate for both Transitional and Closed Canopy swamps would be exposed infrequently up to TY36. At TY37, the project area would be submerged continually (i.e., permanently). Under FWP, due to the assumed additional accretion/organic matter production, both the Transitional and Closed Canopy swamps would never reach the permanently flooded condition. Additionally, it is assumed that the MSP would not be operated to facilitate swamp floor dewatering during September and October or other periods when water levels are normally low. Under FWOP, the water exchange rate would be "low" for both Transitional and Closed Canopy swamps. Under FWP, the water exchange would be "high" (Table 10).

Table 10. WVA V3 inputs for the Transitional and Closed Canopy swamps.

Transitional Canopy		
TY	FWOP Flooding Duration	FWOP Flow Exchange
0	semi-perm	low
1	semi-perm	low
19	semi-perm	low
37	perm.	low
45	perm.	low
50	perm.	low

Transitional Canopy		
TY	FWP Flooding Duration	FWP Flow Exchange
0	semi-perm	low
1	semi-perm	high
19	semi-perm	high
37	semi-perm	high
45	semi-perm	high
50	semi-perm	high

Closed Canopy		
TY	FWOP Flooding Duration	FWOP Flow Exchange
0	semi-perm	low
1	semi-perm	low
19	semi-perm	low
37	perm.	low
50	perm.	low

Closed Canopy		
TY	FWP Flooding Duration	FWP Flow Exchange
0	semi-perm	low
1	semi-perm	high
19	semi-perm	high
37	semi-perm	high
50	semi-perm	high

V4 – Mean High Salinity During the Growing Season

The 2020 project area mean high growing season salinity is 0.6 parts per thousand (ppt). Because the MSP swamp would average 0.61 feet deep in 2021, the volume of water within a square foot area above the substrate is 0.61 ft^3 or 17.26 liters (L). Assuming that salinity in ppt equals grams of salt/L, then the 2021 grams of salt in the water above the substrate is 17.26 L x 0.61 g/L = 10.35 g. Assuming that increased flooding due to RSLR will be at a salinity of 2.0 ppt (for all RSLR water level increases), the grams of salt and water volume (using RSLR-predicted water elevation increases) above the substrate can be determined. Once determined, these values enable the calculation of FWOP salinities (Table 11).

FWP salinities were determined assuming that the MSP would discharge fresh water (salinity = 0.2 ppt as per CPRA WVA) and would maintain fresh conditions in receiving area swamps except possibly during the fall when Mississippi River stages may not permit high volume discharges. It is assumed that under FWP, the highest 33% of growing season salinities (2.64 months) would occur during 64% of August, and all of September and October. It is assumed that the MSP will maintain fresh conditions throughout all of August at 0.2 ppt. In September and October, the project would not operate but area salinities would remain fresh for September due to prior freshwater loading of the swamp and Lake Maurepas systems. It is possible that low MSP discharges could also be conducted to retard saltwater entry from Lake Maurepas into Hope Canal and from Hope Canal into the benefit areas. In October, it is therefore assumed that salinities would be half of FWOP. A weighted average based on assumed monthly salinities for the 2.6 months discussed above was used to calculate FWP salinity. Salinities for Transitional Forest is assumed to be the same in the Closed Canopy areas.

Transitional Canopy		
TY	FWOP salinity (ppt)	FWP salinity (ppt)
0	0.7	0.7
1	0.8	0.3
4	0.8	0.3
19	1.2	0.3
37	1.4	0.4
45	1.5	0.4
50	1.5	0.4

Closed Canopy		
TY	FWOP salinity (ppt)	FWP salinity (ppt)
0	0.7	0.7
1	0.8	0.3
4	0.8	0.3
19	1.2	0.3
37	1.4	0.4
50	1.5	0.4

V5: Size of Contiguous Forested Area

Keim and others' (2010) habitat classifications and recent imagery were used in ESRI's ArcGIS PRO 2.3 software to estimate the project area forested acreage. Currently, the entire project area is larger than 500 acres and was rated as a Class 1 for TY0. The only assumed difference between FWOP and FWP was the construction of the MSP conveyance channel. Contiguous forested area was predicted to exceed 500 acres for both the Transitional and Closed Canopy areas, under both FWOP and FWP. Therefore, a V5 of Class 5 was used for all TYs, except for the Transitional Canopy WVA which were assumed to have converted entirely to marsh in TY50 and was therefore assigned a Class 1 rating. See Appendix F for more details.

V6: Suitability and Traversability of Surrounding Land Uses

Transitional Canopy and Closed Canopy forest types exist in a patchy mosaic within the project area and vicinity (Keim et al., 2010). Creation of separate buffers around individual forest cover patches was considered, but ultimately not performed, because of the size and number of individual patches within the project areas. Instead, a 0.5-mile buffer was created for the Primary and Secondary Benefit areas. The 2016 National Land Cover Data (NLCD) were used to calculate TY0 and FWOP TY1-TY50 values. Similar to V5, the only assumed difference between FWOP and FWP was the construction of the MSP conveyance channel. The channel area was removed from the Forest category and added to the Agriculture (Open Water) category for both the Primary and Secondary Benefit areas (Tables 12 and 13). Because the WVA spreadsheet accepts only whole numbers (percentages), 98% was entered for Forest and 2% for Developed (in both Transitional and Closed Canopy areas, FWOP and FWP). Note that when the forest collapses (i.e., transitions to marsh) the forest acreage would be reduced to 0. However, since forest and marsh have the same suitability, the percent forest/marsh remained 98%. See Appendix F.

Table 12. Land cover types for the Primary Benefit Area.

Land Use Type	FWOP Percent	FWP Percent
Forest	98.2%	97.8%
Developed	1.6%	1.6%
Agriculture	0.2%	0.6%
Other	0.0%	0.0%

Table 13. Land cover types for the Secondary Benefit Area.

Land Use Type	FWOP Percent	FWP Percent
Forest	98.0%	97.7%
Developed	1.8%	1.8%
Agriculture	0.2%	0.5%

Other	0.0%	0.0%

V7: Disturbance

The effect of disturbance is measured by the distance to the disturbance, and the type of disturbance. Creation of separate buffers around individual forest cover patches was considered, but ultimately not done for similar reasons to those outlined for V6. The 2016 NLCD data and available imagery were used to classify the disturbance type. There were two disturbance areas.

1. The I-10 corridor was assumed to be a Class 1 disturbance for all scenarios.
2. The Hope Canal was assumed to be a Class 2 disturbance for FWOP TY0-TY50. Hope Canal was assumed to be a Class 4 disturbance for FWP TY1-TY50, because of reduced access associated with the assumption that the boat launch at Highway 61 would be removed as a part of construction.

Disturbance type/distance zone areas were digitized and acreages were calculated. Using the percentage of each zone and its Suitability Index (SI), weighted average SIs were calculated for each disturbance type and distance combination (Table 14). The resulting weighted SIs were directly input into WVA spreadsheets, because it was not possible to create a spreadsheet SI identical to that of the weighted SI shown below. See also Appendix F.

Table 14. Disturbance weighted SI values for the Primary and Secondary Benefit areas.

FWOP Primary Benefit Area				
SI	area-sub	area	percentage	weighted SI
0.50	328.39	269.17	0.07	0.04
0.26	48.63	46.84	0.01	0.00
0.26	205.21	184.41	0.05	0.01
0.01	20.80	20.80	0.01	0.00
1.00		3146.91	0.86	0.86
TOTAL	3668.13			**0.91**

FWP Primary Benefit Area				
SI	area-sub	area	percentage	weighted SI
0.50	328.39	0.00	0.07	0.04
0.26	48.63	0.00	0.01	0.00
0.26	205.21	184.41	0.05	0.01
0.01	20.80	20.80	0.01	0.00
1.00		3462.92	0.94	0.94
TOTAL	3668.13			**1.00**

Acreage Inputs

At FWOP TY45, the Transitional Canopy area reaches 33% canopy coverage. Afterwards, it converts to marsh and therefore zero swamp acres are entered into the spreadsheet's TY50 acreage line rather than the previous forest acreage. See Tables 15 and 16. Under FWP, the 33% canopy threshold is not reached for Transitional Canopy areas. The Closed Canopy area never reaches the 33% canopy threshold under either FWOP or FWP.

Secondary Benefit Area

The Secondary Benefit Area was assumed to provide 75% of the benefits (in AAHUs) that would occur in the Primary Benefit Area (on a per acre basis). The 75% reduction was a unanimous decision of the Habitat Evaluation Team (HET) based upon the assumption that the WSE contours and the spacing between them is the hydrologic modeling output that provides the most direct and best estimate of MSP related swamp benefits (better than total nitrogen contours). WSE elevation contours within roughly the center of each benefit zone were identified (1.1 ft for the Primary Area, and 0.85 ft for the Secondary Area: 0.85/1.1 ft = 0.77, or 77%, see Figure 11). Given that some portions of the Secondary Benefit Area extend northward beyond the 0.8 ft contour, it was decided to round the 77% value downward to 75% to be more conservative.

Tertiary Benefit Area

The Tertiary Benefit area was determined in a manner similar to how the Secondary Benefit Area was determined. The 0.6 mg/L summer total nitrogen contour was used generally as the basis for determining the outer limit of Tertiary Benefit area. Assuming that the center of the Primary Benefit Area is represented by 1.3 mg/L, then the Tertiary Benefit area is calculated as 0.6/1.3 = 46% (rounded to 45%) of the Primary Area benefits on a per acre basis.

AAHU CALCULATION

Project: MD Primary_ClosedCan_All Lands_IntSLR

Future Without Project

TY	Acres	x HSI	Total HUs	Cummulative HUs
0	2743	0.72	1969.91	
1	2743	0.65	1789.86	1879.89
4	2743	0.65	1787.72	5366.38
19	2743	0.66	1804.39	26940.86
37	2743	0.60	1644.67	31041.55
50	2743	0.51	1404.72	19821.07

Max TY= 50

Total CHUs = 85049.75

AAHUs = 1700.99

Future With Project

TY	Acres	x HSI	Total HUs	Cummulative HUs
0	2743	0.72	1969.91	
1	2743	0.82	2242.25	2106.08
4	2743	0.75	2058.24	6450.74
19	2743	0.76	2074.40	30994.85
37	2743	0.76	2074.40	37339.28
50	2743	0.76	2074.40	26967.25

Max TY= 50

Total CHUs = 103858.21

AAHUs = 2077.16

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project AAHUs =	2077.16
B. Future Without Project AAHUs =	1700.99
Net Change (FWP - FWOP) =	376.17

AAHU CALCULATION

Project: MD Primary_TransCan_All Lands_IntSLR

Future Without Project

TY	Acres	x HSI	Total HUs	Cummulative HUs
0	2089	0.71	1486.39	
1	2089	0.72	1499.76	1493.07
4	2089	0.72	1497.72	4496.21
19	2089	0.71	1482.87	22354.37
37	2089	0.59	1233.55	24447.76
46	2089	0.57	1185.82	10887.19
47	0	0.00	0.00	395.27
50	0	0.00	0.00	0.00

Max TY= 50

Total CHUs = 64073.88

AAHUs = 1281.48

Future With Project

TY	Acres	x HSI	Total HUs	Cummulative HUs
0	2089	0.71	1486.39	
1	2089	0.82	1715.31	1600.85
4	2089	0.82	1715.49	5146.19
19	2089	0.83	1734.77	25876.94
37	2089	0.83	1734.77	31225.90
50	2089	0.83	1734.77	22552.04

Max TY= 50

Total CHUs = 86401.91

AAHUs = 1728.04

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project AAHUs =	1728.04
B. Future Without Project AAHUs =	1281.48
Net Change (FWP - FWOP) =	446.56

Table 16. WVA spreadsheet AAHU Calculations – Closed Canopy and Transitional Canopy swamp areas for state-owned lands ONLY.

Closed Canopy

Future Without Project			Total	Cummulative
TY	Acres	x HSI	HUs	HUs
0	1900	0.72	1364.50	
1	1900	0.65	1239.79	1302.15
4	1900	0.65	1238.31	3717.14
19	1900	0.66	1249.85	18661.19
37	1900	0.60	1139.22	21501.62
50	1900	0.51	973.01	13729.50

Max TY= 50

Total CHUs =	58911.60
AAHUs =	1178.23

Future With Project			Total	Cummulative
TY	Acres	x HSI	HUs	HUs
0	1900	0.72	1364.50	
1	1900	0.82	1553.15	1458.83
4	1900	0.75	1425.69	4468.25
19	1900	0.76	1436.88	21469.27
37	1900	0.76	1436.88	25863.88
50	1900	0.76	1436.88	18679.47

Max TY= 50

Total CHUs =	71939.70
AAHUs =	1438.79

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project AAHUs =	1438.79
B. Future Without Project AAHUs =	1178.23
Net Change (FWP - FWOP) =	**260.56**

Transitional Canopy

Future Without Project			Total	Cummulative
TY	Acres	x HSI	HUs	HUs
0	1750	0.71	1245.18	
1	1750	0.72	1256.38	1250.78
4	1750	0.72	1254.67	3766.57
19	1750	0.71	1242.23	18726.73
37	1750	0.59	1033.37	20480.41
46	1750	0.57	993.39	9120.43
47	0	0.00	0.00	331.13
50	0	0.00	0.00	0.00

Max TY= 50

Total CHUs =	53676.06
AAHUs =	1073.52

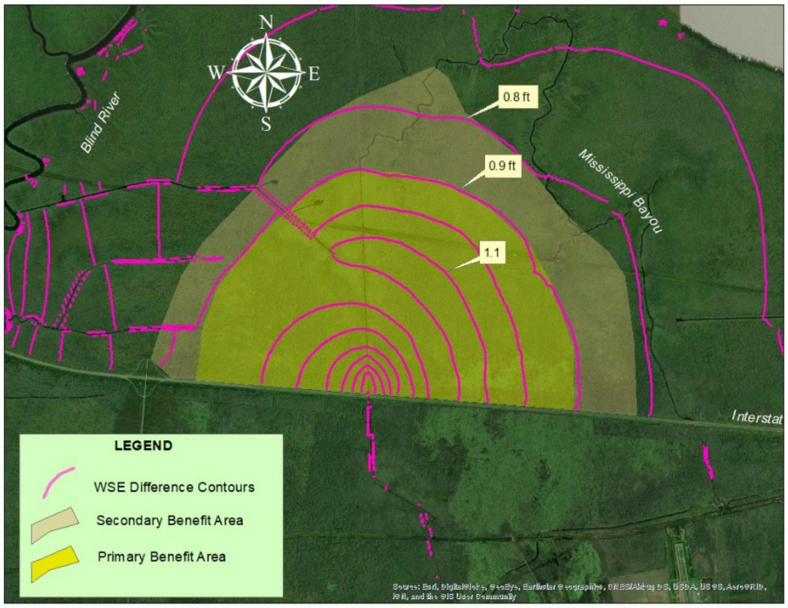
Future With Project			Total	Cummulative
TY	Acres	x HSI	HUs	HUs
0	1750	0.71	1245.18	
1	1750	0.82	1436.95	1341.06
4	1750	0.82	1437.10	4311.07
19	1750	0.83	1453.26	21677.66
37	1750	0.83	1453.26	26158.60
50	1750	0.83	1453.26	18892.33

Max TY= 50

Total CHUs =	72380.73
AAHUs =	1447.61

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project AAHUs =	1447.61
B. Future Without Project AAHUs =	1073.52
Net Change (FWP - FWOP) =	**374.09**

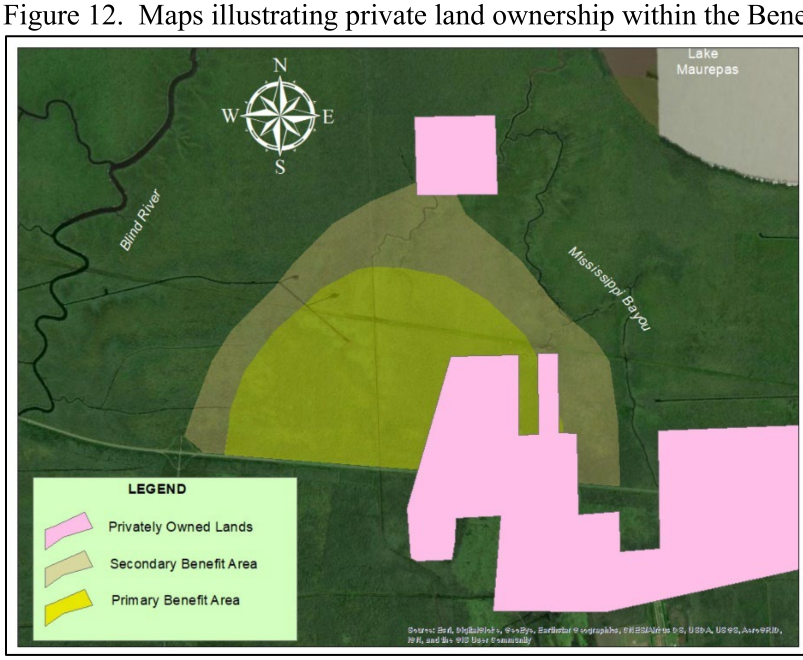
Figure 11. WSE Difference contours used to determine Secondary Area benefits.



WVA Results

The Primary and Secondary Benefit areas are located mostly on state-owned lands, but include some privately owned lands (Figure 12). The Primary and Secondary Benefit areas are located mostly on state-owned lands, but include some privately owned lands (Figure 12). If used for mitigation, private property would be required to be policy compliant and to prevent future activities that could reduce MSP benefits on private lands. This could result in additional costs and acquiring these lands may be difficult. Therefore, the team assessed WVAs benefits for both public land only as well as for public plus private lands (all lands).

Figure 12. Maps illustrating private land ownership within the Benefit areas.



Under the Intermediate Sea Level Rise scenario, for public ONLY lands, the MSP would provide 634.65 AAHUs to swamps in the Primary Benefit Area, 408.16 AAHUs to swamps in the Secondary Benefit Area, and 196.60

AAHUs for swamps in the Tertiary Benefit Area, for a total benefit of 1,239.41 AAHUs (Table 17). Total MSP related swamp benefits on public plus private lands would be 1,481.80 AAHUs (822.73 AAHUs in the Primary Area, 432.05 AAHUs in the Secondary Area, and 227.03 AAHUs in the Tertiary Area. Considering the construction related swamp impacts of -52.39 AAHUs, the net MSP benefits under the Intermediated Sea Level Rise scenario are 1,429.41 and 1,187.02 AAHUs, for all lands and public ONLY lands, respectively.

Table 17. MSP swamp receiving area Primary, Secondary, and Tertiary Benefit Area net benefits (AAHUs) under all three Sea Level Rise scenarios.

Maurepas Diversion Swamp Benefits (LOW SLR)	Public + Private Land		Public Land ONLY	
	Closed Canopy (AAHUs)	Trans Canopy (AAHUs)	Closed Canopy (AAHUs)	Trans Canopy (AAHUs)
Primary Benefit Area	301.04	244.07	208.51	204.46
Secondary Benefit Area	70.45	188.02	67.18	177.19
Tertiary Benefit Area	39.34	97.22	38.55	81.12
Subtotals	410.83	529.31	314.25	462.78
TOTALS		940.14		777.02
Construction Impacts		-52.39		-52.39
Net Project AAHUs		**887.75**		**724.63**

Maurepas Diversion Swamp Benefits (Intermediate SLR)	Public + Private Land		Public Land ONLY	
	Closed Canopy (AAHUs)	Trans Canopy (AAHUs)	Closed Canopy (AAHUs)	Trans Canopy (AAHUs)
Primary Benefit Area	376.17	446.56	260.56	374.09
Secondary Benefit Area	88.03	344.01	83.95	324.20
Tertiary Benefit Area	49.16	177.87	48.18	148.43
Subtotals	513.36	968.44	392.69	846.72
TOTALS		1481.80		1239.41
Construction Impacts		-52.39		-52.39
Net Project AAHUs		**1,429.41**		**1,187.02**

Maurepas Diversion Swamp Benefits (HIGH SLR)	Public + Private Land		Public Land ONLY	
	Closed Canopy (AAHUs)	Trans Canopy (AAHUs)	Closed Canopy (AAHUs)	Trans Canopy (AAHUs)
Primary Benefit Area	1177.38	1018.53	815.54	853.25
Secondary Benefit Area	275.54	784.63	262.77	739.47
Tertiary Benefit Area	153.86	405.69	150.79	338.54
Subtotals	1606.78	2208.86	1229.10	1931.26
TOTALS		3815.63		3160.36
Construction Impacts		-52.39		-52.39
Net Project AAHUs		**3,763.24**		**3,107.97**

Acres have been rounded to nearest whole unit and AAHU values have been rounded to second decimal place

LITERATURE CITED

Effler, R.S.; Goyer, R.A.; Lenhard, G.J. Baldcypress and water tupelo responses to insect defoliation and nutrient augmentation in Maurepas Swamp, Louisiana, USA. For. Ecol. Manag. 2006, 236, 295–304.

Ewel, K.C., and L.P. Wickenheiser. 1988. Effect of swamp size on growth rates of cypress trees. Am. Midl. Nat. Oct. 1988, Vol. 120, No. 2, p. 362-370.

Keim, R.F., Braud, D.H., Shaffer, G.P., Chambers, J.L., 2010, Mapping coastal wetland forests in coastal Louisiana: Baton Rouge, Louisiana Department of Environmental Quality, 21 p.

Saltus, C.L. and Suir, G.M. 2019. Remotely Sensed Habitat Assessment of Swamp and Bottomland Hardwood Habitat: West Shore Lake Pontchartrain Hurricane Damage Risk Reduction System Potential Impact Area. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Shaffer, G.P.; Day, J.W.; Kandalepas, D.; Wood, W.B.; Hunter, R.G.; Lane, R.R.; Hillmann, E.R. Decline of the Maurepas Swamp, Pontchartrain Basin, Louisiana, and Approaches to Restoration. Water 2016, 8, 101.

APPENDIX A

FWOP and FWP Project Area Average Submergence Calculations

						FWP Accretion/yr		
						0.5	cm	
		CRMS	CRMS	CRMS		0.016404	ft	
		63	97	5414				
		Total	Total	Total	**FWOP**		FWP	
		Substrate	Substrate	Substrate	**Submerg.**	FWP	Submerg.	
		Submerg.	Submerg.	Submerg.	**Ave.**	Accr.	Ave.	
TY	Year	(ft)	(ft)	(ft)	**(ft)**	(ft/yr)	(ft)	
	2021	-0.81992	-0.44709	-0.56092	**-0.6093**		-0.60931	
	2022	-0.83549	-0.46266	-0.57649	**-0.62488**		-0.62488	
	2023	-0.85124	-0.47841	-0.59224	**-0.64063**		-0.64063	**Ramp-Up**
	2024	-0.86717	-0.49434	-0.60817	**-0.65656**		-0.65656	**Accretion**
0	2025	-0.88327	-0.51044	-0.62427	**-0.67266**		-0.67266	**Reductions**
1	2026	-0.89956	-0.52672	-0.64055	**-0.68894**	0.000984	-0.68796	**6%**
2	2027	-0.91602	-0.54318	-0.65701	**-0.70541**	0.007054	-0.69835	**37%**
3	2028	-0.93266	-0.55982	-0.67365	**-0.72204**	0.01542	-0.70662	**51%**
4	2029	-0.94947	-0.57664	-0.69047	**-0.73886**	0.031824	-0.70704	
5	2030	-0.96647	-0.59363	-0.70746	**-0.75585**	0.048228	-0.70763	
6	2031	-0.98364	-0.6108	-0.72463	**-0.77303**	0.064633	-0.70839	
7	2032	-1.00099	-0.62815	-0.74198	**-0.79037**	0.081037	-0.70934	
8	2033	-1.01851	-0.64568	-0.75951	**-0.8079**	0.097441	-0.71046	
9	2034	-1.03622	-0.66339	-0.77722	**-0.82561**	0.113845	-0.71176	
10	2035	-1.0541	-0.68127	-0.7951	**-0.84349**	0.130249	-0.71324	
11	2036	-1.07216	-0.69933	-0.81316	**-0.86155**	0.146654	-0.7149	
12	2037	-1.0904	-0.71757	-0.8314	**-0.87979**	0.163058	-0.71673	
13	2038	-1.10882	-0.73598	-0.84981	**-0.8982**	0.179462	-0.71874	
14	2039	-1.12741	-0.75458	-0.86841	**-0.9168**	0.195866	-0.72093	
15	2040	-1.14618	-0.77335	-0.88718	**-0.93557**	0.21227	-0.7233	
16	2041	-1.16513	-0.7923	-0.90613	**-0.95452**	0.228675	-0.72584	
17	2042	-1.18426	-0.81143	-0.92525	**-0.97365**	0.245079	-0.72857	
18	2043	-1.20356	-0.83073	-0.94456	**-0.99295**	0.261483	-0.73147	
19	**2044**	-1.22305	-0.85021	-0.96404	**-1.01243**	0.277887	-0.73455	
20	2045	-1.24271	-0.86987	-0.9837	**-1.03209**	0.294291	-0.7378	
21	2046	-1.26255	-0.88971	-1.00354	**-1.05193**	0.310696	-0.74124	
22	2047	-1.28256	-0.90973	-1.02356	**-1.07195**	0.3271	-0.74485	
23	2048	-1.30276	-0.92992	-1.04375	**-1.09214**	0.343504	-0.74864	
24	2049	-1.32313	-0.95029	-1.06412	**-1.11251**	0.359908	-0.75261	
25	2050	-1.34368	-0.97084	-1.08467	**-1.13306**	0.376312	-0.75675	
26	2051	-1.3644	-0.99157	-1.1054	**-1.15379**	0.392717	-0.76107	
27	2052	-1.38531	-1.01247	-1.1263	**-1.1747**	0.409121	-0.76557	
28	2053	-1.40639	-1.03356	-1.14739	**-1.19578**	0.425525	-0.77025	
29	2054	-1.42765	-1.05482	-1.16865	**-1.21704**	0.441929	-0.77511	
30	2055	-1.44909	-1.07626	-1.19009	**-1.23848**	0.458333	-0.78014	
31	2056	-1.47071	-1.09787	-1.2117	**-1.26009**	0.474738	-0.78536	
32	2057	-1.4925	-1.11967	-1.2335	**-1.28189**	0.491142	-0.79075	
33	2058	-1.51447	-1.14164	-1.25547	**-1.30386**	0.507546	-0.79631	
34	2059	-1.53662	-1.16379	-1.27762	**-1.32601**	0.52395	-0.80206	
35	2060	-1.55895	-1.18611	-1.29994	**-1.34834**	0.540354	-0.80798	
36	2061	-1.58145	-1.20862	-1.32245	**-1.37084**	0.556759	-0.81408	
37	2062	-1.60414	-1.2313	-1.34513	**-1.39352**	0.573163	-0.82036	
38	2063	-1.627	-1.25416	-1.36799	**-1.41638**	0.589567	-0.82682	
39	2064	-1.65003	-1.2772	-1.39103	**-1.43942**	0.605971	-0.83345	
40	2065	-1.67325	-1.30042	-1.41425	**-1.46264**	0.622375	-0.84026	
41	2066	-1.69664	-1.32381	-1.43764	**-1.48603**	0.63878	-0.84725	
42	2067	-1.72022	-1.34738	-1.46121	**-1.5096**	0.655184	-0.85442	
43	2068	-1.74396	-1.37113	-1.48496	**-1.53335**	0.671588	-0.86176	
44	2069	-1.76789	-1.39506	-1.50889	**-1.55728**	0.687992	-0.86929	
45	2070	-1.792	-1.41916	-1.53299	**-1.58138**	0.704396	-0.87699	
46	2071	-1.81628	-1.44345	-1.55728	**-1.60567**	0.720801	-0.88487	
47	2072	-1.84074	-1.46791	-1.58174	**-1.63013**	0.737205	-0.89292	
48	2073	-1.86538	-1.49254	-1.60637	**-1.65477**	0.753609	-0.90116	
49	2074	-1.89019	-1.51736	-1.63119	**-1.67958**	0.770013	-0.90957	
50	2075	-1.91519	-1.54235	-1.65618	**-1.70458**	0.786417	-0.91816	

APPENDIX B

Pontchartrain Basin CRMS - Cypress dbh Growth Rates

		Water Exchange		Station Elevation (feet)	Mean WL 2013-2019 (feet)	Mean Submergence (feet)	WL below soil (percent)	Mean Sal (ppt)	Max Sal (ppt)		Ave Dbh Rate (cm/yr)	n
65	Swamp	low	upper basi	0.42	1.56	1.14	0.00%	0.07	0.17		0.15926	30
5167	Swamp	high	upper basi	0.65	1.11	0.46	25.66%	0.12	0.29		0.445991	11
39	Swamp	low	upper basi	0.21	1.58	1.37	0.00%	0.13	0.43		0.296014	50
5373	Swamp	high	middle bas	0.3	1.2	0.9	7%	0.16	0.5		0.314382	22
63	Swamp	high	middle bas	0.41	1.16	0.75	11.26%	0.13	0.28		0.361823	13
59	Swamp	low	middle bas	0.58	1.37	0.79	0.00%	0.11	0.21		0.56152	10
89	Swamp	low	middle bas	0.03	1.38	1.35	0.00%	0.13	0.24		0.263618	11
47	Swamp	low	middle bas	0.91	0.93	0.02	49.71%	0.16	0.36		0.353892	25
5414	Swamp	low	middle bas	0.29	0.77	0.48	20.00%	0.15	0.45		0.64722	5
97	Swamp	low	middle bas	0.61	0.99	0.38	29.90%	0.12	0.23		0.211359	17
5845	Swamp	high	middle bas	0.53	1.03	0.5	24.63%	0.09	0.41		0.488875	4
38	Swamp	high	mid basin -	0.35	0.99	0.64	18.89%	0.08	0.41		0.7647	1
8	Swamp	high	mid basin -	0.44	1.23	0.79	0.24%	0.17	0.3		0.231079	44
5267	Swamp	high	mid basin -	0.42	0.78	0.36	30.66%	0.06	0.82		0.33535	2
61	Swamp	low	middle bas	0.37	0.66	0.29	29.92%	0.11	0.4		0.55	6
46	Swamp	high	mid - near	0.95	1.05	0.1	47.18%	0.08	0.4		0.41717	10
5452	Swamp	high	mid -near l	0.4	0.8	0.4	28.99%	0.03	0.65		0.269996	25
5255	Swamp	low	Lower -SW	0.57	0.86	0.29	32.94%	0.11	0.43		0.601867	3
90	Swamp	low	lower -nea	-0.16	1.06	1.22	0%	- -	- -		0.275045	11
58	Swamp	low	lower-S La	0.6	1.27	0.67	0.42%	0.14	0.27		0.3537	2
6209	Swamp	high	lower - bai	0.6	0.8	0.2	39.64%	0.9	5.73		0.3014	1
103	Swamp	high	lower - bai	0.77	0.98	0.21	39.78%	1.31	5.95		0.0215	5

Pontchartrain Basin CRMS Tupelo dbh Growth Rates

ain Basin		Water Exchange		Station Elevation (feet)	Mean WL 2013-2019 (feet)	Mean ubmergenc (feet)	WL below soil (percent)	Mean Sal (ppt)	Max Sal (ppt)	Canopy Cover Rate	Ave Dbh Rate (cm/yr)	n
65	Swamp	low	upper basi	0.42	1.56	1.14	0.00%	0.07	0.17	0.1409	0.039946	26
5167	Swamp	high	upper basi	0.65	1.11	0.46	25.66%	0.12	0.29		0.0986	49
39	Swamp	low	upper basi	0.21	1.58	1.37	0.00%	0.13	0.43	-0.8932	0.275106	35
5373	Swamp	high	middle bas	0.3	1.2	0.9	7%	0.16	0.5		0.179933	3
63	Swamp	high	middle bas	0.41	1.16	0.75	11.26%	0.13	0.28	0.1424	0.183457	37
59	Swamp	low	middle bas	0.58	1.37	0.79	0.00%	0.11	0.21		0.254381	52
89	Swamp	low	middle bas	0.03	1.38	1.35	0.00%	0.13	0.24	0.2466	0.203283	41
47	Swamp	low	middle bas	0.91	0.93	0.02	49.71%	0.16	0.36	0.245	0.210734	35
5414	Swamp	low	middle bas	0.29	0.77	0.48	20.00%	0.15	0.45	-2.1255	0.122262	37
97	Swamp	low	middle bas	0.61	0.99	0.38	29.90%	0.12	0.23	0	0.115506	31
5845	Swamp	high	middle bas	0.53	1.03	0.5	24.63%	0.09	0.41	0.0222	-0.09622	14
38	Swamp	high	mid basin -	0.35	0.99	0.64	18.89%	0.08	0.41	-0.7006	0.097863	49
8	Swamp	high	mid basin -	0.44	1.23	0.79	0.24%	0.17	0.3	0.3715	0.15922	67
5267	Swamp	high	mid basin -	0.42	0.78	0.36	30.66%	0.06	0.82		0.098558	12
61	Swamp	low	middle bas	0.37	0.66	0.29	29.92%	0.11	0.4	1.12198	0.211369	52
46	Swamp	high	mid - near	0.95	1.05	0.1	47.18%	0.08	0.4		0.128402	54
5452	Swamp	high	mid -near l	0.4	0.8	0.4	28.99%	0.03	0.65		0.038533	63
5255	Swamp	low	Lower -SW	0.57	0.86	0.29	32.94%	0.11	0.43	-0.3585	0.179787	30
90	Swamp	low	lower -nea	-0.16	1.06	1.22	0%	- -	- -	-0.5646	0.246613	23
58	Swamp	low	lower-S La	0.6	1.27	0.67	0.42%	0.14	0.27		0.052859	17
6209	#REF!	high	lower - bai	0.6	0.8	0.2	39.64%	0.9	5.73			
103	#REF!	high	lower - bai	0.77	0.98	0.21	39.78%	1.31	5.95			

Pontchartrain Cypress dbh growth rates sorted into thirds

	Sorted Growth	n			
1	0.7647	1			
2	0.64722	5			
3	0.601867	3		Weigthed	
4	0.56152	10		Growth	
5	0.55	6		Rates	
6	0.488875	4			
7	0.445991	11	40	0.539575	High
8	0.41717	10			
9	0.361823	13			
10	0.353892	25			
11	0.3537	2			
12	0.33535	2			
13	0.314382	22			
14	0.296014	50	124	0.329177	Med
15	0.275045	11			
16	0.269996	25			
17	0.263618	11			
18	0.231079	44			
19	0.211359	17			
20	0.15926	30	138	0.226185	Low

Pontchartrain Tupelo dbh growth rates sorted into thirds					
	Sorted dbh Growth (cm/yr)	n			
1	0.275106	35			
2	0.254381	52			
3	0.246613	23			
4	0.211369	52			
5	0.210734	35			
6	0.203283	41			
7	0.183457	37	275	**0.22552**	**= Weighted Ave High Tier**
8	0.179933	3			
9	0.179787	30			
10	0.15922	67			
11	0.128402	54			
12	0.122262	37			
13	0.115506	31			
14	0.0986	49	271	**0.134578**	**= Weighted Ave Med Tier**
15	0.098558	12			
16	0.097863	49			
17	0.052859	17			
18	0.039946	26			
19	0.038533	63			
20	-0.09622	14	181	**0.0497**	**= Weighted Ave Low Tier**

APPENDIX C

Atchafalaya Basin CRMS Cypress dbh Growth Rates (all stations).

Atch CRMS#		got veg dat	Position	Station Elevation (feet)	Mean WL 2013-2019 (feet)	Mean ubmergenc (feet)	Time WL soil (percent)	Mean Sal (ppt)	Max Sal (ppt)		Bald Cypress Growth (cm/yr)	n
4900	Swamp	Y	on natural	0.93	1.89	0.96	3.70%	0.17	0.29		0.53776	5
5003	Swamp	Y	on natural	0.37	1.82	1.45	3.34%	0.17	0.29		1.742483	6
4938	Swamp	Y	on natural	1.51	2.14	0.63	28.72%	0.17	0.29		0.927733	6
6042	Swamp	Y	on natural	1.52	1.76	0.24	51.06%	0.16	0.29		1.410425	16
4782	Swamp	Y	on natural	1.82	1.88	0.06	55.38%	0.19	0.5		1.0934	4

Atchafalaya Basin CRMS Tupelo dbh Growth Rates (all stations).

Atch CRMS#		got veg dat	Basin Position	Station Elevation (feet)	Mean WL 2013-2019 (feet)	Mean ubmergenc (feet)	Time WL soil (percent)	Mean Sal (ppt)	Max Sal (ppt)		Bald Cypress Growth (cm/yr)	n		
4900	Swamp	Y	on natural levee	0.93	1.89	0.96	0.037	0.17	0.29		1.26173478	23		29
5003	Swamp	Y	on natural levee	0.37	1.82	1.45	0.0334	0.17	0.29		0.43819762	26		11
4938	Swamp	Y	on natural levee	1.51	2.14	0.63	0.2872	0.17	0.29		0.63920118	86		55
6042	Swamp	Y	on natural levee	1.52	1.76	0.24	0.5106	0.16	0.29		0.97545882	34		33
4782	Swamp	Y	on natural levee	1.82	1.88	0.06	0.5538	0.19	0.5		0.48468447	38		18
4809											0.32589	20		7
4808											0.33496111	36		12
4782											0.48468447	38		18
4779											0.33082698	63		21
6008											0.30066452	31		9

APPENDIX D

Dbh calculations (red font denotes predicted dbh in inches).

FWOP	FWOP Transitional Forest																			
	2018 Ave dbh	Growth Rate (cm/yr) =	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330
	Cypress	TY								0	1	2	3	4	5	6	7	8	9	10
	(cm)	Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
cm	39.395536		39.40	39.73	40.05	40.38	40.71	41.04	41.37	41.70	42.03	42.36	42.69	43.02	43.35	43.68	44.01	44.34	44.67	45.00
inches			15.51	15.64	15.77	15.90	16.03	16.16	16.29	16.42	16.55	16.68	16.81	16.94	17.07	17.20	17.33	17.46	17.59	17.72
FWOP	FWOP Transitional Forest																			
	2018 Ave dbh	Growth Rate (cm/yr) =	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142
	Non-Cypress	TY								0	1	2	3	4	5	6	7	8	9	10
	(cm)	Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
cm	25.56381		25.56	25.71	25.85	25.99	26.13	26.27	26.41	26.56	26.70	26.84	26.98	27.12	27.27	27.41	27.55	27.69	27.83	27.97
inches			10.06	10.12	10.18	10.23	10.29	10.34	10.40	10.46	10.51	10.57	10.62	10.68	10.73	10.79	10.85	10.90	10.96	11.01
	FWOP Closed Canopy Forest																			
FWOP	2018 Ave dbh	Growth Rate (cm/yr) =	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330
	Cypress	TY								0	1	2	3	4	5	6	7	8	9	10
	(cm)	Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
cm	32.306522		32.31	32.64	32.97	33.30	33.62	33.95	34.28	34.61	34.94	35.27	35.60	35.93	36.26	36.59	36.92	37.25	37.58	37.91
inches			12.72	12.85	12.98	13.11	13.24	13.37	13.50	13.63	13.76	13.89	14.02	14.15	14.28	14.41	14.54	14.67	14.79	14.92
FWOP	FWOP Closed Canopy Forest																			
	2018 Ave dbh	Growth Rate (cm/yr) =	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142
	Non-Cypress	TY								0	1	2	3	4	5	6	7	8	9	10
	(cm)	Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
cm	34.366667		34.37	34.51	34.65	34.79	34.93	35.08	35.22	35.36	35.50	35.64	35.78	35.93	36.07	36.21	36.35	36.49	36.64	36.78
inches			13.53	13.59	13.64	13.70	13.75	13.81	13.87	13.92	13.98	14.03	14.09	14.14	14.20	14.26	14.31	14.37	14.42	14.48
	0.842 = Post Ramp-Up growth rate							0.512 = FWP growth rate increase (cm/yr)												
FWP	FWP Transitional Forest										6%	37%	51%							
	2018 Ave dbh	Growth Rate (cm/yr) =									0.360	0.519	0.591	0.842	0.842	0.842	0.842	0.842	0.842	0.842
	Cypress	TY								0	1	2	3	4	5	6	7	8	9	10
	(cm)	Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
cm	39.395536		39.40	39.73	40.05	40.38	40.71	41.04	41.37	41.70	42.06	42.58	43.17	44.01	44.86	45.70	46.54	47.38	48.22	49.07
inches			15.51	15.64	15.77	15.90	16.03	16.16	16.29	16.42	16.56	16.76	17.00	17.33	17.66	17.99	18.32	18.65	18.99	19.32
	0.342 = Post Ramp-Up growth rate							0.200 = FWP growth rate increase (cm/yr)												
FWP	FWP Transitional Forest										6%	37%	51%							
	2018 Ave dbh	Growth Rate (cm/yr) =									0.154	0.216	0.244	0.342	0.342	0.342	0.342	0.342	0.342	0.342
	Non-Cypress	TY								0	1	2	3	4	5	6	7	8	9	10
	(cm)	Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
cm	25.56381		25.56	25.71	25.85	25.99	26.13	26.27	26.41	26.56	26.71	26.93	27.17	27.51	27.85	28.19	28.54	28.88	29.22	29.56
inches			10.06	10.12	10.18	10.23	10.29	10.34	10.40	10.46	10.52	10.60	10.70	10.83	10.97	11.10	11.23	11.37	11.50	11.64
	0.842 = Post Ramp-Up growth rate							0.512 = FWP growth rate increase (cm/yr)												
FWP	FWP Closed Canopy Forest										6%	37%	51%							
	2018 Ave dbh	Growth Rate (cm/yr) =									0.360	0.519	0.591	0.842	0.842	0.842	0.842	0.842	0.842	0.842
	Cypress	TY								0	1	2	3	4	5	6	7	8	9	10
	(cm)	Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
cm	32.306522		32.31	32.64	32.97	33.30	33.62	33.95	34.28	34.61	34.97	35.49	36.08	36.93	37.77	38.61	39.45	40.29	41.13	41.98
inches			12.72	12.85	12.98	13.11	13.24	13.37	13.50	13.63	13.77	13.97	14.21	14.54	14.87	15.20	15.53	15.86	16.19	16.53
	0.342 = Post Ramp-Up growth rate							0.200 = FWP growth rate increase (cm/yr)												
FWP	FWP Closed Canopy Forest										6%	37%	51%							
	2018 Ave dbh	Growth Rate (cm/yr) =									0.154	0.216	0.244	0.342	0.342	0.342	0.342	0.342	0.342	0.342
	Non-Cypress	TY								0	1	2	3	4	5	6	7	8	9	10
	(cm)	Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
cm	34.366667		34.37	34.51	34.65	34.79	34.93	35.08	35.22	35.36	35.51	35.73	35.97	36.31	36.66	37.00	37.34	37.68	38.02	38.36
inches			13.53	13.59	13.64	13.70	13.75	13.81	13.87	13.92	13.98	14.07	14.16	14.30	14.43	14.57	14.70	14.84	14.97	15.10

3-Year Discharge Ramp-Up Period							
Diversion Discharge	# Days @ Normal Ops	TY1 # days	TY1 % of Normal Ops	TY2 # days	TY2 % of Normal Ops	TY3 # days	TY3 % of Normal Ops
>= 1000 cfs	139	67	48%	99	71%	114	82%
>= 1500 cfs	138	14	10%	66	48%	86	62%
>= 1750 cfs	115	7	6%	43	37%	59	51%
>= 2000 cfs	77	7	9%	29	38%	43	56%

FWOP	FWOP Transitional Forest										0.226											
	2018 Ave dbh	Growth Rate (cm/yr) =	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226
	Cypress	TY	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	(cm)	Year	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055
cm	39.395536		45.33	45.66	45.99	46.32	46.64	46.97	47.30	47.63	47.86	48.09	48.31	48.54	48.76	48.99	49.22	49.44	49.67	49.90	50.12	50.35
inches			17.85	17.97	18.10	18.23	18.36	18.49	18.62	18.75	18.84	18.93	19.02	19.11	19.20	19.29	19.38	19.47	19.55	19.64	19.73	19.82
FWOP	FWOP Transitional Forest										0.00											
	2018 Ave dbh	Growth Rate (cm/yr) =	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Non-Cypress	TY	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	(cm)	Year	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055
cm	25.56381		28.12	28.26	28.40	28.54	28.68	28.83	28.97	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11
inches			11.07	11.13	11.18	11.24	11.29	11.35	11.40	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46
	FWOP Closed Canopy Forest										0.226											
FWOP	2018 Ave dbh	Growth Rate (cm/yr) =	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226	0.226
	Cypress	TY	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	(cm)	Year	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055
cm	32.306522		38.24	38.57	38.90	39.23	39.56	39.89	40.21	40.54	40.77	41.00	41.22	41.45	41.68	41.90	42.13	42.35	42.58	42.81	43.03	43.26
inches			15.05	15.18	15.31	15.44	15.57	15.70	15.83	15.96	16.05	16.14	16.23	16.32	16.41	16.50	16.59	16.67	16.76	16.85	16.94	17.03
FWOP	FWOP Closed Canopy Forest										0.00											
	2018 Ave dbh	Growth Rate (cm/yr) =	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.142	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Non-Cypress	TY	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	(cm)	Year	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055
cm	34.366667		36.92	37.06	37.20	37.35	37.49	37.63	37.77	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91
inches			14.54	14.59	14.65	14.70	14.76	14.81	14.87	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93
FWP	FWP Transitional Forest																					
	2018 Ave dbh	Growth Rate (cm/yr) =	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842
	Cypress	TY	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	(cm)	Year	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055
cm	39.395536		49.91	50.75	51.59	52.43	53.28	54.12	54.96	55.80	56.64	57.48	58.33	59.17	60.01	60.85	61.69	62.54	63.38	64.22	65.06	65.90
inches			19.65	19.98	20.31	20.64	20.97	21.31	21.64	21.97	22.30	22.63	22.96	23.29	23.63	23.96	24.29	24.62	24.95	25.28	25.62	25.95
FWP	FWP Transitional Forest																					
	2018 Ave dbh	Growth Rate (cm/yr) =	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342
	Non-Cypress	TY	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	(cm)	Year	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055
cm	25.56381		29.90	30.24	30.59	30.93	31.27	31.61	31.95	32.29	32.64	32.98	33.32	33.66	34.00	34.34	34.69	35.03	35.37	35.71	36.05	36.39
inches			11.77	11.91	12.04	12.18	12.31	12.45	12.58	12.71	12.85	12.98	13.12	13.25	13.39	13.52	13.66	13.79	13.93	14.06	14.19	14.33
FWP	FWP Closed Canopy Forest																					
	2018 Ave dbh	Growth Rate (cm/yr) =	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842	0.842
	Cypress	TY	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	(cm)	Year	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055
cm	32.306522		42.82	43.66	44.50	45.34	46.19	47.03	47.87	48.71	49.55	50.40	51.24	52.08	52.92	53.76	54.61	55.45	56.29	57.13	57.97	58.82
inches			16.86	17.19	17.52	17.85	18.18	18.52	18.85	19.18	19.51	19.84	20.17	20.50	20.84	21.17	21.50	21.83	22.16	22.49	22.82	23.16
FWP	FWP Closed Canopy Forest																					
	2018 Ave dbh	Growth Rate (cm/yr) =	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342	0.342
	Non-Cypress	TY	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
	(cm)	Year	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055
cm	34.366667		38.71	39.05	39.39	39.73	40.07	40.41	40.76	41.10	41.44	41.78	42.12	42.46	42.81	43.15	43.49	43.83	44.17	44.51	44.86	45.20
inches			15.24	15.37	15.51	15.64	15.78	15.91	16.05	16.18	16.31	16.45	16.58	16.72	16.85	16.99	17.12	17.26	17.39	17.53	17.66	17.79

FWOP	FWOP Transitional Forest					0.00													
	2018 Ave dbh	Growth Rate (cm/yr) =	0.226	0.226	0.226	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Cypress	TY	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	(cm)	Year	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
cm	39.395536		51.25	51.48	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70	51.70
inches			20.18	20.27	20.36	20.36	20.36	20.36	20.36	20.36	20.36	20.36	20.36	20.36	20.36	20.36	20.36	20.36	20.36
FWOP	FWOP Transitional Forest																		
	2018 Ave dbh	Growth Rate (cm/yr) =	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Non-Cypress	TY	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	(cm)	Year	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
cm	25.56381		29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11	29.11
inches			11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46	11.46
	FWOP Closed Canopy Forest					0.00													
FWOP	2018 Ave dbh	Growth Rate (cm/yr) =	0.226	0.226	0.226	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	Cypress	TY	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	(cm)	Year	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
cm	32.306522		44.16	44.39	44.62	44.62	44.62	44.62	44.62	44.62	44.62	44.62	44.62	44.62	44.62	44.62	44.62	44.62	44.62
inches			17.39	17.48	17.57	17.57	17.57	17.57	17.57	17.57	17.57	17.57	17.57	17.57	17.57	17.57	17.57	17.57	17.57
FWOP	FWOP Closed Canopy Forest																		
	2018 Ave dbh	Growth Rate (cm/yr) =	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Non-Cypress	TY	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	(cm)	Year	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
cm	34.366667		37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91	37.91
inches			14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93	14.93
FWP	FWP Transitional Forest					50% = reduction in with-project growth rate increase TY38 - TY50													
	2018 Ave dbh	Growth Rate (cm/yr) =	0.842	0.842	0.842	0.842	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586
	Cypress	TY	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	(cm)	Year	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
cm	39.395536		69.27	70.11	70.96	71.80	72.38	72.97	73.55	74.14	74.73	75.31	75.90	76.48	77.07	77.65	78.24	78.83	79.41
inches			27.27	27.60	27.94	28.27	28.50	28.73	28.96	29.19	29.42	29.65	29.88	30.11	30.34	30.57	30.80	31.03	31.26
FWP	FWP Transitional Forest					50% = reduction in with-project growth rate increase TY38 - TY50													
	2018 Ave dbh	Growth Rate (cm/yr) =	0.342	0.342	0.342	0.342	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242
	Non-Cypress	TY	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	(cm)	Year	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
cm	25.56381		37.76	38.10	38.44	38.79	39.03	39.27	39.51	39.75	40.00	40.24	40.48	40.72	40.96	41.20	41.45	41.69	41.93
inches			14.87	15.00	15.14	15.27	15.37	15.46	15.56	15.65	15.75	15.84	15.94	16.03	16.13	16.22	16.32	16.41	16.51
FWP	FWP Closed Canopy Forest					50% = reduction in with-project growth rate increase TY38 - TY50													
	2018 Ave dbh	Growth Rate (cm/yr) =	0.842	0.842	0.842	0.842	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586	0.586
	Cypress	TY	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	(cm)	Year	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
cm	32.306522		62.18	63.02	63.87	64.71	65.29	65.88	66.47	67.05	67.64	68.22	68.81	69.39	69.98	70.57	71.15	71.74	72.32
inches			24.48	24.81	25.14	25.48	25.71	25.94	26.17	26.40	26.63	26.86	27.09	27.32	27.55	27.78	28.01	28.24	28.47
FWP	FWP Closed Canopy Forest					50% = reduction in with-project growth rate increase TY38 - TY50													
	2018 Ave dbh	Growth Rate (cm/yr) =	0.342	0.342	0.342	0.342	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242	0.242
	Non-Cypress	TY	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	(cm)	Year	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
cm	34.366667		46.56	46.91	47.25	47.59	47.83	48.07	48.31	48.56	48.80	49.04	49.28	49.52	49.76	50.01	50.25	50.49	50.73
inches			18.33	18.47	18.60	18.74	18.83	18.93	19.02	19.12	19.21	19.31	19.40	19.50	19.59	19.69	19.78	19.88	19.97

APPENDIX E

Basal area calculations.

FWOP: BA - Transitional Cypress — 75.1 = 2018 CRMS Basal Area (ft2/acre)

								TY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	dbh (inches)	15.5	15.6	15.8	15.9	16.0	16.2	16.3	16.4	16.5	16.7	16.8	16.9	17.1	17.2	17.3	17.5	17.6	17.7	17.8	18.0	18.1	18.2	18.4	18.5	18.6	18.8
x	Fraction Change	1.00	1.01	1.02	1.03	1.03	1.04	1.05	1.06	1.07	1.08	1.08	1.09	1.10	1.11	1.12	1.13	1.13	1.14	1.15	1.16	1.17	1.18	1.18	1.19	1.20	1.21
	Basal Area (ft2/ac)	75.08	75.71	76.33	76.96	77.59	78.22	78.85	79.47	80.10	80.73	81.36	81.99	82.61	83.24	83.87	84.50	85.13	85.75	86.38	87.01	87.64	88.27	88.89	89.52	90.15	90.78
-0.1781 '= BA loss @ TY37 (ft2/ac)	BA adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Basal Area (ft2/ac)	**75.1**	**75.71**	**76.33**	**76.96**	**77.59**	**78.22**	**78.85**	**79.47**	**80.10**	**80.73**	**81.36**	**81.99**	**82.61**	**83.24**	**83.87**	**84.50**	**85.13**	**85.75**	**86.38**	**87.01**	**87.64**	**88.27**	**88.89**	**89.52**	**90.15**	**90.78**
																0.63											

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
dbh (inches)	18.8	18.9	19.0	19.1	19.2	19.3	19.4	19.5	19.6	19.6	19.7	19.8	19.9	20.0	20.1	20.2	20.3	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4	20.4
Fraction Change	1.21	1.22	1.23	1.23	1.24	1.24	1.25	1.26	1.26	1.27	1.27	1.28	1.28	1.29	1.30	1.30	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31	1.31
Basal Area (ft2/ac)	91.21	91.64	92.07	92.50	92.93	93.36	93.79	94.23	94.66	95.09	95.52	95.95	96.38	96.81	97.24	97.67	98.10	98.54	98.54	98.54	98.54	98.54	98.54	98.54	98.54	98.54	98.54	98.54	98.54	98.54	98.54	98.54
BA adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.178	-0.356	-0.534	-0.712	-0.890	-1.068	-1.246	-1.425	-1.603	-1.781	-1.959	-2.137	-2.315	-2.493
Basal Area (ft2/ac)	**91.21**	**91.64**	**92.07**	**92.50**	**92.93**	**93.36**	**93.79**	**94.23**	**94.66**	**95.09**	**95.52**	**95.95**	**96.38**	**96.81**	**97.24**	**97.67**	**98.10**	**98.54**	**98.36**	**98.18**	**98.00**	**97.82**	**97.65**	**97.47**	**97.29**	**97.11**	**96.93**	**96.76**	**96.58**	**96.40**	**96.22**	**96.04**

FWOP: BA - Transitional NON-Cypress — 104.6 = 2018 CRMS Basal Area (ft2/acre)

								TY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	dbh (inches)	10.1	10.1	10.2	10.2	10.3	10.3	10.4	10.5	10.5	10.6	10.6	10.7	10.7	10.8	10.8	10.9	11.0	11.0	11.1	11.1	11.2	11.2	11.3	11.3	11.4	11.5
x	Fraction Change	1.00	1.01	1.01	1.02	1.02	1.03	1.03	1.04	1.04	1.05	1.06	1.06	1.07	1.07	1.08	1.08	1.09	1.09	1.10	1.11	1.11	1.12	1.12	1.13	1.13	1.14
-0.534 = Recruit/Mort TY0 to TY18	Basal Area (ft2/ac)	104.6	105.2	105.8	106.4	107.0	107.5	108.1	108.7	109.3	109.9	110.4	111.0	111.6	112.2	112.8	113.4	113.9	114.5	115.1	115.7	116.3	116.8	117.4	118.0	118.6	119.2
-2.0250 = Recruit/Mort > =TY19	BA Recruit/Mort Adj.	0.0	-0.5	-1.1	-1.6	-2.1	-2.7	-3.2	-3.7	-4.3	-4.8	-5.3	-5.9	-6.4	-6.9	-7.5	-8.0	-8.5	-9.1	-9.6	-10.1	-10.7	-11.2	-11.8	-12.3	-12.8	-13.4
	Adjusted BA (ft2/acre)	**104.6**	**104.7**	**104.7**	**104.8**	**104.8**	**104.9**	**104.9**	**105.0**	**105.0**	**105.1**	**105.1**	**105.2**	**105.2**	**105.2**	**105.3**	**105.3**	**105.4**	**105.4**	**105.5**	**105.5**	**105.6**	**105.6**	**105.7**	**105.7**	**105.8**	**105.8**

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
dbh (inches)	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
Fraction Change	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14	1.14
Basal Area (ft2/ac)	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2	119.2
BA Recruit/Mort Adj.	-15.4	-17.4	-19.4	-21.5	-23.5	-25.5	-27.5	-29.6	-31.6	-33.6	-35.6	-37.7	-39.7	-41.7	-43.7	-45.8	-47.8	-49.8	-51.8	-53.9	-55.9	-57.9	-59.9	-62.0	-64.0	-66.0	-68.0	-70.1	-72.1	-74.1	-76.1	-78.2
Adjusted BA (ft2/acre)	**103.8**	**101.8**	**99.7**	**97.7**	**95.7**	**93.7**	**91.6**	**89.6**	**87.6**	**85.6**	**83.5**	**81.5**	**79.5**	**77.5**	**75.4**	**73.4**	**71.4**	**69.4**	**67.3**	**65.3**	**63.3**	**61.3**	**59.2**	**57.2**	**55.2**	**53.2**	**51.1**	**49.1**	**47.1**	**45.1**	**43.0**	**41.0**

FWOP: BA - Closed Canopy - Cypress — 161.7 = 2018 CRMS Basal Area (ft2/acre)

								TY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	dbh (inches)	12.7	12.8	13.0	13.1	13.2	13.4	13.5	13.6	13.8	13.9	14.0	14.1	14.3	14.4	14.5	14.7	14.8	14.9	15.1	15.2	15.3	15.4	15.6	15.7	15.8	16.0
	Fraction Change	1.00	1.01	1.02	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.19	1.20	1.21	1.22	1.23	1.24	1.25
x	Basal Area (ft2/ac)	161.7	163.345	164.994	166.643	168.292	169.941	171.591	173.24	174.889	176.538	178.188	179.837	181.486	183.135	184.784	186.434	188.083	189.732	191.381	193.03	194.68	196.329	197.978	199.627	201.277	202.926
-0.178 '= BA loss @ TY37 (ft2/ac)	BA adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Basal Area (ft2/ac)	**161.7**	**163.3**	**165.0**	**166.6**	**168.3**	**169.9**	**171.6**	**173.2**	**174.9**	**176.5**	**178.2**	**179.8**	**181.5**	**183.1**	**184.8**	**186.4**	**188.1**	**189.7**	**191.4**	**193.0**	**194.7**	**196.3**	**198.0**	**199.6**	**201.3**	**202.9**

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
dbh (inches)	16.1	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8	16.9	16.9	17.0	17.1	17.2	17.3	17.4	17.5	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
Fraction Change	1.26	1.27	1.28	1.28	1.29	1.30	1.30	1.31	1.32	1.33	1.33	1.34	1.35	1.35	1.36	1.37	1.37	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38	1.38
Basal Area (ft2/ac)	204.058	205.19	206.322	207.454	208.586	209.718	210.85	211.982	213.114	214.246	215.379	216.511	217.643	218.775	219.907	221.039	222.171	223.303	223.303	223.303	223.303	223.303	223.303	223.303	223.303	223.303	223.303	223.303	223.303	223.303	223.303	223.303
BA adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-0.178	-0.356	-0.534	-0.712	-0.890	-1.068	-1.246	-1.425	-1.603	-1.781	-1.959	-2.137	-2.315	-2.493
Basal Area (ft2/ac)	**204.1**	**205.2**	**206.3**	**207.5**	**208.6**	**209.7**	**210.9**	**212.0**	**213.1**	**214.2**	**215.4**	**216.5**	**217.6**	**218.8**	**219.9**	**221.0**	**222.2**	**223.3**	**223.1**	**222.9**	**222.8**	**222.6**	**222.4**	**222.2**	**222.1**	**221.9**	**221.7**	**221.5**	**221.3**	**221.2**	**221.0**	**220.8**

FWOP: BA - Closed Canopy - NON-Cypress — 122.6 = 2018 CRMS Basal Area (ft2/acre)

								TY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	dbh (inches)	13.5	13.6	13.6	13.7	13.8	13.8	13.9	13.9	14.0	14.0	14.1	14.1	14.2	14.3	14.3	14.4	14.4	14.5	14.5	14.6	14.6	14.7	14.8	14.8	14.9	14.9
x	Fraction Change	1.00	1.00	1.01	1.01	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.05	1.05	1.05	1.06	1.06	1.07	1.07	1.07	1.08	1.08	1.09	1.09	1.09	1.10	1.10
-0.534 = Recruit/Mort TY0 to TY18	Basal Area (ft2/ac)	122.6	123.084	123.59	124.096	124.602	125.108	125.614	126.119	126.625	127.131	127.637	128.143	128.649	129.155	129.661	130.167	130.672	131.178	131.684	132.19	132.696	133.202	133.708	134.214	134.719	135.225
-2.025 = Recruit/Mort > =TY19	BA Recruit/Mort Adj.	0.000	-0.534	-1.068	-1.603	-2.137	-2.671	-3.205	-3.74	-4.27	-4.81	-5.34	-5.88	-6.41	-6.94	-7.48	-8.01	-8.55	-9.08	-9.62	-10.15	-10.68	-11.22	-11.75	-12.29	-12.82	-13.36
	Adjusted BA (ft2/acre)	**122.6**	**122.6**	**122.5**	**122.5**	**122.5**	**122.4**	**122.4**	**122.4**	**122.4**	**122.3**	**122.3**	**122.3**	**122.2**	**122.2**	**122.2**	**122.2**	**122.1**	**122.1**	**122.1**	**122.0**	**122.0**	**122.0**	**122.0**	**121.9**	**121.9**	**121.9**

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
dbh (inches)	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9	14.9
Fraction Change	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Basal Area (ft2/ac)	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225	135.225
BA Recruit/Mort Adj.	-15.38	-17.41	-19.43	-21.46	-23.48	-25.51	-27.53	-29.56	-31.58	-33.61	-35.63	-37.66	-39.68	-41.71	-43.73	-45.76	-47.78	-49.81	-51.83	-53.86	-55.88	-57.91	-59.93	-61.96	-63.98	-66.01	-68.03	-70.06	-72.08	-74.11	-76.13	-78.16
Adjusted BA (ft2/acre)	**119.8**	**117.8**	**115.8**	**113.8**	**111.7**	**109.7**	**107.7**	**105.7**	**103.6**	**101.6**	**99.6**	**97.6**	**95.5**	**93.5**	**91.5**	**89.5**	**87.4**	**85.4**	**83.4**	**81.4**	**79.3**	**77.3**	**75.3**	**73.3**	**71.2**	**69.2**	**67.2**	**65.2**	**63.1**	**61.1**	**59.1**	**57.1**

FWP BA - Transitional - Cypress

								TY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	dbh (inches)								16.4	16.6	16.8	17.0	17.3	17.7	18.0	18.3	18.7	19.0	19.3	19.6	20.0	20.3	20.6	21.0	21.3	21.6	22.0
x	Fraction Change								1.00	1.01	1.02	1.04	1.06	1.08	1.10	1.12	1.14	1.16	1.18	1.20	1.22	1.24	1.26	1.28	1.30	1.32	1.34
0.000 = no BA adjustment for surv.	Basal Area (ft2/ac)								79.5	80.2	81.1	82.3	83.9	85.5	87.1	88.7	90.3	91.9	93.5	95.1	96.7	98.3	99.9	101.5	103.1	104.7	106.3
	BA adjustment								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Basal Area (ft2/ac)								**79.5**	**80.2**	**81.1**	**82.3**	**83.9**	**85.5**	**87.1**	**88.7**	**90.3**	**91.9**	**93.5**	**95.1**	**96.7**	**98.3**	**99.9**	**101.5**	**103.1**	**104.7**	**106.3**

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
dbh (inches)	22.3	22.6	23.0	23.3	23.6	24.0	24.3	24.6	25.0	25.3	25.6	25.9	26.3	26.6	26.9	27.3	27.6	27.9	28.3	28.5	28.7	29.0	29.2	29.4	29.7	29.9	30.1	30.3	30.6	30.8	31.0	31.3
Fraction Change	1.36	1.38	1.40	1.42	1.44	1.46	1.48	1.50	1.52	1.54	1.56	1.58	1.60	1.62	1.64	1.66	1.68	1.70	1.72	1.74	1.75	1.76	1.78	1.79	1.81	1.82	1.83	1.85	1.86	1.88	1.89	1.90
Basal Area (ft2/ac)	107.9	109.6	111.2	112.8	114.4	116.0	117.6	119.2	120.8	122.4	124.0	125.6	127.2	128.8	130.4	132.0	133.6	135.2	136.8	137.9	139.1	140.2	141.3	142.4	143.5	144.6	145.8	146.9	148.0	149.1	150.2	151.3
BA adjustment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Basal Area (ft2/ac)	**107.9**	**109.6**	**111.2**	**112.8**	**114.4**	**116.0**	**117.6**	**119.2**	**120.8**	**122.4**	**124.0**	**125.6**	**127.2**	**128.8**	**130.4**	**132.0**	**133.6**	**135.2**	**136.8**	**137.9**	**139.1**	**140.2**	**141.3**	**142.4**	**143.5**	**144.6**	**145.8**	**146.9**	**148.0**	**149.1**	**150.2**	**151.3**

FWP BA - Transitional NON-Cypress

								TY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	dbh (inches)								10.5	10.5	10.6	10.7	10.8	11.0	11.1	11.2	11.4	11.5	11.6	11.8	11.9	12.0	12.2	12.3	12.4	12.6	12.7
x	Fraction Change								1.00	1.01	1.01	1.02	1.04	1.05	1.06	1.07	1.09	1.10	1.11	1.13	1.14	1.15	1.16	1.18	1.19	1.20	1.22
0.000 = no BA adjustment for surv./	Basal Area (ft2/ac)								105.0	105.6	106.4	107.4	108.7	110.1	111.4	112.8	114.1	115.5	116.8	118.2	119.5	120.9	122.2	123.6	124.9	126.3	127.6
0.000 = no BA adjustment for surv./	BA adjustment								0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Adjusted BA (ft2/acre)								**105.0**	**105.6**	**106.4**	**107.4**	**108.7**	**110.1**	**111.4**	**112.8**	**114.1**	**115.5**	**116.8**	**118.2**	**119.5**	**120.9**	**122.2**	**123.6**	**124.9**	**126.3**	**127.6**

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
dbh (inches)	12.8	13.0	13.1	13.3	13.4	13.5	13.7	13.8	13.9	14.1	14.2	14.3	14.5	14.6	14.7	14.9	15.0	15.1	15.3	15.4	15.5	15.6	15.7	15.7	15.8	15.9	16.0	16.1	16.2	16.3	16.4	16.5
Fraction Change	1.23	1.24	1.25	1.27	1.28	1.29	1.31	1.32	1.33	1.34	1.36	1.37	1.38	1.40	1.41	1.42	1.43	1.45	1.46	1.47	1.48	1.49	1.50	1.51	1.52	1.52	1.53	1.54	1.55	1.56	1.57	1.58
Basal Area (ft2/ac)	129.0	130.3	131.7	133.0	134.4	135.8	137.1	138.5	139.8	141.2	142.5	143.9	145.2	146.6	147.9	149.3	150.6	152.0	153.3	154.3	155.2	156.2	157.1	158.1	159.0	160.0	161.0	161.9	162.9	163.8	164.8	165.7
BA adjustment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Adjusted BA (ft2/acre)	**129.0**	**130.3**	**131.7**	**133.0**	**134.4**	**135.8**	**137.1**	**138.5**	**139.8**	**141.2**	**142.5**	**143.9**	**145.2**	**146.6**	**147.9**	**149.3**	**150.6**	**152.0**	**153.3**	**154.3**	**155.2**	**156.2**	**157.1**	**158.1**	**159.0**	**160.0**	**161.0**	**161.9**	**162.9**	**163.8**	**164.8**	**165.7**

FWP BA - Closed Canopy - Cypress

								TY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	dbh (inches)								13.6	13.8	14.0	14.2	14.5	14.9	15.2	15.5	15.9	16.2	16.5	16.9	17.2	17.5	17.9	18.2	18.5	18.8	19.2
	Fraction Change								1.00	1.01	1.03	1.04	1.07	1.09	1.12	1.14	1.16	1.19	1.21	1.24	1.26	1.29	1.31	1.33	1.36	1.38	1.41
x	Basal Area (ft2/ac)								173.2	175.0	177.6	180.6	184.8	189.0	193.2	197.5	201.7	205.9	210.1	214.3	218.5	222.7	227.0	231.2	235.4	239.6	243.8
0.000 = no BA adjustment for surv./	BA adjustment								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjusted Basal Area (ft2/ac)								**173.2**	**175.0**	**177.6**	**180.6**	**184.8**	**189.0**	**193.2**	**197.5**	**201.7**	**205.9**	**210.1**	**214.3**	**218.5**	**222.7**	**227.0**	**231.2**	**235.4**	**239.6**	**243.8**

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
dbh (inches)	19.5	19.8	20.2	20.5	20.8	21.2	21.5	21.8	22.2	22.5	22.8	23.2	23.5	23.8	24.1	24.5	24.8	25.1	25.5	25.7	25.9	26.2	26.4	26.6	26.9	27.1	27.3	27.6	27.8	28.0	28.2	28.5
Fraction Change	1.43	1.46	1.48	1.50	1.53	1.55	1.58	1.60	1.63	1.65	1.67	1.70	1.72	1.75	1.77	1.80	1.82	1.85	1.87	1.89	1.90	1.92	1.94	1.95	1.97	1.99	2.00	2.02	2.04	2.06	2.07	2.09
Basal Area (ft2/ac)	248.0	252.2	256.4	260.7	264.9	269.1	273.3	277.5	281.7	285.9	290.2	294.4	298.6	302.8	307.0	311.2	315.4	319.7	323.9	326.8	329.7	332.7	335.6	338.5	341.5	344.4	347.3	350.3	353.2	356.1	359.0	362.0
BA adjustment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Adjusted Basal Area (ft2/ac)	**248.0**	**252.2**	**256.4**	**260.7**	**264.9**	**269.1**	**273.3**	**277.5**	**281.7**	**285.9**	**290.2**	**294.4**	**298.6**	**302.8**	**307.0**	**311.2**	**315.4**	**319.7**	**323.9**	**326.8**	**329.7**	**332.7**	**335.6**	**338.5**	**341.5**	**344.4**	**347.3**	**350.3**	**353.2**	**356.1**	**359.0**	**362.0**

FWP BA - Closed Canopy - NON-Cypress

								TY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
		2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043
	dbh (inches)								13.9	14.0	14.1	14.2	14.3	14.4	14.6	14.7	14.8	15.0	15.1	15.2	15.4	15.5	15.6	15.8	15.9	16.0	16.2
	Fraction Change								1.00	1.00	1.01	1.02	1.03	1.04	1.05	1.06	1.07	1.08	1.08	1.09	1.10	1.11	1.12	1.13	1.14	1.15	1.16
0.000 = no BA adjustment for surv./	Basal Area (ft2/ac)								122.4	122.912	123.659	124.503	125.685	126.868	128.05	129.233	130.415	131.598	132.78	133.963	135.145	136.328	137.51	138.693	139.875	141.058	142.24
0.000 = no BA adjustment for surv./	BA adjustment								0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Adjusted BA (ft2/acre)								**122.4**	**122.9**	**123.7**	**124.5**	**125.7**	**126.9**	**128.1**	**129.2**	**130.4**	**131.6**	**132.8**	**134.0**	**135.1**	**136.3**	**137.5**	**138.7**	**139.9**	**141.1**	**142.2**

	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075
dbh (inches)	16.3	16.4	16.6	16.7	16.9	17.0	17.1	17.3	17.4	17.5	17.7	17.8	17.9	18.1	18.2	18.3	18.5	18.6	18.7	18.8	18.9	19.0	19.1	19.2	19.3	19.4	19.5	19.6	19.7	19.8	19.9	20.0
Fraction Change	1.17	1.18	1.19	1.20	1.21	1.22	1.23	1.24	1.25	1.26	1.27	1.28	1.29	1.30	1.31	1.32	1.33	1.34	1.35	1.35	1.36	1.37	1.37	1.38	1.39	1.39	1.40	1.41	1.41	1.42	1.43	1.43
Basal Area (ft2/ac)	143.423	144.605	145.788	146.97	148.153	149.335	150.518	151.7	152.883	154.065	155.248	156.43	157.613	158.795	159.978	161.16	162.343	163.525	164.708	165.544	166.381	167.218	168.054	168.891	169.728	170.565	171.401	172.238	173.075	173.911	174.748	175.585
BA adjustment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Adjusted BA (ft2/acre)	**143.4**	**144.6**	**145.8**	**147.0**	**148.2**	**149.3**	**150.5**	**151.7**	**152.9**	**154.1**	**155.2**	**156.4**	**157.6**	**158.8**	**160.0**	**161.2**	**162.3**	**163.5**	**164.7**	**165.5**	**166.4**	**167.2**	**168.1**	**168.9**	**169.7**	**170.6**	**171.4**	**172.2**	**173.1**	**173.9**	**174.7**	**175.6**

APPENDIX F

Project Benefit Area Calculation, V5, V6, V7

Maurepas Diversion WVA Analysis May 2020 – Patrick Smith 2020-05-21 Update

I. **Project Benefit Area**
   a. Sub-Area 1
      i. Based on what the IET assumes to be the area with the most Project impacts (i.e., benefits).
      ii. Polygon was created in GIS software based on H&H report
         1. Estimated “red-orange” area for the TKN (?) modeling results
         2. Shapefiles were not available
      iii. Transmission corridors and canals were removed before acreages were calculated.
   b. Sub-Area 2
      i. Polygon drawing based on what the IET assumes to be the area with the next-most Project impacts (ie, benefits).
      ii. Polygon was created in GIS software based on H&H report
         1. Orange-yellow TKN modeling results
         2. Percent diversion water results were also used
      iii. Transmission corridors and canals were removed before acreages were calculated.
   c. Results
      i. Sub-Area 1 (Keim’s Classification)
         1. Other – 79.8 acres
         2. Closed Canopy – 1,861.4 acres
         3. Open Canopy – 1,458.2 acres
         4. Marsh – 178.1 acres
      ii. Sub-Area 2 (Keim’s Classification)
         1. Other – 50.9 acres
         2. Closed Canopy – 1,359.9 acres
         3. Open Canopy – 1,422.7 acres
         4. Marsh – 129.4 acres
   d. Risks (Indicates how new information would affect analysis/results; High, Moderate, Low, Very Low)
      i. No operations plan available (High – could greatly impact benefit area)
         1. No operations specific H&H models
      ii. Nutrient modeling may not be accurate (Moderate – was heavily relied upon; could impact benefit area)
      iii. No sediment transport modeling / module (Moderate – could greatly impact benefit area; not high because other data and models were available)
      iv. Keim’s classification is more than 10 years old (Low – area has likely changed in the last 10 years, with less closed canopy and more of the other habitat types being the most likely changes)

II. V5

a. Methods
   i. Imagery in ArcGIS Pro was surveyed to determine any breaks larger than 75 feet wide
   ii. Keim and other's (2010) classifications were used to distinguish marsh from forested habitats
   iii. Acreages were calculated for all contiguous forested areas based on GIS and Keim and other's (2010) classifications

b. Results
   i. Sub-Area 1
      1. FWOP/FWP TY0 – Collapse SI =1.0
   ii. Sub-Area 2
      1. FWOP/FWP TY0 – Collapse SI =1.0

c. Risks (Indicates how new information would affect analysis/results)
   i. Keim and other's (2010) classifications are more than 10 years old (Low – Based on this classification, some forested areas are close to becoming isolated because of marsh. If these are isolated, this is not likely to significantly alter WVA results)
   ii. Assumes no gradual conversion of habitats (Very Low – may be a reasonable assumption)

III. V6

a. TY0
   i. NLCD 2016 data clipped to polygons and then weighted average for each sub-area

b. FWOP TY1 - Collapse
   i. Assumes no change in land cover. Same as TY0.

c. FWP TY1 – Collapse
   i. Assumes no change in land cover, other than the construction of the Maurepas Diversion channel
      1. Changed this area from NLCD to all open water.

d. Results

FWOP TY0 – until collapse /FWP TY0		Sub-Area 1			
Land use	NLCD attributes	Acres	%	SI	Weighted SI
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	3678.6	98.2	1	0.98
Abandoned ag	None	0.0	0.0	0.6	0.00
Pasture hayfields	Hay/pasture	0.0	0.0	0.4	0.00
Active ag	Cultivate Crops, Open water	8.7	0.2	0.2	0.00
Development	Barren Land, Developed (high, medium, low intensity) developed open space	60.3	1.6	0.01	0.00
Total		3747.6	100		0.98

FWP TY1 - UNTIL COLLAPSE	Sub-Area 1

Land use	NLCD attributes	Acres	%	SI	Weighted SI
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	3664.6	97.8	1	0.98
Abandoned ag	None	0.0	0.0	0.6	0.00
Pasture hayfields	Hay/pasture	0.0	0.0	0.4	0.00
Active ag	Cultivate Crops, Open water	22.7	0.6	0.2	0.00
Development	Barren Land, Developed (high, medium, low intensity) developed open space	60.3	1.6	0.01	0.00
Total		3747.6	100		0.98

Existing Conditions/FWOP/FWP TY0 (UNTIL COLLAPSE)		Sub-Area 2			
Land use	NLCD attributes	Acres	%	SI	Weighted SI
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	7450.7	98.0	1	0.98
Abandoned ag	None	0.0	0.0	0.6	0.00
Pasture hayfields	Hay/pasture	0.0	0.0	0.4	0.00
Active ag	Cultivate Crops, Open water	17.3	0.2	0.2	0.00
Development	Barren Land, Developed (high, medium, low intensity) developed open space	134.1	1.8	0.01	0.00
Total		7602.1	100		0.98

FWP TY1 - Until Collapse		Sub-Area 2			
Land use	NLCD attributes	Acres	%	SI	Weighted SI
Bottomland hardwood	Emergent herbaceous wetlands, Evergreen forest, herbaceous, mixed forest, woody wetlands	7428.0	97.7	1	0.98
Abandoned ag	None	0.0	0.0	0.6	0.00
Pasture hayfields	Hay/pasture	0.0	0.0	0.4	0.00
Active ag	Cultivate Crops, Open water	40.0	0.5	0.2	0.00
Development	Barren Land, Developed (high, medium, low intensity) developed open space	134.1	1.8	0.01	0.00
Total		7602.1	100		0.98

e. Risks (Indicates how new information would affect analysis/results)
   i. Assumes no gradual conversion of habitats (Very Low – may be a reasonable assumption)
   ii. Does not include any other habitat type for Maurepas Diversion Channel (Very Low – would be small area; not likely to significantly influence results)

IV. V7

a. TY0
   i. Arc-map imagery to estimate I-10 (Class 1) and Hope Canal (Class 2) disturbances
      1. Hope Canal was assumed to be Class two because there were several boats and houses observed during a site visit in Fall 2018

b. FWOP TY1-TY50
   i. No change to TY0 for TY1-TY50.

c. FWP TY1-TY50

i. No change, except that Hope Canal will go from a Class 2 disturbance to Class 4 because of reduced access associated with the assumed removal of the boat launch at HWY 61

d. Results

FWOP/FWP TY0	Area 1			
SI	area-sub	area	percentage	weighted SI
0.50	328.39	269.17	0.07	0.04
0.26	48.63	46.84	0.01	0.00
0.26	205.21	184.41	0.05	0.01
0.01	20.80	20.80	0.01	0.00
1.00		3146.91	0.86	0.86
TOTAL	3668.13			0.91

FWP TY1 - TY50	Area 1			
SI	area-sub	area	percentage	weighted SI
0.50	328.39	0.00	0.07	0.04
0.26	48.63	0.00	0.01	0.00
0.26	205.21	184.41	0.05	0.01
0.01	20.80	20.80	0.01	0.00
1.00		3462.92	0.94	0.94
TOTAL	3668.13			1.00

FWP/FWOP all TYs	Area 2			
SI	area-sub	area	percentage	weighted SI
0.50	131.80	112.54	0.04	0.02
0.26	19.26	19.26	0.01	0.00
0.26	75.27	68.25	0.02	0.01
0.01	7.03	7.03	0.00	0.00
1.00		2861.98	0.93	0.93
TOTAL	3069.05			0.96

e. Risks(Indicates how new information would affect analysis/results)

i. Hope Canal may not qualify for Class II, “waterways commonly used by small to mid-sized boats”. (Low – not likely to significantly impact results; though see FWOP vs FWP TY1-TY50 for Area 1; 0.91 vs. 1).

ii. Does not include any other habitat type for Maurepas Swamp Project Conveyance Channel (Very Low – would be small area; not likely to significantly influence results)

Maurepas Swamp Project

Direct Impacts

Wetland Value Assessment

Project Information Sheet

Prepared by:

Kristen Ramsey, CPRA
Cathy Breaux, FWS
Patrick Smith, USACE
Kristen Butcher, USACE

February 15, 2021

WVA Model Versions

These Wetland Value Assessment (WVA) models were developed under the Coastal Wetlands Planning, Protection, and Restoration Act program to determine benefits of proposed coastal wetland restoration projects. This WVA uses the Swamp Community Model for Civil Works Version 2.0 (Swamp WVA) as well as the Bottomland Hardwoods Community Model for Civil Works (Version 1.2). These models are approved for regional use on US Army Corps of Engineers (USACE) Civil Works projects. Further information on these models may be obtained from the USACE, New Orleans District, RPEDS (https://ecolibrary.planusace.us/ (use the search term "WVA")). The WVA was conducted to assess the proposed Maurepas Swamp Project for unavoidable impacts associated with its construction.

Maurepas Swamp Project Direct Impact Area

The project footprint (Figure 1) consists of roughly 105 acres of bottomland hardwood forest and approximately 116 acres of swamp habitat. All of the water, pipeline corridors, and other non-wetland areas were removed from within the project area and acreages were calculated for the remaining wetland habitats. The extent of the impact area was for this WVA was determined by shape files of permanent and temporary impacts of all project features including but not limited to the project right-of-way, in-situ borrow areas, railroad shoofly, staging areas, temporary and permanent access roads, weirs, embankment clearing, dredging and spoil areas, culverts, docks, intake structures, levee ties, and coffer dam.

Other vegetation and wetland vegetation were assumed to be swamp habitat acres. This is because the MSP construction footprint includes degraded swamp habitat and based on experience in the field, these areas could be patches of low canopy cover swamp habitats. This assumption is consistent with the West Shore Lake Pontchartrain Project (WSLP) WVAs. See Appendix B for more information.

The Maurepas Swamp Project (MSP) and the WSLP levee would be adjacent and/or co-located for part of their construction areas, and the CPRA is currently designing both the MSP and the reaches of the WSLP levee system which would be co-located/adjacent to the MSP. Since these projects are co-located, rather than tease out individual project features for impacts analysis, the impacts associated with the construction of this extent of the levee were included in this assessment. This is discussed more in depth in the WVA Results section of this report.

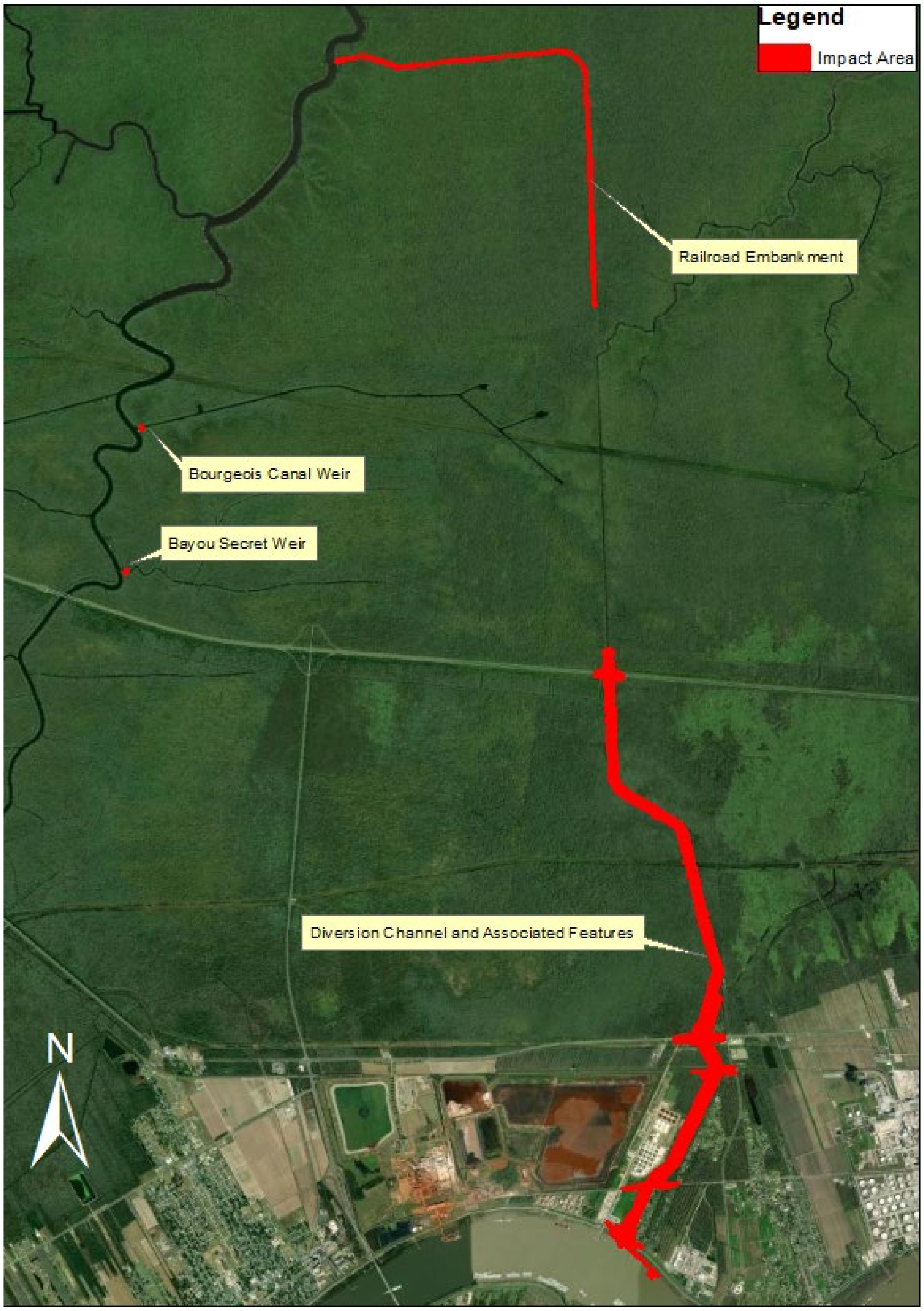
The USACE Engineer Research and Development Center (ERDC) developed a habitat differentiation GIS tool for the project area and vicinity (Suir et al. 2021). This tool was used to calculate acres for the project impacts by existing habitat type.

Habitat within the project impact area consists of both bottomland hardwood (BLH) and swamp (Suir et al. 2021). Separate WVAs were calculated for each impact area and type combination for a total of 3 WVAs:

1. Conveyance Channel and Associated Features – Swamp
2. Conveyance Channel and Associated Features – BLH; and
3. Railroad Embankment and Weir - Swamp.

To capture the reduction of benefits under the FWP, all impacts were assumed to be permanent impacts, and it was assumed that beginning in TY1 the FWP would provide 0% of the benefits (AAHUs) provided in the FWOP.

Figure 1. Map showing the locations of the project impact areas.



Project Life
This impacts WVA analysis was conducted assuming a 50-yr project life from 2020 (TY0) to 2070 (TY50), with data from 2020 serving as the baseline for initial conditions. CPRA estimates a period of 5 years between the commencement of construction activities and the beginning of MSP operations. Because of this delay in operations, the accompanying project benefits WVA assumes a 50-yr project life from 2025 to 2075. Site-specific data which were collected in 2013 for the WSLP WVA and used in the WVA was projected forward to 2020, and then forward for the 50-year project life.

Assumed MSP Construction Plan
The MSP project is comprised of the following elements: an intake channel from the MR; an automated gated structure in the MRL; a sedimentation basin; a 28,000± foot (ft) long conveyance channel; submerged weirs in Bayou Secret and Bourgeois Canal; check valves on culverts under the I-10 crossing; box culverts under River Road, CN Railroad, and Airline Highway; a bridge over the channel at the KCS Railroad; cuts to the abandoned railroad embankment; and reshaping the geometry of the existing Hope Canal channel under I-10.

The western-most three reaches of the WSLP Project (WSLP-111, WSLP-112, and WSLP-113) are to be constructed parallel to and immediately adjacent to the MSP. Due to the co-location of the MSP and the three reaches of the WSLP Project in the same alignment corridor, both CPRA and USACE have agreed to design the two projects together, enabling close coordination between the projects. As a result, it was assumed that the MSP would be constructed concurrently with WSLP and would have the same construction start date (TY0).

Data Collection
Baseline data for this WVA were collected from field trips conducted in July and December 2013, November 11, 2020 and December 7-8, 2020 for swamp and BLH habitat quality. In addition to field sites, data from Louisiana's Coastwide Reference Monitoring System (CRMS) stations CRMS0059 (Reserve) and CRMS5373 (Hope), such as hydrology and salinity, were also used (CPRA 2020). One tenth acre (37.2 ft radius) size plots were used for most field sites, and if sites differed from this size, they were adjusted to represent 1/10 acre in size. Parameters such as diameter at breast height (DBH), stand structure, and hydrology were taken at each field site. Sites were either directly within the project impact footprint or immediately adjacent to (and representative of) the impact area. A total of 13 plots representing swamp and BLH habitat throughout the project area were used to develop baseline data:

- WSLP NW11
- WSLP NW12
- WSLP NW13
- Embankment - Ridge 1
- Embankment – Ridge 2
- Embankment – Swamp 1
- Embankment – Swamp 2
- Bayou Secret North
- Bourgeois Canal North

- Bourgeois Canal South
- Hope Canal 1
- Hope Canal 2; and
- Hope Canal 3.

In-growth Spreadsheets

Ingrowth spreadsheets were used to predict tree growth for individual trees from plots. This spreadsheet grows individual tree DBH and field site basal area over time. All swamp plots were separated into baldcypress (*Taxodium distichum*) and tupelogum et al. tree species groups while BLH plots maintained a single in-growth spreadsheet for each plot.

Outputs from each plot's in-growth spreadsheets including tree composition (BLH V1), stand structure (swamp V1), stand maturity (swamp and BLH V2), and understory/midstory (VLH V3) for each plot were developed individually then combined in the appropriate WVAs by area. See sections on Variables 1, 2, and 3 below.

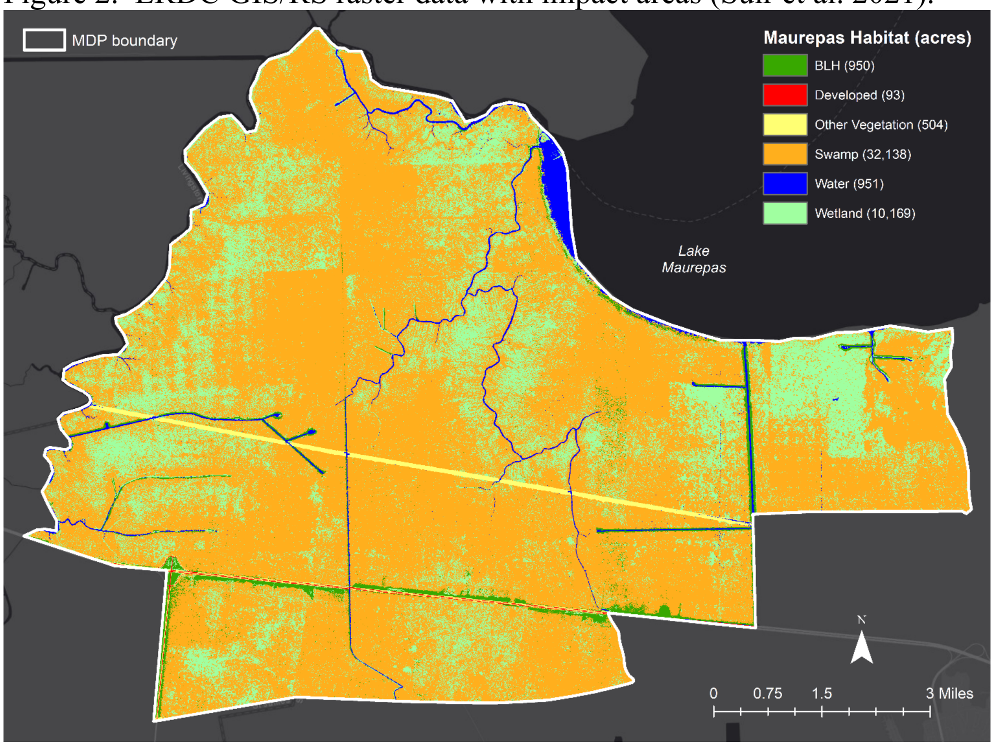
A growth factor for baldcypress was used to project tree growth of typical cypress swamp. The growth factor is based on a regression (Y=-0.512X-0.1) based on literature growth rates for specific tree species (Visser and Sasser 1995), and Mr. Bern Wood (Southeastern Louisiana University - working with Dr. Gary Shaffer) during a February 2010 verbal communication with the USFWS (Angela Trahan, personal communication). Data from Mr. Bern Wood were collected from Maurepas Swamp Wildlife Management Area, a Wildlife Management Area in the Project Area and vicinity, study sites.

- DBH data were collected in centimeters and then converted to inches for use in the in-growth spreadsheets.
- Trees that were listed as less than <4cm DBH were entered as 1.0 inch DBH.
- Each plot had notes on the condition of individual trees. Growth rates and life spans were adjusted based on field observations and site conditions.
- The maximum growth reduction factor based on site conditions was -2.15 (a more significant reduction factor would signify extreme tree stress and would equate to short-term tree death).
- The minimum growth reduction factor (-0.1) for baldcypress occurs in areas where there are optimum hydrologic conditions (i.e., sufficient soil moisture but no inundation).
- Initial and future Relative Sea Level Rise (RSLR) growth rates are presented in the tables below (Tables 2 - 4). Initial growth rates were based on dominant trees (baldcypress, tupelogum, maple, etc.) and site conditions of each plot (healthy and sustainable, moderately degraded, highly degraded, etc.).
- Average DBH and basal area of each subplot were calculated and combined for each target year, and then averaged (by DBH) or summed (number of trees and basal area) by plot.

Assessing Current Habitat Type and Health of the Project Area

The Maurepas Swamp Project (MSP) Habitat Evaluation Team (HET) asked the ERDC to utilize remote sensing techniques to identify and assess the current condition of BLH and swamp habitats within the project area (Suir et al. 2021). This effort resulted in the production of a habitat differentiation raster which provided baseline knowledge of the location and quality of these habitats for use in the environmental assessments of this project. Habitats were distinguished using a variety of data sources including satellite imagery, LIDAR data, WVA field data, the National Land Cover Dataset (NLCD), and the USFWS National Wetland Inventory and used a Maximum Likelihood Classification method. These data were used to determine the amount and spatial extent of habitat types for WVA variables and acreages (Figure 2). Swamp habitats were mostly located along the northern portion of the conveyance channel, the railroad embankment, and at the Bayou Secret and Bourgeois Canal weirs, while the majority of BLH habitat was primarily confined to the areas between swamp habitats and developed areas mostly in the southern portion of the conveyance channel. This was corroborated with field observations.

Figure 2. ERDC GIS/RS raster data with impact areas (Suir et al. 2021).



The HET used the ERDC GIS/RS Habitat Raster data for each impact area to determine all impact area acres for evaluation (Table 1). Table 1 is a list of the impact areas, habitat type impacted, and shows the acres used in each WVA based on the ERDC GIS/RS outputs applied to the project area.

Table 1. Project impact acreages from Suir et al. (2021).

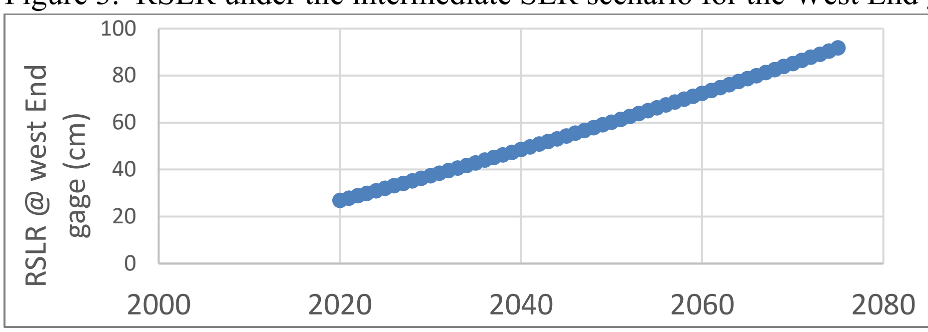
Impact Area	Habitat Type	Impacts (acres)
Conveyance Channel and Associated Features	Swamp	107.26
	BLH	105.37
Weir and Embankment	Swamp	8.72
Total		221.3

Acreage Inputs
The majority of direct impacts associated with the construction of the weirs at Bayou Secret and Bourgeois Canal were located in open water, with only a small area of impacts occurring within swamp or BLH habitat. Due to the small impact size, all swamp impacts associated with weir construction are grouped with the swamp impacts for the embankment, and all BLH impacts associated with the construction of the weir are grouped with the BLH impacts for the conveyance channel and associated features. The impacted habitat at the two weirs were considered similar to and could be represented by the average habitat quality of their respective WVAs for embankment and the conveyance channel. For simplicity all impacts, including temporary impacts, were assumed to be both direct and permanent impacts.

RSLR, Inundation and Target Years
In accordance with the USACE EC-1165-2-212, relative sea level rise (RSLR) was determined using the Lake Pontchartrain at West End USGS Gauge (gage number 85625) to determine base and future subsidence and sea level rise (SLR) levels and RSLR (Figure 3). 2070 Intermediate SLR was determined to be 0.85 feet NAVD88 and RSLR was determined to be 2.32 feet, North American Vertical Datum of 1988 (NAVD 88). Future projections used 2.32 feet as a basis to rerun long-term simulations to compare FWP and FWOP.

RSLR under the intermediate SLR scenario was determined using the West End Lake Pontchartrain gage (Figure 3) and per Corps of Engineers protocols. Subsidence at that gage is 7.1 mm/yr. CRMS accretion measurements from the three stations within or adjacent to the project area polygon were examined. The value from CRMS 63 was exceptionally high. That value was considered an outlier and not used when computing the average project area accretion rate of 5.65 mm/yr. The RSLR data accounts for subsidence, accretion, and sea level rise.

Figure 3. RSLR under the intermediate SLR scenario for the West End gage (from Corps web site).



Baseline inundations were determined using water depth estimates from the field and nearby CRMS stations. The RSLR data were applied to those elevations to forecast the future depths relative to substrate elevation for each station. Initial and future RSLR growth rates are presented in the tables below (Tables 2 – 4). Initial growth rates were based on dominate trees (baldcypress, tupelogum, maple, etc.) and site conditions of each plot (healthy and sustainable, moderately degraded, highly degraded, etc.).

Table 2. Initial and future growth rates for Conveyance Channel and Associated Features – BLH plots.

Conveyance Channel and Associated Features - BLH					
Plot Name	**Existing Water Depth (feet)**	**Sea Level Rise (feet)**	**Future Total Water Depth (feet)**	**Initial Growth factor**	**Future (RSLR) Growth Factor (max -2.4)**
NW11	-1.4	2.32	0.9	0.30	-0.6
NW12	-5.2	2.32	-2.9	1.10	1.10
NW13	-3.0	2.32	-0.7	-0.60	-0.60
Bourgeois Canal North	-3.5	2.32	-1.2	0.30	0.3

Table 3. Initial and future growth rates for Conveyance Channel and Associated Features – Swamp plots.

Conveyance Channel and Associated Features - Swamp					
Plot Name	**Existing Water Depth (feet)**	**Sea Level Rise (feet)**	**Future Total Water Depth (feet)**	**Initial Growth factor**	**Future (RSLR) Growth Factor (max -2.4)**
Hope 1 cypress	1.0	2.32	3.3	-0.10	-1.8
Hope 1 other	1.0	2.32	3.3	0.30	-1.8
Hope 2 cypress	1.0	2.32	3.3	-0.10	-1.8
Hope 2 other	1.0	2.32	3.3	0.30	-1.8
Hope 3 cypress	0.8	2.32	3.1	-0.10	-1.7
Hope 3 other	0.8	2.32	3.1	0.30	-1.7

Table 4. Initial and future growth rates for Railroad Embankment and Weirs – Swamp plots.

Railroad Embankment and Weirs- Swamp					
Plot Name	**Existing Water Depth (feet)**	**Sea Level Rise (feet)**	**Future Total Water Depth (feet)**	**Initial Growth factor**	**Future (RSLR) Growth Factor (max -2.4)**
Ridge 1 cypress	-2.5	2.32	-0.2	-0.10	0.10
Ridge 1 other	-2.5	2.32	-0.2	0.30	0.10
Ridge 2 cypress	0.5	2.32	2.8	-0.10	-2.4
Ridge 2 other	0.5	2.32	2.8	0.30	-2.4
Embank. Swamp 1 cyp.	1.5	2.32	3.8	-0.10	-2.1
Embank. Swamp 1 other	1.5	2.32	3.8	0.30	-2.0
Embank. Swamp 2 cyp.	2.5	2.32	4.8	-1.29	-2.4
Embank. Swamp 2 other	2.5	2.32	4.8	-1.79	-2.4
Bayou Secret N. cyp.	-0.1	2.32	2.2	-2.15	-2.4
Bayou Secret N. other	-0.1	2.32	2.2	-1.99	-2.4
Bourgeois Canal S cyp.	0.1	2.32	2.4	-2.15	-2.4
Bourgeois Canal S other	0.1	2.32	2.4	-1.99	-2.4

Target years are the same for both swamp and BLH WVA, and for both FWOP and FWP conditions. Target years used for the WVAs include TY0, TY1, TY37, TY50. TY37 is intended to capture changes due to RSLR. For each project area CRMS station, instances when the 2015-2020 daily average water elevation was below the substrate elevation were determined and the highest 99th percentile elevation difference (i.e., substrate exposure value) was recorded. The 100th percentile (maximum) substrate exposure value was not used because of several apparent outlier values at one station. The average water elevation increase which would equal or exceed the 99th percentile substrate exposure was determined for each CRMS station, and then averaged over the three CRMS stations to obtain an average FWOP 100% inundation depth of 1.37-ft, which would occur at TY37 (Appendix A). Therefore, TY37 was selected as a target year when the area became permanently inundated. In determining future with-project conditions, all project-related direct (construction) impacts were assumed to occur in Target Year 1.

V1 (Swamp) – Stand Structure

Site-specific canopy cover data were collected during field site visits at plots Hope 1, Hope 2, Hope 3, Ridge 1, Ridge 2, Embankment Swamp 1, Embankment Swamp 2, Bayou Secret North, and Bourgeois Canal South. Data was collected for each plot and were then averaged to obtain canopy values for each WVA. Existing stands are currently around 70 years old. There are existing hydrologic restrictions and we cannot assume much improvement into the future with an estimated 2.32-foot increase for intermediate RSLR. For swamp plots in the FWOP, it was assumed that when the 100% submergence year is reached (TY37 = 2057), stand structure will drop by one class value starting in TY37 unless it is already at the lowest class value (class 1). The FWP percent cover values were determined by reducing FWOP values 100% for TY1-TY50 (Tables 5-6).

Table 5. V1 stand structure values for the Conveyance Channel and Associated Features – Swamp plots.

FWOP Conveyance Channel and Associated Features – Swamp				
TY	Canopy	Mid-Story	Herbaceous	Class
0	73	40	12	4
1	73	40	12	4
37	49	32	35	3
50	49	32	35	3

FWP Conveyance Channel and Associated Features – Swamp				
TY	Canopy	Mid-Story	Herbaceous	Class
0	73	40	12	4
1	0	0	0	1
37	0	0	0	1
50	0	0	0	1

Table 6. V1 stand structure values for the Railroad Embankment and Weir – Swamp plots.

FWOP Railroad Embankment and Weir – Swamp				
TY	Canopy	Mid-Story	Herbaceous	Class
0	39	30	54	3
1	39	30	54	3
37	39	32	32	2
50	39	32	32	2

FWP Railroad Embankment and Weir – Swamp				
TY	Canopy	Mid-Story	Herbaceous	Class
0	39	30	54	3
1	0	0	0	1
37	0	0	0	1
50	0	0	0	1

V1 (BLH) – Tree Species Composition

Wildlife species that utilize bottomland hardwoods depend heavily on mast, other edible seeds, and tree buds as primary sources of food. The basic assumptions for this variable are: 1) more production of mast (hard and/or soft) and other edible seeds is better than less production, and 2) because of its availability during late fall and winter and its high energy content, hard mast is more critical than soft mast, other edible seeds, and buds. Table 7 shows the class values based on tree species.

Table 7. BLH Variable V1 Tree Species Association Class descriptions.

Class 1:	Less than 25% of overstory canopy consists of mast or other edible-seed producing trees or more than 50% of soft mast present but no hard mast.
Class 2:	25% to 50% of overstory canopy consists of mast or other edible-seed producing trees, but hard mast producers constitute less than 10% of the canopy
Class 3:	25% to 50% of overstory canopy consists of mast or other edible-seed producing trees, and hard mast producers constitute more than 10% of the canopy.
Class 4:	Greater than 50% of overstory canopy consists of mast or other edible-seed producing trees, but hard mast producers constitute less than 20% of the canopy.
Class 5:	Greater than 50% of overstory canopy consists of mast or other edible-seed producing trees, and hard mast producers constitute more than 20% of the canopy.

Tree species composition data were collected from field sites NW11, NW12, NW13, and Bourgeois Canal North. Data were collected for each plot and were then averaged to obtain baseline canopy values for each WVA. Projections for each site were processed through the WVA Site-Ingrowth spreadsheets. BLH plots were significantly higher in elevation than most of the swamp plots and are less likely to become severely inundated and stressed in the FWOP. Therefore, BLH Class remains the same for the project life FWOP. The FWP tree species composition was determined by reducing FWOP class ratings to the lowest class value (class 1) for TY1-TY50 (Table 8).

Table 8. V1 tree species association values for Conveyance Channel and Associated Features – BLH plots.

FWOP Conveyance Channel and Associated Features – BLH	
TY	Class
0	4
1	4
37	4
50	4

FWP Conveyance Channel and Associated Features – BLH	
TY	Class
0	4
1	1
37	1
50	1

Swamp and BLH Stand Maturity (V2)

Stand maturity (V2) data were collected from all site visits for baseline estimates. DBH values were converted to inches for use in the in-growth spreadsheets. Ingrowth spreadsheets were used to predict tree growth for individual trees from plots. Average DBH and total basal area of each plot was calculated and combined for each target year, and then averaged (by DBH) or summed (number of trees and basal area) by plot.

The spreadsheets grow individual tree DBH and field site basal areas in over time using various growth factors. Initial and future growth factors were determined as described in the In-growth Spreadsheet section and Tables 2 - 4.

Each plot had notes on the condition of individual trees, and growth rates and life spans were adjusted based on field observations. In the primary in-growth spreadsheet, the maximum growth reduction factor based on site conditions was -2.15 (a more significant reduction factor would signify extreme tree stress and would equate to short-term tree death). The maximum growth reduction factor occurs at a total of 4 feet of inundation, beyond which extreme tree stress and death would occur in less than 10 years (based on field observations). Plots with a RSLR growth rate determined to be less than -2.4 based on the correlated calculations, were capped at a minimum of -2.4 growth rate. Growth rates less than -2.4 produced errors and grew trees in reverse (shrinking rather than growing in DBH). The minimum growth reduction factor (-0.1) occurs in areas where there are optimum hydrologic conditions (i.e., sufficient soil moisture but no inundation). Growth rates were assumed to slow severely as water levels increase with RSLR. Intermediate RSLR was used that predicted a 2.32-foot increase (See the RSLR, Inundation and Target Years Section for more details).

Trees less than 6 inches DBH exist in the data set but were not counted in the average DBH or basal area inputs for the WVA model until they were grown in to a DBH greater than 6 inches. Trees that were listed as less than 4 cm DBH were entered into the in-growth spreadsheets as 1.0-inch DBH. Branches of split-trunk trees were entered as separate trees. It was assumed that topped trees and the smallest branch of split-trunk trees would not continue to grow in.

Table 9. Initial Site-specific Growth Rates by species and habitat condition.

Initial Site-specific Growth Rates	
Site Description	Growth Factor
Baldcypress (healthy / sustainable for next 50 years)	-0.10
Baldcypress (moderately degraded / likely to convert to marsh within 31-50 years - - - If in TY0 - 20)	-1.29
Baldcypress (moderately degraded / likely to convert to marsh within 31-50 years - - - If in TY21 - 50)	-2.15
Baldcypress (highly degraded / likely to convert to marsh within 20-30 years - - - If in TY0 - 20)	-1.69
Baldcypress (highly degraded / likely to convert to marsh within 31-50 years - - - If in TY21 - 50)	-2.15
Cedar elm, winded elm, black tupelo, hickories, or sugarbery dominated stands	-0.60
Cottonwood	3.00
Overcup oak	-0.70
Pecan	0.40
Red oaks (any)	1.10
Tupelo (healthy / sustainable for next 50 years)	0.30
Tupelo (moderately degraded / likely to convert to marsh within 31-50 years - - - If in TY0 - 20)	-1.79
Tupelo (moderately degraded / likely to convert to marsh within 31-50 years - - - If in TY21 - 50)	-1.99
Tupelo (highly degraded / likely to convert to marsh within 20-30 years - - - If in TY0 - 20)	-1.99
Tupelo (highly degraded / likely to convert to marsh within 31-50 years - - - If in TY21 - 50)	-2.06
Water hickory	-0.60
White oaks (any)	-0.20
Willow	2.00

V2 (Swamp) – Stand Maturity (DBH and basal area)

Projections for each site were processed through the WVA Site-Ingrowth spreadsheets and are provided in Tables 10-13 below. All swamp plots were separated into baldcypress and tupelogum et al. tree species groups. Data was collected and projected for each plot and were then averaged to obtain stand maturity values for each WVA. Growth factors applied to each plot are provided in Tables 3 and 4 above.

Table 10. Baldypress in-growth summary table for Conveyance Channel and Associated Features – Swamp plots.

Conveyance Channel and Assoc. Features Swamp - Cypress							
Hope 1, Hope 2, and Hope 3							
AVERAGE	TOTAL	HEALTHY					
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
19.4	899.4	19.6	924.5	26.8	2110.0	28.2	2323.4
Hope 1							
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
24.5	265.4	24.7	271.6	26.4	551.6	27.6	596.2
Hope 2							
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
15.9	356.0	16.2	367.4	25.9	917.4	27.4	1017.9
Hope 3							
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
17.8	278.0	18.0	285.5	28.1	641.0	29.7	709.3

Table 11. Tupelo et al. in-growth summary table for Conveyance Channel and Associated Features – Swamp plots.

Conveyance Channel and Assoc. Features Swamp - Other							
Hope 1, Hope 2, and Hope 3							
AVERAGE	TOTAL	HEALTHY					
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
9.0	592.1	10.1	624.1	15.5	3454.2	16.8	3976.7
Hope 1							
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
11.9	515.2	12.2	538.8	17.3	2581.1	18.6	2947.9
Hope 2							
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
6.2	20.7	8.8	25.6	13.6	433.0	14.7	508.4
Hope 3							
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
9.0	56.2	9.3	59.7	15.6	440.1	17.0	520.4

Table 12. Cypress in-growth summary table for Railroad Embankment and Weir – Swamp plots.

Railroad Embankment and Weirs Swamp - Cypress								
Ridge 1, Ridge 2, Swamp 1, Swamp 2, Bayou Secret, Bourgeois Canal South								
AVERAGE TOTAL HEALTHY	TY 0.0		TY 1.0		TY 37.0		TY 50.0	
	DBH	BA	DBH	BA	DBH	BA	DBH	BA
	12.3	264.1	12.3	271.8	18.8	605.3	16.9	679.1
Ridge 1	0.0	0.0	0.0	0.0	9.8	45.5	13.0	80.5
Ridge 2	10.8	18.4	11.0	19.3	20.7	67.8	21.5	73.0
Swamp 1	18.4	142.1	18.7	146.0	28.7	327.7	29.7	350.2
Swamp 2	10.8	26.3	9.8	28.6	14.8	62.2	12.3	69.1
Bayou Secret	8.9	43.2	8.9	43.6	10.4	59.0	10.6	61.2
Bourgeois Canal South	25.0	34.1	25.1	34.3	28.1	43.1	14.4	45.1

Table 13. Tupelogum et al. in-growth summary table for Railroad Embankment and Weir – Swamp plots

Railroad Embankment and Weirs Swamp - Other							
Ridge 1, Ridge 2, Swamp 1, Swamp 2, Bayou Secret, Bourgeois Canal South							
AVERAGE TOTAL		HEALTHY					
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
9.7	658.1	9.3	705.4	12.3	4275.1	11.1	5331.5
Ridge 1							
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
11.1	44.1	9.6	51.7	12.7	1000.4	16.7	1681.1
Ridge 2							
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
7.5	27.3	7.8	29.4	12.2	1476.2	12.4	1545.4
Swamp 1							
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
10.6	151.8	10.7	161.3	16.2	1056.8	17.2	1186.8
Swamp 2							
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
10.2	143.5	9.9	149.2	12.1	257.2	7.6	301.2
Bayou Secret							
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
8.6	215.8	8.1	235.4	10.2	366.1	8.4	446.9
Bourgeois Canal South							
TY 0.0		TY 1.0		TY 37.0		TY 50.0	
DBH	BA	DBH	BA	DBH	BA	DBH	BA
10.0	75.6	9.7	78.4	10.6	118.4	4.0	170.1

The FWP DBH and basal area values were determined by reducing FWOP values 100% for TY1-TY50 (Tables 14-15).

Table 14. FWP V2 summary table for Conveyance Channel and Associated Features – Swamp plots

FWOP Conveyance Channel and Associated Features – Swamp				
TY	Cypress DBH	Cypress BA	Tupelo et al. DBH	Tupelo et al. BA
0	19.4	899.4	9.0	592
1	19.6	924.5	10.1	624
37	26.8	2110.0	15.5	3454
50	28.2	2323.4	16.8	3667

FWP Conveyance Channel and Associated Features – Swamp				
TY	Cypress DBH	Cypress BA	Tupelo et al. DBH	Tupelo et al. BA
0	19.4	899.4	9.0	592.1
1	0	0	0	0
37	0	0	0	0
50	0	0	0	0

Table 15. FWP V2 summary table for Railroad Embankment and Weir – Swamp plots.

FWOP Railroad Embankment and Weir – Swamp				
TY	Cypress DBH	Cypress BA	Tupelo et al. DBH	Tupelo et al. BA
0	12.3	264.1	9.7	658
1	12.3	271.8	9.3	705
37	18.8	605.3	12.3	4275
50	16.9	679.1	11.1	5332

FWP Railroad Embankment and Weir – Swamp				
TY	Cypress DBH	Cypress BA	Tupelo et al. DBH	Tupelo et al. BA
0	12.3	264.1	9.7	658.1
1	0	0	0	0
37	0	0	0	0
50	0	0	0	0

V2 (BLH) – Stand Maturity (age or DBH)

The spreadsheets grow individual tree DBH and field site basal areas in over time. Unlike swamp plots, BLH plots were not separated into baldcypress and other tree species groups, and maintained a single ingrowth spreadsheet for each plot. Data were collected and projected for each plot and were then averaged to obtain stand maturity values for each WVA.

Table 16. V1, V2, and V3 In-growth summary table for Conveyance Channel and Associated Features – BLH plots.

	Conveyance Channel and Assoc. Features and Bourgeois Canal North BLH									
	NW11, NW12, NW13, Bourgeois Canal North									
	AVERAGE	TOTAL	HEALTHY							
	TY 0.0		TY 1.0		TY 37.0		TY 50.0			
	DBH	BA	DBH	BA	DBH	BA	DBH	BA		
	12.9	344.3	11.0	366.0	15.8	1933.3	19.6	2832.9		
# of Trees >6"	32.0		36.0		122.0		122.0			
	% Overstory	69.0		Hard-mast	6.8					
	% Midstory	58.3		Soft-mast	72.8					
	% Ground	46.3		Non-mast	20.5					
				Class	4.0					
	NW11									
	TY 0.0		TY 1.0		TY 37.0		TY 50.0			
	DBH	BA	DBH	BA	DBH	BA	DBH	BA		
	17.9	148.2	18.3	153.2	19.3	552.3	22.0	702.2		
# of Trees >6"	8.0		8.0		23.0		23.0			
	% Overstory	50		Hard-mast	0					
	% Midstory	50 √		Soft-mast	95					
	% Ground	45		Non-mast	5					
	NW12									
	TY 0.0		TY 1.0		TY 37.0		TY 50.0			
	DBH	BA	DBH	BA	DBH	BA	DBH	BA		
	15.2	100.6	15.6	105.2	22.9	478.4	28.1	693.9		
# of Trees >6"	7.0		7.0		15.0		15.0			
	% Overstory	91		Hard-mast	25					
	% Midstory	88 √		Soft-mast	75					
	% Ground	30		Non-mast	0					
	NW13									
	TY 0.0		TY 1.0		TY 37.0		TY 50.0			
	DBH	BA	DBH	BA	DBH	BA	DBH	BA		
	12.0	74.2	12.2	76.6	14.9	238.1	17.7	326.2		
# of Trees >6"	9.0		9.0		17.0		17.0			
	% Overstory	75		Hard-mast	0					
	% Midstory	80 √		Soft-mast	100					
	% Ground	80		Non-mast	0					
	Bourgeois Canal North									
	TY 0.0		TY 1.0		TY 37.0		TY 50.0			
	DBH	BA	DBH	BA	DBH	BA	DBH	BA		
	7.0	21.3	6.8	31.0	13.3	664.5	17.3	1110.6		
# of Trees >6"	8.0		12.0		67.0		67.0			
	% Overstory	60		Hard-mast	2					
	% Midstory	15 √		Soft-mast	21					
	% Ground	30		Non-mast	77					

The FWP DBH values were determined by reducing FWOP values 100% for TY1-TY50. FWOP and FWP stand maturity values are shown below (Table 17).

Table 17. V2 summary table for Conveyance Channel and Associated Features – BLH plots

FWOP Conveyance Channel and Associated Features – BLH	
TY	DBH
0	12.9
1	11.0
37	15.8
50	19.6

FWP Conveyance Channel and Associated Features – BLH	
TY	DBH
0	12.9
1	0
37	0
50	0

V3 (Swamp) – Water Regime (Flooding Duration and Water Exchange)

The HET used ERDC RS/GIS data (Saltus and Suir, 2019), WVA field observations, H&H model results (Agnew, 2019), and CRMS data from 2007 or 2012 to 2019 (CPRA, 2020) to estimate values for these variables. Table 18 below shows the percent inundation for the period of analysis for each CRMS station used. CRMS0059 (Reserve) was inundated the entire period of analysis (2012-2019), while CRMS5373 (Hope) was inundated approximately 96% of the period of analysis (2007-2019). These are the two closest CRMS station but only CRMS0059 is within the project area. Both stations are located along waterways which would likely have more water flux than interior swamps. Station data from CRMS0059 and CRMS5373 indicated that there is flooding all or most of the time at the station sites (Table 18). Based on field observation, there were some dry or low water level areas as well as completely inundated areas within the project area.

Table 18. CRMS5373 (Hope Canal) and CRMS0059 (Reserve) inundation and mean growing season salinities.

CRMS 5373			
Year	Mean Salinity	Mean growing season salinity	Inundation
2007	0.48	0.43	0.99
2008	0.30	0.30	0.87
2009	0.43	0.51	0.87
2010	0.26	0.26	0.98
2011	0.54	0.56	0.97
2012	0.26	0.20	0.97
2013	0.23	0.22	0.99
2014	0.19	0.16	0.96
2015	0.16	0.18	0.96
2016	0.14	0.13	0.98
2017	0.15	0.13	0.98
2018	0.16	0.17	0.95
2019	0.13	0.12	N/A

CRMS0059			
Year	Mean Salinity	Mean growing season salinity	Inundation
2012	0.33	0.26	1.00
2013	0.31	0.28	1.00
2014	0.18	0.14	1.00
2015	0.20	0.21	1.00
2016	0.11	0.09	1.00
2017	0.10	0.08	1.00
2018	0.12	0.12	1.00
2019	0.10	0.10	1.00

Based on U.S. Army Engineer Research and Development Center's (ERDC) Remotely Sensed Habitat Assessment and Geographic Information Systems (GIS) data (ERDC RS/GIS data), WVA field observations, hydrologic model results, and CRMS data from 2007 or 2012 to 2019, the level of inundation was determined to vary from dry to deep (3 feet or deeper). Each plot was categorized into the following water levels: dry, low water (< 1 foot inundated), wet (1-2 feet inundated), moderate water (2-3 feet inundated), and deep (> 3 feet inundated) based on field site visits, CRMS data (Table 15), and ERDC RS/GIS data. Older data (e.g., field site data from 2013) were reviewed and categorized based on notes and recollection. Floating aquatic vegetation was observed during field site visits. WVA field site inundation levels were averaged to estimate sub-area flood duration values. Most swamp plots were estimated to have semi-permanent to permanent flood durations (Table 19).

Average water levels were increased by 2.32 feet for each plot and re-categorized by the same group ranges at TY37. This method corroborated our assumption that all swamp would become permanently flooded in the future. Based on RSLR and accretion data under FWOP, the project area would be exposed infrequently up to TY36. At TY37, the project area would be submerged continually (i.e., permanently). Therefore, under the FWOP condition for direct swamp impacts, the Flood Duration drops from semi-permanent to permanent at TY 37. Under FWOP, the water flow/exchange would be low for both the Conveyance Channel and Weir and Railroad Embankment and Weir swamps for all target years. Under the FWP, the habitat within each impact area is assumed to go to zero at construction (TY1-50). FWOP and FWP water regime values are shown below (Table 19).

The same information is used to calculate the SIs for Swamp V3 and BLH V4. These variables are somewhat interchangeably referred to as water regime or hydrology as they consider the flooding duration and amount of water flow or exchange in forested wetlands using eight categories. For swamp the optimal water regime is assumed to be seasonal (compared to temporary for BLH) flooding with abundant and consistent riverine/tidal input and water flow-through (SI=1.0).

Table 19. V3 Summary table for direct swamp impacts.

Embankment (Swamp)					Embankment (Swamp)			
TY	FWOP Flood Duration	FWOP Flow/Exchange	SI		TY	FWP Flood Duration	FWP Flow/Exchange	SI
0	semi-perm	low	0.45		0	semi-perm	low	0.45
1	semi-perm	low	0.45		1			0
37	perm	low	0.3		37			0
50	perm	low	0.3		50			0

Hope Canal (Swamp)					Hope Canal (Swamp)			
TY	FWOP Flood Duration	FWOP Flow/Exchange	SI		TY	FWP Flood Duration	FWP Flow/Exchange	SI
0	semi-perm	low	0.45		0	semi-perm	low	0.45
1	semi-perm	low	0.45		1			0
37	perm	low	0.3		37			0
50	perm	low	0.3		50			0

V3 (BLH) – Understory/Midstory

Understory and midstory data were collected from all site visits for baseline estimates. Data for each site were entered into the WVA in-growth spreadsheets and then averaged for input into the WVA model (Table 16). The BLH sites were typically much higher in elevation than the swamp sites and will not reach a permanently flooded condition. Therefore, under the FWOP, baseline values remain unchanged across all target years. The FWP DBH values were determined by reducing FWOP values 100% for TY1-TY50. FWOP and FWP understory and midstory values are shown below (Table 20).

Table 20. V2 summary table for Conveyance Channel and Associated Features – BLH plots

FWOP Conveyance Channel and Associated Features – BLH		
TY	% Understory	% Midstory
0	46	58
1	46	58
37	46	58
50	46	58

FWP Conveyance Channel and Associated Features – BLH		
TY	% Understory	% Midstory
0	46	58
1	0	0
37	0	0
50	0	0

V4 (Swamp) – Mean High Salinity During the Growing Season

Baseline salinity estimates were based on nearby CRMS station salinities of recent years (2010-2019) to represent salinities after the Mississippi River Gulf Outlet (MRGO) was closed in 2009, the Inner Harbor Navigation Canal-Lake Borgne Surge Barrier (surge barrier) was closed in 2010, and the Seabrook floodgate complex was completed in 2012. Since these closures, salinities have been lower in the Pontchartrain Basin and the project area. For swamp the WVA standard is to use the mean high growing season salinity, which is from March 1 through October 31.

The HET used 0.7 parts per thousand (ppt) as the baseline salinity for swamp (TY0). Because the project area swamp would average 0.61 feet deep in 2021, the volume of water within a square foot area above the substrate is 0.61 ft^3 or 17.26 liters (L). Assuming that increased flooding due to RSLR will be at a salinity of 2.0 ppt (for all RSLR water level increases), the grams of salt and water volume (using RSLR-predicted water elevation increases) above the substrate can be determined. Under the FWOP condition, salinity is 0.7 ppt at TY0 and increases to 1.5 ppt by the end of project life (Table 21**).** Under the FWP, salinities from the Maurepas Swamp Project Benefits WVA (Paille, 2021) were assumed although the habitat within each impact area is assumed to go to zero at construction (TY1-50).

Table 21. V4 Summary table for direct swamp impacts.

Conveyance Channel and Associated Features – Swamp		
TY	FWOP Salinity	FWP Salinity
0	0.7	0.7
1	0.8	0.3
37	1.2	0.4
50	1.5	0.4

Railroad Embankment and Weir – Swamp		
TY	FWOP Salinity	FWP Salinity
0	0.7	0.7
1	0.8	0.3
37	1.2	0.4
50	1.5	0.4

V4 (BLH) – Hydrology

The same information is used to calculate the SIs for BLH V4 as was used for Swamp V3. These variables are somewhat interchangeably referred to as water regime or hydrology as they consider the flooding duration and amount of water flow or exchange in forested wetlands. The optimal water regime for BLH is assumed to be temporary (compared to seasonal for swamp) flooding with abundant and consistent riverine input and water flow-through (SI = 1.0).

To determine BLH V4 SIs, information from the WSLP Construction impacts WVA was used (Breaux, 2020). For this WVA, the three sites comprising the "west area" were chosen to represent the habitat impacts of the conveyance channel as it spans north to south (NW11, NW12, NW13).

The BLH sites were mostly dry. Most BLH habitats may receive some standing water, but the water table is likely below the ground for much of the year. Water inputs come predominantly from rainfall and there was very limited water exchange from riverine and/or tidal inputs. Healthy BLH is typically in higher elevation and drain well.

As in swamp, the 2.32 foot RSLR projection was added to existing ground elevation estimates, derived from LIDAR and field data. FWOP TY50 flood duration were increased, but the flow/exchange ratings were assumed to remain the same.

Based on field observations, aerial imagery, CRMS data, and H&H modeling, BLH was given a low or moderate flow exchange and either temporary or seasonal flood duration. Under the FWOP condition, the flood duration is low until impacts of SLR are observed at TY37 at which point flood duration changes to seasonal. At TY50, the flood duration becomes semi-permanent. Under the FWP, the areas were assumed to have no flow or exchange and the habitat within each impact area is assumed to go to zero at construction (TY1-50). FWOP and FWP hydrology values are shown below (Table 22).

Table 22. V4 Summary table for BLH impacts.

FWOP Conveyance Channel and Associated Features – BLH		
TY	Flood Duration	Flow/ Exchange
0	temporary	low
1	temporary	low
37	seasonal	low
50	semi-permanent	low

FWP Conveyance Channel and Associated Features – BLH		
TY	Flood Duration	Flow/ Exchange
0	temporary	low
1	permanent	none
37	permanent	none
50	permanent	none

V5 (Swamp and BLH) – Size of Contiguous Forested Area

Although edge and diversity, which are dominant features of small forested tracts, are important for certain wildlife species, it is important to understand four concepts: 1) species which thrive in edge habitat are highly mobile and presently occur in substantial numbers, 2) because of forest fragmentation and ongoing timber harvesting by man, edge and diversity are quite available, 3) most species found in "edge" habitat are "generalists" in habitat use and are quite capable of existing in larger tracts, and 4) those species in greatest need of conservation are "specialists" in habitat use and require large forested tracts. Therefore, the basic assumption for this variable is that larger forested tracts are less common and offer higher quality habitat than smaller tracts. For this model, tracts greater than 500 acres in size are considered large enough to warrant being considered optimal.

The Suir et al. (2021) GIS/RS data (Figure 2), 2016 National Land Cover Database (NLCD) data, FWI, and available imagery were used to determine sizes of contiguous forested areas for each impact area evaluated (i.e., Conveyance Channel and Associated Features, and Railroad Embankment and Weir). A weighted average by proportion of impact area for each contiguous forest size category was calculated to determine their Suitability Index (SI) for the FWOP baseline. These SIs were then entered directly into the WVA spreadsheets. The same SI was applied for both the swamp and BLH WVAs for the conveyance channel and associated features impact area, because swamp and BLH were considered together as a large contiguous forest (Table 23). A separate SI was calculated for the railroad embankment and weir swamp WVAs (Table 23). The footprint of the WSLP St. John the Baptist Parish levee and associated features were assumed to be non-forested habitats for this variable. See Appendix B for more details.

Table 23. SI for baseline and future projections of Size of Contiguous Forest Area

FWOP (TY0, TY1, TY37, and TY50), and FWP (TY0)	
Impact Area	**SI**
Conveyance Channel and Associated Features – Swamp	0.90
Railroad Embankment and Weir – Swamp	1.00
Conveyance Channel and Associated Features – BLH	0.90

In the FWP, the project footprint changed to non-forested habitat (TY1-50). The FWP Suitability Index (SI) values were classified as "unused" for TY1-TY50.

<u>V6 (Swamp and BLH) – Suitability and Traversability of Surrounding Land Uses</u>

The 2016 NLCD was used to categorize surrounding land uses. A 0.5-mile buffer was placed around the project footprint. The percent of each land use within the buffer was used to calculate a weighted average of land use by SI for each impact area. The weighted average SIs were directly entered into the WVA spreadsheets. The same SI was applied for both the swamp and BLH WVAs for the conveyance channel and associated features impact area, because swamp and BLH were considered together as a large contiguous forest (Table 24). A separate SI was calculated for the railroad embankment and weir swamp WVAs (Table 24).

In the FWOP (TY1), it is assumed that WSLP would be constructed. The WSLP footprint was considered to be Developed, Low Intensity, because the Mississippi River levee in the NCLD was indicated as such. All land within the WSLP footprint was changed from the NCLD classification to Developed, Low Intensity for TY1 and TY50. The railroad embankment was not affected, because none of the WSLP footprint was located within the embankment 0.5-mile buffer. Similar to V5, the only assumed difference between FWOP and FWP was the construction of the Maurepas Swamp Project. In the FWP, the project footprint land use classification was changed to 100% development, and the FWP SI values were set to zero for Y1-TY50. See Appendix B for more details.

Table 24. V6 summary table for baseline and future projections of Size of Suitability and Traversability of Surrounding Land Uses

FWOP (TY0, TY1, TY37, and TY50), and FWP (TY0)				
Impact Area	**TY0 SI**	**TY1 SI**	**TY37 SI**	**TY50 SI**
Conveyance Channel and Associated Features – Swamp	0.78	0.76	0.76	0.72
Railroad Embankment and Weir – Swamp	0.99	0.99	0.99	0.99
Conveyance Channel and Associated Features – BLH	0.78	0.76	0.76	0.72

V7 (Swamp and BLH) – Disturbance

The disturbance variable is scored as the distance from the disturbance and the type of disturbance. The 2021 ERDC GIS/RS data, 2016 NLCD data, FWI, and available imagery were used to classify the disturbance type such as highways, industrial areas, waterways, agriculture, homes, etc. Similar to V5 and V6, swamp and BLH habitats were considered together as a large contiguous forest for V7. Each impact area was buffered and distances to disturbance classes were calculated for each impact area. Also similar to V5, the WSLP St. John the Baptist Parish levee footprint was applied to the FWOP condition. Disturbance type/distance zone areas were digitized and acreages were calculated. Weighted average SIs were calculated for each disturbance type and distance combination. The resulting weighted SIs were directly input into WVA spreadsheets. The SI was assumed to remain unchanged throughout target years in the FWOP (TY0-50). In the FWP, the FWP SI values were set to zero and the habitat acreage within each impact area was assumed to go to zero at construction (TY1-50). See Table 25 below.

Table 25. Disturbance weighted SI values for the Impact Areas.

FWOP (TY0, TY1, TY37, and TY50), and FWP (TY0)	
Impact Area	**SI**
Conveyance Channel and Associated Features – Swamp	0.50
Railroad Embankment and Weirs – Swamp	0.99
Conveyance Channel and Associated Features – BLH	0.50

See Appendix B for a summary of all disturbance values.

WVA Results

The product of a Habitat Suitability Index (HIS) value and the acreage of available habitat for a given target year is known as the Habitat Unit (HU). The HU is the basic unit for measuring project effects on fish and wildlife habitat. Future HUs change according to changes in habitat quality and/or quantity. Results are annualized over the project life to determine the Average Annual Habitat Units (AAHUs) available for each habitat type. The change (increase or decrease) in AAHUs between FWP and FWOP scenarios provide a measure of anticipated impacts, and a net loss of AAHUs indicates that the project is damaging to that habitat type.

Due to the co-location of the WSLP levee and MSP, there are many shared project features between the projects. In an attempt to simplify the separation of these shared features and their associated impacts, the acreage of habitat impacted by the construction of the levee was included in the evaluation of the impacts associated with the construction of the MSP. Changes in each variable are predicted for FWOP and FWP scenarios over a 50-year project life. See Appendix C for initial AAHU change calculations for each WVA conducted as part of this assessment.

Since the net loss of AAHUs associated with the construction of WSLP was previously assessed in the SEA 571 WSLP WVAs, NEPA cleared impacts (AAHUs) associated with WSLP levee construction were removed from the assessment included in Appendix C in order to avoid accounting for the impacts of shared features twice. A summary of this methodology is included in Appendix D of this report.

Results of the WVAs conducted indicate that the construction of the proposed project will result in the direct impact of -52.387 AAHUs to swamp habitat and -29.124 AAHUs of direct impacts to BLH habitat. Table 26 below provides a summary of direct impacts associated with project construction.

Table 26. Direct impacts associated with construction of the MSP.

MSP AAHUs (Appendix C)		WSLP levee system SEA 571 AAHUs for adjacent area (Appendix D)	Total adjusted AAHUs
BLH	-70.4	41.276	-29.124
Swamp	-67.95	15.563	-52.387

Impacts to BLH habitat as a result of project construction would not be mitigated as a result of the MSP operation. A mitigation plan for these impacts would be developed at a later time.

LITERATURE CITED

Effler, R.S.; Goyer, R.A.; Lenhard, G.J. Baldcypress and water tupelo responses to insect defoliation and nutrient augmentation in Maurepas Swamp, Louisiana, USA. For. Ecol. Manag. 2006, 236, 295–304.

Ewel, K.C., and L.P. Wickenheiser. 1988. Effect of swamp size on growth rates of cypress trees. Am. Midl. Nat. Oct. 1988, Vol. 120, No. 2, p. 362-370.

Keim, R.F., Braud, D.H., Shaffer, G.P., Chambers, J.L., 2010a, Mapping coastal wetland forests in coastal Louisiana: Baton Rouge, Louisiana Department of Environmental Quality, 21 p.

Saltus, C.L. and Suir, G.M. 2019. Remotely Sensed Habitat Assessment of Swamp and Bottomland Hardwood Habitat: West Shore Lake Pontchartrain Hurricane Damage Risk Reduction System Potential Impact Area. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

Suir, G.M. Saltus, C.L. and Jackson, S.S. 2021. Remotely Sensed Assessment of Swamp, BLH, and Wetland Habitat within the Maurepas Diversion Project Potential Impact Area. U.S. Army Engineer Research and Development Center, Vicksburg, MS

Shaffer, G.P.; Day, J.W.; Kandalepas, D.; Wood, W.B.; Hunter, R.G.; Lane, R.R.; Hillmann, E.R. Decline of the Maurepas Swamp, Pontchartrain Basin, Louisiana, and Approaches to Restoration. Water 2016, 8, 101.

APPENDIX A

FWOP and FWP Project Area Average Submergence Calculations

						Alternative FWS Accretion Rates			
						FWS =0.50 cm/yr		FWS =1.0 cm/yr	
						0.5	cm		
		CRMS	CRMS	CRMS		0.016404	ft	0.032808	ft
		63	97	5414					
TY	Year	Total Substrate Submerg. (ft)	Total Substrate Submerg. (ft)	Total Substrate Submerg. (ft)	**FWOP Submerg. Ave. (ft)**	FWP Accr. (ft/yr)	FWP Submerg. Ave. (ft)	FWP Accr. (ft/yr)	FWP Submerg. Ave. (ft)
	2021	-0.81992	-0.44709	-0.56092	**-0.6093**		-0.60931		-0.60931
	2022	-0.83549	-0.46266	-0.57649	**-0.62488**		-0.62488		-0.62488
	2023	-0.85124	-0.47841	-0.59224	**-0.64063**		-0.64063		-0.64063
	2024	-0.86717	-0.49434	-0.60817	**-0.65656**		-0.65656		-0.65656
0	2025	-0.88327	-0.51044	-0.62427	**-0.67266**		-0.67266		-0.67266
1	2026	-0.89956	-0.52672	-0.64055	**-0.68894**	0.016404	-0.67254	0.032808	-0.65614
2	2027	-0.91602	-0.54318	-0.65701	**-0.70541**	0.032808	-0.6726	0.065617	-0.63979
3	2028	-0.93266	-0.55982	-0.67365	**-0.72204**	0.049213	-0.67283	0.098425	-0.62362
4	2029	-0.94947	-0.57664	-0.69047	**-0.73886**	0.065617	-0.67324	0.131234	-0.60763
5	2030	-0.96647	-0.59363	-0.70746	**-0.75585**	0.082021	-0.67383	0.164042	-0.59181
6	2031	-0.98364	-0.6108	-0.72463	**-0.77303**	0.098425	-0.6746	0.19685	-0.57617
7	2032	-1.00099	-0.62815	-0.74198	**-0.79037**	0.114829	-0.67555	0.229659	-0.56072
8	2033	-1.01851	-0.64568	-0.75951	**-0.8079**	0.131234	-0.67667	0.262467	-0.54543
9	2034	-1.03622	-0.66339	-0.77722	**-0.82561**	0.147638	-0.67797	0.295276	-0.53033
10	2035	-1.0541	-0.68127	-0.7951	**-0.84349**	0.164042	-0.67945	0.328084	-0.51541
11	2036	-1.07216	-0.69933	-0.81316	**-0.86155**	0.180446	-0.6811	0.360892	-0.50066
12	2037	-1.0904	-0.71757	-0.8314	**-0.87979**	0.19685	-0.68294	0.393701	-0.48609
13	2038	-1.10882	-0.73598	-0.84981	**-0.8982**	0.213255	-0.68495	0.426509	-0.4717
14	2039	-1.12741	-0.75458	-0.86841	**-0.9168**	0.229659	-0.68714	0.459318	-0.45748
15	2040	-1.14618	-0.77335	-0.88718	**-0.93557**	0.246063	-0.68951	0.492126	-0.44344
16	2041	-1.16513	-0.7923	-0.90613	**-0.95452**	0.262467	-0.69205	0.524934	-0.42958
17	2042	-1.18426	-0.81143	-0.92525	**-0.97365**	0.278871	-0.69477	0.557743	-0.4159
18	2043	-1.20356	-0.83073	-0.94456	**-0.99295**	0.295276	-0.69768	0.590551	-0.4024
19	2044	-1.22305	-0.85021	-0.96404	**-1.01243**	0.31168	-0.70075	0.62336	-0.38907
20	2045	-1.24271	-0.86987	-0.9837	**-1.03209**	0.328084	-0.70401	0.656168	-0.37593
21	2046	-1.26255	-0.88971	-1.00354	**-1.05193**	0.344488	-0.70744	0.688976	-0.36296
22	2047	-1.28256	-0.90973	-1.02356	**-1.07195**	0.360892	-0.71106	0.721785	-0.35016
23	2048	-1.30276	-0.92992	-1.04375	**-1.09214**	0.377297	-0.71485	0.754593	-0.33755
24	2049	-1.32313	-0.95029	-1.06412	**-1.11251**	0.393701	-0.71881	0.787402	-0.32511
25	2050	-1.34368	-0.97084	-1.08467	**-1.13306**	0.410105	-0.72296	0.82021	-0.31285
26	2051	-1.3644	-0.99157	-1.1054	**-1.15379**	0.426509	-0.72728	0.853018	-0.30077
27	2052	-1.38531	-1.01247	-1.1263	**-1.1747**	0.442913	-0.73178	0.885827	-0.28887
28	2053	-1.40639	-1.03356	-1.14739	**-1.19578**	0.459318	-0.73646	0.918635	-0.27714
29	2054	-1.42765	-1.05482	-1.16865	**-1.21704**	0.475722	-0.74132	0.951444	-0.2656
30	2055	-1.44909	-1.07626	-1.19009	**-1.23848**	0.492126	-0.74635	0.984252	-0.25423
31	2056	-1.47071	-1.09787	-1.2117	**-1.26009**	0.50853	-0.75156	1.01706	-0.24303
32	2057	-1.4925	-1.11967	-1.2335	**-1.28189**	0.524934	-0.75695	1.049869	-0.23202
33	2058	-1.51447	-1.14164	-1.25547	**-1.30386**	0.541339	-0.76252	1.082677	-0.22118
34	2059	-1.53662	-1.16379	-1.27762	**-1.32601**	0.557743	-0.76827	1.115486	-0.21052
35	2060	-1.55895	-1.18611	-1.29994	**-1.34834**	0.574147	-0.77419	1.148294	-0.20004
36	2061	-1.58145	-1.20862	-1.32245	**-1.37084**	0.590551	-0.78029	1.181102	-0.18974
37	2062	-1.60414	-1.2313	-1.34513	**-1.39352**	0.606955	-0.78657	1.213911	-0.17961
38	2063	-1.627	-1.25416	-1.36799	**-1.41638**	0.62336	-0.79302	1.246719	-0.16966
39	2064	-1.65003	-1.2772	-1.39103	**-1.43942**	0.639764	-0.79966	1.279528	-0.15989
40	2065	-1.67325	-1.30042	-1.41425	**-1.46264**	0.656168	-0.80647	1.312336	-0.1503
41	2066	-1.69664	-1.32381	-1.43764	**-1.48603**	0.672572	-0.81346	1.345144	-0.14089
42	2067	-1.72022	-1.34738	-1.46121	**-1.5096**	0.688976	-0.82063	1.377953	-0.13165
43	2068	-1.74396	-1.37113	-1.48496	**-1.53335**	0.705381	-0.82797	1.410761	-0.12259
44	2069	-1.76789	-1.39506	-1.50889	**-1.55728**	0.721785	-0.83549	1.44357	-0.11371
45	2070	-1.792	-1.41916	-1.53299	**-1.58138**	0.738189	-0.8432	1.476378	-0.10501
46	2071	-1.81628	-1.44345	-1.55728	**-1.60567**	0.754593	-0.85107	1.509186	-0.09648
47	2072	-1.84074	-1.46791	-1.58174	**-1.63013**	0.770997	-0.85913	1.541995	-0.08813
48	2073	-1.86538	-1.49254	-1.60637	**-1.65477**	0.787402	-0.86736	1.574803	-0.07996
49	2074	-1.89019	-1.51736	-1.63119	**-1.67958**	0.803806	-0.87578	1.607612	-0.07197
50	2075	-1.91519	-1.54235	-1.65618	**-1.70458**	0.82021	-0.88437	1.64042	-0.06416

APPENDIX B

Project Area Calculation, V5, V6, V7, Construction Direct Impacts

MSP WVA Analysis January 2021 – Patrick Smith

Feature and habitat type:

Bourgeious Canal			
Permanent		Temporary	
Habitat	Acres	Habitat	Acres
Developed		Developed	
Water	0.036	Water	0.142
Other Vegetation		Other Vegetation	
Swamp	0.003	Swamp	0.039
Other Wetland		Other Wetland	
Agriculture		Agriculture	
BLH	0.013	BLH	0.076

ID	Habitat Type
1	Developed
2	Water
3	Other Vegetation
4	Swamp
5	Other Wetland
7	Agriculture
8	BLH

Bayou Secret			
Permanent		Temporary	
Habitat	Acres	Habitat	Acres
Developed		Developed	
Water	0.024	Water	0.078
Other Vegetation		Other Vegetation	
Swamp	0.005	Swamp	0.056
Other Wetland		Other Wetland	
Agriculture		Agriculture	
BLH		BLH	

Diversion Channel and Associated Features			
Permanent		Temporary	
Habitat	Acres	Habitat	Acres
Developed	33.002	Developed	8.108
Water	21.321	Water	3.445
Other Veg	17.333	Other Veg	3.032
Swamp	80.443	Swamp	2.786
Other Wet	3.639	Other Wet	0.030
Agriculture		Agricultur	0.002
BLH	99.052	BLH	5.393

RR Embankment			
Permanent		Temporary	
Habitat	Acres	Habitat	Acres
Developed	0.007	Developed	
Water	0.015	Water	
Other Vegetation		Other Vegetation	
Swamp	6.968	Swamp	
Other Wetland	1.651	Other Wetland	
Agriculture		Agriculture	
BLH	0.837	BLH	

Feature and habitat type acreages:

Diversion Channel and Associated Features			RR Embankment
Swamp	BLH		Swamp
107.2619552	105.3700593		8.723511731

Conveyance Channel and Associated Features Swamp: Sum of Other Vegetation, Swamp, and Wetland Vegetation for this feature only. This was done because the area is dominated by degraded swamp and it is likely that these habitats represent low canopy density swamp habitats. These habitats were patchy and often surrounded by larger expanses of swamp which may be further evidence that this assumption is correct. This is consistent with the WSLP WVA.

Conveyance Channel and Associated Features BLH: Sum of BLH for all features. This was done because there was very little BLH habitat outside of the conveyance channel and associated features.

RR Embankment Swamp: Sum of Other Vegetation, Swamp, and Wetland Vegetation for all features except the Conveyance Channel and Associated Features. This was done because there was very little Swamp habitat outside of the conveyance channel and associated features, and the RR Embankment.

V5

For this variable, Swamp and BLH were considered together as a large contiguous forest. The ERDC GIS/RS data, 2016 National Land Cover Database (NLCD) data, and available imagery were used to determine sizes of contiguous forested areas for each project feature evaluated. A weighted averages was calculated for each to determine their HSI for baseline, FWOP TY 0,1,50. The WSLP St. John the Baptist Parish levee footprint was changed to non-forested habitat.

V5 Summary

For this variable, Swamp and BLH were considered together as a large contiguous forest. The ERDC GIS/RS data, 2016 National Land Cover Database (NLCD) data, and available imagery were used to determine sizes of contiguous forested areas for each project feature evaluated. A weighted averages was calculated for each to determine their HSI for baseline, FWOP TY 0,1,50. The WSLP St. John the Baptist Parish levee footprint was changed to non-forested habitat.

					Channel, FWOP TY0,1,50				
Area #		sqft	acres of forest patch	acres of channel	porportion of forested channel	SI	Weighted SI	Swamp	BLH
1		524,645.32	12.04419927	12.04419927	0.056643395	0.4	0.022657358	107.262	105.3701
2		9,124,821.78	209.477084	40.25170317	0.189302177	0.8	0.151441741		
3		1,926,206.74	44.21962213	11.74695271	0.055245457	0.6	0.033147274		
4		232,484.00	5.337098255	1.130068871	0.005314669	0.4	0.002125868		
						SI ->	**0.902866543**		

RR Embankment FWOP TY 0, 1, 50	
SI ->	**1.00**

V6

Value	Habitat
11	Open Water
12	Perennial Ice/Snow
21	Developed, Open Space
22	Developed, Low Intensity
23	Developed, Medium Intensity
24	Developed, High Intensity
31	Barren Land (Rock/Sand/Clay)
41	Deciduous Forest
42	Evergreen Forest
43	Mixed Forest
51	Dwarf Scrub
52	Shrub/Scrub
71	Grassland/Herbaceous
72	Sedge/Herbaceous
73	Lichens
74	Moss
81	Pasture/Hay
82	Cultivated Crops
90	Woody Wetlands
95	Emergent Herbaceous Wetlands

FWOP TY0 Channel:

Channel						
Value	Count	acres	Percent	Habitat	Weighting Factor	Weighted Percetage
11	1363	303.1244	0.068472	Open Water	0.2	0.013694364
21	978	217.5023	0.049131	Developed, Open Space	0.01	0.000491309
22	1347	299.5661	0.067668	Developed, Low Intensity	0.01	0.00067668
23	266	59.15707	0.013363	Developed, Medium Intensity	0.01	0.000133628
24	144	32.02488	0.007234	Developed, High Intensity	0.01	7.234E-05
31	344	76.50388	0.017281	Barren Land (Rock/Sand/Clay)	0.6	0.010368733
41	38	8.45101	0.001909	Deciduous Forest	1	0.001908972
42	11	2.446345	0.000553	Evergreen Forest	1	0.000552597
43	73	16.23484	0.003667	Mixed Forest	1	0.003667236
71	167	37.13997	0.008389	Grassland/Herbaceous	1	0.00838943
81	419	93.18351	0.021049	Pasture/Hay	0.4	0.008419572
82	211	46.92535	0.0106	Cultivated Crops	0.2	0.002119964
90	13609	3026.574	0.683663	Woody Wetlands	1	0.683663217
95	936	208.1617	0.047021	Emergent Herbaceous Wetland	1	0.047020999
		4426.995	1		**SI->**	**0.781179041**

FWOP TY0 Embankment and Weirs:

RR Embankment						
VALUE	COUNT	acres	Percent	Habitat	Weighting Factor	Weighted Percentage
11	207	46.03577	0.014603	Open Water	0.2	0.002920635
71	2	0.44479	0.000141	Grassland/Herbaceous	1	0.000141093
90	13019	2895.361	0.918448	Woody Wetlands	1	0.918447972
95	947	210.6081	0.066808	Emergent Herbaceous Wetlands	1	0.06680776
		3152.449	1		**SI ->**	**0.98831746**

FWOP TY1 Channel:

Channel, TY1						
Value	Count	acres	Percent	Habitat	Weighting Factor	Weighted Percetage
11	1363	303.124385	0.068471818	Open Water	0.2	0.013694364
21	978	216.390335	0.048879735	Developed, Open Space	0.01	0.000488797
22	1347	401.867765	0.09077665	Developed, Low Intensity	0.01	0.000907767
23	266	57.600305	0.013011152	Developed, Medium Intensity	0.01	0.000130112
24	144	32.02488	0.007234	Developed, High Intensity	0.01	7.234E-05
31	344	76.50388	0.017281222	Barren Land (Rock/Sand/Clay)	0.6	0.010368733
41	38	6.894245	0.001557319	Deciduous Forest	1	0.001557319
42	11	2.446345	0.000552597	Evergreen Forest	1	0.000552597
43	73	14.010885	0.003164875	Mixed Forest	1	0.003164875
71	167	37.139965	0.00838943	Grassland/Herbaceous	1	0.00838943
81	419	93.183505	0.02104893	Pasture/Hay	0.4	0.008419572
82	211	46.480555	0.010499347	Cultivated Crops	0.2	0.002099869
90	13609	2935.391605	0.663066412	Woody Wetlands	1	0.663066412
95	936	203.936215	0.046066513	Emergent Herbaceous Wetlands	1	0.046066513
		4426.99487	1		**SI->**	**0.7589787**

FWOP TY1 Embankment and Weirs:

RR Embankment, TY1						
VALUE	COUNT	acres	Percent	Habitat	Weighting Factor	Weighted Percentage
11	207	46.035765	0.014603175	Open Water	0.2	0.002920635
71	2	0.44479	0.000141093	Grassland/Herbaceous	1	0.000141093
90	13019	2895.360505	0.918447972	Woody Wetlands	1	0.918447972
95	947	210.608065	0.06680776	Emergent Herbaceous Wetlands	1	0.06680776
		3152.449125	1		**SI ->**	**0.98831746**

FWOP TY1 WSLP:

WSLP						
Value	Count	acres	Percent	Habitat	Weighting Factor	Weighted Percetage
21	5	1.111975	0.010373444	Developed, Open Space	0.01	0.000103734
22	22	4.89269	0.045643154	Developed, Low Intensity	0.01	0.000456432
23	7	1.556765	0.014522822	Developed, Medium Intensity	0.01	0.000145228
41	7	1.556765	0.014522822	Deciduous Forest	1	0.014522822
43	10	2.22395	0.020746888	Mixed Forest	1	0.020746888
82	2	0.44479	0.004149378	Cultivated Crops	0.2	0.000829876
90	410	91.18195	0.850622407	Woody Wetlands	1	0.850622407
95	19	4.225505	0.039419087	Emergent Herbaceous Wetlands	1	0.039419087
		107.19439	1			

FWOP TY1 - Assumes WSLP would be constructed. WSLP footprint was considered to be Developed, Low Intensity, because the MRL levee in the NCLD was indicated as such. All land within the WSLP Footprint was changed from the NCLD classificaiton to Developed, Low Intensity for TY1 and TY50 based on this assumption. RR Embankment was not changed, because none of the WSLP footprint was located within the the RR Embankment 0.5 mile buffer

FWOP TY50 Channel:

Channel, TY50						
Value	Count	acres	Percent	Habitat	Weighting Factor	Weighted Percetage
11	1363	303.124385	0.068471818	Open Water	0.2	0.013694364
21	978	267.630143	0.060454134	Developed, Open Space	0.01	0.000604541
22	1347	401.867765	0.09077665	Developed, Low Intensity	0.01	0.000907767
23	266	57.600305	0.013011152	Developed, Medium Intensity	0.01	0.000130112
24	144	32.02488	0.007234	Developed, High Intensity	0.01	7.234E-05
31	344	76.50388	0.017281222	Barren Land (Rock/Sand/Clay)	0.6	0.010368733
41	38	6.894245	0.001557319	Deciduous Forest	1	0.001557319
42	11	2.446345	0.000552597	Evergreen Forest	1	0.000552597
43	73	14.010885	0.003164875	Mixed Forest	1	0.003164875
71	167	37.139965	0.00838943	Grassland/Herbaceous	1	0.00838943
81	419	46.5917525	0.010524465	Pasture/Hay	0.4	0.004209786
82	211	41.8324995	0.009449412	Cultivated Crops	0.2	0.001889882
90	13609	2935.391605	0.663066412	Woody Wetlands	1	0.663066412
95	936	203.936215	0.046066513	Emergent Herbaceous Wetlands	1	0.046066513
		4426.99487	1		SI->	**0.754674671**

FWOP TY50 Embankment and Weirs:

RR Embankment, TY50						
VALUE	COUNT	acres	Percent	Habitat	Weighting Factor	Weighted Percentage
11	207	46.035765	0.014603175	Open Water	0.2	0.002920635
71	2	0.44479	0.000141093	Grassland/Herbaceous	1	0.000141093
90	13019	2895.360505	0.918447972	Woody Wetlands	1	0.918447972
95	947	210.608065	0.06680776	Emergent Herbaceous Wetlands	1	0.06680776
		3152.449125	1		SI ->	**0.98831746**

FWOP TY50 - Assumes WSLP would be constructed. WSLP footprint was considered to be Developed, Low Intensity, because the MRL levee in the NCLD was indicated as such. All land within the WSLP Footprint was changed from the NCLD classificaiton to Developed, Low Intensity for TY1 and TY50 based on this assumption. All Pasture/Hay and Cultivated Crops habitat within the WSLP levee system was assumed to be developed for TY50. This is consistent with the WSLP WVA. RR Embankment was not changed, because none of the WSLP footprint was located within the the RR Embankment 0.5 mile buffer

V6 Summary Table (all target years):

Suitability Index by feature and TY		
TY	Channel	RR Embankment
0	0.78	0.98831746
1	0.76	0.98831746
50	0.75	0.98831746

V7

Similar to V5, Swamp and BLH were considered together as a large contiguous forest for V7. Each impact area was buffered and distance to disturbances were calculated with a weighted average to determine the resulting HSI. Also similar to V5, The WSLP St. John levee footprint was applied to the FWOP condition to determine the HSI. There was no ag land within 500 feet of either polygon based on the ERDC habitat analysis.

TY0, TY1, TY50 - Channel

Hope Canal (Class 2; 40% within 50 feet, 60% 50-200 feet)			
habitat type	Value	Count	acres
developed	1	2	0.001044669
water	2	33833	17.67215027
other vegetation	3	2022	1.056160785
swamp	4	102100	53.33037396
wetland	5	6347	3.315258409
BLH	8	55106	28.78377657

Cha_65			
OID_	Value	Count	acres
develope	1	610	0.318624174
water	2	300	0.156700413
other veg	3	1460	0.762608678
swamp	4	4821	2.51817564
BLH	8	18748	9.792731156

Cha_26			
OID_	Value	Count	acres
develope	1	7540	3.938403719
water	2	3179	1.660502045
other veg	3	11367	5.937378657
swamp	4	13992	7.308507272
wetland	5	213	0.111257293
BLH	8	60974	31.84883665

SI = 0.26		proportion	
BLH	43.36234728	0.437774016	
Swamp	36.43786048	0.359294798	
	Total	0.398071862	0.26
		SI	0.103498684

SI = 0.01		proportion	
BLH	7.663173		
Swamp	10.65302		
	Total	0.0913677	0.01
		SI	0.0009137

SI=0.65		proportion	
BLH	9.792731		
Swamp	2.518176		
	Total	0.121391451	0.65
		SI	0.078904

SI=1		proportion	
BLH	wetland		
Swamp	0		
	Total	0.190297	1
		SI	0.190297

Diversion Channel total acres	
Habitat	Acres
Developed	33.00162936
Water	21.32118056
Other Vegetation	17.33315504
Swamp	80.44320179
Other Wetland	3.638583595
Agriculture	
BLH	99.05189819

SI = 0.50		proportion	
BLH	17.27027	0.1743557	
Swamp	34.62108	0.3495246	
	Total	0.2588525	0.5
		SI	0.1294262

Grand SI	0.50303983

TY0, TY1, TY50 – Embankment and Weirs

RR Embankment, SI = 50			
Habitat Type	Value	Count	Acres
developed	1	14	0.007313
water	2	21	0.010969
swamp	4	65	0.033952
wetland	5	177	0.092453

Habitat Type Key	
developed	1
water	2
other vegetation	3
swamp	4
wetland	5
BLH	8

RR Embankment total acres	
habitat	acres
Developed	0.007313
Water	0.015148
Other Vegetation	
Swamp	6.968467
Other Wetland	1.6511
Agriculture	
BLH	0.83678

SI = 0.5		proportion	
BLH	0	0	
Swamp	0.126405	0.014665	
	Total	0.014665	0.5
		SI	0.007332

SI = 1		proportion	
BLH	0.83678	0	
Swamp	8.493162	0.985335	
	Total	0.985335	1
		SI	0.985335

Grand SI	**0.992668**

APPENDIX C

WVA spreadsheet AAHU Calculations – Conveyance Channel and Associated Features – Swamp

AAHU CALCULATION

Project: Diversion Channel and Associated Features - Swamp

Future Without Project			Total	Cummulative
TY	Acres	x HSI	HUs	HUs
0	107	0.66	71.17	
1	107	0.67	71.49	71.33
37	107	0.55	59.09	2350.40
50	107	0.54	58.32	763.17
Max TY=	50		Total	
			CHUs =	3184.90
			AAHUs =	63.70

Future With Project			Total	Cummulative
TY	Acres	x HSI	HUs	HUs
0	107	0.66	70.99	
1	0	0.00	0.00	23.66
37	0	0.00	0.00	0.00
50	0	0.00	0.00	0.00
Max TY=	50		Total	
			CHUs =	23.66
			AAHUs =	0.47

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project AAHUs =	0.47
B. Future Without Project AAHUs =	63.70
Net Change (FWP - FWOP) =	-63.22

WVA spreadsheet AAHU Calculations – Conveyance Channel and Associated Features – BLH

AAHU CALCULATION

Project: Diversion Channel and Associated Features - BLH

Future Without Project			Total	Cummulative
TY	**Acres**	**x HSI**	**HUs**	**HUs**
0	105.3700593	0.69	72.79	
1	105.3700593	0.60	63.68	68.23
37	105.3700593	0.70	73.33	2466.17
50	105.3700593	0.78	82.06	1010.05
Max TY=	50		**Total AAHUs =**	**3544.45**
			AAHUs =	**70.89**

Future With Project			Total	Cummulative
TY	**Acres**	**x HSI**	**HUs**	**HUs**
0	105.3700593	**0.69**	72.79	
1	0		0.00	24.26
37	0		0.00	0.00
50	0		0.00	0.00
Max TY=	50		**Total AAHUs =**	**24.26**
			AAHUs =	**0.49**

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future Without Prokect AAHUs =	70.89
B. Future With Prokect AAHUs =	0.49
Net Change (FWP - FWOP) =	-70.40

WVA spreadsheet AAHU Calculations – Railroad Embankment and Weirs – Swamp

AAHU CALCULATION

Project: **Railroad Embankment and Weirs - Swamp**

Future Without Project			Total	Cummulative
TY	Acres	x HSI	HUs	HUs
0	9	0.63	5.51	
1	9	0.63	5.45	5.48
37	9	0.50	4.38	176.99
50	9	0.48	4.22	55.90
Max TY=	50		Total CHUs =	238.37
			AAHUs =	4.77

Future With Project			Total	Cummulative
TY	Acres	x HSI	HUs	HUs
0	9	0.63	5.69	
1	0	0.00	0.00	1.90
37	0	0.00	0.00	0.00
50	0	0.00	0.00	0.00
Max TY=	50		Total CHUs =	1.90
			AAHUs =	0.04

NET CHANGE IN AAHUs DUE TO PROJECT	
A. Future With Project AAHUs =	0.04
B. Future Without Project AAHUs =	4.77
Net Change (FWP - FWOP) =	-4.73

APPENDIX D

2021-02-02 Memorandum for Record – Maurepas Swamp Project and WSLP Overlap

Subject: CEMVN-PDS-C proposed solutions to account for potential overlap of West Shore Lake Pontchartrain (WSLP) Hurricane and Storm Damage Risk Reduction System and River Reintroduction into Maurepas Swamp Project (MSD) footprint for calculation of MSD direct impacts Wetland Value Assessments (WVAs).

Background: Project shapefiles were provided by the Louisiana Coastal Protection and Restoration Authority (CPRA) to CEMVN-PDS-C. The Habitat Evaluation Team (HET) requested that CEMVN-PDS-C calculate acres by habitat type (i.e., swamp and BLH) for MSD direct impacts. The MSD and the WSLP would be adjacent and/or co-located for part of their construction areas, and the CPRA is currently designing the entire MSD and the WSLP levee system where it would be co-located/adjacent to the MD.

Several project shapefiles were provided by the CPRA including ones titled "Permanent_Impacts", "Temporary_Impacts", and "WSLP_Boundary". The CPRA stated the Permanent_Impacts and Temporary_Impacts shapes include MD and WSLP impacts, and the WSLP_Boundary is WSLP levee system only impacts. The HET decided that Temporary_Impacts should be treated as permanent for simplicity and to reduce the risk of under-estimating MD construction direct impacts.

Two other GIS sources of information were used.

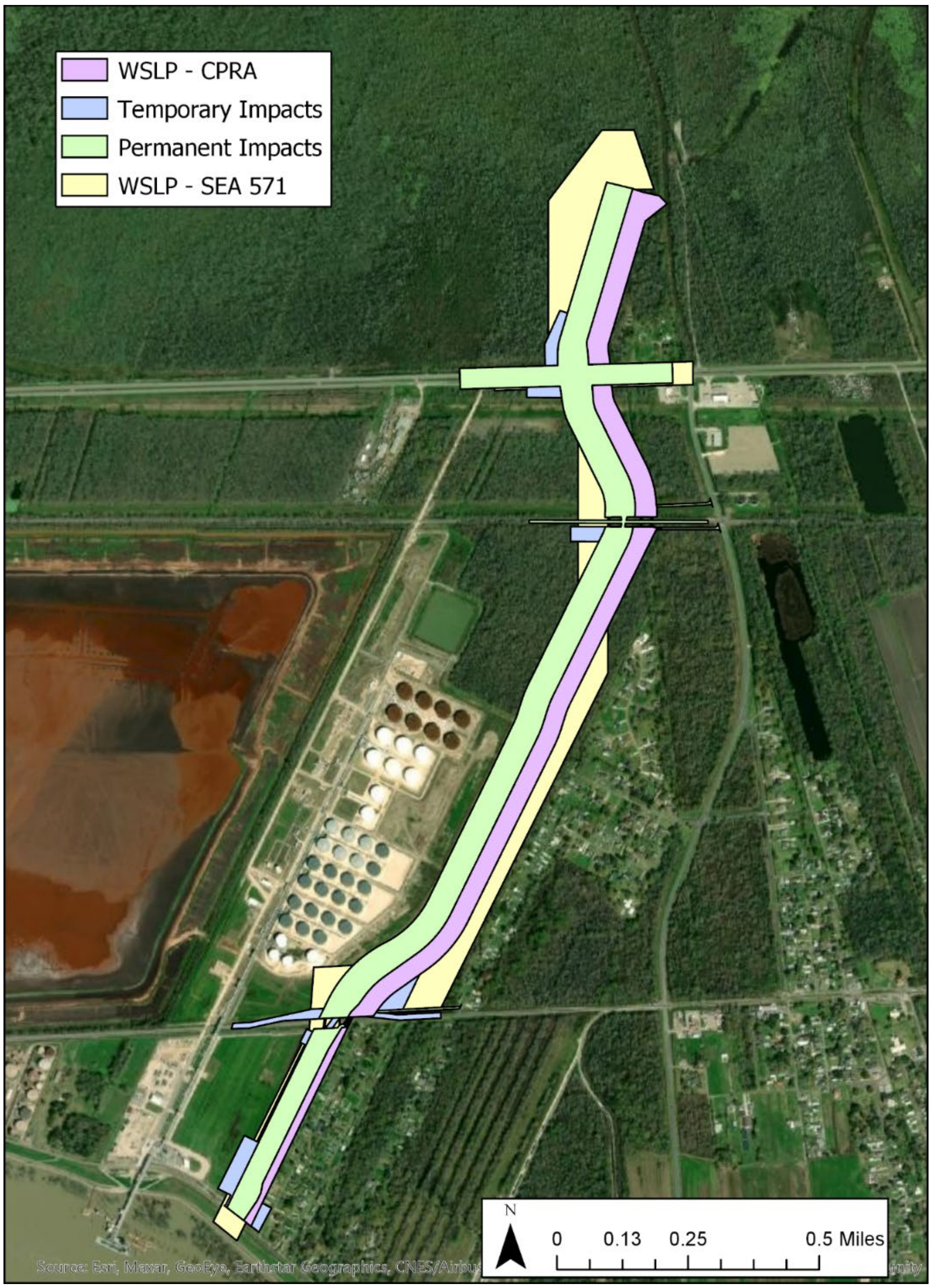
1. The USACE Engineer Research and Development Center (ERDC) developed habitat classification data that were used to distinguish habitats within the Project area(s) and vicinity (ERDC habitat raster); and
2. WSLP levee system footprint shapefiles as described in Supplemental Environmental Assessment 571 (SEA 571 WSLP levee system shapes).

The WSLP levee system footprint assessed in the SEA 571 WSLP WVAs was based on CEMVN's 10/2019 design. The WSLP levee system is being re-designed so that the MSD can be located adjacent to it and these projects would have many shared features. The CPRA provided a document describing the interaction between the MD and WSLP levee system (Attachment 1).

Methodology and Results: Initially, the ERDC habitat classification data was clipped to the entire MSD Temporary_Impacts and Permanent_Impacts shapefiles, part of which includes the adjacent WSLP levee footprint. Acres by habitat type were then calculated and summed from the clipped shapefiles. The results of this were used in the CPRA's WVA spreadsheets provided on 1/14/2021.

Two methods were used to remove potential WSLP levee system impacts from the initial estimate described in the first paragraph of this section. For each method, the Temporary_Impacts, Permanent_Impacts, WSLP_Boundary, and SEA 571 WSLP levee system shapes were clipped from the western edge of the Hope Canal Pump Station to the Mississippi River levee (Figure 1). This was done to isolate the sections where the MD would be adjacent to the WSLP levee.

Figure 1: Map depicted the Temporary_Impacts, Permanent_Impacts, WSLP_Boundary (named WSLP – CPRA), and the SEA 571 WSLP levee system shapefiles (WSLP – SEA 571) clipped between the Hope Canal Pump Station and the Mississippi River Levee.



Method 1: The ERDC habitat raster was used to calculate acres by habitat from the clipped SEA 571 WSLP levee system shapes. The AAHU/acres by habitat type from the SEA 571 WSLP WVAs were applied to the acres by habitat calculated using the ERDC habitat raster. This calculation resulted in the SEA 571 WSLP WVAs AAHUs for the WSLP levee system that would be adjacent to the MD, which were then subtracted from the CPRA's 1/13/2021 Maurepas Swamp Project AAHUs (Table 2).

Table 1	Jan 13, 2021 MD AAHUs	WSLP levee system SEA 571 AAHUs for adjacent area	Method 1 MD AAHUs
BLH	-71.69	-41.276	-30.414
Swamp	-68.04	-15.563	-52.477

Method 2: The WSLPBoundary shape was removed from the Permanent_Impacts shapefiles to estimate the MD only construction footprint from the updated CPRA designs. Acres by habitat type using the ERDC habitat raster was calculated for the estimated MD only construction footprint. The new acres were then applied to the 1/13/2021 WVA spreadsheets (Table 3).

Table 2	Method 2 MD Acres	Method 2 MD AAHUs
BLH	78.55652926	-53.7
Swamp	94.87060886	-60.74

Conclusion: Method 1 is recommended, because this is the most consistent with WSLP Project National Environmental Policy Act (NEPA) documentation. The SEA 571 allows for the WSLP levee system design and location to be modified to accommodate for construction of the MSD and provides an estimate of the approximate impacts of the entire WSLP levee system. Method 1 uses the WSLP levee system impacts estimated for SEA 571 and removes these impacts from the CPRA's updated MSD and WSLP design where they are adjacent and/or co-located.

Construction impacts associated with the MSD should be re-evaluated if the MSD is not constructed to mitigate for WSLP swamp impacts.

<u>Attachment 1</u>

Interaction between Maurepas Swamp Project and WSLP Reaches -111, -112 and -113

Response to email request from Patrick sent 1-25-21
Version 1
CPRA provided to USACE 2-2-21

WSLP Design Changes

<u>I-Wall vs Levee</u>

The proposed Project ROW from River Road to the Canadian National Railroad (CN RR) is 300-feet (ft) wide, based on existing agreements with the owners of the industrial facility (tank farm). The width extends from the ROW line along Marathon Petroleum's property on the west side to the back property line of the residents along Marigold Street. The residential property line is a "hard" boundary that cannot be extended to the east without the taking of developed private property. The WSLP Project could fit a full levee section, built to the 2070 design elevation, within the area between the Marathon Petroleum and residential properties. However, the construction of the Maurepas Conveyance Channel and guide levees greatly restricts the area within which the WSLP flood protection can be constructed. To continue the line of flood protection, the WSLP Project design has been revised from a full levee section to a short levee section with a 4-ft high I-wall, constructed to the 2070 design elevation.

<u>Construction of Stability Berm</u>

The width available for construction in the area between CN RR and the Kansas City Southern Railroad (KCS RR) is also defined on the west side by the Marathon Petroleum ROW line. On the east side, the residential properties are set-back about 200-ft, providing ample room to install a full levee section. However, because the Maurepas Conveyance Channel will be constructed adjacent to the levee on the west side, provision must be made for levee stability. Preliminary geotechnical engineering stability analyses have been run to determine the requirements to meet the stability factors of safety (FOS). A stability berm 55-ft wide was determined to be necessary to provide the required FOS. The stability berm would be constructed from the CN RR to the tie-in at the USACE Pump Station Complex, a distance of approximately 9300-ft (1 ¾ miles).

[Note: The cost of the stability berm is shared between the two projects, as described below.]

<u>Impact at Crossings</u>

At the River Road crossing, the WSLP floodgate installation will have to be coordinated with overall phasing of the Maurepas multi-phase construction process. At the CN RR, the WSLP floodgate is installed at an angle to the tracks to accommodate the Maurepas Project features. The floodgate could be installed more perpendicular to the railroad track, thus making it shorter and less expensive, if the WSLP features alone were constructed. At the KCS RR crossing, the MSP includes installation of a bridge, which has to be raised 1.15-ft. That will require that the floodgate crossing will have to be slightly elevated as well. The raising of Airline Highway to the design elevation is a requirement of the WSLP Project, the construction of the MSP will have minimal to no impact on that work.

Impact at Pump Station Complex

The original proposal for the WSLP Pump Station complex involved bypass gravity drainage as well as the pump station discharge into the existing Hope Canal. The construction of the Maurepas Conveyance Channel tie-in to the Hope Canal routes the eastern guide levee across the existing canal. Thus, the construction of the Maurepas Project requires a change in the discharge routing of both the gravity and pumped flow streams. To accommodate this several changes were made in the Pump Station Complex design: 1) a wing-wall was added to prevent discharge from flowing west, 2) a training dike was added to route the discharge to the northeast, 3) the Environmental Canal was upsized to increase its flow carrying capacity, 4) a bridge over the existing Hope Canal was added to enable access to the MSP eastern guide levee, 5) the area between the wing-wall\training dike was designed to be graded and backfilled, and 6) an access road from the MSP guide levee was added to provide access to the existing LDWF north-south road into the swamp.

Project Synergies

Roadway Detour Cost Sharing

At each of the roads and railroads, the costs of constructing the detours to bypass traffic would be shared by the two projects. At River Road, the roadway will be temporarily rerouted to the south to enable construction of the Maurepas culverts under the roadway as well as the WSLP pilasters and other features immediately adjacent to the road to occur. At Airline Highway, the four lanes of traffic will be diverted to one side for the first phase of construction and to the opposite side for the second phase. The lane shifts will allow both the Maurepas Culverts and the WSLP Project roadway raise to occur simultaneously.

Railroad Shoofly and Flagger Cost Sharing

At both the CN RR and the KCS RR, a shoofly will be constructed to maintain rail traffic operations during construction of both crossings. Removal of the rails will allow the Maurepas culverts at the CN RR and bridge at the KCS RR to be constructed. It will also allow the gated crossings of the WSLP Project to be constructed at both locations during the respective train traffic rerouting. Thus, the two projects will share the costs of the shoofly construction a significant savings for the WSLP Project. Further, during all railroad outages, the costs for flaggers will also be shared, which is also substantial.

Stability Berm Cost Sharing

The stability berm for the levee section is only required because of the adjacent Maurepas Conveyance Channel. However, the WSLP flood protection levee now serves for what was previously a smaller guide levee for the Conveyance Channel. Therefore, the MSP is sharing the cost for half of the stability berm construction because of the dual use of the WSLP levee.

Other Items being Cost-Shared

Both projects benefit from the following items:

- Geotechnical investigations,
- Pile load tests,
- Truck washdown racks,
- Temporary access roads, and
- Staging and lay-down areas

Additional items that both projects may benefit from include:

- Mobilization/Demobilization costs, if the contracts are divided into reaches by location,
- Possible sharing of temporary and permanent easements
- Land rights research efforts

Summary of the Maurepas Swamp Project Benefits and Impacts

Implementation and operation of the MSP would result in net benefits to swamp, but net impacts to BLH of -29.12 AAHUs (see Table 26).

Table S-1. Summary of MSP Swamp Benefits/Impacts under the Intermediate Sea Level Rise scenario.

Maurepas Diversion Benefits (Intermediate SLR)	Public + Private Land		Public Land ONLY	
	Closed Canopy (AAHUs)	Trans Canopy (AAHUs)	Closed Canopy (AAHUs)	Trans Canopy (AAHUs)
Primary Benefit Area	376.17	446.56	260.56	374.09
Secondary Benefit Area	88.03	344.01	83.95	324.20
Tertiary Benefit Area	49.16	177.87	48.18	148.43
Subtotals	513.36	968.44	392.69	846.72
TOTALS		1481.80		1239.41
Construction Impacts		-52.39		-52.39
Net Project AAHUs		**1,429.41**		**1,187.02**

South of I-10 Wetland Value Assessment Project Information Sheet

Maurepas Swamp Project - South of I-10 Impact Areas
WVA Project Information Sheet

Dec. 16, 2021

Swamp Impact Areas

The Maurepas Swamp Project (MSP) would enlarge Hope Canal and construct guide levees on either side, extending from near the Mississippi River to just north of I-10. This would impact drainage as the swamps adjoining Hope Canal drain to the north primarily via Hope Canal. The MSP would install 16 lateral relief valves (gated 20" diameter culverts) on each side of the Canal between Hwy 61 and I-10 to provide drainage and allow river water introduction. These culverts would be open during non-diversion operation periods to provide drainage, but would be closed during diversion operations to preclude flooding adjoining swamps. Annually, the culverts would be opened twice for a duration of one week, during the last week of a diversion operation event to allow introduction of Mississippi River water into those adjoining swamps.

Delft modeling was conducted to demonstrate FWP project impacts to drainage following a 2-yr rainfall event (5.1 inches per New Orleans precip data). Using model results, differences between FWOP and FWP water surface elevations (WSE) were mapped to help identify areas of impact. Impact areas occur west of LA641, between LA641 and Hope Canal (a low elevation swamp and high elevation swamp), and east of Hope Canal (Figure 1). Acreage by habitat type are listed in Table 1.

Figure 1. Map illustrating the locations of south I-10 MSP impact areas.

Table 1. Acreage of south I-10 impact areas.

Habitat Type	West of LA641	Low Elev.Zone Btn LA641 and Hope Canal	High Elev. Zone Btn LA641 and Hope Canal	East of Hope Canal
Closed Canopy Swamp	738	1,203	835	2,717
Transitional Swamp	447	1,085	488	2,305
BLH	-	471	825	534
Marsh	138	605	725	262
Water	-	4	33	976
TOTAL	1,323	3,369	2,906	6,794

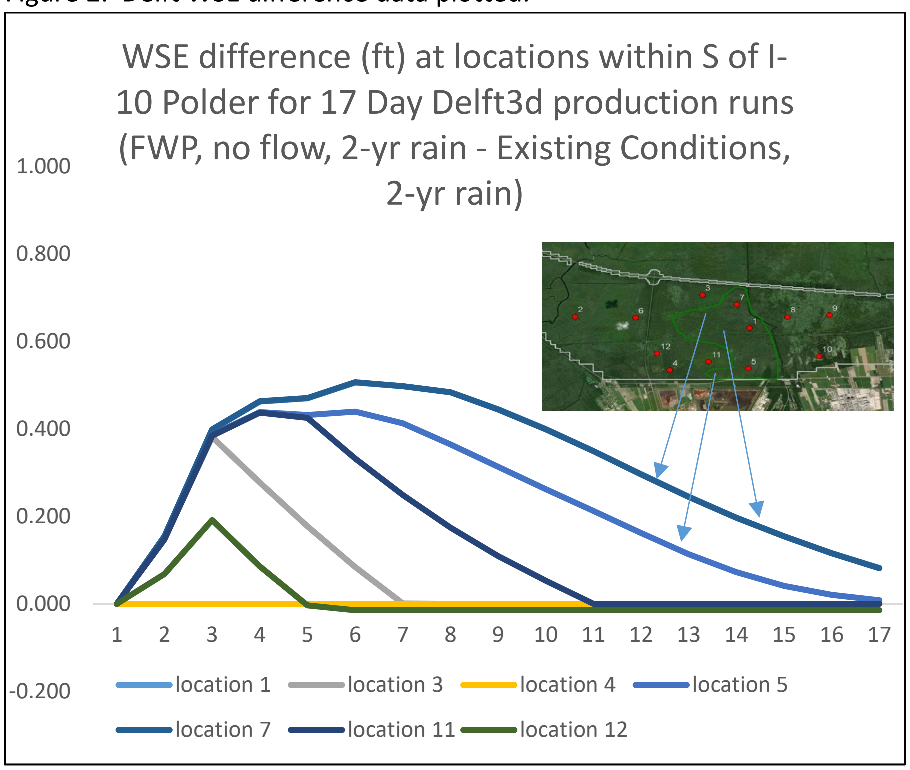
Calculation of FWP annual average WSE increase

The modeled 5.1 inch rain event is equivalent to the average monthly New Orleans rainfall during months the diversion typically would not be operated (Table 2). During the diversion operation months, the average monthly rainfall of 5.6 inches is 110% of the modeled rainfall amount (5.1 inches). Because the modeling was conducted for a 17-day period, the area under the curve was calculated and then applied to a 30 day period to estimate FWP WSE increase for a month at the various model output locations (Figure 2). The same process was conducted for model results during months when the diversion was operating (when LRVs were closed, and when the higher head north of I-10 retards drainage through the culverts under I-10. For those months, the calculated monthly WSE increase was multiplied by 110% since the average monthly precipitation is greater during those months. The colored columns in Table 2 shows the monthly WSE values, and the calculation of average annual WSE increase values.

Table 2. Average monthly precipitation and calculation of average annual WSE increases.

Monthly Average FWP WSE Increases						
Month	**Low** WSE Incr. (ft)	**High** WSE Incr. (ft)	**East** WSE Incr. (ft)	**West** WSE Incr. (ft)	**BLH** West of Hope WSE Incr. (ft)	**BLH** East of Hope WSE Incr. (ft)
Jan	0.696	0.184	0.237	0.236	0.326	0.237
Feb	0.696	0.184	0.237	0.236	0.326	0.237
Mar	0.696	0.184	0.237	0.236	0.326	0.237
Apr	0.116	0.031	0.002	0.018	0.072	0.002
May	0.696	0.184	0.237	0.236	0.326	0.237
Jun	0.696	0.184	0.237	0.236	0.326	0.237
Jul	0.116	0.031	0.002	0.018	0.072	0.002
Aug	0.116	0.031	0.002	0.018	0.072	0.002
Sep	0.116	0.031	0.002	0.018	0.072	0.002
Oct	0.116	0.031	0.002	0.018	0.072	0.002
Nov	0.116	0.031	0.002	0.018	0.072	0.002
Dec	0.116	0.031	0.002	0.018	0.072	0.002
Ave =	**0.36**	**0.09**	**0.10**	**0.11**	**0.18**	**0.10**

Figure 2. Delft WSE difference data plotted.



Calculation of site inundation

CRMS 59 and 5373 are assumed to represent the Low, High, and East swamps. CRMS 39 is assumed to represent the west swamp. Average site inundation was calculated by subtracted the substrate elevation from the ave WSE over the last 5 years. Using the RSLR estimates from the West End Blvd tide gage, FWOP inundation was calculated for each CMRS station. For the areas represented by CRMS 59 and 5373, the FWOP inundation values from each of those CRMS stations were averaged to obtain the area average FWOP inundation. FWP inundation was calculated by adding the with-project additional WSE increases (Table 2) to the average FWOP inundation amounts beginning at TY1. Accordingly to CRMS 5373 data, during low water events, the WSE may fall roughly 1.0 feet below the swamp floor. During the last 5 years, the 95 percentile value of WSE below swamp at CRMS 5373 site = 0.783 ft. When this value is added to the baseline average site submergence value, one obtains the 100% submergence value. The year the site is submerged to that extent, a TY was established during which various tree canopy loss rate was increased, and dbh growth rates reduced (as discussed below). For the west swamps, CRMS 39 data shows that the area is already beyond the 100% submergence point.

Selection of Target Years

In addition to the standard TYs 0, 1, and 50, additional TYs were established at the 100% inundation year, the 3.0’ ft submergence year (High SLR scenario only), and the year immediately preceding a canopy cover of 33% or less, and the first year canopy cover drops to 33% or lower (Table 3).

Table 3. Summary of TYs in swamp WVAs.

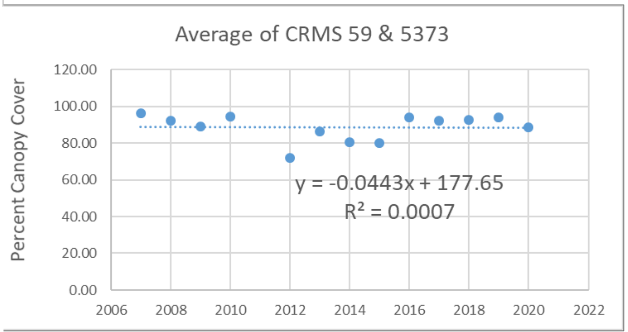
single underline = 100% submergence TY, double underline = 3.0 ft submergence TY

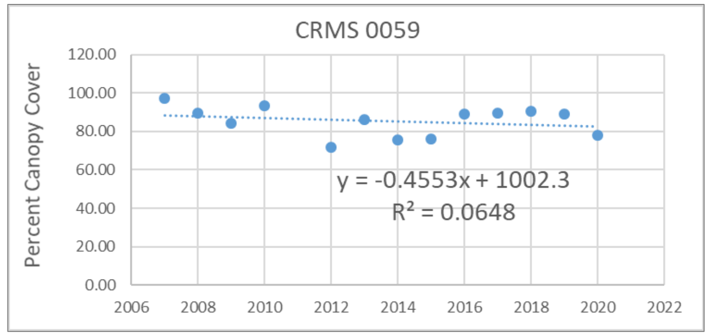
FWOP TYs (Low SLR)		**FWP TYs (Low)**	
Low Swamp FWOP	0 ,1, 50	Low Swamp FWP	0, 1, 31, 50
High Swamp FWOP	0 ,1, 50	High Swamp FWP	0 ,1, 50
West Swamp FWOP TYs		West Swamp FWOP	
Trans Canopy	0, 1, 33, 34, 50	Closed Canopy	0, 1, 30, 31, 50
Closed Canopy	0, 1, 46, 47, 50	Trans Canopy	0, 1, 43, 44, 50
East Swamp FWOP	0, 1, 50	East Swamp FWP	0, 1, 50
FWOP TYs (INT SLR)		**FWP TYs (INT)**	
Low Swamp FWOP	0 ,1, 34, 50	Low Swamp FWP	0, 1, 18, 50
High Swamp FWOP	0 ,1, 34, 50	High Swamp FWP	0, 1, 30, 50
West Swamp FWOP TYs		West Swamp FWOP	
Trans Canopy	0, 1, 33, 34, 50	Trans Canopy	0, 1, 30, 31, 50
Closed Canopy	0, 1, 46, 47, 50	Closed Canopy	0, 1, 43, 44, 50
East Swamp FWOP	0, 1, 34, 50	East Swamp FWP	0, 1, 30, 50
FWOP TYs (High SLR)		**FWP TYs (High SLR)**	
Low Swamp FWOP TYs			
Trans Canopy	0 ,1, 16, 39, 50	0, 1, 8, 33, 40, 41, 50	
Closed Canopy	0 ,1, 16, 39, 50	0, 1, 8, 33, 50	
High Swamp FWOP			
Trans Canopy	0, 1, 16, 39, 50	0, 1, 14, 38, 45, 46, 50	
Closed Canopy	0, 1, 16, 39, 50	0, 1, 14, 38, 50	
West Swamp FWOP TYs			
Trans Canopy	0, 1, 31, 32, 50	0, 1, 28, 29, 50	
Closed Canopy	0, 1, 31, 36, 37, 50	0, 1, 28, 33, 34, 50	
East Swamp FWOP			
Trans Canopy	0, 1, 16, 39, 50	0, 1, 13, 37, 44, 45, 50	
Closed Canopy	0, 1, 16, 39, 50	0, 1, 13, 37, 50	

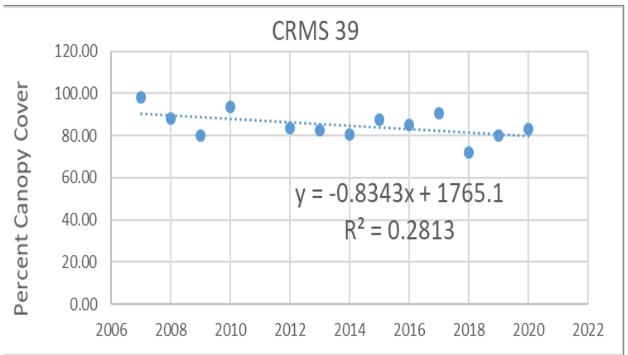
V1 Canopy Cover

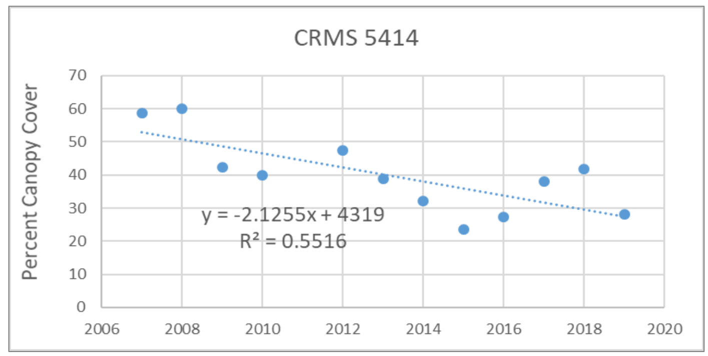
For the Low, High, and East swamp represented by CRMS 59 and 5373, the average canopy change rate of -0.0443%/yr was applied to the predicted percent canopy at 2025 using the equations shown on the plot (Figure 3). At the 100% inundation year, the canopy rate was changed to that of CRMS 59 (-0.455%/yr). For the West swamp represented by CRMS 39, the rate of -0.834%/yr was applied to the predicted percent canopy at 2025. Under the High SLR scenario, if the 3.0 ft submergence year was reached, then the canopy rate was changed to the CRMS 5414 rate of -2.126%/yr (all swamp areas). Under FWP, the same rates were applied, however, because of the FWP WSE increase, the 100% submergence TY occurs earlier. Therefore, the TY50 value is less under FWP vs FWOP. Canopy cover values are listed in Appendix A.

Figure 3. Canopy cover data used in swamp WVAs.









V2 Dbh and Dbh growth rates

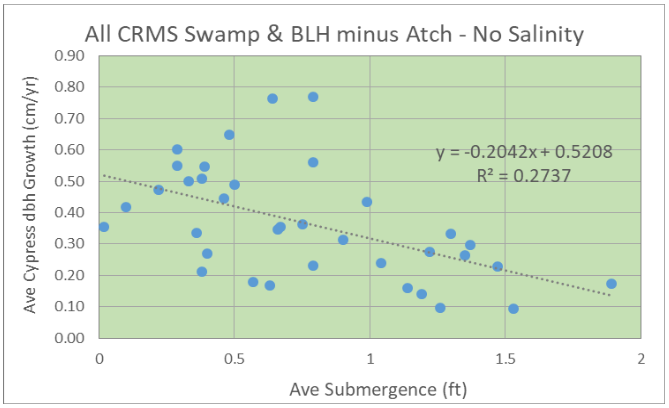
The CRMS 59 and 5373 weighted average cypress dbh growth rate = 0.392 cm/yr (above the middle tier average rate of 0.329 cm/yr). This rate was assumed to slow to 0.275 cm/yr (average of the middle and low tier rates) at the 1.0 ft submergence year (TY0). At the 100% subm year, the rate was assumed to be zero. These rates were applied to the 2018 observed weighted ave cypress dbh of 43.11 cm. Dbh values were calculated in cm, then converted to inches for entry into the WVA spreadsheets.

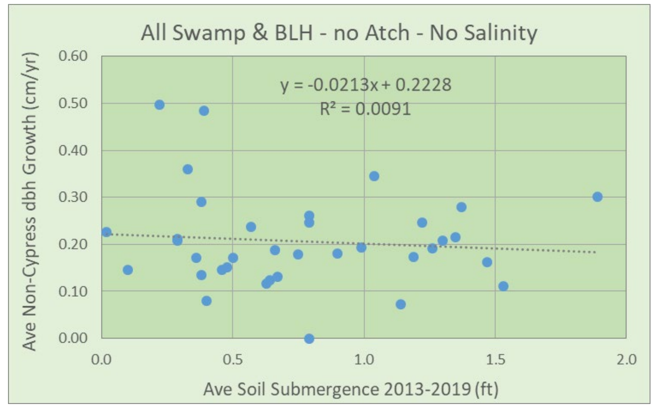
The CMRS 59 and 5373 weighted average non-cypress dbh growth rate = 0.250 cm/yr (greater than the average top tier value of 0.225 cm/yr). At the 1.0 ft submergence year (TY0), this rate was assumed to slow to 0.180 cm/yr (weighted ave of top and middle tier). At the 100% subm TY, the rate was assumed to be zero. FWOP, these rates were applied to the 2018 observed weighted ave non-cypress dbh of 24.42 cm. Dbh values were calculated in cm, then converted to inches for entry into the WVA spreadsheets.

For the West swamp represented by CMRS 39, the cypress dbh growth rate 0.296 cm/yr was applied throughout the project life under FWOP. Similarly, the CRMS 39 non-cypress dbh growth rate of 0.275 cm/yr was applied throughout the project life under FWOP.

Under FWP, dbh growth rate in areas not receiving river water inputs were reduced to account for FWP WSE increase. Previously prepared submergence vs dbh growth rate plots were used for this (Figure 4). WVA input values are provided in Appendix A.

Figure 4. Submergence vs Dbh growth rate plots for cypresss and non-cypress (from CRMS data).





See Table 4 for the FWOP and FWP dbh growth rates used for south I-10 swamp areas (cypress/non-cypress).

Table 4. FWOP and FWP dbh growth rates (cypress/non-cypress).*

	FWOP	**FWOP**	**FWOP**	**FWP**	**FWP**	**FWP**
	2018	Post 1' subm	Post 100% subm	2018	Post 1' subm	Post 100% subm
Swamp	Dbh growth	Dbh growth	Dbh growth	Dbh growth	Dbh growth	Dbh growth
Area	cm/yr	cm/yr	cm/yr	cm/yr	cm/yr	cm/yr
West	0.296/0.275	0.296/0.275	0.296/0.275*	0.296/0.275	0.274/0.273	0.274/0.273*
Low	0.392/0.250	0.275/0.180	0/0	0.392/0.250	0.275/0.180	0/0
High	0.392/0.250	0.275/0.180	0/0	0.392/0.250	0.257/0.178	0/0
East	0.392/0.250	0.275/0.180	0/0	0.392/0.250	0.275/0.180	0/0

* West swamp at > 100% subm for all project life but at 3' subm, dbh growth = 0

<u>V2 Basal Area</u>

CRMS data from south I-10 stations reveal relatively high dbh growth rates and healthy canopies. Therefore, no basal area reduction factors were applied, except when subm > 3.0 ft, an annual basal area change of -1.258 ft^2/ac (calc by multiplying the CMRS 5414 observed non-cypress BA change of -1.31%/y by the non-cypress 2018 predicted CRMS BA of 95.8 ft2/ac). Given there were no observed CRMS cypress BA decreases, the cypress BA change rate was calc as 50% of the non-cypress rate. This change rate was applied at the 3' subm TY. With the exception of this High SLR scenario adjustment, basal area values were determined by calculating the percent dbh change relative to the observed 2018 dbh, and multiplying it to the 2018 observed basal area. Observed 2018 BA values are shown in Table 5. WVA input values are listed in Appendix A.

Table 5. Observed 2018 Basal Area values.

	CRMS 59 & CRMS 5373 (ft^2/ac)	CMRS 39 (ft^2/ac)
Cypress	176.1	162.3
Non-Cypress	95.8	123.4

V3 Water Exchange

Water exchange was considered low for all cases FWOP and FWP, except for FWP at the East swamp. Because FWP introduced river water would efficiently flow eastward toward Mississippi Bayou and the Reserve Relief Canal, the SI for this value was hand-entered as the average between the low and moderate Sis (for both the semi-permanent flooding and permanent flooding conditions).

V3 Flooding Duration

Flooding duration usually begins as semi-permanent, but becomes permanent once the 100% inundation TY is reached. However, the West swamp is permanently flooding beginning in TY0.

V4 Salinity

The mean high growing season salinity was calculated for CRMS 59 and CRMS 5373. Those values were averaged to obtain an average MHGS salinity = 0.22 ppt. It was assumed that the volume of water due to RSLR would be at 1.0 ppt. The resulting salinity was then calculated for each TY. Under FWP, it was assumed that the diversion would maintain existing salinities, except during the month of October, when salinity would be half that of FWOP October salinities. FWP MHGS salinity was thus calculated using the FWP October estimated salinity. WVA values are listed in Appendix A.

V5 Forest Size

Forest size was determined via GIS analysis using the latest available imagery.

V6 Land Use

Using 2019 land use data, the land use WVA inputs were prepared via GIS analysis.

V7 Disturbance

Using 2019 land use data, the disturbance WVA inputs were prepared via GIS analysis.

WVA Results

Table 6 provides the results of south I-10 swamp WVAs.

Table 6. WVA results for south I-10 swamps.

South I-10 Swamp WVA Results	updated 8-Dec-2021					
	LOW SLR		**INT SLR**		**HIGH SLR**	
Swamp Location	**Trans Canopy AAHUs**	**Closed Canopy AAHUs**	**Trans Canopy AAHUs**	**Closed Canopy AAHUs**	**Trans Canopy AAHUs**	**Closed Canopy AAHUs**
Low Elevation Swamp	-50.20	-62.92	-54.92	-55.80	-167.65	-71.86
High Elevation Swamp	-0.27	-0.52	-2.15	-4.68	-26.57	-29.08
West Swamp	-16.70	-27.57	-14.74	-23.94	-14.64	-24.09
East Swamp	13.29	17.62	1.64	0.49	-136.87	-87.6
Swamp Totals		**-127.27**		**-154.1**		**-558.36**

South I-10 BLH Impact Areas

West of Hope Canal BLH

Using the Corps-certified BLH WVA model version 1.2, a WVA was run for South of I-10 BLH west of Hope Canal, and another WVA run for South of I-10 BLH east of Hope Canal. As described for the South I-10 swamp WVAs, the FWP average annual WSE increase for west of Hope Canal BLH was calculated as 0.18 ft (using modeling output points 5 and 11 located within the BLH zone – see file: WSE Diff Calc_19-Dec-21.xlsx). The baseline FWOP submergence was determined using CRMS 59 and 5373. Predicted RSLR per the West End Blvd gage was applied to the CMRS submergence to predicted FWOP submergence. FWP submergence was calculated by adding the FWP WSE increase to the FWOP submergence every year beginning in TY1. At the 100% submergence year (Table 7), the dbh growth rate was reduced (see V2 discussion below) given that prolonged submergence causes stress of most BLH species.

Table 7. West BLH 100% submergence TYs.

	FWOP	FWP
Low SLR	none	45
Int SLR	34	26
High SLR	16	12

V1 Tree Species Association

Since there are no BLH CRMS stations in the area, the CRMS 59 non-cypress and non-tupelo species were used as a surrogate. Species consist almost entirely of red maple and green ash (soft mast species). This is consistent with observations of BLH seen immediately north of Hwy 61. It is assumed that hard mast species will not recruit into this environment. Accordingly, the V1 is currently that of a Class 1, and assumed to remain such under both FWOP and FWP.

V2 Stand Maturity

CRMS 59 data was used to calculate an average 2018 dbh of 7.4 inches and an average basal area of 37.3 ft^2/ac for BLH species > 6 inches dbh. Using the FWS's In-Growth spreadsheet, growth rates for tupelo were used as they can be adjusted to account for differing conditions. Accordingly, the pre-100% submergence growth rate adjustment factor of -1.79 was used, and post-100% submergence the -2.06 factor was used (with default mortality). Dbh values used are shown in Table 8.

Table 8. West BLH dbh values.

	FWOP				FWP		
	TY 0	TY 1		TY 50	TY 1		TY 50
Low SLR	7.9	8.0		11.7	8.0	TY45 - 11.4	11.6
Int SLR	7.9	8.0	TY34 - 10.5	11.3	8.0	TY26 - 9.9	11.1
High SLR	7.9	8.0	TY16 - 9.1	10.8	8.0	TY12 - 8.8	10.7

V3 Understory-Midstory

Herbaceous cover percent values from west of Hope Canal swamp were used for BLH understory. Midstory values were assumed. Both midstory and understory are assumed to gradually decrease with increasing RSLR and due to FWP WSE increase (Tables 9 & 10).

Table 9. West BLH Understory values.

	FWOP	FWP

	TY 0	TY 1		TY 50	TY 1		TY 50
Low SLR	32	32		27	32	TY45 - 27	26
Int SLR	32	32	TY34 - 29	26	32	TY26 - 28	25
High SLR	32	32	TY16 - 29	23	32	TY12 - 29	22

Table 10. West BLH Midstory values.

	FWOP				FWP		
	TY 0	TY 1		TY 50	TY 1		TY 50
Low SLR	20	20		16	20	TY45-16	15
Int SLR	20	20	TY34-17	15	20	TY26-17	14
High SLR	20	20	TY16-18	13	20	TY12-18	12

V4 Hydrology

Flow-Exchange is low under FWOP and FWP for all TYs. Flooding duration is initially semi-permanent, but becomes permanent once the 100% submergence TY is reached (see Table 10).

V5 Forest Size

The size of contiguous forest is greater than 500 acres (Class 5) for FWOP and FWP for all years.

V6 Surrounding Land Use

Per land cover data analysis, forest/marsh = 83%, pasture = 1%, agriculture/water = 7%, and developed = 9%. These percents are assumed to remain unchanged FWOP and FWP, for all TYs.

V7 Disturbance

Per analysis of land cover data, a weighted average Suitability Index (SI) of applicable distance classes and disturbance types was calculated as 0.849. This SI was assumed to remain unchanged FWOP and FWP, for all TYs.

WVA Results for West of Hope Canal indirect BLH Impacts:

SLR Scenario	West of Hope C. (AAHUs)
Low	**-14.21**
Int	**-4.86**
High	**-6.07**

East of Hope Canal BLH

Using the Corps-certified BLH WVA model version 1.2, a WVA was run for South of I-10 BLH west of Hope Canal, and another for South of I-10 BLH east of Hope Canal. As described for the South I-10 swamp WVAs, the FWP average annual WSE increase for east of Hope Canal BLH was calculated as 0.10 ft (using modeling output points 8 and 9 - see file: WSE Diff Calc 19-Dec-21.xlsx). The baseline FWOP submergence was determined using CRMS

59 and 5373. Predicted RSLR per the West End Blvd gage was applied to the CMRS submergence to predicted FWOP submergence. FWP submergence was calculated by adding the FWP WSE increase (0.10 ft) to the FWOP submergence every year beginning in TY1. At the 100% submergence year (Table 11), the dbh growth rate was reduced (see V2 discussion below) given that submergence causes stress of most BLH species.

Table 11. East BLH 100% submergence TYs.

	FWOP	FWP
Low SLR	none	none
Int SLR	34	30
High SLR	16	13

V1 Tree Species Association

Since there are no BLH CRMS stations in the area, the CRMS 59 non-cypress and non-tupelo species were used – those species consist almost entirely of red maple and green ash (soft mast species). This is consistent with observations of BLH seen immediately north of Hwy 61. It is assumed that hard mast species will not recruit into this environment. Accordingly, the V1 is currently that of a Class 1, and assumed to remain such under both FWOP and FWP.

V2 Stand Maturity

CRMS 59 data was used to calculate an average 2018 dbh of 7.4 inches and an average basal area of 37.3 ft^2/ac for BLH species > 6 inches dbh. Using the FWS's In-Growth spreadsheet, growth rates for tupelo were used as they can be adjusted to account for differing conditions. Accordingly, the pre-100% submergence growth rate adjustment factor of -1.79 was used, and post-100% submergence the -2.06 factor was used (with default mortality). Dbh values used are shown in Table 12.

Table 12. East BLH dbh values.

	FWOP				FWP		
	TY 0	TY 1		TY 50	TY 1		TY 50
Low SLR	7.9	8.0		11.7	8.0		11.7
Int SLR	7.9	8.0	TY34 - 10.5	11.3	8.0	TY30 - 10.1	11.2
High SLR	7.9	8.0	TY16 - 9.1	10.8	8.0	TY13 - 8.9	10.7

V3 Understory-Midstory

Percent herbaceous cover values from west of Hope Canal swamp was used for BLH understory. Midstory values were assumed. Both midstory and understory area assumed to gradually decrease with increasing RSLR and due to FWP WSE increase (Tables 13 & 14).

Table 13. West BLH Understory values.

	FWOP				FWP		
	TY 0	TY 1		TY 50	TY 1		TY 50
Low SLR	32	32		27	32		26
Int SLR	32	32	TY34 - 29	26	32	TY30 - 28	25
High SLR	32	32	TY16 - 29	23	32	TY13 - 29	22

Table 14. West BLH Midstory values.

	FWOP				FWP		
	TY 0	TY 1		TY 50	TY 1		TY 50
Low SLR	20	20		16	20		15
Int SLR	20	20	TY34-17	15	20	TY30-17	14
High SLR	20	20	TY16-18	13	20	TY13-18	12

<u>V4 Hydrology</u>
Flow-Exchange is low under FWOP and FWP for all TYs. Flooding duration is initially semi-permanent, but becomes permanent once the 100% submergence TY is reached (see Table 11).

<u>V5 Forest Size</u>
Per land cover analysis, a weighted SI of 0.980 was calculated for current conditions. This remains unchanged for FWOP and FWP for all years.

<u>V6 Surrounding Land Use</u>
Per land cover data analysis, a current FWOP weighted ave SI of 0.679 was calculated. For FWP, a weighted ave SI of 0.668 was calculated. These values are assumed to remain unchanged for all TYs.

<u>V7 Disturbance</u>
Per analysis of land cover data, a weighted average Suitability Index (SI) of applicable distance classes and disturbance types was calculated as 0.380. This SI was assumed to remain unchanged FWOP and FWP, for all TYs.

<u>WVA Results for East of Hope Canal indirect BLH Impacts</u>:

SLR Scenario	East of Hope C. (AAHUs)
Low	**-0.82**
Int	**-1.85**
High	**-1.89**

South I-10 Marsh Indirect Impacts

Marshes south of I-10 consist primarily of small scattered marshes located amidst the swamp forest, on powerline right-of-ways, or in areas where the swamp canopy is less than the 33% cover threshold needed to classify an area as swamp (Figure @@@@@). Water areas located within the swamps and marshes, were also totaled and combined with the marsh to calculate a total project area for WVA purpose (Table 15).

Figure @@@@@. Location of indirectly impacted marshes located south of I-10

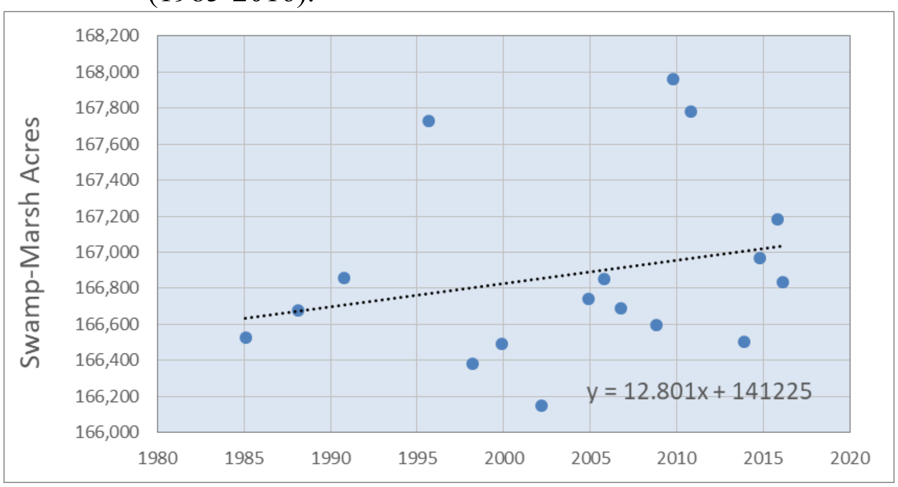
Rather than conduct separate WVA runs for marshes within West, Low, High, and East swamp areas, it was decided to combine all the marsh area into a single WVA. To determine the FWP WSE increase, a weighted average value was calculated using the marsh acreages and associated WSE increases for each respective area.

Table 15. South I-10 marsh & water acreages, plus calculation of FWP WSE increase.

	TY1 Water ac	TY1 Marsh ac	FWP WSE Incr. (ft)	WSE x acres		
Low	4.23	604.91	0.36	217.7676		
High	33.36	724.56	0.09	65.2104		
West	0	138.11	0.11	15.1921		
East	976	262	0.10	26.24		
	1,013	1,730	0.66	324.4101		
2,743		63%			0.19	= weighted ave FWP WSE Incr. (ft)

USGS land acreage data for the subject area shows no land loss within the area (Figure 1).

Figure ____. USGS land loss data for the area (polygon 218) show a 0.01%/year gain rate (1985-2016).



The gain rate of 0.01% per year is calculated as the average annual gain of 12.81 acres/yr divided by the 1985 predicted acreage of 166,636 acres. Under the low SLR scenario, it is assumed that there is no land loss or gain. Under the intermediate and high sea level rise scenarios, increases in relative sea level rise (RSLR) cause marsh loss rates to gradually increase in proportion to submergence. Future RSLR is calculated per Corps Engineering Circular **EC 1165-2-212.**

FWP target years of 0, 1, and 50 were used for both FWOP and FWP.

V1 Percent Marsh:
Under the low SLR scenario, both the FWOP and FWP V1 values are assumed to remain at the baseline 63% throughout the project life. See Table 16 for V1 values.

Table 16. Marsh WVA V1 values.

	FWOP	FWOP	FWOP	FWP	FWP	FWP
	TY0	TY1	TY50	TY0	TY1	TY50
Low SLR	63%	63%	63%	63%	63%	63%
Int SLR	61%	61%	50%	61%	61%	49%
High SLR	55%	54%	10%	55%	54%	5%

V2 Submerged Aquatic Vegetation:

No observed SAV data was available for these areas. Given that many of the open water areas are covered by duckweed, it was assumed that percent SAV was zero for all years FWOP and FWP.

V3 Marsh-Water Interspersion:

Table 17. Marsh WVA Interspersion values.

	FWOP	FWOP	FWOP	FWP	FWP	FWP
	TY0	TY1	TY50	TY0	TY1	TY50
Low SLR	Class2-10% Class3-90%	Class2-10% Class3-90%	Class2-10% Class3-90%	Class2-10% Class3-90%	Class2-10% Class3-90%	Class2-10% Class3-90%
Int SLR	Class2-10% Class3-90%	Class2-10% Class3-90%	Class3-100%	Class2-10% Class3-90%	Class2-10% Class3-90%	Class3-100%
High SLR	Class3-100%	Class3-00%	Class4-10% Class5-90%	Class3-100%	Class3-100%	Class4-8% Class5-92%

V4 Shallow Open Water:

Water depth measurements were not available. Therefore assumed values were used. V4 was assumed to decrease over time due to RSLR (Table 18).

Table 18. Marsh WVA V4 values.

	FWOP	FWOP	FWOP	FWP	FWP	FWP
	TY0	TY1	TY50	TY0	TY1	TY50
Low SLR	70	70	60	70	70	60
Int SLR	70	70	55	70	70	55
High SLR	70	70	20	70	70	20

V5 Salinity:

Since the majority of south I-10 water acres are located east of Hope Canal, salinity values are based on the CRMS 59 2021 growing season salinity of 0.13 ppt. Assuming a 1.0 ppt average salinity associated with RSLR, future salinities were calculated (Table 19).

Table 19. Marsh WVA salinity values.

	FWOP	FWOP	FWOP	FWP	FWP	FWP
	TY0	TY1	TY50	TY0	TY1	TY50
Low SLR	0.2	0.2	0.5	0.2	0.2	0.2
Int SLR	0.2	0.2	0.6	0.2	0.2	0.2
High SLR	0.2	0.3	0.8	0.2	0.2	0.3

V6 Fish Access:

Marsh and water areas are interspersed amidst the swamp. In many cases, there are no bayous or channels connecting those marsh/water areas to Lake Maurepas. Because there is little or no tidal exchange in these areas, together with the highly organic substrate, and solid duckweed coverage in some areas, these areas likely have persistent low or no dissolved oxygen concentrations. In consultation with the NMFS, a 3,000 foot buffer along Hope Canal, Mississippi Bayou, and the Reserve Relief Canal was assumed to be the extent of swamps/marshes that would support use by estuarine dependent species, and/or exchange detritus with the tidal system beyond the immediate project area. Consequently, 18% of the project area has fish access (see below calculations).

	Marsh	Water	Total		TOTAL Project area (ac)
Diversion canal buffer	60.16	156.37	216.53	8%	2,743
Miss B & RR Canal buffer	118.91	159.19	278.10	10%	
		no fish access =		82%	

Under FWOP, the 18% of the project area within the buffer areas has an access rating of 1.0. The remaining 82% has a FWOP & FWP rating of 0.0001. Under FWOP and FWP, the 10% of the area within the Mississippi Bayou and Reserve Relief Canal buffer remains at an access value of 1.0. FWOP the Hope Canal buffer has a access rating of 1.0. The FWP guide levees and LRVs along the Hope Canal reduces the access ratings within that buffer. Given that the LRVs remain closed for 5 months of the year, and are open for 7 months, a weighted average structure rating of 0.375 was calculated per table below using the open culvert and flapgated culvert structure ratings. By applying these assumptions, the FWOP V6 = 0.18, and the FWP V6 = 0.13.

LRV Culvert Operation	Months	Str Rating	Mon x SR		
flapgated	5	0.2	1.00		
open	7	0.5	3.5		
			4.50		
				0.375	**= Rating of LRVs**

South I-10 Marsh WVA Results

South I-10 Marsh WVA Results	
Low SLR	-11.87
Intermediate SLR	-19.54
High SLR	-27.85

Appendix A

Swamp WVA Inputs

V1 Canopy Cover - Low SLR:

TY	Low Swamp Area FWOP Closed Canopy Swamp	Low Swamp Area FWOP Trans Canopy Swamp	TY	Low Swamp Area FWP Closed Canopy Swamp	Low Swamp Area FWP Trans Canopy Swamp
0	87.94	63.23	0	87.94	63.23
1	87.90	63.18	1	87.90	63.18
50	85.73	61.01	31	86.16	61.44
			50	77.51	52.79

TY	High Swamp Area FWOP Closed Canopy Swamp	High Swamp Area FWOP Trans Canopy Swamp	TY	High Swamp Area FWP Closed Canopy Swamp	High Swamp Area FWP Trans Canopy Swamp
0	87.94	63.23	0	87.94	63.23
1	87.90	63.18	1	87.90	63.18
50	85.73	61.01	50	85.73	61.01

TY	West Swamp Area FWOP Closed Canopy Swamp	TY	West Swamp Area FWOP Trans Canopy Swamp	TY	West Swamp Area **FWP** Closed Canopy Swamp	TY	West Swamp Area **FWP** Trans Canopy Swamp
0	74.57	0	63.23	0	74.57	0	63.23
1	73.68	1	62.33	1	71.00	1	59.65
46	33.48	33	33.75	43	33.48	30	33.75
47	0	34	0	44	33	31	0
50	0	50	0	50	0	50	0

TY	East Swamp Area FWOP Closed Canopy Swamp	TY	East Swamp Area FWOP Trans Canopy Swamp	TY	East Swamp Area **FWP** Closed Canopy Swamp	TY	East Swamp Area **FWP** Trans Canopy Swamp
0	87.94	0	63.23	0	87.94	0	63.23
1	87.90	1	63.18	1	87.90	1	63.18
50	85.73	50	61.01	50	85.73	50	61.01

V1 Canopy Cover – INT SLR:

TY	Low Swamp Area FWOP Closed Canopy Swamp	Low Swamp Area FWOP Trans Canopy Swamp	TY	Low Swamp Area FWP Closed Canopy Swamp	Low Swamp Area FWP Trans Canopy Swamp
0	87.94	63.23	0	87.94	63.23
1	87.90	63.18	1	87.90	63.18
34	86.03	61.31	18	86.73	62.02
50	78.74	54.03	50	72.16	47.45

TY	High Swamp Area FWOP Closed Canopy Swamp	High Swamp Area FWOP Trans Canopy Swamp	TY	High Swamp Area FWP Closed Canopy Swamp	High Swamp Area FWP Trans Canopy Swamp
0	87.94	63.23	0	87.94	63.23
1	87.90	63.18	1	87.90	63.18
34	86.03	61.31	30	86.20	61.49
50	78.74	54.03	50	77.10	52.38

TY	West Swamp Area FWOP Closed Canopy Swamp	TY	West Swamp Area FWOP Trans Canopy Swamp	TY	West Swamp Area **FWP** Closed Canopy Swamp	TY	West Swamp Area **FWP** Trans Canopy Swamp
0	74.57	0	63.23	0	74.57	0	63.23
1	73.68	1	62.33	1	71.00	1	59.65
46	33.48	33	33.75	43	33.48	30	33.75
47	0	34	0	44	0	31	0
50	0	50	0	50	0	50	0

TY	East Swamp Area FWOP Closed Canopy Swamp	TY	East Swamp Area FWOP Trans Canopy Swamp	TY	East Swamp Area **FWP** Closed Canopy Swamp	TY	East Swamp Area **FWP** Trans Canopy Swamp
0	87.94	0	63.23	0	87.94	0	63.23
1	87.90	1	63.18	1	87.90	1	63.18
34	86.03	34	61.31	30	86.20	30	61.49
50	78.74	50	54.03	50	77.10	50	52.38

TY	Low Swamp Area FWOP Closed Canopy Swamp	Low Swamp Area FWOP Trans Canopy Swamp
0	87.94	63.23
1	87.90	63.18
16	86.82	62.11
39	74.68	56.95
50	51.30	33.57

TY	Low Swamp Area FWP Closed Canopy Swamp	Low Swamp Area FWP Trans Canopy Swamp
0	87.94	63.23
1	87.90	63.18
8	87.18	62.46
33	74.12	49.41
40		34.53
41		0
50	37.99	0

TY	High Swamp Area FWOP Closed Canopy Swamp	High Swamp Area FWOP Trans Canopy Swamp
0	87.94	63.23
1	87.90	63.18
16	86.82	62.11
39	74.68	56.95
50	51.30	33.57

TY	High Swamp Area FWP Closed Canopy Swamp	High Swamp Area FWP Trans Canopy Swamp
0	87.94	63.23
1	87.90	63.18
14	86.91	62.20
38	74.31	49.60
45		34.72
46		0
50	48.81	0

V2 Dbh Inputs – Low SLR:

Middle-Low Swamp Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
50	22	13

Middle-Low Swamp Transitional Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
31	20	11
50	20	11

Middle-Low Swamp Closed Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
50	22	13

Middle-Low Swamp Closed Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
31	20	11
50	20	11

Middle-High Swamp Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
50	22	13

Middle-High Swamp Transitional Canopy		
TY	FWP Cypress dbh (inches)	FWP Tupelo dbh (inches)
0	18	10
1	18	10
50	21	12

Middle-High Swamp Closed Canopy		
TY	**FWOP** Cypress dbh (inches)	**FWOP** Tupelo dbh (inches)
0	18	10
1	18	10
50	22	13

Middle-High Swamp Closed Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
50	21	12

WEST Swamp Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
33	22	14
34	0	0
50	0	0

WEST Swamp Transitional Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
30	21	14
31	0	0
50	0	0

WEST Swamp Closed Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
46	23	15
47	0	0
50	0	0

WEST Swamp Closed Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
43	22	15
44	0	0
50	0	0

East Swamp Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
50	22	13

East Swamp Transitional Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
50	21	12

East Swamp Closed Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
50	22	13

East Swamp Closed Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
50	21	12

V2 Dbh Inputs – INT SLR:

Middle-Low Swamp Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
34	22	13
50	22	13

Middle-Low Swamp Transitional Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
18	20	11
50	20	11

Middle-Low Swamp Closed Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
34	22	13
50	22	13

Middle-Low Swamp Closed Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
18	20	11
50	20	11

Middle-High Swamp Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
34	22	13
50	22	13

Middle-High Swamp Transitional Canopy		
TY	FWP Cypress dbh (inches)	FWP Tupelo dbh (inches)
0	18	10
1	18	10
30	21	12
50	21	12

Middle-High Swamp Closed Canopy		
TY	**FWOP** Cypress dbh (inches)	**FWOP** Tupelo dbh (inches)
0	18	10
1	18	10
34	22	13
50	22	13

Middle-High Swamp Closed Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
30	21	12
50	21	12

WEST Swamp Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
33	22	14
34	0	0
50	0	0

WEST Swamp Transitional Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
30	21	14
31	0	0
50	0	0

WEST Swamp Closed Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
46	23	15
47	0	0
50	0	0

WEST Swamp Closed Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
43	22	15
44	0	0
50	0	0

East Swamp Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
34	22	13
50	22	13

East Swamp Transitional Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
30	21	12
50	21	12

East Swamp Closed Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
34	22	13
50	22	13

East Swamp Closed Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
30	21	12
50	21	12

Middle-Low Swamp Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
16	20	11
39	20	11
50	20	11

Middle-Low Swamp Transitional Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
8	19	11
33	19	11
40	19	11
41	0	0
50	0	0

Middle-Low Swamp Closed Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
16	20	11
39	20	11
50	20	11

Middle-Low Swamp Closed Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
8	19	11
33	19	11
50	19	11

Middle-High Swamp Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
16	20	11
39	20	11
50	20	11

Middle-High Swamp Transitional Canopy		
TY	FWP Cypress dbh (inches)	FWP Tupelo dbh (inches)
0	18	10
1	18	10
14	19	11
38	19	11
45	19	11
46	0	0
50	0	0

Middle-High Swamp Closed Canopy		
TY	**FWOP** Cypress dbh (inches)	**FWOP** Tupelo dbh (inches)
0	18	10
1	18	10
16	19	11
39	19	11
50	19	11

Middle-High Swamp Closed Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
14	19	11
38	19	11
50	19	11

WEST Swamp Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
31	21	14
32	0	0
50	0	0

WEST Swamp Transitional Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
28	21	13
29	0	0
50	0	0

WEST Swamp Closed Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	18	10
1	18	10
31	21	14
36	21	14
37	0	0
50	0	0

WEST Swamp Closed Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	18	10
1	18	10
28	21	13
33	21	14
34	0	0
50	0	0

East Swamp Transitional Canopy		
	FWOP	FWOP
	Cypress	Tupelo
	dbh	dbh
TY	(inches)	(inches)
0	18	10
1	18	10
16	20	11
39	20	11
50	20	11

East Swamp Transitional Canopy		
	FWP	**FWP**
	Cypress	Tupelo
	dbh	dbh
TY	(inches)	(inches)
0	18	10
1	18	10
13	19	11
37	19	11
44	19	11
45	0	0
50	0	0

East Swamp Closed Canopy		
	FWOP	FWOP
	Cypress	Tupelo
	dbh	dbh
TY	(inches)	(inches)
0	18	10
1	18	10
16	20	11
39	20	11
50	20	11

East Swamp Closed Canopy		
	FWP	**FWP**
	Cypress	Tupelo
	dbh	dbh
TY	(inches)	(inches)
0	18	10
1	18	10
13	19	11
37	19	11
50	19	11

Low Swamp

Transitional Canopy		
	FWOP	FWOP
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	187	102
1	188	103
50	224	126

Transitional Canopy		
	FWP	**FWP**
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	187	102
1	188	103
31	206	114
50	206	114

Closed Canopy		
	FWOP	FWOP
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	187	102
1	188	103
50	224	126

Closed Canopy		
	FWP	**FWP**
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	187	102
1	188	103
31	206	114
50	206	114

Transitional Canopy		
	FWOP	FWOP
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	187	102
1	188	103
50	224	126

Transitional Canopy		
	FWP	**FWP**
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	187	102
1	188	103
50	217	123

Closed Canopy		
	FWOP	FWOP
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	187	102
1	188	103
50	224	126

Closed Canopy		
	FWP	**FWP**
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	187	102
1	188	103
50	217	123

Transitional Canopy		
	FWOP	FWOP
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	172	132
1	173	133
33	206	162
34	0	0
50	0	0

Transitional Canopy		
	FWP	**FWP**
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	172	132
1	173	133
30	200	158
31	0	0
50	0	0

Closed Canopy		
	FWOP	FWOP
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	172	132
1	173	133
46	206	162
47	0	0
50	0	0

Closed Canopy		
	FWP	**FWP**
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	172	132
1	173	133
43	200	158
44	0	0
50	0	0

Transitional Canopy		
	FWOP	FWOP
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	187	102
1	188	103
50	224	126

Transitional Canopy		
	FWP	**FWP**
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	187	102
1	188	103
50	206	114

Closed Canopy		
	FWOP	FWOP
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	187	102
1	188	103
50	224	126

Closed Canopy		
	FWP	**FWP**
	Cypress	Tupelo
	BA	BA
TY	(ft^2/ac)	(ft^2/ac)
0	187	102
1	188	103
50	206	114

Low Swamp

Transitional Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	187	102
1	188	103
34	224	126
50	224	126

Transitional Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	187	102
1	188	103
18	206	114
50	206	114

Closed Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	187	102
1	188	103
34	224	126
50	224	126

Closed Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	187	102
1	188	103
18	206	114
50	206	114

Transitional Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	187	102
1	188	103
34	224	126
50	224	126

Transitional Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	187	102
1	188	103
30	217	123
50	217	123

Closed Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	187	102
1	188	103
34	224	126
50	224	126

Closed Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	187	102
1	188	103
30	217	123
50	217	123

Transitional Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	172	132
1	173	133
33	206	162
34	0	0
50	0	0

Transitional Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	172	132
1	173	133
30	200	158
31	0	0
50	0	0

Closed Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	172	132
1	173	133
46	206	162
47	0	0
50	0	0

Closed Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	172	132
1	173	133
43	200	158
44	0	0
50	0	0

Transitional Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	187	102
1	188	103
34	224	126
50	224	126

Transitional Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	187	102
1	188	103
30	206	114
50	206	114

Closed Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	187	102
1	188	103
34	224	126
50	224	126

Closed Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	187	102
1	188	103
30	206	114
50	206	114

V2 Basal Area Inputs – High SLR:

Low Swamp

Middle-Low Swamp Transitional Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	187	102
1	188	103
16	204	113
39	203	112
50	196	98

Middle-Low Swamp Transitional Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	187	102
1	188	103
8	195	107
33	194	106
40	190	97
41	0	0
50	0	0

Middle-Low Swamp Closed Canopy		
TY	FWOP Cypress dbh (inches)	FWOP Tupelo dbh (inches)
0	187	102
1	188	103
16	204	113
39	203	112
50	196	98

Middle-Low Swamp Closed Canopy		
TY	**FWP** Cypress dbh (inches)	**FWP** Tupelo dbh (inches)
0	187	102
1	188	103
8	195	107
33	194	106
50	183	85

Transitional Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	187	102
1	188	103
16	204	113
39	203	112
50	196	98

Transitional Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	187	102
1	188	103
14	200	112
38	200	110
45	195	101
46	0	0
50	0	0

Closed Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	187	102
1	188	103
16	201	112
39	201	110
50	194	97

Closed Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	187	102
1	188	103
14	200	112
38	200	110
50	192	95

Transitional Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	172	132
1	173	133
31	187	144
32	0	0
50	0	0

Transitional Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	172	132
1	173	133
28	184	142
29	0	0
50	0	0

Closed Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	172	132
1	173	133
31	185	143
36	182	136
37	0	0
50	0	0

Closed Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	172	132
1	173	133
28	184	142
33	181	136
34	0	0
50	0	0

Transitional Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	187	102
1	188	103
16	204	113
39	203	112
50	196	98

Transitional Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	187	102
1	188	103
13	195	107
37	194	106
44	190	97
45	0	0
50	0	0

Closed Canopy		
TY	FWOP Cypress BA (ft^2/ac)	FWOP Tupelo BA (ft^2/ac)
0	187	102
1	188	103
16	204	113
39	203	112
50	196	98

Closed Canopy		
TY	**FWP** Cypress BA (ft^2/ac)	**FWP** Tupelo BA (ft^2/ac)
0	187	102
1	188	103
13	195	107
37	194	106
50	186	90

V3 Hydrology – Low SLR:

Swamp Area	Water Exchange FWOP	FWP
Low	low	low
High	low	low
West	low	low
East		
semi-perm	low	SI = 0.47
perm	low	SI = 0.31

Swamp Area	TY Flooding Duration Changes from semi-perm to permanent FWOP	FWP
Low	none	31
High	none	none
West	< 0	< 0
East	none	none

V3 Hydrology – INT SLR:

Swamp Area	Water Exchange FWOP	FWP
Low	low	low
High	low	low
West	low	low
East		
semi-perm	low	SI = 0.47
perm	low	SI = 0.31

Swamp Area	TY Flooding Duration Changes from semi-perm to permanent FWOP	FWP
Low	34	18
High	34	30
West	< 0	< 0
East	34	30

Swamp Area	Water Exchange FWOP	FWP
Low	low	low
High	low	low
West	low	low
East		
semi-perm	low	SI = 0.47
perm	low	SI = 0.31

Swamp Area	TY Flooding Duration Changes from semi-perm to permanent FWOP	FWP
Low	16	8
High	16	14
West	< 0	< 0
East	16	13

V4 Salinity Inputs - Low SLR:

Low and High Swamp TY	FWOP salinity (ppt)
0	0.3
1	0.3
50	0.5

Low Swamp TY	FWP salinity (ppt)
0	0.3
1	0.2
31	0.2
50	0.2

High Swamp TY	FWP salinity (ppt)
0	0.3
1	0.2
50	0.2

WEST Swamp Transitional Canopy TY	FWOP Salinity (ppt)	TY	FWP Salinity (ppt)
0	0.28	0	0.28
1	0.28	1	0.18
33	0.42	30	0.20
34	0.43	31	0.21
50	0.48	50	0.21

WEST Swamp Closed Canopy TY	FWOP Salinity (ppt)	TY	FWP Salinity (ppt)
0	0.28	0	0.28
1	0.28	1	0.18
46	0.47	43	0.21
47	0.47	44	0.21
50	0.48	50	0.21

V4 Salinity Inputs – INT SLR:

Low and High Swamp	
TY	FWOP salinity (ppt)
0	0.3
1	0.3
34	0.6
50	0.6

Low Swamp	
TY	**FWP** salinity (ppt)
0	0.3
1	0.2
18	0.2
50	0.2

High Swamp	
TY	**FWP** salinity (ppt)
0	0.3
1	0.2
30	0.2
50	0.2

WEST Swamp Transitional Canopy			
TY	FWOP Salinity (ppt)	TY	FWP Salinity (ppt)
0	0.29	0	0.29
1	0.29	1	0.18
33	0.50	30	0.22
34	0.50	31	0.22
50	0.57	50	0.23

WEST Swamp Closed Canopy			
TY	FWOP Salinity (ppt)	TY	FWP Salinity (ppt)
0	0.29	0	0.29
1	0.29	1	0.18
46	0.56	43	0.23
47	0.56	44	0.23
50	0.57	50	0.23

V4 Salinity Inputs – High SLR:

Low and High Swamp	
TY	**FWOP** salinity (ppt)
0	0.3
1	0.3
16	0.6
39	0.7
50	0.8

Low	
TY	**FWP Trans** salinity (ppt)
0	0.3
1	0.2
8	0.2
33	0.3
40	0.3
41	0.3
50	0.3

Low	
TY	**FWP Closed** salinity (ppt)
0	0.3
1	0.2
8	0.2
33	0.3
50	0.3

Low and High Swamp	
TY	**FWOP** salinity (ppt)
0	0.3
1	0.3
16	0.6
39	0.7
50	0.8

High	
TY	**FWP Trans** salinity (ppt)
0	0.3
1	0.2
14	0.2
38	0.3
45	0.3
46	0.3
50	0.3

High	
TY	**FWP Closed** salinity (ppt)
0	0.3
1	0.2
14	0.2
38	0.3
50	0.3

WEST Swamp Transitional Canopy			
TY	FWOP Salinity (ppt)	TY	FWP Salinity (ppt)
0	0.32	0	0.32
1	0.33	1	0.19
31	0.63	28	0.24
32	0.63	29	0.24
50	0.73	50	0.26

WEST Swamp Closed Canopy			
TY	FWOP Salinity (ppt)	TY	FWP Salinity (ppt)
0	0.32	0	0.32
1	0.33	1	0.19
31	0.63	28	0.24
36	0.66	33	0.25
37	0.66	34	0.25
50	0.73	50	0.26

East Transitional Canopy			
TY	FWOP Salinity (ppt)	TY	FWP Salinity (ppt)
0	0.32	0	0.22
1	0.33	1	0.19
16	0.51	13	0.21
39	0.67	37	0.25
50	0.73	44	0.26
		45	0.26
		50	0.26

East Closed Canopy			
TY	FWOP Salinity (ppt)	TY	FWP Salinity (ppt)
0	0.32	0	0.22
1	0.33	1	0.19
16	0.51	13	0.21
39	0.67	37	0.25
50	0.73	50	0.26

V5 Forest Size Inputs (determined by GIS analysis) – All SLR Scenarios:

Swamp Area	FWOP SI	FWP SI
Low	1.0	1.0
High	1.0	1.0
West	1.0	1.0
East	0.980	0.980

V6 Suitability and Traversability of Surrounding Lands (GIS analysis) – All SLR Scenarios.

Swamp Area	**FWOP SI**	**FWP SI**
Low	0.950	0.936
High	0.895	0.886
West	0.679	0.668
East	0.960	0.960

V7 Disturbance (GIS analysis) – All SLR Scenarios.

Swamp Area	**FWOP SI**	**FWP SI**
Low	0.940	0.940
High	0.789	0.789
West	0.770	0.770
East	0.380	0.380

Marsh Wetland Value Assessment Project Information Sheet

Maurepas Diversion – Receiving Area Marshes
Wetland Value Assessment
Project Information Sheet
6-August-2021

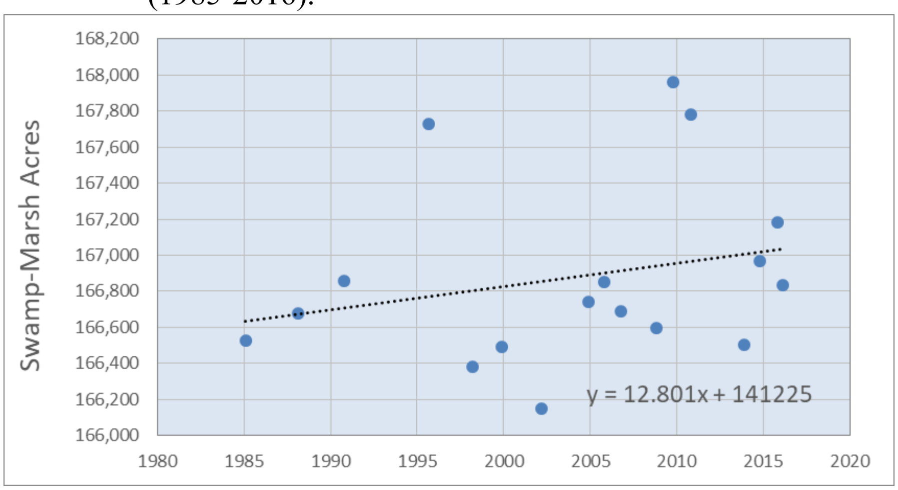
The Maurepas Diversion/Swamp Project is being evaluated as mitigation for swamp impacts associated with the construction of the West Shore Lake Pontchartrain (WSLP) hurricane protection project. While trying to determine marsh acreage within each of the three benefit areas, it was found that the forest acreage actually included open water acres of bayous and canals. In June, Patrick Smith (New Orleans Corps of Engineers) recalculated acreages for forest types and marshes to correct this error. The results are shown in Table 1 below.

Table 1. Updated habitat type acreages by Benefit Area.

June 17, 2021 revised acreage data from Patrick Smith						
	Primary Benefit Area		Secondary Benefit Area		Tertiary Benefit Area	
	Public + Private Lands	Public ONLY Lands	Public + Private Lands	Public ONLY Lands	Public + Private Lands	Public ONLY Lands
Closed Canopy Swamp	2,743.2	1,900.4	856.0	816.4	796.6	780.8
Trans. Canopy Swamp	2,089.2	1,750.2	2,145.9	2,022.5	1,849.2	1,543.2
Marsh*	262.2	208.2	251.5	244.0	288.0	283.6
	5,094.6	3,858.8	3,253.4	3,082.8	2,933.8	2,607.6

Based on current imagery, the marshes are interspersed among forests and those marshes appear to contain no interspersed marsh ponds. Thus the above marsh acreage is assumed to represent the total marsh area (zero water acres amidst the marsh). A USGS analysis of land loss in the swamps and marsh show no loss (Figure 1).

Figure 1. USGS land loss data for the area (polygon 218) show a 0.01%/year gain rate (1985-2016).



The gain rate of 0.01% per year is calculated as the average annual gain of 12.81 acres/yr divided by the 1985 predicted acreage of 166,636 acres. Since there is no internal open water within the marsh that could convert to marsh, the low sea level rise scenario was conducted assuming no marsh gain or loss. Under the intermediate and high sea level rise scenarios, increases in relative sea level rise (RSLR) cause marsh loss rates to gradually increase in proportion to submergence.

For the swamps, it was assumed that an additional 5 mm/yr of accretion would occur FWP in addition to the FWOP rate of 5.65 mm/yr. It is assumed that project area marshes would see less than half that accretion increase. The following accretion assumptions were used:

Primary area FWOP accretion of 10.50 mm per year was taken from CRMS 3913, a marsh station near the southeastern shore of Lake Maurepas. A FWP 20% increase would add 2.1 mm/yr of additional accretion (consisting or both organic and mineral material). This is less than half the FWP accretion rate assumed for the swamps in the Primary Benefit area and is justified assuming that the swamps located closer to the diversion discharge site will capture nutrients and sediments leaving less for the marshes located further from the discharge site. The previously established swamp benefit reduction values for the Secondary and Tertiary Benefit areas (Secondary area benefits = 75% of Primary, and Tertiary area benefits = 45% of Primary) were applied to the Primary Area FWP additional accretion value of 2.1 mm/yr to calculate the FWP accretion values for the Secondary and Tertiary accretion values as follows:

Primary Benefit accretion rate	= 2.1 mm per year
Secondary Benefit accretion rate	= 1.6 mm per year
Tertiary Benefit accretion rate	= 0.9 mm per year

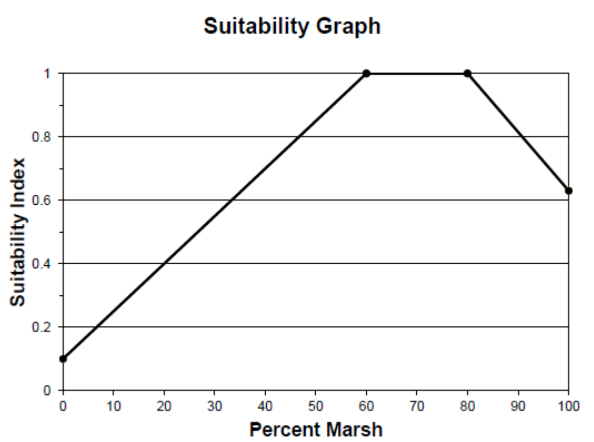
These FWP accretion values were added to the RSLR related submergence rates to reduce the FWP submergence rates and the corresponding FWP marsh loss rates.

FWP target years of 0, 1, 4, and 50 were used for both FWOP and FWP. Target year 4 was used since that would be the FWP first year of full discharge diversion operations following the three year initial discharge operation ramp up (more information on the discharge ramp up operations is available in the swamp PIS).

V1: Percent Marsh:
Under the low SLR scenario, both the FWOP and FWP V1 values remain 100% throughout the project life. Under the intermediate RSLR scenario, the Primary Benefit Area FWOP V1 value begins at 97% and drops to 80% at TY50. However, under FWP, the V1 drops to only 92% by TY50. Because of the V1 Suitability Index (SI) curve (Figure 2), the greater degree of FWOP

Figure 2. V1 Suitability Index curve within the Corps of Engineers certified fresh marsh model.

Variable V1 Percent of wetland area covered by emergent vegetation (Revised September 2017).



marsh loss results in higher SI values compared to the healthier marsh under FWP. Because the V1 SI values are the most important variable determining the WVA result, the WVA results yield negative results although the ecosystem is more degraded under FWOP than FWP. This SI curve reflects the greater fish and wildlife habitat value of marshes with interspersed internal open water areas compared to a more solid marsh lacking internal open water. If this assessment were run over a longer period of time, the more degraded FWOP marsh would generate less benefit than the healthier FWP marsh. This apparent V1 anomaly has been previously recognized and is the reason why the Coastal Wetlands Planning, Protection and Restoration Act's (CWPPRA) Environmental Work Group, who initially developed the WVA methodology, decided to use a V1 Suitability Index curve that avoids the situation where the more degraded most scores higher than a more healthy marsh (Figure 3).

Figure 3. CWPPRA's V1 Suitability Index curve for the fresh marsh model.

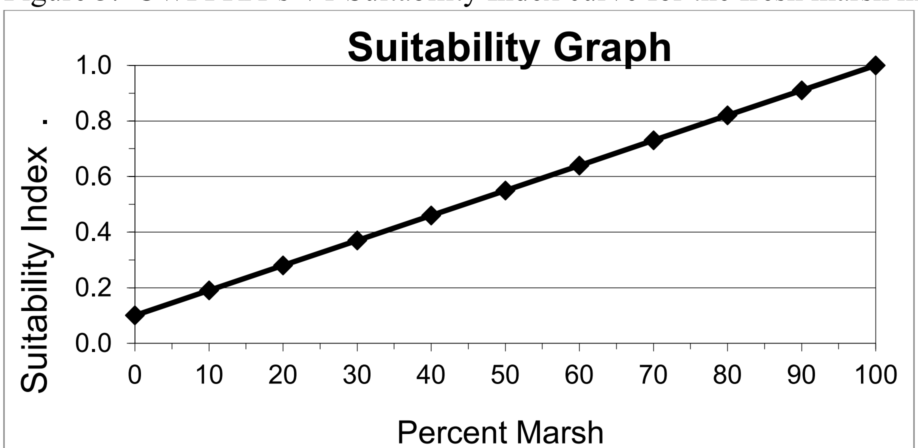


Table 3. V1 and marsh acres.

Public & Private Lands

Aug 5, 2021 checked

Low RSLR

Primary Benefit Area

TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP V1 (%)	FWP Marsh (ac)
0	100	262	100	262
1	100	262	100	262
4	100	262	100	262
50	100	262	100	262

Secondary Benefit Area

TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP V1 (%)	FWP Marsh (ac)
0	100	252	100	252
1	100	252	100	252
4	100	252	100	252
50	100	252	100	252

Tertiary Benefit Area

TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP V1 (%)	FWP Marsh (ac)
0	100	288	100	288
1	100	288	100	288
4	100	288	100	288
50	100	288	100	288

Intermediate RLSR

Primary Benefit Area

FWOP TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP TY	FWP V1 (%)	FWP Marsh (ac)
0	97	254	0	97	254
1	97	254	1	97	254
4	96	252	4	97	254
50	80	210	50	92	241
					31

Secondary Benefit Area

FWOP TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP TY	FWP V1 (%)	FWP Marsh (ac)
0	97	244	0	97	244
1	97	244	1	97	244
4	96	242	4	97	244
50	80	202	50	89	224
					23

Tertiary Benefit Area

FWOP TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP TY	FWP V1 (%)	FWP Marsh (ac)
0	97	279	0	97	279
1	97	279	1	97	279
4	96	276	4	96	276
50	80	230	50	85	245
					15

High RSLR

Primary Benefit Area

FWOP TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP TY	FWP V1 (%)	FWP Marsh (ac)
0	87	228	0	87	228
1	86	225	1	86	225
4	83	217	4	84	220
50	15	39	50	27	71
					31

Secondary Benefit Area

FWOP TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP TY	FWP V1 (%)	FWP Marsh (ac)
0	87	219	0	87	219
1	86	217	1	86	217
4	83	209	4	84	212
50	15	38	50	24	60
					23

Tertiary Benefit Area

FWOP TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP TY	FWP V1 (%)	FWP Marsh (ac)
0	87	251	0	87	251
1	86	248	1	86	248
4	83	239	4	84	242
50	15	43	50	20	58
					14

Table 3 continued. V1 and marsh acres.

Public ONLY Lands

Low RSLR

Primary Benefit Area

TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP V1 (%)	FWP Marsh (ac)
0	100	208	100	208
1	100	208	100	208
4	100	208	100	208
50	100	208	100	208

Secondary Benefit Area

TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP V1 (%)	FWP Marsh (ac)
0	100	244	100	244
1	100	244	100	244
4	100	244	100	244
50	100	244	100	244

Tertiary Benefit Area

TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP V1 (%)	FWP Marsh (ac)
0	100	284	100	284
1	100	284	100	284
4	100	284	100	284
50	100	284	100	284

Intermediate RLSR

Primary Benefit Area

FWOP TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP TY	FWP V1 (%)	FWP Marsh (ac)
0	97	202	0	97	202
1	97	202	1	97	202
4	96	200	4	97	202
50	80	166	50	92	191
					25

Secondary Benefit Area

FWOP TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP TY	FWP V1 (%)	FWP Marsh (ac)
0	97	237	0	97	237
1	97	237	1	97	237
4	96	234	4	97	237
50	80	195	50	89	217
					22

Tertiary Benefit Area

FWOP TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP TY	FWP V1 (%)	FWP Marsh (ac)
0	97	275	0	97	275
1	97	275	1	97	275
4	96	272	4	96	272
50	80	227	50	85	241
					14

High RSLR

Primary Benefit Area

FWOP TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP TY	FWP V1 (%)	FWP Marsh (ac)
0	87	181	0	87	181
1	86	179	1	86	179
4	83	173	4	84	175
50	15	31	50	27	56
					25

Secondary Benefit Area

FWOP TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP TY	FWP V1 (%)	FWP Marsh (ac)
0	87	212	0	87	212
1	86	210	1	86	210
4	83	203	4	84	205
50	15	37	50	24	59
					22

Tertiary Benefit Area

FWOP TY	FWOP V1 (%)	FWOP Marsh (ac)	FWP TY	FWP V1 (%)	FWP Marsh (ac)
0	87	247	0	87	247
1	86	244	1	86	244
4	83	236	4	84	239
50	15	43	50	20	57
					14

Variable 2: Percent Submerged Aquatic Vegetation:
FWOP it was assumed that submerged aquatic vegetation (SAV) would increase when marsh degradation resulted in creation of open water. However, when the percent marsh dropped to 30% or less, it was assumed that large fetch and increased turbidity would begin discouraging SAV. FWP it was assumed that SAV would increase due to nutrient supply as long as the marsh was not too degraded (Table 4).

Variable 3: Interspersion:
It was assumed that under both FWOP and FWP, that marsh degradation would occur in the manner such that open water was evenly distributed throughout the marsh areas (Table 5).

Variable 4: Percent Shallow Open Water:
It was assumed a baseline of 10% shallow open water (SOW) exists at TY0. With SLR and marsh loss, the percent was assumed to decrease under FWOP. Under FWP, it was assumed that increased organic matter production and deposition of sediment would increase SOW relative to FWOP. Nevertheless, under FWP, SOW would decrease with SLR and increasing marsh loss (Table 6).

Variable 5 - Fresh Marsh Salinity:
The fresh marsh WVA model utilizes mean growing season salinity and the swamp model uses the mean high growing season salinities. Given that swamp model salinities were already calculated, they were used in the marsh model under the assumption that use of those salinity values would not change the WVA results substantially, especially given the issues with the Variable 1 curve showing negative results FWP as discussed above.

The 2020 project area growing season salinity is 0.29 parts per thousand (ppt) which is 48% of the mean high growing season used in the swamp WVAs (per average of CRMS 63, 97, and 5414). Because the project area swamp would average 0.61 feet deep in 2021, the volume of water within a square foot area above the substrate is 0.61 ft^3 or 17.26 liters (L). Assuming that salinity in ppt equals grams of salt/L, then the 2021 grams of salt in the water above the substrate is 17.26 L x 0.29 g/L = 5.00 g. Assuming that increased flooding due to RSLR will be at a salinity of 0.97 ppt (calculated as 48% of the 2.0 ppt RSLR value used in the swamp WVAs) for all RSLR water level increases, the grams of salt and water volume using RSLR-predicted water elevation increases above the substrate can be determined. Once determined, these values enable the calculation of FWOP future salinities (Table 7).

FWP salinities were determined assuming that the diversion would discharge fresh water (salinity = 0.2 ppt as per CPRA WVA) and would maintain fresh conditions in receiving area swamps except possibly during the fall when Mississippi River stages may not permit high volume diversion discharges. It is assumed that under FWP, the highest growing season salinities (2.64 months) would occur during August, September and October. It is assumed that the diversion will maintain fresh conditions throughout all of August at 0.2 ppt. In September and October, the diversion would not operate but area salinities would remain fresh for

September due to prior freshwater loading of the swamp and Lake Maurepas systems. It is possible that low diversion discharges could also be conducted to retard saltwater entry from Lake Maurepas into Hope Canal and from Hope Canal into the project area. In October, it is therefore assumed that salinities would be half of FWOP. A weighted average based on assumed monthly salinities for the 2.6 months discussed above was used to calculate FWP salinity (Table 7).

Table 4. V2 Percent Submerged Aquatic Vegetation.

Aug 5, 2021 checked

Public & Private Lands

Low RSLR				Low RSLR				Low RSLR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)
0	10	0	10	0	10	0	10	0	10	0	10
1	10	1	11	1	10	1	11	1	10	1	11
4	10	4	14	4	10	4	14	4	10	4	14
50	11	50	14	50	11	50	14	50	11	50	14

Intermediate RLSR				Intermediate RLSR				Intermediate RLSR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)
0	10	0	10	0	10	0	10	0	10	0	10
1	10	1	11	1	10	1	11	1	10	1	11
4	10	4	14	4	10	4	14	4	10	4	14
50	12	50	17	50	12	50	17	50	12	50	16

High RSLR				High RSLR				High RSLR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)
0	10	0	10	0	10	0	10	0	10	0	10
1	10	1	11	1	10	1	11	1	10	1	11
4	10	4	14	4	10	4	14	4	10	4	14
50	6	50	11	50	5	50	11	50	4	50	10

Public ONLY Lands

Low RSLR				Low RSLR				Low RSLR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)
0	10	0	10	0	10	0	10	0	10	0	10
1	10	1	11	1	10	1	11	1	10	1	11
4	10	4	14	4	10	4	14	4	10	4	14
50	11	50	14	50	12	50	14	50	11	50	14

Intermediate RLSR				Intermediate RLSR				Intermediate RLSR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)	TY	V2 (%)
0	10	0	10	0	10	0	10	0	10	0	10
1	10	1	11	1	10	1	11	1	10	1	11
4	10	4	14	4	10	4	14	4	10	4	14
50	12	50	17	50	12	50	17	50	12	50	16

High RSLR				High RSLR				High RSLR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V1 (%)	TY	V1 (%)	TY	V1 (%)	TY	V1 (%)	TY	V1 (%)	TY	V1 (%)
0	10	0	10	0	10	0	10	0	10	0	10
1	10	1	11	1	10	1	11	1	10	1	11
4	10	4	14	4	10	4	14	4	10	4	14
50	5	50	11	50	5	50	11	50	4	50	10

Table 5. V3 Marsh-Water Interspersion values.

Public & Private Lands

Low RSLR				Low RSLR				Low RSLR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)
0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%
1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%
4	Class3 - 100%	4	Class3 - 100%	4	Class3 - 100%	4	Class3 - 100%	4	Class3 - 100%	4	Class3 - 100%
50	Class3 - 100%	50	Class3 - 100%	50	Class3 - 100%	50	Class3 - 100%	50	Class3 - 100%	50	Class3 - 100%

Intermediate RLSR				Intermediate RLSR				Intermediate RLSR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)
0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%
1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%
4	Class1 - 100%	4	Class3 - 100%	4	Class1 - 100%	4	Class3 - 100%	4	Class1 - 100%	4	Class1 - 100%
50	Class1 - 73%	50	Class1 - 100%	50	Class1 - 73%	50	Class1 - 83%	50	Class1 - 73%	50	Class1 - 71%
	Class2 - 27%				Class2 - 27%		Class2 - 17%		Class2 - 27%		Class2 - 29%

High RSLR				High RSLR				High RSLR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)
0	Class1 - 81%	0	Class1 - 81%	0	Class1 - 81%	0	Class1 - 81%	0	Class1 - 81%	0	Class1 - 81%
	Class2 - 19%		Class2 - 19%		Class2 - 19%		Class2 - 19%		Class2 - 19%		Class2 - 19%
1	Class1 - 80%	1	Class1 - 80%	1	Class1 - 80%	1	Class1 - 80%	1	Class1 - 80%	1	Class1 - 80%
	Class2 - 20%		Class2 - 20%		Class2 - 20%		Class2 - 20%		Class2 - 20%		Class2 - 20%
4	Class1 - 76%	4	Class1 - 78%	4	Class1 - 76%	4	Class1 - 78%	4	Class1 - 76%	4	Class1 - 78%
	Class2 - 24%		Class2 - 22%		Class2 - 24%		Class2 - 22%		Class2 - 24%		Class2 - 22%
50	Class4 - 21%	50	Class4 - 33%	50	Class4 - 21%	50	Class4 - 30%	50	Class4 - 21%	50	Class4 - 26%
	Class5 - 79%		Class5 - 67%		Class5 - 79%		Class5 - 70%		Class5 - 79%		Class5 - 74%

Public ONLY Lands

Low RSLR				Low RSLR				Low RSLR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)
0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%
1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%
4	Class3 - 100%	4	Class3 - 100%	4	Class3 - 100%	4	Class3 - 100%	4	Class3 - 100%	4	Class3 - 100%
50	Class3 - 100%	50	Class3 - 100%	50	Class3 - 100%	50	Class3 - 100%	50	Class3 - 100%	50	Class3 - 100%

Intermediate RLSR				Intermediate RLSR				Intermediate RLSR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)
0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%	0	Class3 - 100%
1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%	1	Class3 - 100%
4	Class1 - 100%	4	Class3 - 100%	4	Class1 - 100%	4	Class3 - 100%	4	Class1 - 100%	4	Class1 - 100%
50	Class1 - 73%	50	Class1 - 100%	50	Class1 - 73%	50	Class1 - 83%	50	Class1 - 73%	50	Class1 -78%
	Class2 - 27%				Class2 - 27%		Class2 - 17%		Class2 - 27%		Class2 - 22%

High RSLR				High RSLR				High RSLR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)	TY	V3 (%)
0	Class1 - 81%	0	Class1 - 81%	0	Class1 - 81%	0	Class1 - 81%	0	Class1 - 81%	0	Class1 - 81%
	Class2 - 19%		Class2 - 19%		Class2 - 19%		Class2 - 19%		Class2 - 19%		Class2 - 19%
1	Class1 - 80%	1	Class1 - 80%	1	Class1 - 80%	1	Class1 - 80%	1	Class1 - 80%	1	Class1 - 80%
	Class2 - 20%		Class2 - 20%		Class2 - 20%		Class2 - 20%		Class2 - 20%		Class2 - 20%
4	Class1 - 77%	4	Class1 - 78%	4	Class1 - 75%	4	Class1 - 78%	4	Class1 - 75%	4	Class1 - 78%
	Class2 - 23%		Class2 - 22%		Class2 - 25%		Class2 - 22%		Class2 - 25%		Class2 - 22%
50	Class4 - 21%	50	Class4 - 33%	50	Class4 - 21%	50	Class4 - 30%	50	Class4 - 21%	50	Class4 - 26%
	Class5 - 79%		Class5 - 67%		Class5 - 79%		Class5 - 70%		Class5 - 79%		Class5 - 74%

Table 6. V4 Percent Shallow Open Water values.

Public & Private Lands

Low RSLR				Low RSLR				Low RSLR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)
0	10	0	10	0	10	0	10	0	10	0	10
1	10	1	10	1	10	1	10	1	10	1	10
4	10	4	10	4	10	4	10	4	10	4	10
50	8	50	11	50	8	50	11	50	8	50	10

Intermediate RLSR				Intermediate RLSR				Intermediate RLSR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)
0	10	0	10	0	10	0	10	0	10	0	10
1	10	1	10	1	10	1	10	1	10	1	10
4	10	4	10	4	10	4	10	4	10	4	10
50	7	50	10	50	6	50	10	50	6	50	9

High RSLR				High RSLR				High RSLR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)
0	9	0	9	0	9	0	9	0	9	0	9
1	9	1	9	1	9	1	9	1	9	1	9
4	9	4	9	4	9	4	9	4	9	4	9
50	4	50	6	50	4	50	6	50	3	50	5

Public ONLY Lands

Low RSLR				Low RSLR				Low RSLR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)
0	10	0	10	0	10	0	10	0	10	0	10
1	10	1	10	1	10	1	10	1	10	1	10
4	10	4	10	4	10	4	10	4	10	4	10
50	8	50	11	50	8	50	11	50	8	50	10

Intermediate RLSR				Intermediate RLSR				Intermediate RLSR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)
0	10	0	10	0	10	0	10	0	10	0	10
1	10	1	10	1	10	1	10	1	10	1	10
4	10	4	10	4	10	4	10	4	10	4	10
50	7	50	10	50	6	50	10	50	6	50	9

High RSLR				High RSLR				High RSLR			
Primary Benefit Area				Secondary Benefit Area				Tertiary Benefit Area			
FWOP		FWP		FWOP		FWP		FWOP		FWP	
TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)	TY	V4 (%)
0	9	0	9	0	9	0	9	0	9	0	9
1	9	1	9	1	9	1	9	1	9	1	9
4	9	4	9	4	9	4	9	4	9	4	9
22	4	50	6	22	4	50	6	22	3	50	5

<u>Variable 6 – Fish Access Values:</u>

No impediments to fish access are known to occur within the project area FWOP. Although some outfall management weir structures would be built FWP, those are located in more heavily forested areas and assumed not to affect the scattered marsh areas. Hence, a V6 value of 1.0 was used for all areas, all years, for both FWOP and FWP.

Table 7. V5 Fresh Marsh Salinity Values.

Public & Private Lands

Low RSLR				Low RSLR				Low RSLR			
Primary Benefit Area				**Secondary Benefit Area**				**Tertiary Benefit Area**			
FWOP		**FWP**		**FWOP**		**FWP**		**FWOP**		**FWP**	
TY	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**
0	0.33	0	0.37	0	0.33	0	0.37	0	0.33	0	0.37
1	0.34	1	0.19	1	0.34	1	0.19	1	0.34	1	0.19
4	0.37	4	0.19	4	0.37	4	0.19	4	0.37	4	0.19
50	0.61	50	0.24	50	0.61	50	0.24	50	0.61	50	0.24

Intermediate RLSR				Intermediate RLSR				Intermediate RLSR			
Primary Benefit Area				**Secondary Benefit Area**				**Tertiary Benefit Area**			
FWOP		**FWP**		**FWOP**		**FWP**		**FWOP**		**FWP**	
TY	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**
0	0.35	0	0.35	0	0.35	0	0.35	0	0.35	0	0.35
1	0.37	1	0.19	1	0.37	1	0.19	1	0.37	1	0.19
4	0.41	4	0.2	4	0.41	4	0.2	4	0.41	4	0.2
50	0.72	50	0.26	50	0.72	50	0.26	50	0.72	50	0.26

High RSLR				High RSLR				High RSLR			
Primary Benefit Area				**Secondary Benefit Area**				**Tertiary Benefit Area**			
FWOP		**FWP**		**FWOP**		**FWP**		**FWOP**		**FWP**	
TY	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**
0	0.41	0	0.41	0	0.41	0	0.41	0	0.41	0	0.41
1	0.43	1	0.21	1	0.43	1	0.21	1	0.43	1	0.21
4	0.50	4	0.22	4	0.50	4	0.22	4	0.50	4	0.22
50	0.84	50	0.28	50	0.84	50	0.28	50	0.84	50	0.28

Public ONLY Lands

Low RSLR				Low RSLR				Low RSLR			
Primary Benefit Area				**Secondary Benefit Area**				**Tertiary Benefit Area**			
FWOP		**FWP**		**FWOP**		**FWP**		**FWOP**		**FWP**	
TY	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**
0	0.37	0	0.37	0	0.37	0	0.37	0	0.37	0	0.37
1	0.34	1	0.19	1	0.34	1	0.19	1	0.34	1	0.19
4	0.37	4	0.19	4	0.37	4	0.19	4	0.37	4	0.19
50	0.61	50	0.24	50	0.61	50	0.24	50	0.61	50	0.24

Intermediate RLSR				Intermediate RLSR				Intermediate RLSR			
Primary Benefit Area				**Secondary Benefit Area**				**Tertiary Benefit Area**			
FWOP		**FWP**		**FWOP**		**FWP**		**FWOP**		**FWP**	
TY	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**
0	0.35	0	0.35	0	0.35	0	0.35	0	0.35	0	0.35
1	0.37	1	0.19	1	0.37	1	0.19	1	0.37	1	0.19
4	0.41	4	0.2	4	0.41	4	0.2	4	0.41	4	0.2
50	0.72	50	0.26	50	0.72	50	0.26	50	0.72	50	0.26

High RSLR				High RSLR				High RSLR			
Primary Benefit Area				**Secondary Benefit Area**				**Tertiary Benefit Area**			
FWOP		**FWP**		**FWOP**		**FWP**		**FWOP**		**FWP**	
TY	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**	**TY**	**V5 ppt**
0	0.41	0	0.41	0	0.41	0	0.41	0	0.41	0	0.41
1	0.43	1	0.21	1	0.43	1	0.21	1	0.43	1	0.21
4	0.50	4	0.22	4	0.50	4	0.22	4	0.50	4	0.22
50	0.84	50	0.28	50	0.84	50	0.28	50	0.84	50	0.28

WVA Results:

Table 8 provides net acres (FWP marsh ac minus FWOP marsh ac at TY50) and AAHUs using both the Corps certified marsh model and the CWPPRA marsh model. The negative results using the Corps certified model suggest that project implementation has adverse effects on project area marsh, however, marsh loss rates are reduced FWP. Those negative results are associate solely due to lesser habitat quality associated with the more intact marshes under FWP conditions due to the Variable 1 Suitability Index curve as discussed above. These negative results are misleading. Use of the CWPPRA V1 Suitability Index curve provides positive benefits. Because of the anomalies associated with the Corps certified V1 Suitability Index curve, these marsh WVA results should not be used to assess marsh mitigation benefits/impacts associated with the proposed project.

Table 8. WVA results in AAHUs and net acres at TY50.

Corps Certified WVA Marsh Model

RSLR Scenario	Primary Benefit Area		Secondary Benefit		Tertiary Benefit Area	
	Area All Land (AAHUs)	Area Public Lands (AAHUs)	Area All Land (AAHUs)	Area Public Lands (AAHUs)	Area All Land (AAHUs)	Area Public Lands (AAHUs)
Low SLR	0.20	0.16	0.19	0.19	0.22	0.22
Intermediate SLR	-7.21	-5.72	-5.21	-5.04	-0.81	-0.95
High SLR	11.65	9.54	9.24	8.93	7.27	7.15

RSLR Scenario	Primary Benefit Area		Secondary Benefit Area		Tertiary Benefit Area	
	Area All Land Net ac	Area Public Lands Net ac	Area All Land Net ac	Area Public Lands Net ac	Area All Land Net ac	Area Public Lands Net ac
Low SLR	0	0	0	0	0	0
Intermediate SLR	31	25	23	22	15	14
High SLR	31	25	23	22	14	14

CWPPRA WVA Marsh Model

RSLR Scenario	Primary Benefit Area		Secondary Benefit		Tertiary Benefit Area	
	Area All Land (AAHUs)	Area Public Lands (AAHUs)	Area All Land (AAHUs)	Area Public Lands (AAHUs)	Area All Land (AAHUs)	Area Public Lands (AAHUs)
Low SLR	0.20	0.16	0.19	0.19	0.22	0.22
Intermediate SLR	10.91	8.66	7.94	7.69	6.29	6.04
High SLR	10.11	8.31	8.39	8.11	7.22	7.10

RSLR Scenario	Primary Benefit Area		Secondary Benefit Area		Tertiary Benefit Area	
	Area All Land Net ac	Area Public Lands Net ac	Area All Land Net ac	Area Public Lands Net ac	Area All Land Net ac	Area Public Lands Net ac
Low SLR	0	0	0	0	0	0
Intermediate SLR	31	25	23	22	14	14
High SLR	31	25	23	22	14	14

Addendum to be added to Appendix E of the DSEIS:

The USFWS conducted additional habitat modeling to meet their agency needs. The USFWS used an un-certified WVA model to assess for Project impacts to the mitigation area marsh in addition to the approved for use Fresh/Intermediate Coastal Marsh Model version 2.0, because the results from the approved for use WVA yielded negative AAHUs even though the marsh ecosystem is more degraded for FWOP than FWP. The un-certified WVA model is used by other Federal programs (e.g., CWPPRA). The USFWS prefers the un-certified WVA model because it scores more contiguous marsh areas higher than the approved for use WVA. They cite the primary difference between the two models being the Suitability Index for Variable 1. The results of the un-certified model are included in the USFWS's documentation in Appendix E. The Corps did not consider the results of the un-certified WVA model when assessing project impacts.