Appendix 4

Draft General Conformity Determination

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US Army Corps of Engineers ®
Galveston District

Draft General Conformity Determination for Houston Ship Channel Project Deficiency Report (Flare at the Intersection of the Houston Ship Channel and Bayport Ship Channel)

Chambers County, Texas

Prepared for:

U.S. Army Corps of Engineers, Galveston District

Provided by:

The Port of Houston Authority

Prepared by:

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September 2015

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1 INTRODUCTION

The U.S. Army Corps of Engineers (USACE), Galveston District is proposing to implement a Preferred Alternative ("the Proposed Project") to correct deficiencies in the Houston Ship Channel (HSC) as recommended in the HSC Project Deficiency Report (PDR) for the HSC Flare at the Intersection of the HSC and Bayport Ship Channel (BSC). The Proposed Project is a Federally-proposed action to dredge portions of the HSC to wider dimensions to correct deficiencies in the exiting channel that pose navigation safety issues. In accordance with the General Conformity (GC) regulations promulgated under the Clean Air Act in 40 CFR Part 93 Subpart B, Determining Conformity of Federal Actions to State or Federal Implementation Plans (EPA 2010a), this Draft General Conformity Determination (GCD) has been prepared to analyze and document the GC-related air emissions that will result from the proposed project and document that these emissions conform to the last U.S. Environmental Protection Agency (EPA) approved State Implementation Plan (SIP) applicable to the Houston/Galveston/Brazoria (HGB) ozone non-attainment area (NAA).

1.1 Project Background

The HSC consists of a 45-foot deep, 530-foot wide channel throughout the Galveston Bay reach, including the reach which intersects the BSC. Additionally, a 250-foot wide barge lane is currently maintained on the east side of the HSC to separate the faster, deep-draft ship traffic from the slower, shallow-draft barge traffic. The BSC is a 4.1-mile-long deep-draft waterway that extends from the HSC at Mile 20.5, west across Galveston Bay. At its confluence with the BSC, the HSC has a Flare with a current radius of 3,000 feet that is a deepened and curving part of the channel that provides a turning lane for vessels turning out of/in to the HSC onto/out of the BSC. The BSC is currently maintained at a depth of 40 feet mean low tide (MLT) and a width of 300 feet and terminates at a 40-x-1,600-foot turning basin. It is currently being deepened to -45 feet MLT (plus two feet of advanced maintenance and two feet of allowable overdredge), and widened by 100 feet in the open bay reach and by 50 feet inside of the land cut (the land-locked portion).

The current channel configuration contributes to navigational deficiencies from vessels turning from the HSC into the BSC. When vessels traveling north-south along the HSC have to turn onto the BSC which runs east-west, these vessels must slow significantly to make the turn because of the "angle of attack" required in maneuvering through the turn via the existing Flare. Additionally, inbound vessels on the HSC turning into Bayport must make two course changes (an S-curve) in a short distance because of the dogleg in the HSC near its intersection with the BSC. The required slow speed of the turning vessel results in loss of some maneuverability and the need for tug assistance. The average vessel uses two tugs to facilitate the turn. When making the turn, the ship must angle into the Bayport Channel, which can result in the stern of the ship swinging into the east bank of the HSC. Without tug assist, these vessels cannot make this turn under the present configuration.

Additionally, this area is designated a "precautionary zone" because of the high concentration of traffic and safety risks associated with the congestion. This precautionary zone is designated by the 33 Code of Federal Regulations (CFR) Section 161.35 – "Navigation and Navigable Waterways, Vessel Traffic Management, Vessel Traffic Service Houston/Galveston" and is defined as "a routing measure comprising an area within defined limits where vessels must navigate with particular caution and within which the direction of traffic may be recommended." As such,

additional communication and coordination with the U.S. Coast Guard is required by law to ensure channel safety among all vessels. This designation indicates the need for additional safety measures to prevent incidents and also supports the continued need for a separation of barge traffic from the larger vessels in the area.

Normal atmospheric conditions often include winds from the south or the north, which further contributes to the maneuverability problem. Channel traffic includes deep-draft vessels on the BSC and HSC, as well as barge traffic throughout the area. Currently the situation is controlled by traffic management systems and pilot-to-pilot coordination to facilitate movement of the vessels into and out of Bayport. Aside from basic traffic "rules of the road," there is no legal control over the barge traffic.

1.1.1 Project Description, Purpose, and Need

The Proposed Project consists of dredging to increase the existing southern radius of the Flare to 4,000 feet, widening the HSC by a maximum 235 feet to the east between about HSC Station 26+484 and HSC Station 30+090, and relocating the existing barge lanes to accommodate the widened HSC. The barge lanes will be relocated to the east of the HSC widening and consistent with the original design, by means of a transition with a maximum width of approximately 235 feet. The project location is shown in Figure 1, and the Proposed Project is illustrated in Figure 2.

New work material dredged from the project would be hydraulically placed in the existing Placement Area (PA) 14 in a berm along the interior of the perimeter dike. The berm would provide increased future dike foundation strength by displacing and consolidating some of the existing softer materials beneath the berm, provide a base upon which to build future dike raises, and provide desirable clay soils for future dike raises. The upland confined Mid Bay PA would be considered as an alternate location for new work placement should unforeseen circumstances occur prior to construction precluding the use of or limiting the capacity of PA 14, provided the material is similarly placed within the upland confined Mid Bay PA on the interior slope of the existing perimeter dike to form a berm, where it may also be used for future dike raising construction.

Maintenance materials would be placed in nearby HSC PAs and Beneficial Use (BU) sites, including existing PA 15, PA 14, Mid Bay PA, Atkinson Island BU Marsh Cells M7/8/9, and M10, as well as any other existing Atkinson Island BU Marsh Cells requiring renourishment. The future PA 15/PA 14 connection would also be utilized for maintenance.

The purpose of the proposed project is to correct a design deficiency and conduct a corrective action through a channel modification required to make the project function on an interim basis as initially intended in a safe, viable, and reliable manner. The ultimate fix will require a study of the HSC within Galveston Bay to address potential channel widening, passing lanes, and anchorage areas. The study will be conducted under the authority of section 216 of the Flood Control Act of 1970, Review of Completed Projects. In the interim, the recommendation is to prepare a PDR to document the scope of the plan to alleviate the navigation safety concerns in the vicinity of the intersection of the HSC and BSC. The HSC contains a deficiency inherent in the design in the Houston-Galveston Navigation Channels, Texas, Limited Reevaluation Report and Final Supplemental Environmental Impact Statement completed in November 1995 (1995 LRR/SEIS). The Houston-Galveston Navigation Channels, Texas, Project (HGNC) was authorized in the Water

Resources Development Act of 1996 (WRDA 1996), Section 101(a)(30), P.L. 104-303. The channel design for the HGNC did not fully account for impacts of the channel improvements within the HSC in the vicinity of the Bayport Ship Channel (BSC). A hazardous and unacceptable navigation condition has resulted. Increased traffic and vessel size afforded by the channel improvements authorized by WRDA 1996 has increased the potential for collisions and accidents within this section of the HSC. The intersection of the HSC and BSC has been a major safety concern for over a decade.

The need for the project is demonstrated by five project deficiency criteria in Engineer Regulation (ER) 1165-2-119, *Modifications to Completed Projects*. These are 1) a requirement to make the project function as initially intended by the designer in a safe, viable and reliable manner, 2) the need to address deficiencies associated with the current (and not changed) conditions, 3) a need to correct deficiencies of existing project features, 4) justification by safety considerations, and 5) the project is required, not due to inadequate maintenance, whether by local or Federal interests, but by deficiencies inherent in the design of the existing channel.

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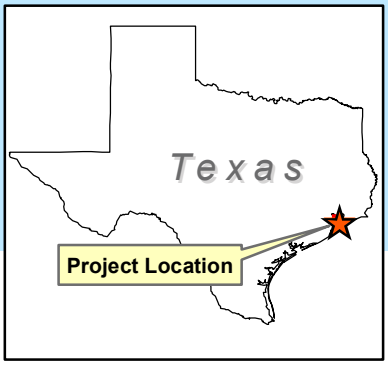

GENERAL NOTES

1. Project limits & features are shown for illustrative purposes only.
2. Proposed project extent shown is to toe line.

Legend

Proposed Project Footprint

- Flare Easing
- Channel Widener and Barge Lane Relocation

Proposed Dredged Material Placement

- New Work
- Maintenance
- Existing Channel Alignment

HSC PDR FLARE AT BAYPORT
Draft General Conformity Determination

Project Vicinity Map

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date September 2015	Job No. 60345436	Figure 1

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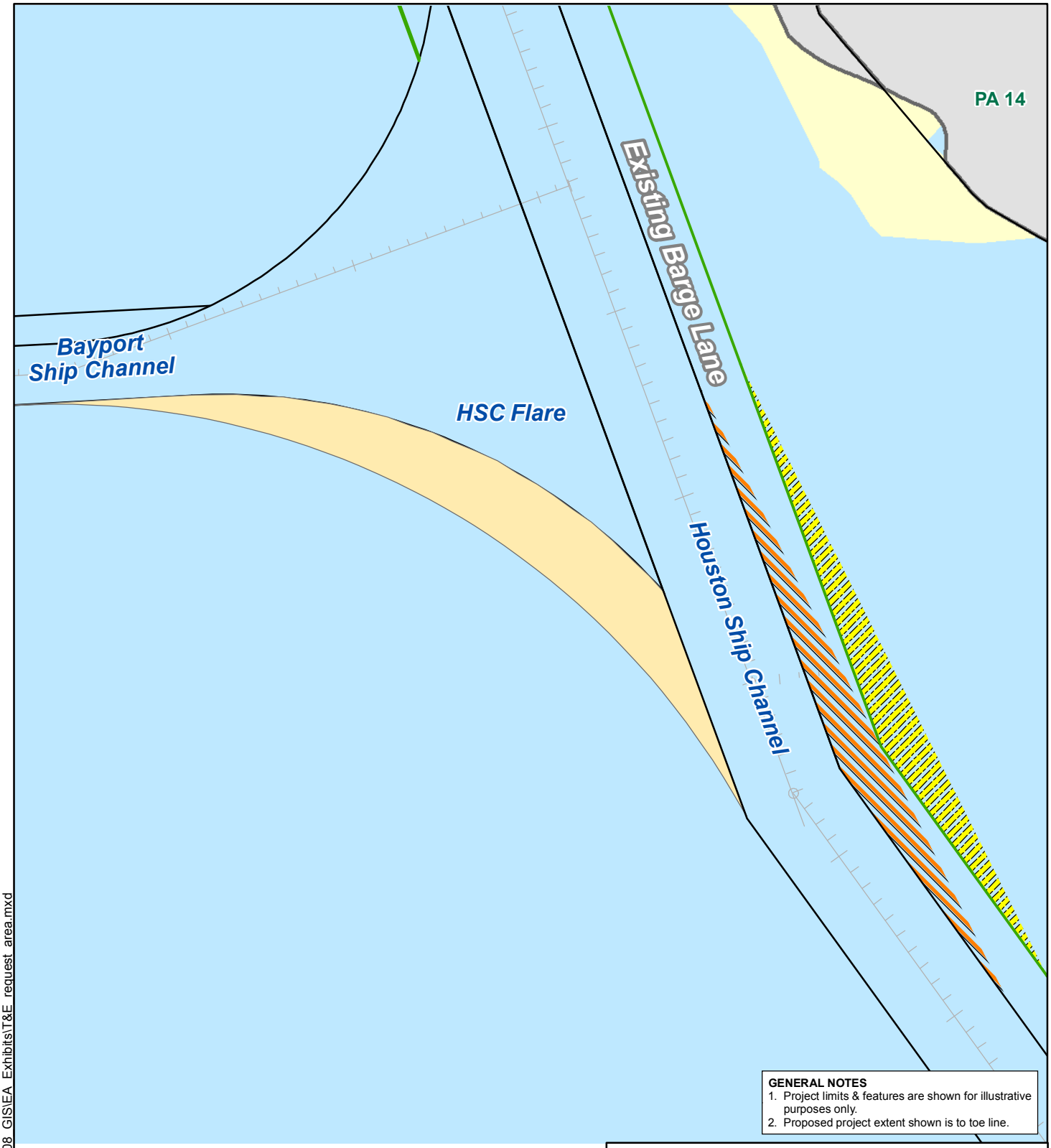

GENERAL NOTES
1. Project limits & features are shown for illustrative purposes only.
2. Proposed project extent shown is to toe line.

Legend

- Existing Barge Lane Toe
- Existing Main Channel Toe
- Barge Lane Relocation
- Main Channel Widener
- Flare Easing

N W E S

0 500
Feet

HSC PDR FLARE AT BAYPORT
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Project Area and Proposed Project

Turner Collie & Braden Inc.
GAHAGAN & BRYANT ASSOCIATES

Date September 2015 | Job No. 60345436 | Figure 2

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1.2 Regulatory Background

General Conformity is a Federal regulatory program designed to ensure that actions taken by Federal entities, such as permits issued by the USACE, do not hinder states' efforts to meet the national ambient air quality standards (NAAQS). The definition of a Federal action as specified in 40 CFR 93.152 includes "…a permit, license, or other approval for some aspect of a nonfederal undertaking, (and) the relevant activity is the part, portion, or phase of the nonfederal undertaking that requires the federal permit, license, or approval."

With regard to a dredging project such as the Proposed Project, the Federal Action consists of a Federal project being funded and implemented by the USACE, which is subject to General Conformity review. Placement of dredged material is part of the proposed Federal Action, and is subject to General Conformity. Maintenance dredging is not subject to General Conformity review.

The EPA has established a series of steps to determine whether a given Federal Action is subject to General Conformity review as follows (EPA 2010b).

1. Whether the action will occur in a nonattainment or maintenance area (see **Table 1-1** below for the attainment status of the project area);
2. Whether one or more of the specific exemptions apply to the action;
3. Whether the federal agency has included the action on its list of "presumed to conform" actions;
4. Whether the total direct and indirect emissions are below or above the *de minimis* levels (see **Table 1-2** below for the *de minimis* levels); and/or
5. Where the facility has an emission budget approved by the state as part of the SIP, the federal agency determines if the emissions from the proposed action are within the budget.

Regarding the Proposed Project to implement the corrective actions recommended by the PDR,

1. The action will be occurring in the 8-county Houston-Galveston-Brazoria (HGB) ozone nonattainment area, which is designated as marginal nonattainment for the 2008 ozone standard;
2. None of the specific exemptions apply to the action, except to the extent that any of the dredging to be carried out is maintenance dredging, which is specifically exempt;
3. The USACE has not included dredging projects on a list of "presumed to conform" actions;
4. Total direct and indirect emissions, as currently estimated, will exceed the *de minimis* level of 100 tons of oxides of nitrogen (NO_x) in a marginal nonattainment area. (see **Table 2-1** in Section 2 for estimated project related emissions); and
5. The USACE does not possess an emissions budget approved as part of the HGB area SIP.

Based on the discussion presented above and the emissions presented below in Section 2, a General Conformity determination is required for NO_x emissions from the proposed project. Since the action is required to demonstrate conformity, one or more of the following conditions must be met (EPA 2010b).

1. Demonstrating that the total direct and indirect emissions are specifically identified and accounted for in the applicable SIP;
2. Obtaining a written statement from the state documenting that the total direct and indirect emissions from the action, along with all other emissions in the area, will not exceed the SIP emission budget;
3. Obtaining a written commitment from the state to revise the SIP to include the emissions from the action;
4. Obtaining a statement from the metropolitan planning organization (MPO) for the area documenting that any on-road motor vehicle emissions are included in the current regional emission analysis for the area's transportation plan or transportation improvement program;
5. Fully offsetting the total direct and indirect emissions by reducing emissions of the same pollutant or precursor in the same nonattainment or maintenance area.

A sixth potential demonstration method, conducting air quality modeling that demonstrates that the emissions will not cause or contribute to new violations of the standards, or increase the frequency or severity of any existing violations of the standards, is not available for the proposed project, because modeling is not acceptable for ozone nonattainment areas due to the complexity of ozone formation from precursor pollutants and the limitations of current air quality models.

Of the options detailed above, the USACE elected to utilize the second option, obtaining concurrence from the Texas Commission on Environmental Quality (TCEQ) that the total direct and indirect NO_x emissions from the action will not exceed the applicable SIP emissions budget, because of the very low level of emissions compared with the SIP budget, and the temporary nature of the emissions.

Table 1-1: Attainment Status of Houston-Galveston-Brazoria Area

Pollutant	Primary NAAQS	Averaging Period	Designation	Counties	Attainment Deadline
Ozone (O_3)*	0.075 ppm (2008 standard, not final)	8-hour	Marginal Nonattainment	*	July 20, 2015**
Lead (Pb)	0.15 µg/m^3 (2008 std)	Rolling 3-Month Avg.	Attainment/Unclassifiable		
	1.5 µg/m^3 (1978 std)	Quarterly Average	Attainment/Unclassifiable		
Carbon Monoxide (CO)	9 ppm	8-hour	Attainment/Unclassifiable		
	(10 mg/m^3)				
	35 ppm	1-hour	Attainment/Unclassifiable		
	(40 mg/m^3)				
Nitrogen Dioxide (NO_2)	0.053 ppm (100 µg/m^3)	Annual	Attainment/Unclassifiable		
	100 ppb	1-hour	Pending		
Particulate Matter (PM_{10})	150 µg/m^3	24-hour	Attainment/Unclassifiable		
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3	Annual (Arith. Mean)	Attainment/Unclassifiable		
	35 µg/m^3	24-hour	Attainment/Unclassifiable		
Sulfur Dioxide (SO_2)	0.03 ppm	Annual (Arith. Mean)	Standard Revoked August 23, 2010		
	0.14 ppm	24-hour	Standard Revoked August 23, 2010		
	75 ppb	1-hour	Pending		

*Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller Counties
**On February 27, 2015, TCEQ requested a one year attainment data extension to July 20, 2016 in accordance with CAA §81(a)(5). In response, EPA has proposed granting the one year extension to eight Marginal NAAs, including the HGB NAA (Federal Register Volume 80 Issue 166 [Thursday, August 27, 2015] Pages 51992-52002)
Source of table: http://www.tceq.texas.gov/airquality/sip/hgb/hgb-status

Table 1-2: Significant Action Thresholds in Nonattainment Areas

Ambient Pollutant	Nonattainment Status	Tons/yr
Ozone (VOCs or NO_x):		
	Serious NAA's	50
	Severe NAA's	25
	Extreme NAA's	10
	Other ozone NAA's outside an ozone transport region	**100**
	Other ozone NAA's inside an ozone transport region	
	VOC	50
	NO_x	100
Carbon monoxide:	All NAA's	100
SO_2 or NO_2	All NAA's	100
PM–10:		
	Moderate NAA's	100
	Serious NAA's	70
PM–2.5:		
	Direct emissions	100
	SO_2	100
	NO_x (unless determined not to be a significant precursor)	100
	VOC or ammonia (if determined to be significant precursors)	100
Pb:	All NAA's	25

Source of table: 40 CFR §93.153 Applicability. (Amended to include PM2.5)

2 PROJECT CONSTRUCTION EMISSIONS

Project construction emissions of NO_x and VOCs have been estimated because of the Project area's status as an ozone nonattainment area. The emission estimates are based on equipment and activity estimates provided by the project engineers and emission factors and other information from published sources, including the applicant's recently released air emissions inventory, *2007 Goods Movement Air Emissions Inventory at the Port of Houston* (Starcrest 2009), and the emission estimating model MOVES2014. Use of the Goods Movement Emissions Inventory (GMEI) as a source of emission factors and other emissions-related information ensures that the emission estimates presented in this conformity determination are consistent with the applicant's port-wide inventory of air emissions.

The project emissions presented in Table 2-1 have been based on operational and equipment assumptions developed as part of the detailed project planning process, and on published emission factors and other emission-related operational information. Diesel engines used in dredging and placement work have been assumed to be "Tier 1" level engines while the passenger cars and light duty trucks used in employee commuting have been assumed to be typical of the general fleet, using default settings for Harris County, TX in the MOVES2014 model. Details of the emission estimates can be found in Attachment A and in the GMEI report. Note that maintenance dredging to be conducted on the enhanced channel after completion of the proposed project has not been included in these emission estimates because maintenance dredging is not subject to General Conformity review.

Table 2-1: Estimated Emissions from Proposed Project Construction (Tons Per Year)

Component of Work	2016		2017		Total	
	NO_x	VOCs	NO_x	VOCs	NO_x	VOCs
Dredging	186.3	7.4	0.0	0.0	186.3	7.4
Support Vessels	115.0	4.6	0.0	0.0	115.0	4.6
Placement Site Work	0.8	0.1	4.1	0.6	4.9	0.7
Employee Vehicles	0.2	0.04	0.1	0.01	0.3	0.05
Oyster Mitigation	2.4	0.2	0.0	0.0	2.4	0.2
Total	**304.7**	**12.4**	**4.2**	**0.6**	**308.9**	**13.0**

2.1 Dredging Equipment and Supporting Vessel Emissions

Emission sources on the dredge itself consist of diesel-fueled engines that provide power for the various operations required for dredging. The dredge is expected to be a cutter suction dredge equipped with a main engine to provide power to the cutterhead, an engine to power the ladder

pump used to transport the dredged material from the substrate to the surface, an engine to move and position the ladder that guides and positions the cutterhead, and an auxiliary engine to produce electricity for power needs on the dredge. The dredging operation will also require various support vessels such as positioning tugs, crew boats, and survey boats.

The project engineers provided estimated characteristics of the diesel engines on board the dredge such as total horsepower, operating hours, and average operating loads. They also provided typical characteristics of the support vessels, including total installed horsepower and operating hours. Emission factors for all of these diesel engines were obtained from the "harbor craft" section of the GMEI, which lists emission factors for marine engines of various sizes and emission tier levels.

2.2 Dredged Material Placement Site Work

Once the dredged material has been placed in the placement area it will be moved and compacted by non-road equipment such as dozers and loaders. The project engineers provided typical horsepower and operating hours of this type of equipment, and average load factors were obtained from the GMEI. Emission factors were based on the emission certification levels of Tier 1 non-road equipment. Dredged material placement and handling will account for a small percentage (approximately 1.6%) of overall project construction NO_x emissions and approximately 5.5% of VOC emissions.

2.3 Employee Vehicle Commuting

Although a very small part of overall project construction emissions, an estimate has been prepared of emissions from the vehicles of workers commuting to and from the job sites. These emissions were estimated using the MOVES2014 emission estimating model, using the model's estimates for light-duty gas vehicles and light-duty gas trucks, the most likely vehicle types used for commuting. Commuting distance was based on the average commuting distance in Houston according to the Texas Transportation Institute (TTI 2011). On-road vehicle commuting will account for less than 0.1% of overall project construction NO_x emissions and approximately 0.4% of VOC emissions.

3 GENERAL CONFORMITY EVALUATION

As noted in Section 1 (Introduction) and illustrated in Table 2.1 only emissions of NO_x exceed the applicable General Conformity threshold. Therefore, this section addresses NO_x emissions with respect to General Conformity requirements. To demonstrate that the project construction NO_x emissions can be accommodated in the HGB SIP emissions budgets, the most recent EPA-approved ozone SIP demonstration documents were reviewed for emissions inventory information. In consideration of the definition and conformity determination requirements for the most recent revisions to the SIP in 40 CFR §93.152 and §93.158(a)(5)(i)(A) respectively, the latest approved revision to the SIP is the *Emissions Inventory State Implementation Plan Revision for the 2008 Eight-Hour Ozone National Ambient Air Quality Standard for the Houston-Galveston-Brazoria and Dallas-Fort Worth Areas*, approved on April 21, 2015. This revision contains emission inventories for the Year 2011. However, the two previous revisions contained emission inventories for the Year 2018, which is temporally closer to the projected construction Year 2016 for the Proposed Project. Overall, the emissions are also more restrictive (i.e. conservative) for purposes of this comparison, because they are lower, reflecting the expected phase-in of better mandatory emissions reduction technology in future years. Therefore, these 2018 inventories would provide a more appropriate and conservative comparison for demonstration purposes. In consultation with the TCEQ and EPA Region 6, these SIP revisions were selected for demonstrating conformity. The two previous revision documents are the *2010 HGB Attainment Demonstration SIP Revision for 1997 Eight-Hour Ozone* approved by EPA on January 2, 2014, used for marine and non-road mobile sources, and the *2013 HGB MVEB Update SIP Revision for the 1997 Eight-Hour Ozone*, approved by EPA on January 2, 2014, used for on-road mobile sources.

These SIP demonstrations[1] were reviewed to determine the various activity categories of emissions in which the proposed project's construction activities will fall. While the SIPs evaluate NO_x emissions from all sources, including biogenic (non-human-caused) emission sources, this evaluation focuses on the categories most relevant to the proposed project construction emissions, specifically the Construction and Mining and the Commercial Marine categories. Employee commuting emissions have been compared with the SIP's on-road mobile source emissions.

The emissions budgets for the Commercial Marine, Construction and Mining, and on-road Mobile Sources emission budgets in the SIP are presented in Table 3-1. The SIPs' budget projections for 2018 are presented and used for the demonstration because they are the closest in calendar year to the Project's scheduled work. Note, however, that the Project is anticipated to be completed prior to 2018.

[1] *2010 HGB Attainment Demonstration SIP Revision for 1997 Eight-Hour Ozone* adopted by TCEQ on March 10, 2010 and approved by EPA on January 2, 2014 for marine and non-road mobile sources, and the *2013 HGB MVEB Update SIP Revision for the 1997 Eight-Hour Ozone* adopted by TCEQ on April 23, 2013 and approved by EPA on January 2, 2014 for on-road mobile sources.

Table 3-1: Applicable SIP NO_x Emissions for 2018

Categories	2018 Emissions (tpd) NO_x
Commercial Marine	39.24
Construction and Mining	14.68
On-road Mobile Sources	103.34
Totals	**157.26**

Table 3-2 presents the proposed project construction emissions in average tons per day and compares these estimates with the 2018 emissions corresponding to the SIP demonstration.

Table 3-2: Comparison of Proposed Project Emissions with Modeled SIP Emissions Budgets (Tons per Day)

Project Activities*	SIP Inventory Categories	2016 Project NO_x Emissions (tpy)_	(tpd)	HGA SIP 2018 NO_x Emissions Budget (tpd)	% of Budget
Dredging Activities (dredge, support vessels)	Commercial Marine Vessels	302.3	0.83	39.24	2.1%
Land-side Activities (dredged material placement)	Construction and Mining	2.2	0.006	14.68	0.04%
On-road Activities (employee commuting)	On-road Mobile Sources	0.2	0.0005	103.34	0.0005%
Overall Totals		**304.7**	**0.84**	**157.26**	**0.5%**

*For comparison to SIP Inventory Categories, oyster mitigation emissions have been broken out and incorporated into these activities, and are not shown separately.

Overall, the proposed project construction emissions of NO_x represent only 0.5% of emissions from marine, construction, and on-road sources modeled in the SIP for 2018. Emissions from the dredging equipment itself, plus support vessels, represent 2.1% of the commercial marine vessel NO_x emissions modeled in the SIP, while emissions from construction equipment represent 0.04% of construction and mining NO_x emissions. As noted earlier, the applicant is seeking TCEQ concurrence that the NO_x emissions representing these low percentages will not hinder timely attainment of the 2008 8–hour ozone standard.

4 PRELIMINARY GENERAL CONFORMITY DETERMINATION

Section 3 presented the estimated direct and indirect emissions from construction of the project and a comparison to the latest EPA approved SIP emissions budgets for the relevant categories. In summary, the project construction NO_x emissions constitute 2.1% of the Commercial Marine Vessels budget and 0.5% of the total budget of the EPA approved HGB SIP. Though the emissions exceed the *de minimis* conformity threshold for NO_x, they constitute a small percentage of the latest EPA-approved SIP budget emissions.

The PHA and its consultants, on behalf of the USACE, presented the estimated preliminary NO_x and VOC project construction emissions and comparison with the SIP to the TCEQ in a June 16, 2015 meeting to discuss the preliminary draft General Conformity analysis results. Information presented during the meeting indicated that the estimated NO_x project construction emissions were a small percentage of the SIP budget, and that the emissions would be anticipated to be accommodated in the latest approved EPA SIP. The USACE has submitted a letter dated August 25, 2015 summarizing the NO_x and VOC emissions and information presented at the June 16, 2015 meeting, and requesting concurrence with the determination that since the estimated project NO_x emissions represented a low percentage of SIP budget emissions that the emissions can be accommodated in the SIP (reference Attachment B).

Pursuant to the General Conformity Rule (40 CFR 51.851) and associated regulations (40 CFR 93), this Draft GCD has been produced to demonstrate that the emissions of the Proposed Project would comply with the requirements of the General Conformity Rule, and would be in conformity with the SIP (EPA 2010a). The TCEQ General Rule §101.30, Conformity of General Federal Actions to State Implementation Plans, which specified State obligations under General Conformity of Federal actions, was repealed in 2011 due to repeal of most of 40 CFR Part 51. The repeal was submitted to the EPA as a revision to the SIP (State of Texas Secretary of State 2011 Page 2817). However, the relevant obligations are superseded and incorporated into 40 CFR Part 93, Subpart B, which specifies at 40 CFR 93.158(a)(5)(i)(A) that the state must make a determination and document that the total of direct and indirect emissions from the action, or portion thereof, would result in a level of emissions which, together with all other emissions in the HGB NAA, would not exceed the emissions budgets specified in the SIP. Given the temporary nature and small percentage of regional emissions budget that the Proposed Project emissions represents, USACE anticipates that the emissions will conform to the latest EPA-approved SIP. Therefore, the preliminary determination is that the project emissions resulting from the Federal action will result in a level of emissions, which, together with all other emissions in the HGB NAA, would not exceed the emissions budgets specified in the SIP, and the action can be considered to conform with the HGB NAA SIP. A copy of this Draft General Conformity Evaluation report is being provided to the TCEQ, concurrent with the public and agency review period for the Draft EA for the proposed project. Public notice of the availability of this Draft GCD is also being made via public notices in the Houston Chronicle. Copies of the notices and affidavits of publishing will be included in the Final GCD.

This determination will serve as the basis for making a Final GCD for the Proposed Project. Following receipt of the TCEQ's response to USACE's request for a determination of conformity to the latest EPA-approved SIP budget, and following the 30-day public review period for the Draft GCD, a Final GCD will be prepared, containing responses to TCEQ and

public comments, and any necessary revisions to the GCD and determination of conformity. The determination and the availability of the Final General Conformity Determination will be advertised in a public notice within 30 days of its issuance, in accordance with the requirements in 40 CFR Part 93.

5 REFERENCES

Starcrest Consulting Group, LLC. 2009. 2007 Goods Movement Air Emissions Inventory at the Port of Houston.

State of Texas, Secretary of State. 2011. Texas Register, Volume 36, Number 18, Pages 2793-3060, May 06, 2011. University of North Texas Libraries, Government Documents Department, Denton, Texas. Available at: http://texashistory.unt.edu/ark:/67531/metapth176618/ (accessed November 28, 2012).

Texas Transportation Institute, 2011. 2011 Urban Mobility Report. Available at: http://tti.tamu.edu/documents/mobility-report-2011.pdf (Accessed December 2011).

U.S. Environmental Protection Agency (EPA). 2010a. Title 40: Protection of Environment, Part 93 – Determining Conformity of Federal Actions to State or Federal Implementation Plans, Subpart B – Determining Conformity of General Federal Actions to State or Federal Implementation Plans.

EPA. 2010b. Revisions to the General Conformity Regulations. EPA-HQ-OAR-2006-0669. Available at: www.epa.gov/airquality/genconform/documents/20100324rule.pdf (Accessed November 2011).

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ATTACHMENT A
Emissions Estimate Detail for Draft General Conformity Determination
Houston Ship Channel (HSC) Project Deficiency Report (PDR) for the HSC Flare at the Bayport Ship Channel
DRAFT
22 July 2015

The U.S. Army Corps of Engineers (USACE) is proposing a project to address the navigation deficiencies identified in the Houston Ship Channel (HSC) Project Deficiency Report (PDR). Planning for these improvements has included the development of estimates of air emissions associated with the construction phase of the project, which will consist primarily of the dredging and associated work needed to make the improvements, and land-side work to place the dredged material in existing dredged material placement areas.

Emission estimates have been prepared for the dredging and associated activities in support of a Draft General Conformity Determination (GCD) that has been prepared in accordance with the General Conformity (GC) regulations promulgated in 40 CFR Part 93 (Determining Conformity of Federal Actions to State or Federal Implementation Plans). The determination evaluates and documents the GC-related air emissions that will result from the proposed project and documents that these emissions conform to the current State Implementation Plan (SIP) applicable to the Houston/Galveston/Brazoria (HGB) ozone non-attainment area.

The emission estimates used in these evaluations have been based on project-specific activity information and on emissions information drawn from published sources including the *2007 Goods Movement Air Emissions Inventory at the Port of Houston* (GMAEI) Starcrest 2009, and the emission estimating model MOVES2014.

General Conformity Evaluation for Construction Emissions

The information needed to estimate construction emissions for the proposed project includes the following:

- A description of the equipment that will be needed, in terms of type, horsepower, age, and other characteristics;
- Estimates of the operating time (e.g., hours per day, days per week, etc.) of each type of equipment during each phase or component of work;
- Emissions characteristics (emission factors) of each type of equipment;
- Emission calculation methods and equations.

Additionally, assumptions have been made regarding the number of employee commuting days to develop estimates of on-road emissions associated with the project.

Information related to the physical and operational characteristics of the equipment has been developed by the project engineers. The physical information includes the type of

equipment (e.g., dredge, supporting tug boat, dozer), the type of engine on that equipment (e.g., main engine, auxiliary engine) for equipment with more than one engine, the typical rated horsepower for the type of equipment and engine, and, for the dredge and booster pump, the average in-use load factor, which is the average percentage of full power at which the engine is typically operated. The load factors used for tugs and land-side equipment have been obtained from the GMAEI. A summary of the physical and operational characteristics is presented in Table 1 for equipment associated with the dredging and land-side dredged material management, and in Table 2 for equipment associated with the construction of oyster reef mitigation.

The emission factors have primarily been obtained from the harbor craft section of the GMAEI. This includes the marine vessels used in the construction of oyster reef mitigation for the project. The report lists emission factors for engines in various size and horsepower ranges, and three different "tier levels," which reflect emission standards effective when the engines were manufactured. Because the specific equipment to be used on the proposed project is not known, the engines are assumed to be Tier 1 engines, manufactured in approximately the 2000 to 2005 time frame. Emission factors for the land-side equipment (dozers and loaders) have been based on the Tier 1 emission standards for non-road diesel engines. This includes the similar equipment (e.g. excavators) used in the construction of oyster reef mitigation for the project. Emission factors for on-road vehicles used in employee commuting and oyster reef mitigation have been based on the emission estimating model MOVES2014. Employee vehicles are assumed to be a mix of gasoline passenger cars and light pickup trucks, while the pickup truck associated with oyster mitigation is assumed to be a light commercial pickup truck. Table 3 lists the emission factors used in developing the emission estimates.

Emissions from dredges, vessels, and land-side non-road equipment have been estimated using the basic equation:

$$E = \frac{hp \times LF \times hrs \times EF}{(453.59\ g/lb \times 2{,}000\ lb/ton)}$$

where:

E	=	emissions, tons per year
hp	=	rated horsepower of the engine
LF	=	load factor
hrs	=	hours of operation per year
EF	=	emission factor, grams per horsepower-hour
453.59 g/lb	=	conversion constant
2,000 lb/ton	=	conversion constant

As an example, a large tug used as a support vessel may have a main engine rated at 3,000 hp. The average load factor is estimated to be 69%, and it would be expected to operate on this project for 3,864 hours in a year. The Tier 1 emission factor for oxides of nitrogen (NO_x) for this engine is 7.3 g/hp-hr. The estimated emissions would be:

$$E = \frac{3{,}000\ hp \times 0.69 \times 3{,}864\ hrs/yr \times 7.3\ g/hp\text{-}hr}{(453.59\ g/lb \times 2{,}000\ lb/ton)} = 64.4\ tons/yr$$

Emissions from on-road vehicles used by employees while commuting to the job site have been estimated using the equation:

$$E = VMT \times EF \ / \ (453.59\ g/lb \times 2{,}000\ lb/ton)$$

where:

E	=	emissions, tons per year
VMT	=	vehicle miles of travel during the year
EF	=	emission factor, grams per mile of travel
453.59 g/lb	=	conversion constant
2,000 lb/ton	=	conversion constant

The VMT driven by employees has been calculated using the average commuting distance in the Houston area in 2010 (21.2 miles, one way) from the 2011 Urban Mobility Report prepared by the Texas Transportation Institute[1] and an estimate of the number of workers on each task and each work shift (a total of 55 workers over three shifts). With the assumption that the commuting employees would use a combination of gasoline fueled light duty cars and trucks, the average NO_x emission factor is 0.359 grams per mile (g/mile). An example of the commuting emission estimating method is as follows:

$$E = \frac{375{,}452\ miles/year \times 0.359\ g/mile}{(453.59\ g/lb \times 2{,}000\ lb/ton)} = 0.15\ tons/yr$$

Tables 4 and 5 present the emission estimates of NO_x and VOCs, respectively, developed using the methods discussed above. Subtotal and total rows may not exactly match the sums of individual line items due to the effects of rounding of values.

[1] Texas Transportation Institute, TTI's 2011 Urban Mobility Report. September 2011. Available at: http://tti.tamu.edu/documents/mobility-report-2011.pdf

Table 1: Summary of Equipment Physical and Operational Characteristics

Emission Source Description	Marine Engine Category[1]	Rated Horsepower (total)**	Load Factor	Daily Operating Hours	Weekly Operating Hours
Main Engines	Cat 2	7,200	65%	16	112
Ladder Pump	Cat 1	800	65%	16	112
Cutter & Swing	Cat 1	3,600	65%	16	112
Auxiliaries	Cat 1	2,400	60%	16	112
Subtotal hp		14,000			
Support Vessels					
Large Tug	Cat 2	3,000	69%	24	168
Large Tug	Cat 2	1,950	69%	12	84
Small Tug	Cat 1	800	69%	24	168
Crew Boat	Cat 1	800	50%	12	84
Survey Boat	Cat 1	800	50%	12	84
Subtotal hp		7,350			
Land-side Equipment					
Dozers (D6)/ Marsh Buggy*		150	59%	60	420
Loader (966)		170	59%	24	168

* 2 working 24 hrs/day, 1 working 12 hrs/day)

** Horsepower value is total installed for all pieces of equipment in listed category; some equipment types are singular engines while others are sum of multiple engines.

Table 2: Oyster Mitigation Equipment Characteristics

Emission Source Description	Quantity	Rated Horse-power	Load Factor	Daily Operating Hours	Days of Operation
Diesel off-road or marine engines					
CAT 385 excavator	2	530	59%	12	25
Work boat	2	90	59%	2	25
Tug - propulsion	2	250	69%	12	25
Tug - Auxiliary	1	110	20%	12	25
Gasoline on-road engine	**Quant.**	**mi/day**		**Days**	**Miles**
Pickup truck	1	50		25	1,250

Table 3: Emission Factors

Engine Type	Marine Engine Category[1]	NO_x EF	VOC EF	EF Units
Dredge main engine	Cat 2	7.3	0.37	g/hp-hr
Dredge ladder pump	Cat 1	7.3	0.20	g/hp-hr
Dredge cutter & swing	Cat 1	7.3	0.20	g/hp-hr
Dredge auxiliaries	Cat 1	7.3	0.20	g/hp-hr
Large tug	Cat 2	7.3	0.37	g/hp-hr
Small tug	Cat 1	7.3	0.20	g/hp-hr
Crew boat	Cat 1	7.3	0.20	g/hp-hr
Survey boat	Cat 1	7.3	0.20	g/hp-hr
Dozer/loader/excavator	Non-road	6.9	1.00	g/hp-hr
On-road car/light truck	On-road	0.359	0.082	g/mile
On-road pickup truck	On-road	0.509	0.086	g/mile

[1] Marine engine categories are based on the displacement of a single engine cylinder. Category 2 engines are typically larger in overall displacement than Category 1 engines.

Table 4: Project Construction NO_x Emission Estimates

Emission Source Description	Marine Engine Category	NO_x 2016 tpy	NO_x 2017 tpy	NO_x Total tpy
Main Engines	Cat 2	97.1	0.0	97.1
Ladder Pump	Cat 1	10.8	0.0	10.8
Cutter & Swing	Cat 1	48.6	0.0	48.6
Auxiliaries	Cat 1	29.9	0.0	29.9
Subtotal tons		186.3	0.0	186.3
Support Vessels				
Large Tug	Cat 2	64.4	0.0	64.4
Large Tug	Cat 2	20.9	0.0	20.9
Small Tug	Cat 1	17.2	0.0	17.2
Crew Boat	Cat 1	6.2	0.0	6.2
Survey Boat	Cat 1	6.2	0.0	6.2
Subtotal tons		115.0	0.0	115.0
Land-side Equipment				
Dozers (D6)/ Marsh Buggy		0.57	2.83	3.4
Loader (966)		0.26	1.28	1.5
Subtotal tons		0.8	4.1	4.9
Employee Vehicles	miles			
Dredge/support	375,452	0.15	0.00	0.1
Landside	195,888	0.03	0.05	0.1
Subtotal tons		0.2	0.1	0.2
Oyster Mitigation				
CAT 385 excavator		1.4	0.0	1.4
Work boat		0.04	0.0	0.04
Tug - propulsion		0.8	0.0	0.8
Tug - Auxiliary		0.1	0.0	0.1
Pickup truck		0.001	0.0	0.001
Subtotal tons		2.4	0.0	2.4
Total tons		**304.7**	**4.2**	**308.9**

Table 5: Project Construction VOC Emission Estimates

Emission Source Description	Marine Engine Category	VOCs 2016 tpy	VOCs 2017 tpy	VOCs Total tpy
Main Engines	Cat 2	4.9	0.0	4.9
Ladder Pump	Cat 1	0.3	0.0	0.3
Cutter & Swing	Cat 1	1.3	0.0	1.3
Auxiliaries	Cat 1	0.8	0.0	0.8
Subtotal tons		7.4	0.0	7.4
Support Vessels				
Large Tug	Cat 2	3.3	0.0	3.3
Large Tug	Cat 2	0.6	0.0	0.6
Small Tug	Cat 1	0.5	0.0	0.5
Crew Boat	Cat 1	0.2	0.0	0.2
Survey Boat	Cat 1	0.2	0.0	0.2
Subtotal tons		4.6	0.0	4.6
Land-side Equipment				
Dozers (D6)/ Marsh Buggy		0.08	0.41	0.49
Loader (966)		0.04	0.19	0.22
Subtotal tons		0.41	0.60	0.71
Employee Vehicles	miles			
Dredge/support	375,452	0.03	0.00	0.03
Landside	195,888	0.01	0.01	0.02
Subtotal tons		0.04	0.01	0.05
Oyster Mitigation				
CAT 385 excavator		0.21	0.0	0.19
Work boat		0.001	0.0	0.001
Tug - propulsion		0.023	0.0	0.013
Tug - Auxiliary		0.001	0.0	0.001
Pickup truck		0.0001	0.0	0.0001
Subtotal tons		0.23	0.0	0.20
Total tons		**12.4**	**0.6**	**13.0**

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DEPARTMENT OF THE ARMY
GALVESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1229
GALVESTON, TEXAS 77553-1229

August 25, 2015

REPLY TO ATTENTION OF
Plan Formulation Section

Mr. Steve Hagle, P.E.
Deputy Director, Office of Air
Texas Commission on Environmental Quality
MC 122, P.O. Box 13087
Austin, TX 78711-3087

Dear Mr. Hagle:

The U.S. Army Corps of Engineers (USACE) is proposing a project to address the navigation deficiencies identified in the Houston Ship Channel (HSC) Project Deficiency Report (PDR). The USACE proposes to use a hydraulic pipeline dredge to modify the HSC by easing (widening) the existing Flare connecting the HSC to the Bayport Ship Channel (BSC) to a radius of 4,000 feet, and widening the HSC at the channel turn or bend just south of the Flare on the east side of the HSC by a maximum of 235 feet to provide a straighter navigation path up the Bay. Widening the HSC bend would impact the existing east side barge lanes. The barge lanes would be relocated to the east of the proposed HSC widening and consistent with the original design. The new work dredged material would be placed in existing dredged material placement area (PA) 14. The project site is located in Galveston Bay in Chambers County, Texas.

The USACE's implementation of the proposed project modifications would be a Federal action subject to general conformity regulations under Title 40 Code of Federal Regulations (CFR) Part 93, Subpart B. Since the project is located in the Houston-Galveston-Brazoria (HGB) area, which is classified as marginal nonattainment for ozone, and the Nitrogen Oxides (NO_x) emissions are estimated to be above the 100 tons-per-year *de minimis* threshold, a general conformity determination will be required.

Representatives of the Port of Houston Authority (PHA), the project non-federal sponsor, met with members of your staff on June 16, 2015, to provide information on the proposed project modifications and a preliminary estimate of the associated emissions for review. This letter is a follow up to that meeting and is being used to formally request concurrence from the Texas Commission on Environmental Quality (TCEQ) that these estimated emissions can be accommodated in the HGB State Implementation Plan (SIP).

The preliminary emissions estimate presented to you on June 16, 2015 has been revised and is enclosed along with an explanation of the emissions estimate methodology (reference "Documentation of Emissions Estimates for General Conformity"). The emissions from the project would occur in both Harris and Chambers counties and are estimated to be 04.7 tons of NO_x in 2016 and 4.2 tons of NO_x in 2017.

Volatile Organic Compound (VOC) emissions are estimated to be 12.4 tons in 2016, so general conformity will not be required for VOC. A breakdown of the estimated emissions is as follows:

Estimated Emissions from Proposed Project Construction (Tons Per Year)

Component of Work	2016		2017		Total	
	NO_x	VOCs	NO_x	VOCs	NO_x	VOCs
Dredging	186.3	7.4	0.0	0.0	186.3	7.4
Support Vessels	115.0	4.6	0.0	0.0	115.0	4.6
Placement Site Work	0.8	0.1	4.1	0.6	4.9	0.7
Employee Vehicles	0.2	0.04	0.1	0.01	0.3	0.05
Oyster Mitigation	2.4	0.2	0.0	0.0	2.4	0.2
Total	**304.7**	**12.4**	**4.2**	**0.6**	**308.9**	**13.0**

Although the NO_x emissions are above the 100 tons *de minimis* threshold, when compared the project emissions to the emissions inventories in the SIP for the HGB area, this project represents a very small percentage of the emissions inventories in the SIP. As a result, the USACE believes that this project can be accommodated in the SIP as allowed in 40 CFR 93.158(a)(5)(i)(A), which states that the State agency responsible for the SIP can make a determination that the emissions from the Federal action, together with all other emissions in the nonattainment area, would not exceed the emissions budgets specified in the applicable SIP.

For purposes of comparing the project emissions to the applicable SIP, the general conformity regulations require that the most recent U.S. Environmental Protection Agency (EPA) approved SIP is used. For the HGB area, this is the *2010 HGB Attainment Demonstration SIP Revision for 1997 Eight-Hour Ozone* adopted by TCEQ on March 10, 2010 and approved by EPA on January 2, 2014 for marine and non-road mobile sources, and the *2013 HGB MVEB Update SIP Revision for the 1997 Eight-Hour Ozone* adopted by TCEQ on April 23, 2013 and approved by EPA on January 2, 2014 for on-road mobile sources. The following table compares the project emissions to the applicable SIP inventory categories. Since the project construction phase is expected to encompass two calendar years, the table compares the higher year of project emissions against the SIP emissions inventories.

Comparison of Proposed Project Emissions to the SIP Emissions Budgets

				2018	
Project Activities	SIP Inventory Categories	Project NO_x Emissions		HGA SIP Emissions Budget (tpd)	% HGA SIP Emissions Budget (%)
		(tpy)	(tpd)		
Dredging Activities (dredge, support vessels)	Commercial Marine Vessels	302.3	0.83	39.24	2.1%
Land-side Activities (dredged material placement)	Construction and Mining	2.2	0.006	14.68	0.04%
On-road Activities (employee commuting)	On-road Mobile Sources	0.2	0.0005	103.34	0.0005%
	Overall Totals	**304.7**	**0.84**	**157.26**	**0.5%**

Overall, the proposed project construction average daily emissions of NO_x represent only 0.5% of emissions from marine, on-road, and construction sources modeled in the SIP for 2018. Emissions from the dredging equipment itself, plus support vessels, represents 2.1% of the commercial marine vessel emissions modeled in the SIP, while emissions from construction equipment represent only 0.04% on an average daily basis. These small percentages demonstrate that this proposed project can easily be accommodated into the SIP, since the NO_x emissions represent such a low percentage of the applicable SIP inventory categories.

Based on the emissions analysis presented in this letter, the USACE respectfully requests concurrence from the TCEQ per 40 CFR 93.158(a)(5)(i)(A). Please provide concurrence by written letter to Ms. Andrea Catanzaro, at the letterhead address.

If you have any questions, please contact Ms. Catanzaro at the letterhead address or by telephone at 409-766-6346. You may also email her at andrea.catanzaro@usace.army.mil if you prefer.

Sincerely,

Carolyn Murphy
Acting Chief, Plan Formulation Section
Regional Planning and Environmental Center

Enclosure

CF:
Mr. Byron D. Williams
Ms. Jamie Zech
Mr. Kenneth Gathright
Mr. Carl Sepulveda

Documentation of Emission Estimates for General Conformity
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General Conformity Evaluation for Construction Emissions

The information needed to estimate construction emissions for the proposed project includes the following:

- A description of the equipment that will be needed, in terms of type, horsepower, age, and other characteristics;
- Estimates of the operating time (e.g., hours per day, days per week, etc.) of each type of equipment during each phase or component of work;
- Emissions characteristics (emission factors) of each type of equipment;
- Emission calculation methods and equations.

Additionally, assumptions have been made regarding the number of employee commuting days to develop estimates of on-road emissions associated with the project.

Information related to the physical and operational characteristics of the equipment has been developed by the project engineers. The physical information includes the type of equipment (e.g., dredge, supporting tug boat, dozer), the type of engine on that

equipment (e.g., main engine, auxiliary engine) for equipment with more than one engine, the typical rated horsepower for the type of equipment and engine, and, for the dredge and booster pump, the average in-use load factor, which is the average percentage of full power at which the engine is typically operated. The load factors used for tugs and land-side equipment have been obtained from the GMAEI. A summary of the physical and operational characteristics is presented in Table 1 for equipment associated with the dredging and land-side dredged material management, and in Table 2 for equipment associated with the construction of oyster reef mitigation.

The emission factors have primarily been obtained from the harbor craft section of the GMAEI. This includes the marine vessels used in the construction of oyster reef mitigation for the project. The report lists emission factors for engines in various size and horsepower ranges, and three different "tier levels," which reflect emission standards effective when the engines were manufactured. Because the specific equipment to be used on the proposed project is not known, the engines are assumed to be Tier 1 engines, manufactured in approximately the 2000 to 2005 time frame. Emission factors for the land-side equipment (dozers and loaders) have been based on the Tier 1 emission standards for non-road diesel engines. This includes the similar equipment (e.g. excavators) used in the construction of oyster reef mitigation for the project. Emission factors for on-road vehicles used in employee commuting and oyster reef mitigation have been based on the emission estimating model MOVES2014. Employee vehicles are assumed to be a mix of gasoline passenger cars and light pickup trucks, while the pickup truck associated with oyster mitigation is assumed to be a light commercial pickup truck. Table 3 lists the emission factors used in developing the emission estimates.

Emissions from dredges, vessels, and land-side non-road equipment have been estimated using the basic equation:

$$E = \frac{hp \times LF \times hrs \times EF}{(453.59\ g/lb \times 2{,}000\ lb/ton)}$$

where:

E	=	emissions, tons per year
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where:

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The VMT driven by employees has been calculated using the average commuting distance in the Houston area in 2010 (21.2 miles, one way) from the 2011 Urban Mobility Report prepared by the Texas Transportation Institute[1] and an estimate of the number of workers on each task and each work shift (a total of 55 workers over three shifts). With the assumption that the commuting employees would use a combination of gasoline fueled light duty cars and trucks, the average NO_x emission factor is 0.359 grams per mile (g/mile). An example of the commuting emission estimating method is as follows:

$$E = \frac{375{,}452\ miles/year \times 0.359\ g/mile}{(453.59\ g/lb \times 2{,}000\ lb/ton)} = 0.15\ tons/yr$$

Tables 4 and 5 present the emission estimates of NO_x and VOCs, respectively, developed using the methods discussed above. Subtotal and total rows may not exactly match the sums of individual line items due to the effects of rounding of values.

[1] Texas Transportation Institute, TTI's 2011 Urban Mobility Report. September 2011. Available at: http://tti.tamu.edu/documents/mobility-report-2011.pdf

Table 1: Summary of Equipment Physical and Operational Characteristics

Emission Source Description	Marine Engine Category[1]	Rated Horsepower (total)**	Load Factor	Daily Operating Hours	Weekly Operating Hours
Main Engines	Cat 2	7,200	65%	16	112
Ladder Pump	Cat 1	800	65%	16	112
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Auxiliaries	Cat 1	2,400	60%	16	112
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Large Tug	Cat 2	3,000	69%	24	168
Large Tug	Cat 2	1,950	69%	12	84
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Crew Boat	Cat 1	800	50%	12	84
Survey Boat	Cat 1	800	50%	12	84
Subtotal hp		7,350			
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Dozers (D6)/ Marsh Buggy*		150	59%	60	420
Loader (966)		170	59%	24	168

* 2 working 24 hrs/day, 1 working 12 hrs/day)

** Horsepower value is total installed for all pieces of equipment in listed category; some equipment types are singular engines while others are sum of multiple engines.

Table 2: Oyster Mitigation Equipment Characteristics

Emission Source Description	Quantity	Rated Horse-power	Load Factor	Daily Operating Hours	Days of Operation
Diesel off-road or marine engines					
CAT 385 excavator	2	530	59%	12	25
Work boat	2	90	59%	2	25
Tug - propulsion	2	250	69%	12	25
Tug - Auxiliary	1	110	20%	12	25
Gasoline on-road engine	**Quant.**	**mi/day**		**Days**	**Miles**
Pickup truck	1	50		25	1,250

Table 3: Emission Factors

Engine Type	Marine Engine Category[1]	NO_x EF	VOC EF	EF Units
Dredge main engine	Cat 2	7.3	0.37	g/hp-hr
Dredge ladder pump	Cat 1	7.3	0.20	g/hp-hr
Dredge cutter & swing	Cat 1	7.3	0.20	g/hp-hr
Dredge auxiliaries	Cat 1	7.3	0.20	g/hp-hr
Large tug	Cat 2	7.3	0.37	g/hp-hr
Small tug	Cat 1	7.3	0.20	g/hp-hr
Crew boat	Cat 1	7.3	0.20	g/hp-hr
Survey boat	Cat 1	7.3	0.20	g/hp-hr
Dozer/loader/excavator	Non-road	6.9	1.00	g/hp-hr
On-road car/light truck	On-road	0.359	0.082	g/mile
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[1] Marine engine categories are based on the displacement of a single engine cylinder. Category 2 engines are typically larger in overall displacement than Category 1 engines.

Table 4: Project Construction NO_x Emission Estimates

Emission Source Description	Marine Engine Category	NO_x 2016 tpy	NO_x 2017 tpy	NO_x Total tpy
Main Engines	Cat 2	97.1	0.0	97.1
Ladder Pump	Cat 1	10.8	0.0	10.8
Cutter & Swing	Cat 1	48.6	0.0	48.6
Auxiliaries	Cat 1	29.9	0.0	29.9
Subtotal tons		186.3	0.0	186.3
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Large Tug	Cat 2	64.4	0.0	64.4
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Crew Boat	Cat 1	6.2	0.0	6.2
Survey Boat	Cat 1	6.2	0.0	6.2
Subtotal tons		115.0	0.0	115.0
Land-side Equipment				
Dozers (D6)/ Marsh Buggy		0.57	2.83	3.4
Loader (966)		0.26	1.28	1.5
Subtotal tons		0.8	4.1	4.9
Employee Vehicles	miles			
Dredge/support	375,452	0.15	0.00	0.1
Landside	195,888	0.03	0.05	0.1
Subtotal tons		0.2	0.1	0.2
Oyster Mitigation				
CAT 385 excavator		1.4	0.0	1.4
Work boat		0.04	0.0	0.04
Tug - propulsion		0.8	0.0	0.8
Tug - Auxiliary		0.1	0.0	0.1
Pickup truck		0.001	0.0	0.001
Subtotal tons		2.4	0.0	2.4
Total tons		**304.7**	**4.2**	**308.9**

Table 5: Project Construction VOC Emission Estimates

Emission Source Description	Marine Engine Category	VOCs 2016 tpy	VOCs 2017 tpy	VOCs Total tpy
Main Engines	Cat 2	4.9	0.0	4.9
Ladder Pump	Cat 1	0.3	0.0	0.3
Cutter & Swing	Cat 1	1.3	0.0	1.3
Auxiliaries	Cat 1	0.8	0.0	0.8
Subtotal tons		7.4	0.0	7.4
Support Vessels				
Large Tug	Cat 2	3.3	0.0	3.3
Large Tug	Cat 2	0.6	0.0	0.6
Small Tug	Cat 1	0.5	0.0	0.5
Crew Boat	Cat 1	0.2	0.0	0.2
Survey Boat	Cat 1	0.2	0.0	0.2
Subtotal tons		4.6	0.0	4.6
Land-side Equipment				
Dozers (D6)/ Marsh Buggy		0.08	0.41	0.49
Loader (966)		0.04	0.19	0.22
Subtotal tons		0.41	0.60	0.71
Employee Vehicles	miles			
Dredge/support	375,452	0.03	0.00	0.03
Landside	195,888	0.01	0.01	0.02
Subtotal tons		0.04	0.01	0.05
Oyster Mitigation				
CAT 385 excavator		0.21	0.0	0.19
Work boat		0.001	0.0	0.001
Tug - propulsion		0.023	0.0	0.013
Tug - Auxiliary		0.001	0.0	0.001
Pickup truck		0.0001	0.0	0.0001
Subtotal tons		0.23	0.0	0.20
Total tons		**12.4**	**0.6**	**13.0**