APPENDIX Y

Analysis of Cumulative Lightering Activity

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Sea Port Oil Terminal
Deepwater Port Project
Analysis of Cumulative Lightering Activity

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Maritime Administration
U.S. Coast Guard

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ACRONYMS AND ABBREVIATIONS

Name	Description
Bluewater	Bluewater Project
BMOP	Blue Marlin Oil Port
DWP	deepwater port
EIS	Environmental Impact Statement
Enterprise	Enterprise Products Operating LLC
GulfLink	Texas GulfLink Project
MARAD	U.S. Maritime Administration
SPOT	Sea Port Oil Terminal
SPOT Project	Proposed deepwater port for crude oil export in United States Federal waters between 27.2 and 30.8 nautical miles off the coast of Brazoria County, Texas.
trip	A one-way vessel movement from any origin to any destination
U.S.	United States
VLCC	very large crude carrier

1 INTRODUCTION

SPOT Terminal Services LLC (hereafter referred to as the Applicant), a wholly owned subsidiary of Enterprise Products Operating LLC (Enterprise), a Texas limited liability company, is proposing the Sea Port Oil Terminal (SPOT) Project (hereafter referred to as the SPOT Project, SPOT deepwater port [SPOT DWP], or the Project). On January 31, 2019, the Applicant submitted an application to the Maritime Administration (MARAD) and United States (U.S.) Coast Guard seeking a Federal license under the Deepwater Port Act of 1974, as amended, to own, construct, operate, and eventually decommission a deepwater port (DWP) for the transportation of crude oil for export to the global market in U.S. Federal waters between 27.2 and 30.8 nautical miles off the coast of Brazoria County, Texas. The SPOT DWP would allow for up to two very large crude carriers (VLCC) or other crude oil carriers to moor at single point mooring buoys. Enterprise proposes to use its affiliates' existing assets and access to varying grades of crude oil supplies from multiple sources along the northern Texas Gulf Coast. Oil would be delivered to the SPOT DWP via two new collocated, offshore oil pipelines sourced from two new collocated onshore pipelines.

As stated in the Supplemental Draft Environmental Impact Statement (EIS) issued on October 29, 2021, the purpose of the Project is to fully load VLCCs without the need for ship-to-ship transfers and to enable the export of domestically produced ultralight, to light, to heavy grade crude oil to foreign global markets. The SPOT Project is one of four DWP projects on the Gulf Coast outer continental shelf that have submitted applications to MARAD and the U.S. Coast Guard under the Deepwater Port Act of 1974, each with the purpose of fully loading VLCCs.

Fully loaded VLCCs have drafts that exceed the typical depths of deep-draft shipping channels in the United States, and thus cannot be fully loaded at onshore loading facilities (EIA 2018). Instead, VLCCs may be either partially loaded at these "shoreside" facilities and then partially loaded by ship-to-ship transfers from smaller "shuttle" tankers at an offshore location (reverse lightering, hereafter "lightering"), or fully loaded by lightering.[1]

The purpose of this report is to support the cumulative impacts analysis in the Final EIS for the SPOT Project by characterizing the beneficial cumulative impacts of SPOT and the three other Gulf Coast DWP projects in terms of cumulative lightering activity avoided. To do so, this report estimates the cumulative lightering activity necessary under each DWP project's No Action Alternative—specifically the number of shuttle tanker trips necessary to achieve each project's assumed crude oil exports via VLCC, without the presence of a DWP.

[1] "Lightering" typically refers to the process of transferring cargo (in this case, crude oil) from a large vessel to a port or terminal using a smaller shuttle vessel. Industry publications refer to the opposite (transferring crude oil from a shoreside facility to a larger offshore vessel via shuttle tanker) as "reverse lightering." For simplicity, this report refers to all such activity as "lightering."

2 METHODOLOGY

2.1 PROJECTS EVALUATED

The four DWP projects evaluated in this report are shown on Figure 1, and include:

- SPOT Project, as described in Section 1;
- Texas GulfLink Project (GulfLink): approximately 26.6 nautical miles off the coast of Brazoria County, Texas (approximately 7 nautical miles east of the SPOT Project), capable of simultaneously loading two VLCCs;
- Bluewater Project (Bluewater): approximately 21 nautical miles east of the entrance to the Port of Corpus Christi, Texas, capable of simultaneously loading two VLCCs; and
- Blue Marlin Offshore Port (BMOP): approximately 85 nautical miles south-southeast of Sabine Pass, Louisiana, capable of loading a single VLCC.

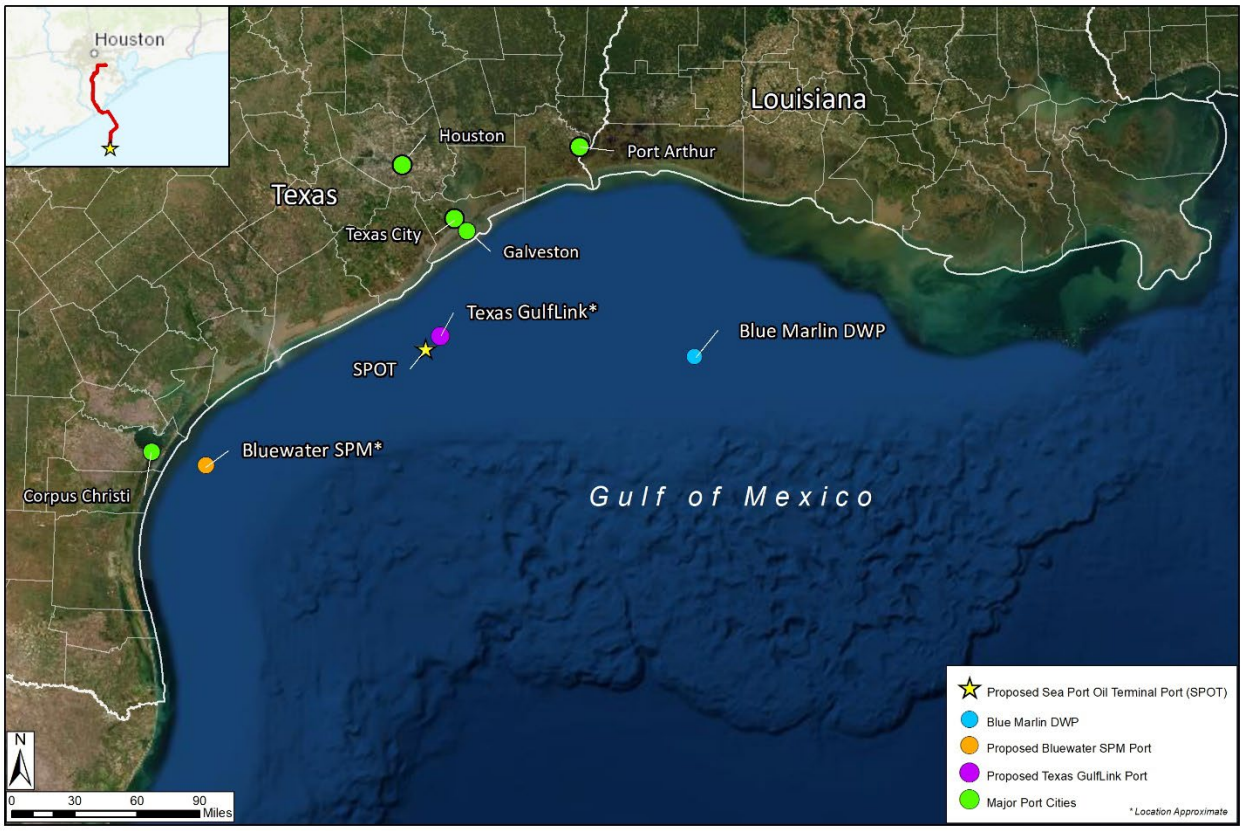

Figure 1: Projects Evaluated

2.2 CALCULATION OF TRIPS

For purposes of this analysis, a "trip" is a one-way vessel movement from any origin to any destination. Thus, a shuttle tanker trip *either* from a shoreside terminal to an offshore lightering area, *or* from the lightering area back to the shoreside terminal or another port location is a trip, as would be *either* a VLCC trip into *or* out of the Gulf Coast region. Thus, a round-trip made by a single shuttle tanker for purposes of lightering would comprise two trips (one outbound, and one return trip inbound).

The following formula was used to calculate the number of annual lightering tanker trips for each DWP project, using either information reported in the application for the project or based on assumptions listed below:

$$T_L = 2 * \left[\frac{(L_A * t_A) + L_S}{t_A + 1}\right] + t_V$$

Where:

- T_L is the total number of annual lightering tanker trips;
- L_A is the number of Aframax tanker loads necessary to fill one VLCC;
- L_S is the number of Suezmax tanker loads necessary to fill one VLCC;
- t_A is the number of Aframax tanker trips per Suezmax tanker trip that each project would use to fill VLCCs; and
- t_V is the number of annual VLCC trips between the shoreside terminal and the offshore lightering area (typically equivalent to the number of annual VLCC trips outbound from the project, or zero if a project's No Action Alternative would not involve shoreside loading).

2.3 ASSUMPTIONS

As stated in Section 1.3 of the Supplemental Draft EIS, the U.S. Energy Information Administration projects that U.S. crude oil production will increase to and hold steady at approximately 13.0 million barrels per day from 2022 through 2050, and will continue to exceed the capacity of existing U.S. refineries through 2050 (EIA 2022). As a result, this analysis assumes that excess North American crude oil production will be sufficient to support the four projects described in Section 2.1, as proposed, for the lifetime of those projects. In addition, this report incorporates the following assumptions to estimate the number of annual lightering tanker trips (shoreside loading percentages reflect channel depths):

- If the SPOT Project is not authorized, Enterprise states that VLCCs proposed to be served by this project would be fully loaded offshore by lightering, with no shoreside loading.
- This analysis assumes that all ports included would be operating at full capacity during the period of time evaluated.
- The No Action Alternative for GulfLink states that most VLCCs served by the project would be partially loaded onshore, completely loaded via lightering, or loaded using a combination of both (MARAD and USCG 2020a). As a conservative measure,[2] this analysis assumes that the VLCCs proposed to be served by GulfLink would be loaded to approximately 50 percent capacity at a

[2] The benefit of a DWP project (regarding vessel trips) increases along with the number of lightering trips avoided. Assuming lower benefits (i.e., fewer lightering trips avoided) is thus a conservative measure that avoids overestimating benefits.

shoreside terminal in Texas City, Texas or another port in the greater Houston-Galveston area before traveling offshore to receive the remainder of their cargo via lightering.

- If the Bluewater Project is not authorized, oil would be partially loaded shoreside and then fully loaded by lightering. As a conservative measure, this analysis assumes that the VLCCs proposed to be served by Bluewater would be loaded to approximately 50 percent at a shoreside terminal in Ingleside, Texas near Corpus Christi, which has a channel depth of 47 feet (Port of Corpus Christi 2022) [3] before traveling offshore to receive the remainder of their cargo via lightering (MARAD and USCG 2021).
- If the BMOP Project is not authorized, oil would continue to be partially loaded shoreside and then fully loaded by lightering unless other DWPs became operational (MARAD and USCG 2020b). As a conservative assumption, taking into account the shallower depth—30 feet—of the Sabine Pass Ship Channel, serving Port Arthur (USACE 2012), this analysis assumes that the VLCCs proposed to be served by BMOP would be loaded to approximately 25 percent at a shoreside terminal in Port Arthur, Texas before traveling offshore to receive the remainder of their cargo via lightering.
- SPOT has stated the volume of crude oil carried in each fully loaded VLCC is equivalent to 2.7 fully loaded Aframax tankers or 1.6 fully loaded Suezmax tankers. SPOT further stated that lightering associated with the No Action Alternative would use Aframax and Suezmax tankers in a 7:1 ratio (i.e., out of eight shuttle tanker loads transferred from shoreside terminals to an offshore VLCC, seven would be Aframax and the remaining one would be a Suezmax tanker).
- Bluewater and BMOP have both stated that each VLCC is equivalent to 4.0 Aframax or 2.0 Suezmax tanker loads. Bluewater has stated that its No Action Alternative would use Aframax and Suezmax tankers in a 2:1 ratio. The same assumption has been made for BMOP.
- The GulfLink Project has stated that each VLCC is equivalent to 4.0 Aframax or 2.0 Suezmax tanker loads. The GulfLink Project Draft EIS does not indicate the ratio of Aframax to Suezmax shuttle tankers; therefore, this analysis assumes the same 2:1 ratio as for Bluewater and BMOP.
- All lightering trips would originate from and return to the major ports listed above associated with each DWP project (Texas City/Houston/Galveston, Ingleside/Corpus Christi, or Port Arthur). While other ports (e.g., Freeport, Texas) could support such trips, this assumption concentrates lightering activity in a smaller number of ports and waterways, and thus reflects a conservative assumption for the purpose of evaluating transportation impacts.

Table 1 summarizes the assumed tanker capacities for each of the three tanker classes used in this analysis. The range in assumptions about the number of shuttle tanker trips required to serve each VLCC in various projects reflects the range in vessel sizes within each class. Whereas the SPOT Project assumptions are based on larger Aframax and Suezmax vessels, the Bluewater assumptions reflect smaller vessels within these classes.

As stated in Section 1, the purpose of this report is to estimate the cumulative lightering activity avoided by construction and operation of the four projects. When applied to the No Action Alternative for the GulfLink and Blue Marlin projects, the SPOT assumptions would generate fewer shuttle tanker trips per

[3] VLCCs have been partially loaded at the South Texas Gateway facility in Ingleside (NGI 2021).

VLCC than the Bluewater assumptions. Applying these assumptions to the GulfLink and Blue Marlin projects is thus a conservative measure, in that it minimizes the beneficial cumulative impacts (i.e., it reduces the lightering activity avoided by operation of all four projects).

Table 1: Tanker Capacities and Draft

Tanker Class	Capacity (dwt)	Fully Loaded Draft (feet)
VLCC	325,000	71
Aframax	120,000	49
Suezmax	200,000	66

Source: SPOT 2019a, Vol IIa, TR01; Oil Tanks 2020
dwt = deadweight tons; VLCC = very large crude carrier

Finally, this report assumes global markets will support the use of VLCCs (instead of smaller vessels) regardless of whether the projects are constructed. This assumption is conservative: lightering to fill VLCCs offshore would generate more total vessel trips than any other scenario (i.e., more than if VLCCs were avoided altogether and exports continued to use only Aframax and Suezmax tankers).

3 ANALYSIS

Table 2 summarizes the annual lightering trips required to transfer the volume of crude oil associated with each DWP project to VLCCs (either with or without partial shoreside loading, depending on the assumptions described in Section 2.3), along with the total trips per project and the cumulative total trips for all four projects. Table 3 compares these lightering tanker trips to existing tanker traffic at the likely home ports of these lightering trips.

Overall, if none of the four DWP projects were constructed, and assuming use of VLCCs in place of smaller vessels, lightering of crude oil to VLCCs otherwise intended for export through the four DWP projects would generate a 25 percent increase in tanker trips in and out of the four major ports likely to serve lightering activity, with as much as a 41 percent increase in the Sabine-Neches Waterway (which serves Port Arthur). Operation of the DWPs would avoid these trips.

Table 2: Calculation of Cumulative Lightering Trips

	Project				
Trip Type	**SPOT**	**GulfLink**	**Bluewater**	**BMOP**	**Total**
No Action Alternative:					
VLCC Shoreside loading percent [a]	0%	50%	50%	25%	--
Aframax shuttle tanker loads per VLCC [b]	2.7	4.0	4.0	4.0	--
Suezmax shuttle tanker loads per VLCC [b]	1.6	2.0	2.0	2.0	--
Number of Aframax tankers per Suezmax tanker [a]	7	2	2	2	--
Average shuttle tanker trips per VLCC	5.1	7.7	7.7	7.7	--
Total lightering trips, No Action Alternative [c]	**1,870**	**2,799**	**1,472**	**2,799**	**8,940**
Annual VLCC trips [d]	730	730	384	730	2,574
Total vessel trips, No Action Alternative	**2,600**	**3,529**	**1,856**	**3,529**	**11,514**

Source: SPOT 2019yy (SPOT Project data); MARAD and USCG 2020a (GulfLink Project data), MARAD and USCG 2020b (Bluewater Project data), MARAD and USCG 2021 (BMOP data)

Bluewater= Bluewater Project; BMOP = Blue Marlin Oil Port; GulfLink = Texas GulfLink Project; SPOT = Sea Port Oil Terminal; VLCC = very large crude carrier

[a] Assumption based on available information from the respective project's application or EIS (see Source above).

[b] Number presented in the respective project's application or EIS (see Source above).

[c] Refer to calculation in Section 2.2.

[d] Reflects the total number of inbound and outbound VLCC trips to and from the project region, regardless of project scenario. For the Proposed Action for each project, this includes all VLCC trips to and from the DWP; for the No-Action Alternative, this includes VLCC trips inbound to either an offshore lightering area or to a shoreside facility, plus trips by fully loaded VLCCs outbound from the region. As described in Section 2, trips between shoreside facilities and offshore lightering areas are included in the "Total lightering trips" category.

Table 3: Comparison of Cumulative Lightering Trips to Existing Tanker Calls

	Tanker Vessel Trips				
Port (DWP Project)	**2015 Trips [a]**	**Cumulative Lightering Added [b]**	**VLCC Trips Added [b]**	**Non-VLCC Export Trips Replaced [c]**	**Net Change [d]**
Houston-Galveston-Texas City (SPOT, GulfLink)	10,682	4,669	1,460	4,314	17%
Corpus Christi (Bluewater)	2,278	1,472	384	1,092	34%
Sabine-Neches Waterway (BMOP)	3,528	2,799	730	2,076	41%
All Projects	**16,488**	**8,940**	**2,574**	**7,482**	**25%**

Bluewater= Bluewater Project; BMOP = Blue Marlin Oil Port; GulfLink = Texas GulfLink Project; SPOT = Sea Port Oil Terminal; VLCC = very large crude carrier

[a] Source: (MARAD 2015). Existing vessel activity reported as "calls"—i.e., inbound trips only. This report assumes that each existing inbound call is associated with an outbound trip; thus, the figure in this column is double the number of calls. MARAD has not published more recent data.

[b] As calculated in Table 2

[c] Reflects the average size of Aframax and Suezmax tankers in Table 1, along with the assumed ratios of Aframax to Suezmax listed in Table 2.

[d] Calculated as: (Cumulative Lightering Added, plus VLCC Trips Added, minus Non-VLCC Export Trips Replaced) divided by 2015 Trips

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