Hammond Wetland Assimilation Monitoring Report

August 2018

By: Robert R. Lane, PhD
Rachael G. Hunter, PhD
John W. Day, PhD
Comite Resources, Inc.
21245 Smith Rd.
Covington, LA 70435

For: Pete Panepinto, Mayor
Guy Palermo, Superintendent
Water & Sewer
City of Hammond
P.O. Box 2788
Hammond, LA 70404-2788

August 27, 2018

Comite Resources, Inc.
21245 Smith Road
Covington, LA 70435

John W. Day, Ph.D.
jwday@comiteres.com
Robert R. Lane, Ph.D. 225-247-3917
rlane@comiteres.com
Rachael G. Hunter, Ph.D. 225-439-3931
rhunter@comiteres.com

Hammond Wetland Assimilation Monitoring Report

Summary of Activities: August 2018

Site visits

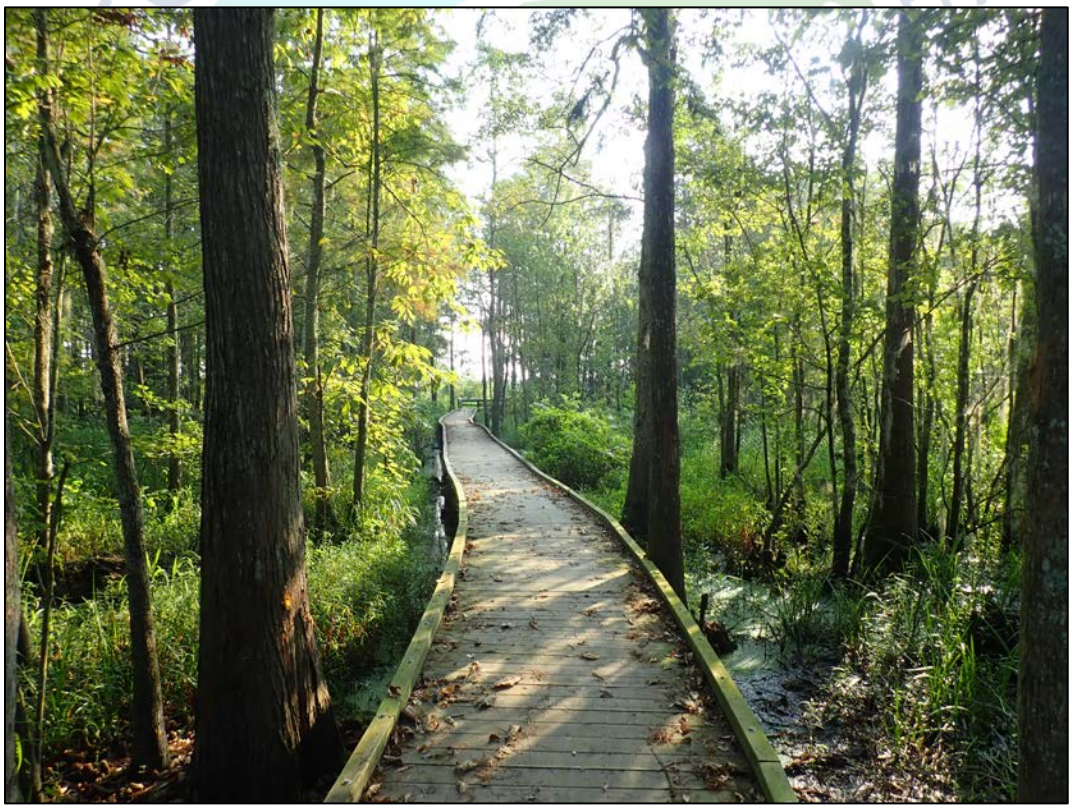
August 23, 2018: Comite Resources staff Jason Day and Joel Mancuso traveled to the Hammond assimilation wetland for monthly monitoring. Discrete water quality parameters (dissolved oxygen, conductivity, temperature, salinity and pH) were measured at the Treatment (BW-1 & BW-4), Mid, Out and Discharge Pipe, as well as the Reference sites M-Con and S-Con (see data below). Leaf litter biomass and water level data were collected from each forested site (Treatment, Mid & S-Con). Majority of flow is between Boardwalks 3 & 4. Measurements were taken at the marsh organ. M-Con and Out sites had no surface water on them.

Boardwalk 4 (BW4) on August 23, 2018.

Discrete water quality data from the Hammond assimilation wetlands on August 23, 2018.

Site	DO (mg/l)	Cond (mS)	Temp. (˚C)	Sal (PSU)	pH	Water Level (cm)
Pipe	1.8	675.9	26.0	0.3	7.0	.
BW1	1.1	686.2	25.3	0.3	6.6	39.7
BW4	0.2	567.0	24.3	0.3	6.8	22.2
Mid	0.9	605.6	24.6	0.3	7.0	34.2
Out	0.1	723.7	28.6	0.3	6.8	.
M-Con	0.4	261.1	27.7	0.1	6.7	.
S-Con	1.3	175.0	27.1	0.1	6.9	9.7

Dissolved oxygen ranged from 0.1 mg/L at the Out site to 1.3 mg/L at the S-Con site. The Pipe had a DO concentration of 1.8 mg/L. Conductivity ranged from 175.0 mS at S-Con to 686.3 mS at BW1. Water temperature ranged from 24.3˚C at the BW4 to 27.7˚C at the M-Con site. Salinity ranged from 0.1 to 0.3 PSU. pH fluctuated from 6.6 at the BW1 site to 7.0 at the Pipe and Mid site. Water level was highest at BW1 (39.7 cm), followed by the Mid (34.2 cm), BW3 (22.2 cm) and S-Con (9.7 cm). All these parameters are within expected normal ranges and there are no issues of concern.



The boardwalk leading top the Mid site on August 23, 2018.

Annual Report

The third annual report was written and submitted to the city (see below).

ANNUAL WETLAND MONITORING REPORT
Summary Sheet

City of Hammond
310 East Charles St.
Hammond, Louisiana 70404-2788

Permit Number: LA0032328
Agency Interest Number: AI19578
Activity Number: PER19990002

GROWTH STUDIES ~ STEM GROWTH (Flora)

Dr. Gary Shaffer, Professor of Biological Science at Southeastern Louisiana University, planted hundreds of baldcypress seedlings within 20 m of the outfall system (Treatment area 1 in the table below) in 2008 (Shaffer et al. 2015). These seedlings have grown very well and in January 2015 a new sampling plot (with three 10x100 m sub plots) was established. Trees were tagged in these sub plots when the site was established and dbh was measured beginning in 2015.

PARAMETER	GROWTH STUDIES ~ STEM GROWTH (Flora)					
	Discharge Area (g/m²/yr) (mean ± standard error)			Reference Area (g/m²/yr) (mean ± standard error)		
	UAA Overall Average	Current Overall Average	Difference[1]	UAA Overall Average	Current Overall Average	Difference[1]
Tmt Area 1 (TMT)	ND[2]	1382.0±521.7	ND			
Tmt Area 2 (MID)	509.4±31.6	805.9±32.4	1			
Forested Reference				245.4±29.2	407.8±79.5	0

[1] The difference in the UAA value and the Current value shall be indicated by **NO INCREASE = 0**, **INCREASE = 1**, or **DECREASE = 2**.
[2]Not determined. See explanation above table.

ANALYSIS OF VARIANCE (ANOVA)

Was there a significant difference (p=0.05) between stem growth (flora) in the control and the treatment area?

☐ YES ✓ NO

There were no differences in mean stem growth among the sites [$F(2,6)=2.5750$, $p=0.1558$]. Although mean stem growth at the Treatment site (1382.0±521.7 g/m^2/yr) was much higher than that at the Forested Reference site (407.8±79.5 g/m^2/yr), there was also a lot of variability among subplots. Mean stem growth at the Treatment and Mid sites was >500 g/m^2/yr, which is typical of forested wetlands receiving reliable sources of freshwater and nutrients, while stem growth at the Forested Reference site was lower, typical of stagnant, nearly permanently flooded interior wetlands (Shaffer et al. 2016).

If yes, please explain the significance between the control and the treatment areas and outline any corrective actions taken, if needed.

GROWTH STUDIES ~ LITTER FALL (Flora)

PARAMETER	GROWTH STUDIES ~ LITTER FALL (Flora)					
	Discharge Area (g/m²/yr) (mean ± standard error)			Reference Area (g/m²/yr) (mean ± standard error)		
	UAA Total Dry Weight	Current Total Dry Weight	Difference[1]	UAA Total Dry Weight	Current Total Dry Weight	Difference[1]
Tmt Area 1 (TMT)	ND[2]	740.0±70.4	-			
Tmt Area 2 (MID)	781.5±62.0	851.3±63.1	0			
Forested Reference				578.6±65.6	328.0±47.2	1

[1] The difference in the UAA value and the Current value shall be indicated by **NO INCREASE = 0**, **INCREASE = 1**, or **DECREASE = 2**.
[2]Not determined.

ANALYSIS OF VARIANCE (ANOVA)

Has there been a significant difference (p=0.05) between the Litter Fall (Flora) in the control and the treatment area?

✓ YES ☐ NO

Mean litterfall at the Treatment (740.0±70.4 g/m^2/yr) and Mid (851.3±63.1 g/m^2/yr) sites was significantly higher than mean litterfall at the Reference site (328.0±47.2 g/m^2/yr) [F(2,15)=20.4188, p=0.0.0001].

If yes, please explain the significance between the control and the treatment areas and outline any corrective actions taken, if needed.

Litterfall at the Forested Reference site has declined since it was first measured during the ecological baseline study, and this site appears to be following the trajectory of decline as described by Shaffer et al. (2016) for stagnant, nearly permanently flooded forested wetlands. This decline is pervasive along the Louisiana coast. No corrective actions are needed at this time.

GROWTH STUDIES ~ Marsh Productivity

PARAMETER	GROWTH STUDIES ~ Marsh Productivity					
	Discharge Area (g/m²/yr) (mean ± standard error)			Reference Area (g/m²/yr) (mean ± standard error)		
	UAA Total Dry Weight	Current Total Dry Weight	Difference[1]	UAA Total Dry Weight	Current Total Dry Weight	Difference[1]
Tmt Area 1 (TMT)	1410.0±214.9	1962.5±457.5	0			
Tmt Area 2 (OUT)	1399.8±215.1	799.2±99.9	0			
Marsh Reference				759.9±125.3	942.1±88.3	0

[1] The difference in the UAA value and the Current value shall be indicated by **NO INCREASE = 0**, **INCREASE = 1**, or **DECREASE = 2**.

ANALYSIS OF VARIANCE (ANOVA)

Has there been a significant difference (p=0.05) between the productivity (Flora) in the control and the treatment area?

☐ YES ✓ NO

There was no significant difference in mean end-of-season live (EOSL) biomass among any of the sites [F(2,13)=2.6195, p=0.1107). Although mean productivity was quite a bit higher at the Treatment area (1962.5±457.5 g/m^2/yr) than the Marsh Reference (942.1±88.3 g/m^2/yr), there was also a lot of variability among the subplots making any differences statistically undetectable.

If yes, please explain the significance between the control and the treatment areas and outline any corrective actions taken, if needed.

WATER STAGES (Surface Water)

Water height (cm) above soil surface.

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Treatment	23.2	26.8	32.4	32.8	24.6	41.3	36.6	42.1	36.6	34.3	43.1	36.1
Mid	NM[1]	27.2	28.7	37.0	24.7	35.1	39.7	34.9	37.2	44.6	50.7	35.6
Out	0.0	0.8	0.0	0.0	2.5	4.2	1.4	0.0	0.0	25.5	10.8	0.0
Forested Reference	0.0	4.3	5.3	1.1	0.3	29.4	0.5	13.7	25.6	46.7	26.8	0.0
Marsh Reference	0.0	0.0	0.3	0.0	0.8	4.0	1.3	2.9	1.5	20.2	12.0	0.0

[1]NM – Not measured.

SUMMARY OF THE OVERALL WATER STAGE FOR ONE YEAR

Water levels were highest at the Treatment and Mid sites that are located adjacent to and near the discharge. Water levels increased at the Out, Forested Reference, and Marsh Reference sites in the latter part of 2017.

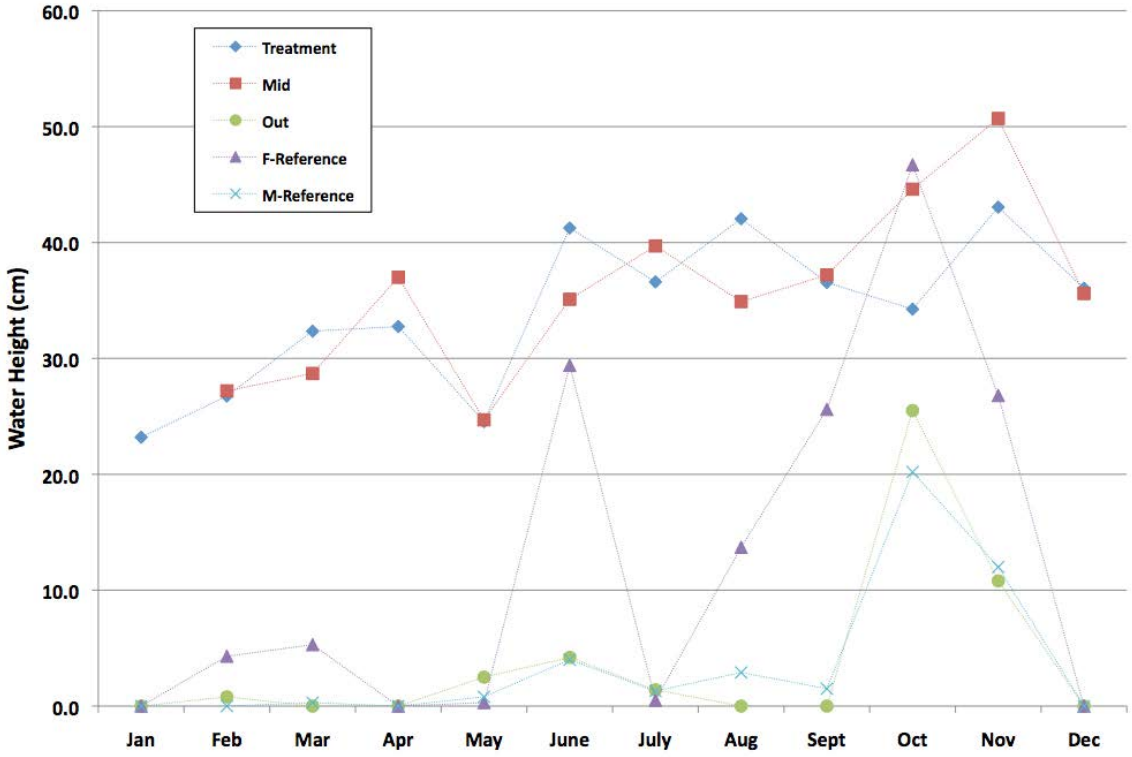


Figure 1. Water depths at the Treatment, Mid, Out, Forested Reference, and Marsh Reference study sites.

NUTRIENT ANALYSIS I (Surface Water)

PARAMETER	NUTRIENT ANALYSIS I (Surface Water)												
	Discharge Area							Reference Area					ANOVA Significant Difference[2] (p=0.05) YES or NO
	UAA Average (mg/L)			Current Average (mg/L)			Difference[1]	UAA Average (mg/L)		Current Average (mg/L)		Difference[1]	
	Treatment Area (mean ± standard error)			Treatment Area (mean ± standard error)				Reference Area (mean ± standard error)		Reference Area (mean ± standard error)			
	TMT	MID	OUT	TMT	MID	OUT		FR[3]	MR[4]	FR	MR		
Total Kjeldahl Nitrogen (TKN)	ND[5]	ND	ND	19.18±6.05	4.42±1.35	1.08±0.44	ND	ND	ND	0.94±0.31	1.07±0.26	ND	FR = Y,N[6] MR = N[7]
Total Phosphorus (TP)	0.46± 0.38	0.11± 0.04	0.11± 0.02	3.88±0.26	3.17±0.29	0.61±0.53	1,1, 0	0.60± 0.49	0.39± 0.29	0.17±0.08	0.25±0.15	0,0	FR = Y,Y MR = N

[1] The difference in the UAA value and the current value shall be indicated by **NO INCREASE=0**, **INCREASE=1**, and **DECREASE=2**.
[2] Analysis of Variance (ANOVA), a significant difference (p=0.05) between the wastewater treatment area and the control area shall be indicated by YES or NO.
[3]Forested Reference.
[4]Marsh Reference.
[5]Not determined because no data were collected during the UAA study.
[6]Treatment and Mid sites compared to the Forested Reference site.
[7]Out site compared to the Marsh Reference site.

NUTRIENT ANALYSIS I (Surface Water) continued:

ANALYSIS OF VARIANCE (ANOVA):

Has there been a significant difference (p=0.05) between the Nutrient Analysis I (Surface Water) in the control and the treatment area?

As indicated in the table as YES or NO.

Mean Total Kjeldahl Nitrogen (TKN) concentration was higher at the Treatment site (19.18±6.05 mg/L) than at the Mid (4.42±1.35 mg/L) and Forested Reference (0.94±0.31 mg/L) sites [F(2,9)=7.3154, p=0.0130]. Mean total phosphorus (TP) concentration was higher at the Treatment (3.88±0.26 mg/L) and Mid sites (3.17±0.29 mg/L) than at the Forested Reference site (0.17±0.08 mg/L) [F(2,9)=64.2878, p=0.0001].

There were no differences detected between the Out (1.08±0.44 mg/L) and Marsh Reference (1.07±0.26mg/L) sites for mean TKN concentration [t(6)=0.0002, p=9889] or mean TP concentration (0.61±0.53 & 0.25±0.15 mg/L, respectively) [t(6)=0.6702, p=0.4443].

If yes, please explain the significant differences between the control and the treatment areas and outline any corrective actions taken, if needed.

As expected, mean TKN concentrations were higher at the Treatment site than at the Mid and Forested Reference sites. This is due to the Treatment site receiving discharge of treated effluent that has higher nutrient concentrations than ambient surface water, and the uptake of these nutrients by the wetlands prior to the water reaching the Mid and Out sites. Mean TP concentration at the Treatment and Mid sites was higher than at the Forested Reference site, reflecting the less efficient uptake of phosphorus compared to nitrogen. Overall, nutrient concentrations declined as effluent flowed from the Treatment to the Out site, indicating a nutrient assimilation gradient as water flows away from the discharge. No corrective actions are needed at this time.

NUTRIENT ANALYSIS II (Surface Water)

PARAMETER	NUTRIENT ANALYSIS II (Surface Water)											
	Discharge Area							Reference Area				
	UAA Average (mg/L)			Current Average (mg/L)			Difference[1]	UAA Average (mg/L)		Current Average (mg/L)		Difference	ANOVA Significant Difference[2] (p=0.05) YES or NO
	Treatment Area (mean ± standard error)			Treatment Area (mean ± standard error)				Reference Area (mean ± standard error)		Reference Area (mean ± standard error)			
	TMT	MID	OUT	TMT	MID	OUT		FR[3]	MR[4]	FR	MR		
Ammonia (NH_3-N)	0.03± 0.02	0.01± 0.005	0.03± 0.01	11.92±3.69	2.27±0.87	0.12±0.05	1,1, 0	0.05± 0.03	0.03± 0.01	0.10±0.01	0.10±0.04	0,0	FR = Y,N[5] MR = N[6]
Nitrate Nitrogen (NO_3-N)	BDL[7]	0.05± 0.02	BDL	0.08±0.03	0.20±0.09	0.06±0.03	1,0, 1	BDL	BDL	0.08±0.02	0.06±0.03	0,0	FR = Y,N MR = N
Nitrite Nitrogen (NO_2-N)	ND[8]	ND	ND	0.02±0.01	0.05±0.02	0.07±0.04	ND	ND	ND	0.01±0.00	0.02±0.01	ND	FR = Y,N MR = N
Phosphate (PO_4-P)	ND	ND	ND	2.87±0.27	2.56±0.19	0.07±0.01	ND	ND	ND	0.07±0.01	0.06±0.02	ND	FR = Y,N MR = N

[1] The difference in the UAA value and the current value shall be indicated by **NO INCREASE=0**, **INCREASE=1**, **DECREASE=2**.
[2] Analysis of Variance (ANOVA), a significant difference (p=0.05) between the wastewater treatment area and the control area shall be indicated by YES or NO.
[3] Forested Reference.
[4] Marsh Reference.
[5] Treatment and Mid sites compared to the Forested Reference site.
[6] Out site compared to the Marsh Reference site.
[7] Below detection limit.
[8] Not determined.

NUTRIENT ANALYSIS II (Surface Water) continued:

ANALYSIS OF VARIANCE (ANOVA):

Has there been a significant difference (p=0.05) between the Nutrient Analysis II (Surface Water) in the control and the treatment area?

As indicated in the table as YES or NO.

Mean NH_3 concentration was higher at the Treatment site (11.92±3.69 mg/L) than at the Mid (2.27±0.87 mg/L) or Forested Reference (0.10±0.01 mg/L) sites [$F(2,9)=8.2618$, $p=0.0092$]. Mean PO_4 exhibited the same pattern of higher concentrations at the Treatment site (2.87±0.27 mg/L) compared to the Mid (2.56±0.19 mg/L) and Forested Reference (0.07±0.01 mg/L) sites [$F(2,9)=64.4918$, $p=0.0001$]. There were no significant differences detected among any of the sites for mean NO_2 [$F(2,9)=2.8866$, $p=0.1075$] or NO_3 [$F(2,9)=1.5108$, $p=0.2718$] concentrations.

Between the Out and Marsh Reference sites there were no significant differences detected in mean NH_3 [$t(6)=0.1716$, $p=6931$] , NO_2 [$t(6)=1.3902$, $p=0.2830$], NO_3 [$t(6)=0.0000$, $p=1.0000$], or PO_4 [$t(6)=0.1381$, $p=0.7229$] .

If yes, please explain the significant differences between the control and the treatment areas and outline any corrective actions taken, if needed.

Mean NH_3 and PO_4 concentrations were higher at the Treatment site and Mid sites than at the Forested Reference site and this is as expected since the Treatment site receives discharge of treated effluent that is higher in NH_3 and PO_4 concentrations than ambient surface water, and the wetland takes up these nutrients as water flows through the assimilation wetlands. No corrective actions are needed at this time.

NUTRIA ASSESSMENT DISCUSSION

Along with normal field activities during 2017, Comite Resources completed ten nutria control trips. A permitted Nuisance Wildlife Control Operator handled all nutria in accordance with Department of Wildlife and Fisheries procedures. 12 Nutria were shot at the assimilation wetland in 2017.

REFERENCES

Shaffer, G.P., J.W. Day, R.G. Hunter, R.R. Lane, C.J. Lundberg, W.B. Wood, E.R. Hillman, J.N. Day, E. Strickland, and D. Kandalepas. 2015. System response, nutria herbivory, and vegetation recovery of a wetland receiving secondarily-treated effluent in coastal Louisiana. Ecological Engineering 79:120-131.

Shaffer, G.P., J.W. Day, D. Kandalepas, W.B. Wood, R.G. Hunter, R.R. Lane, and E.R. Hillman. 2016. Decline of the Maurepas Swamp, Pontchartrain Basin, Louisiana, and approaches to restoration. Water 8:101, doi:10.3390/w8030101.