

land managed by the U.S. Bureau of Land Management, land managed under the Wetland Reserve Program or Grassland Reserve Program, national forests, national or state parks, or Indian Reservations. Two NWRs are within 0.25 mile of the Project. In addition, a National Historic Landmark (King Ranch); the Jamie J. Zapata Memorial Boat Ramp, Fishing Pier, and Kayak Launch Pad (Zapata boat launch); land planned for conservation through the Bahia Grande Coastal Corridor Project; and four Great Texas Coastal Birding Trails, would be crossed by the pipelines (see table 4.8.1-3). In addition, three CRP parcels would be crossed, which are associated with the Lower Rio Grande Valley NWR, as discussed below. Potential impacts on recreational areas in the vicinity of the Project are discussed below, and associated impacts on tourism and recreational fishing are discussed in section 4.9.3.

Three areas managed by the NPS, including the Palo Alto Battlefield, Palmito Ranch Battlefield, and Resaca de la Palma Battlefield, are more than 0.25 mile from the Rio Grande LNG Project. Potential impacts on these areas are discussed in sections 4.8.2 and 4.10.

National Wildlife Refuges

The Lower Rio Grande Valley and Laguna Atascosa NWRs are less than 0.25 mile from the Project. The Lower Rio Grande Valley NWR is a 97,908-acre coastal marsh refuge that was established in 1979 with a management plan focused on protecting biodiversity (FWS 2010f, 2015b). In addition to wildlife viewing opportunities and nature trails, over 6,000 acres of the refuge are designated for big game hunting (FWS 2015b). The NWR also encompasses Boca Chica Beach, which is 5.5 miles southeast of the LNG Terminal site. The Lower Rio Grande Valley NWR, and associated private land held in an easement by the FWS, would be just east of the Pipeline System between at points between MPs 112.9 and 117.1 at distances ranging from ranging from 53 to 1,550 feet.

Established in 1946, the Laguna Atascosa NWR is an 89,845-acre coastal marsh refuge that provides habitat for wintering waterfowl and other migratory birds (FWS 2013a, 2015a). Considered a premiere destination for bird-watching, visitors to the NWR also participate in recreational fishing, hunting, biking and hiking. The Laguna Atascosa NWR is about 211.2 feet from the northern boundary of the LNG Terminal site. The NWR would also be between 53 and 1,320 feet of the Pipeline System in three locations, including MPs 126.0 to 126.2, MPs 132.3 to 134.5, and MPs 134.7 to 135.5 (see table 4.8.1-3). In addition, BND land that is subject to an easement held by the FWS and which serves as a wildlife corridor for terrestrial animals (including the ocelot) would be crossed by the Pipeline System between MPs 134.5 and 134.7; this wildlife corridor would be crossed by HDD and is discussed further in section 4.6.

**Table 4.8.1-3
Recreation Areas Located within 0.25 Mile of the Rio Grande LNG Project^a**

County / Facility	Landowner / Easement Holder	Existing Land Use Type ^b	Enter MP	Exit MP	Closest Distance (feet)	Crossing Length (miles)	Crossing Method(s)	Construction Impacts (acres)	Operation Impacts (acres)
Cameron	Private land in easement with Lower Rio Grande Valley NWR	N/A	112.9	115.9	52.8	N/A	N/A	N/A	N/A
		N/A	113 + 340 ft ^c	113 + 340 ft ^c	52.8	N/A	N/A	N/A	N/A
	Lower Rio Grande Valley NWR	N/A	113 + 8,690 ft ^c	113 + 8,690 ft ^c	369.6	N/A	N/A	N/A	N/A
		N/A	115.3	117.1	52.8	N/A	N/A	N/A	N/A
		N/A	116.7	117.1	52.8	N/A	N/A	N/A	N/A
		N/A	126.0	126.2	52.8	N/A	N/A	N/A	N/A
		N/A	132.3	134.5	52.8	N/A	N/A	N/A	N/A
		N/A	134.7	135.5	52.8	N/A	N/A	N/A	N/A
		N/A	134.5	134.7	0.0	0.2	HDD	0.0	0.0
		N/A	I/C	135.5	135.6	0.0	0.1	HDD	0.0
LNG Terminal	Laguna Atascosa NWR	N/A	--	--	211.2	N/A	N/A	N/A	N/A
Kennedy (none crossed)									
Kleberg									
Pipelines 1 and 2	King Ranch	OL, OW, FL, NW, I/C	0.0	19.1	0.0	19.1	Various ^d	918.1	338.4
		N/A	45.7	49.0	52.8	N/A	N/A		
		OL, I/C, OW, NW, FL	49.0	60.1	0.0	11.1	Various ^d		
		OL	60.6	60.7	0.0	0.1	Various ^d		

**Table 4.8-1-3 (continued)
Recreation Areas Located within 0.25 Mile of the Rio Grande LNG Project^a**

County / Facility	Landowner / Easement Holder ^a	Existing Land Use Type ^b	Enter MP	Exit MP	Closest Distance (feet)	Crossing Length (miles)	Crossing Method(s)	Construction Impacts (acres)	Operation Impacts (acres)
Willacy (none crossed)									
Jim Wells									
Header System	King Ranch	I/C, OL, OW, FL	HS-2.4	HS-0.0	0.0	2.4	Various ^d	79.4	31.0

^a Notes: N/A = Special use area would not be crossed by the Rio Grande LNG Terminal Project.

^a Four Great Texas Birding Trails would be crossed by the pipelines; however, as these features are larger areas (not linear trails) and without discrete boundaries, they are discussed in the text but excluded from this table.

^b I/C – industrial/commercial; OL – open land; OW – open water; NW – non-forested wetlands; FL – shrub/forest land; N/A – not crossed.

^c Due to a short reroute since issuance of the draft EIS, the beginning and ending milepost is presented as feet downstream of the nearest original milepost.

^d Crossing methods include open-cut, as well as specialized construction methods at discrete resources such as waterbodies, wetlands, and roads, as described in section 2.3.2.1.

In general, the NWRs and associated land in proximity to the Project are expected to experience some temporary impacts during construction. Designated hunting land within these NWRs would not be crossed; the closest parcel where hunting is allowed would be 0.8 mile north of MP 102. Clearing activities, increased noise and dust, and limited access may prevent or curtail use of the NWRs by the public at discrete locations; however, given the size of each NWR, the public could make use of those areas unaffected by construction. As the distance to construction work areas increase, impacts would generally decrease. Where recreational use would be allowed to proceed near construction activities, RG Developers would implement mitigation measures similar to those described in section 4.8.1.3, and in consultation with land managers.

Given the distance to huntable land of the Lower Rio Grande Valley NWR and Boca Chica Beach (about 5.5 miles to the southeast), no direct impacts on these areas are expected. Further, users of the Laguna Atascosa NWR near the BSC may observe a small increase in vessel traffic during the construction period and may also observe LNG carrier traffic through the channel during operation of the LNG Terminal. However, because LNG carrier traffic would be consistent with the existing use of the BSC, we have determined that the resulting impact on users of the Laguna Atascosa NWR would be minor. Impacts associated with construction traffic are discussed in section 4.9.8.

King Ranch National Historic Landmark

As discussed further in section 4.10, King Ranch was established in 1853 and was designated as a National Historic Landmark in 1961 (King Ranch 2016). A popular tourist destination, King Ranch is an 825,000-acre ranch that is divided into four divisions: Santa Gertrudis, Laureles, Norias, and Encino. Collectively these divisions span about 1,300 square miles of land in south Texas. In addition to ranching and farming operations, King Ranch offers hunting opportunities for deer, antelope, wild turkey, quail, javelina, and wild hog. The entire 2.4-mile-long Header System and Compressor Station 1 (MP 0.0) would be on King Ranch. In addition, Pipelines 1 and 2 would cross King Ranch at three locations for a total crossing distance of 30.3 miles (see table 4.8.1-3).

Impacts on King Ranch from pipeline construction would be similar to those discussed above in section 4.8.1.2 (Agricultural and Open Land). Where construction activities would occur in close proximity to visitors, RB Pipeline would post signs, establish reduced speed limits, and provide safety training regarding site-specific uses and safety concerns to minimize impacts and enhance safety during construction. RB Pipeline is continuing to coordinate with managers of the ranch to identify designated hunting land. If hunting areas are identified adjacent to or within proposed construction work areas, and if requested by the landowner, RB Pipeline would develop a site-specific mitigation plan to be implemented during hunting season.

Jamie J. Zapata Memorial Boat Ramp, Fishing Pier, and Kayak Launch Pad

Cameron County's Zapata boat launch is a public access site that contains a boat launch, 55-foot fishing pier, and 20-foot kayak launch pad providing access to the BSC and San Martin Lake. The site includes two pavilions and solar lighting to allow for nighttime fishing (Texas General Land Office 2016). The Zapata boat launch is located off SH-48, about 1.7 miles west

of the LNG Terminal site. The parking lot of the Zapata boat launch is within the path of the proposed pipeline route between MPs 133.5 and 133.6, but would be crossed by HDD concurrently with the Channel to San Martin Lake. Use of the HDD crossing method would avoid direct impacts on the site, and would not impact the operation of the boat launch (i.e., there would not be any temporary closures). However, there would be increased noise and traffic from the HDD activities, which could occur up to 24 hours a day, 7 days a week, for 10 weeks. The Zapata boat launch would be about 1,500 feet from the HDD exit point and over 3,000 feet from the HDD entry point; at these distances, the sound level from HDD construction would be perceived as moderate to quiet.

Bahia Grande Coastal Corridor Project

As identified during scoping, the Bahia Coastal Corridor Project is a multi-stage project that is currently underway with the goal of acquiring land for conservation purposes. The Nature Conservancy, Conservancy Fund, FWS, and TPWD are working to identify parcels for acquisition, through purchase or easement, to connect the Lower Rio Grande Valley NWR, Laguna Atascosa NWR, Boca Chica State Park, and other privately held land to provide protection for various threatened and endangered species, as discussed in section 4.7.

An existing easement held by the FWS on BND land that is part of this overall effort would be crossed by the Pipeline System between MPs 134.5 and 135.5; however, this crossing would be conducted by HDD, therefore direct impacts would be avoided. To date, the conservation sponsors noted above have identified, and are attempting to acquire, an additional 1,852 acres of a total acquisition goal of 10,000 acres. The land currently identified for acquisition would be at least 5 miles away from the Rio Grande LNG Project. As such no direct impacts are anticipated on lands expected to be acquired.

Great Texas Coastal Birding Trails

Four Great Texas Coastal Birding Trails, as designated by the TPWD, would be within 0.25 mile of the Project: King Ranch Trail, Hawk Alley Trail, Olmos Creek Trail, and Texas 48 Scenic Drive. These recreation areas are not linear trail systems but are larger tracts of land designated by the TPWD that offer discrete locations where the public can observe birds and other wildlife. The King Ranch Trail is considered to be the entire parcel and as such, impacts on this area are included in the discussion above (King Ranch). None of these “trails” are state-designated as Texas Scenic Drives, nor under the National Scenic Byways Program (23 USC 162).

Given these trails are not discrete linear features, a variety of crossings methods would be applied, including typical upland construction and specialized construction methods such as those used for waterbody or wetland crossings, as well as HDD (between MPs 18.8 and 19.2). Noise and dust produced during construction would have a temporary impact on trail users, as well as changes in visual setting of areas where active construction occurs. However, given these trails are associated with large tracts of land, users could opt to visit areas unaffected by construction.

Conservation Reserve Programs

Lands managed by the NRCS and the FSA that would be crossed by the pipeline facilities are contracted as SAFE as part of the CRP program. Environmentally sensitive areas are voluntarily converted from cropland and/or ranch/grazing land per the terms of a 10- or 15-year contract (U.S. Department of Agriculture 2017). The CRP-SAFE contract affords financial assistance to eligible farmers and ranchers to establish the appropriate vegetation cover to support target wildlife, and the land is managed per the terms of a conservation plan developed collaboratively by the landowner and the NRCS. The pipeline facilities would cross three areas subject to CRP-SAFE contracts, all of which are in Cameron County (between MPs 113.0 and 116.5). Initial consultation between the FSA and RB Pipeline indicated that these parcels have been designated for the protection of ocelot habitat (see section 4.7.1.4).

According to correspondence with the Cameron County FSA Office, disturbance of habitat established per the conservation plan for these CRP-SAFE contracts can result in cancellation of the contracts, and the contract owner would be required to repay all cost share payments received per the terms of the contract as well as 25 percent liquidated damages (U.S. Department of Agriculture 2017). Individual landowners could negotiate compensation of any anticipated fees or penalties as part of the easement agreement for each corresponding contract. RB Pipeline met with the FSA, NRCS, and applicable landowners to visit each of these parcels, and agreed to adopt alternative pipeline routes to address landowner concerns and reduce impacts on the parcels. Although the pipelines would still cross these CRP-SAFE parcels, they are currently proposed to predominantly cross the parcels adjacent to existing disturbance and would therefore minimize fragmentation of the habitat. As discussed in section 4.7, consultation with the FWS is ongoing regarding impacts on the ocelot and ocelot habitat.

General Impacts and Mitigation

One of the primary concerns when recreation and special interest areas are in close proximity to a project is the impact of construction on the purpose for which the area was established (e.g., the recreational activities, public access, and resources the area aims to protect). Construction could alter visual aesthetics by removing existing vegetation and disturbing soils; these potential impacts are discussed in section 4.8.2. Construction could also generate dust and noise, which could be a nuisance to recreational users, and could generally interfere with or diminish the quality of the recreational experience by affecting wildlife movements or disturbing hikers and bikers while using trails.

During the 7-year construction period for the LNG Terminal, noise from construction would be audible at recreation areas near the site. Noise from clearing, grading, and construction would be continuous for the duration of those activities, as discussed in section 4.11.2. Alternatively, pile-driving, which would be required for the installation of the marine facilities and foundations would be louder than typical construction noise and would be most prominent for receptors in or along the BSC near the LNG Terminal site. Based upon the construction schedule provided by RG LNG (see table 2.3-1 and section 2.5.1.3), land-based, impact pile-driving operations for the first stage of construction (including LNG Train 1 and related offsite utilities) would require between 114 and 165 days; each subsequent stage of construction would require less time. Pile-driving at the MOF would only be required over a 3-month period, land-

or water-based pile-driving at the Berth 2 jetty would take place for a 5-month period, and would occur over a 2-day period for the fixed aid to navigation structure. Construction of the Berth 1 jetty would be conducted prior to dredging the marine berth and would require about 4 months for land-based pile-driving.

In general, construction of the Pipeline System would result in impacts on recreational and special interest areas that would be temporary and limited to the period of active construction, which typically would last only several days to several weeks in any one area. For areas in proximity to the Pipeline System, RB Pipeline would implement the requirements and mitigation included in its Plan and Procedures. As described throughout this EIS, implementation of these requirements would generally minimize, and to some extent mitigate, potential impacts on resources and activities in recreation and special use areas.

During construction of the Rio Grande LNG Project, most non-local workers, and in some cases their families, would reside primarily in one of the five counties within the Project area, with the bulk of the workforce residing in Cameron County given the proximity to the LNG Terminal site (see section 4.9.6). RG LNG anticipates that up to 270 permanent employees would be hired to operate the LNG Terminal, and the Pipeline System would require up to 20 new permanent employees. It is likely that some workers and/or their families would visit nearby recreation areas in those counties, resulting in indirect impacts. However, given the existing inventory of recreation areas in these counties and their large geographic area with multiple access points, is it likely that these facilities would be able to accommodate use by workers and/or their families; therefore, we conclude that the overall impact on these facilities would not be significant.

4.8.2 Visual Resources

“Visual resources” refers to the composite of basic terrain features, geologic features, hydrologic features, vegetation patterns, and anthropogenic features that influence the visual appeal of an area for residents or visitors. In general, impacts on visual resources may occur during construction when large equipment, excavation activities, spoil piles, and construction materials are visible to local residents and visitors, and during operation to the extent that facilities or portions of facilities and their lighting are visible to residents and visitors. The degree of visual impact resulting from the proposed facilities would be highly variable among individuals, and would typically be determined by the general character of the existing landscape and the visually prominent features of the proposed facilities.

4.8.2.1 LNG Terminal

The existing viewshed of the proposed LNG Terminal site includes predominately open land with scrub-shrub vegetation. Land surrounding the site includes open land with scrub-shrub vegetation with the BSC and SH-48 framing the southern and northern site boundaries. As described in section 4.9.8.2, the Port of Brownsville and the BSC support the movement of domestic and foreign products, which included about 7.6 million metric tons of cargo with over 1,050 vessel-calls in 2014 (Port of Brownsville 2015). As such, the movement of these vessels contributes to the characterization of the existing viewshed. Visual receptors in the vicinity of the LNG Terminal site would include recreational and commercial users of the BSC, motorists

on SH-48, and visitors to the Laguna Atascosa NWR, and other nearby recreation areas discussed in section 4.8.1.5.

Construction of the LNG Terminal would increase traffic on SH-48 and within the waters of the BSC, as described in section 4.9.8. Construction of these facilities would affect the views of those using these transportation corridors, as well as for visitors at nearby recreation areas.

There are no residences within the LNG Terminal site; the closest residential areas are about 2.2 miles away. Given the LNG Terminal site's proximity to residential areas, it would be possible to see the LNG Terminal from some vantage points in Port Isabel and Laguna Heights, in particular elevated sites such as the Port Isabel Lighthouse; however, the distance to the LNG Terminal site limits its visibility and as such it would not be a prominent feature in the viewshed for these residences.

The changes to the visual character of the area during construction that land and water-based receptors could observe include the presence of equipment and workers, the increase in construction-related traffic (on land and in the BSC), and the installation of large structures at the LNG Terminal site (e.g., LNG trains, storage tanks). These receptors traveling along the highway and BSC would have a short time (i.e., until the vehicle or vessel passes the site) to view the site during construction.

To support construction of the LNG Terminal, RG LNG proposes to use two storage areas, one of which would also serve as an offsite parking location for construction work. The Port Isabel and the Port of Brownsville storage areas would be located in areas of heavy industry. As such, visual receptors in the vicinity of these storage areas would include workers and visitors at nearby industrial/commercial facilities and motorists on nearby roadways. Given the location of the storage areas at existing industrial sites, impacts on visual receptors would be minor and temporary.

While the vessel transits associated with construction and operation of the LNG Terminal would result in a moderate increase in traffic in the BSC, this increase would have a minimal impact on the viewshed because the vessels would be consistent with current use and visual character of the waterway.

Permanent changes to the visual character of the area would result from the operation of the LNG Terminal due to the presence of aboveground structures. The most prominent visual feature at the LNG Terminal site would be the four LNG storage tanks, each of which would be 275 feet wide and 175 feet in height. To help mitigate visual impacts from the LNG Terminal features, RG LNG has proposed to use ground flares that would be 6 feet in height and surrounded by a 67-foot-high vertical wall to reduce the heat and limit the visibility of flare-offs. Other visible structures within the LNG Terminal site would include six LNG trains, two marine loading berths, one turning basin, four LNG and two LNG truck loading bays, and Compressor Station 3. In addition, the structures within the LNG Terminal site would require lighting. RG LNG has developed mitigation measures that would reduce day and nighttime visibility of the aboveground facilities at the LNG Terminal site, including the selection of grey tank coloring, horticultural plantings, and the construction of a levee that would obstruct most construction activities and low-to-ground operational facilities from view. Several light reduction techniques

would also be implemented including limiting the amount of outdoor lighting installed, dimming lights at night, and directing lights downward. Further, in section 4.6.1.2, we have recommended that RG Developers coordinate with the TPWD and FWS to finalize nighttime lighting plans to minimize impacts on wildlife; these finalized measures would also minimize the impacts of lighting on human receptors.

Numerous public comments identified concerns with the visual impact of the LNG Terminal to surrounding communities, specifically including Port Isabel and South Padre Island. RG LNG developed visual simulations from several scenarios at key observation points (KOP) in the vicinity of the LNG Terminal site, as listed below. In response to concerns raised by the NPS for visual impacts on historic and architectural resources, RG LNG further conducted visual simulations for KOPs associated with the Port Isabel Lighthouse, Palo Alto Battlefield National Historical Park/National Historic Landmark, and Resaca de la Palma and Palmito Ranch Battlefields. These simulations are included in appendix L. The following summarizes the potential impacts on the viewshed based on the viewshed simulations developed by RG LNG:

- Bahia Grande Channel (0.2 mile west-southwest of the property boundary) – RG LNG conducted visual simulations for both daytime and nighttime visual impacts from the south side of SH-48, near the Bahia Grande Channel (see figures 1 through 3 in appendix L). Due to the proximity of the Bahia Grande Channel to the LNG Terminal site and lack of visual buffers, most of the structures within the LNG Terminal would be visible during the daytime. However, from this vantage point the most prominent feature would be the non-jurisdictional power lines that would be constructed by AEP, which would run parallel to this section of SH-48 (see section 1.4.2). In the evening, when facilities would be illuminated, the LNG Terminal site would be visible; however, individual structures within the site would be more difficult to distinguish from one another. Visual receptors familiar with the existing nighttime appearance of the channel would likely notice the change in viewscape from the terminal lighting, while those less familiar with the existing setting may not notice the change. Anglers fishing from stationary locations near the LNG Terminal site would potentially find the change in the viewscape most notable, which could result in a change in usage patterns; however, the increase in lighting may also attract fish to the local vicinity, which may benefit nighttime anglers. Impacts on fishermen at or accessing waters near Bahia Grande Channel are discussed further in section 4.9.3.2.
- SH-48 (2.6 miles north-northeast of the property boundary) – RG LNG conducted visual simulations for both daytime and nighttime visual impacts approaching the LNG Terminal site from the north on SH-48 (see figures 4 through 6 in appendix L). The most prominent features during the day from this vantage point would include the storage tanks, while other structures at the site would be visible but not distinguishable from one another. In the evening, when facilities would be illuminated, the LNG Terminal site would be visible, but at a distance that would make it difficult to distinguish one structure from one another.
- Jaime J. Zapata Memorial Boat Ramp, Fishing Pier, and Kayak Launch Pad (Zapata boat launch) (1.7 miles southwest of the property boundary) – RG LNG conducted visual simulations for daytime only visual impacts at the boat launch as this site, which

conforms to the peak use of the site (see figures 7 and 8 in appendix L). Due to lack of visual buffers, the LNG Terminal site would be visible during the daytime; however, given the distance from the boat launch, individual structures would be difficult to see.

- Port Isabel Lighthouse (4.0 miles northeast of the property boundary) – RG LNG conducted visual simulations for daytime only visual impacts at the lighthouse to conform to the time when visual receptors would likely be present at the site (see figures 9 and 10 in appendix L). While it would be possible to see the LNG Terminal site from the lighthouse under ideal visibility conditions, the distance to the LNG Terminal site would make it difficult to see. Further, Port Isabel is used for maintenance and repairs of ships and platforms, as such infrastructure like the Noble Driller shown in figures 9 and 10 (appendix L) characterizes the existing viewshed, thereby minimizing the visual impact of the LNG Terminal.
- Shrimp Basin (4.8 miles southwest of the property boundary) – RG LNG conducted visual simulations for daytime only visual impacts at the shrimp basin to conform to the time when visual receptors would likely be present at the site (see figures 11 and 12 in appendix L). While the existing vegetation buffer would obscure much of the LNG Terminal site, the storage tanks would be visible, but would not be readily distinguishable as such.
- Isla Blanca Park Boat Ramp (4.8 miles northeast of the property boundary) – RG LNG conducted visual simulations for daytime only visual impacts at the boat ramp to conform to the time when visual receptors would likely be present at the site (see figures 13 and 14 in appendix L). The LNG Terminal site would be a visible feature on the horizon from this vantage point; however, given the distance to the site, the storage tanks, which would be the terminals most prominent feature, would not be distinguishable as such.
- Isla Grand Hotel (6.3 miles northeast of the property boundary) – RG LNG conducted visual simulations for daytime only visual impacts, from the highest vantage point (the 12th floor) at the site (see figures 15 and figures 16 in appendix L). The LNG Terminal would not be visible from this vantage point given the distance between the two sites.
- Palmetto Pilings (4.9 miles southeast of the property boundary) – RG LNG conducted visual simulations for daytime only visual impacts at the historical marker to conform to the time when visual receptors would likely be present at the site (see figures 17 and 18 in appendix L). Due to the distance from the LNG Terminal site and the existing vegetation buffer, the LNG Terminal site is partially obscured; however, the storage tanks would be visible.
- Palo Alto Battlefield (12.0 miles west of the property boundary) – RG LNG conducted visual simulations for daytime only visual impacts at the battlefield to conform to the time when visual receptors would likely be present at the site (see figures 19 and 20 in appendix L). To determine whether the LNG Terminal structures would be visible by persons of average height, a viewpoint toward the terminal site was set 6 feet above the highest ground elevation in the battlefield. The results illustrate that while the

viewshed from the KOP within the battlefield would be minimally altered, the LNG Terminal would not be discernable from the Palo Alto Battlefield due to the distance, vegetation screening, and the proposed grey color of the LNG tanks.

- Fort Belknap (4.1 miles south-southwest of the property boundary) – RG LNG conducted visual simulations for daytime only visual impacts at Fort Belknap to conform to the time when visual receptors would likely be present at the site (see figures 21 and 22 in appendix L). While it would be possible to see the LNG Terminal site from Fort Belknap, the distance to the LNG Terminal site would make it difficult to detect. The presence of existing development, including several visible high-rise buildings, reduces the minor visual impact that would result from construction and operation of the terminal. In addition, visitors reading the historical marker would be facing away from the terminal.

Although not selected for the placement of a KOP, Resaca de la Palma Battlefield is approximately 2 miles further west than the Palo Alto Battlefield within the Brownsville city limits. The battlefield viewshed is surrounded by a former channel of the Rio Grande; municipal infrastructure including street lighting, traffic signals, and a public high school; residential housing; and commercial developments. At a distance of over 14 miles west of the LNG Terminal site, construction and operation of the LNG Terminal would have no impact on the viewshed of Resaca de la Palma Battlefield.

Based on our review of the visual simulations, most of the vantage points are at a distance far enough away from the LNG Terminal site that impacts on the viewshed would be permanent, but negligible or minor (i.e., at the lighthouse, hotel, shrimp basin, and historic battlegrounds/landmarks), and individual structures within the LNG Terminal site would not be discernable. Visual receptors within nearby waters north of the LNG Terminal site, such as Laguna Madre, would be at lower elevations and/or far enough away such that the nearby shoreline areas would obscure the LNG Terminal site. Visual receptors at locations closer to the LNG Terminal site (i.e., on SH-48, Bahia Grande Channel, and Zapata boat launch), would be able to discern individual structures; however, these receptors would generally not be stationary and therefore would have a short viewing time (i.e., until the vehicle or vessel passes the site). See section 4.10.2 for additional discussion of visual impacts on National Historic Landmarks.

In accordance with federal safety regulations (see section 4.12), facilities would be illuminated at night. To minimize visual impacts from lighting at the LNG Terminal site, RG LNG has stated that it would develop a lighting plan. Key components of the plan identified in the application include limited lighting that would be based on FAA regulation, use of directional controls, selection of a neutral color to mitigate impacts on wildlife, and low-light model security cameras. We have recommended in section 4.6.1.2 that RG Developers coordinate with the TPWD and FWS to finalize nighttime lighting plans.

Nighttime visual receptors in close proximity to the LNG Terminal would consist of motorists along SH-48 and boaters in the nearby waters of the BSC, San Martin Lake, and the Bahia Grande Channel. Based on the visual simulations from the Bahia Grande Channel, we have determined that there would be a permanent and moderate impact on visual resources for users in the immediate vicinity of the proposed LNG Terminal site.

4.8.2.2 Pipeline Facilities

The pipeline facilities would be constructed across large parcels of land consisting mostly of open land used for ranching and grazing, as well as agricultural land. This land also contains numerous easements for oil and gas pipelines, including at least 50 known foreign pipelines that would be crossed by the proposed Pipeline System. As a result, the existing viewshed is characterized, in part, by existing infrastructure associated with these systems.

RB Pipeline's right-of-way vegetation clearing would cause the primary impact on visual resources during construction and operation of the pipelines and associated facilities. To minimize visual impacts, portions of the right-of-way would be adjacent to existing permanent rights-of-way, which would minimize development of new corridor. This would also help to limit the extent of changes in the viewshed. Clearing forested land within the construction right-of-way, and maintaining the permanent right-of-way as herbaceous and scrub-shrub vegetation types would change the viewshed for visual receptors in the area; however, forest land crossed by the proposed pipeline is generally small pockets of trees, areas of where trees are not densely present, and/or areas where the pipeline is collocated with U.S. Highway 77, resulting in minimal visual impacts from tree clearing. For the portions of the right-of-way adjacent to existing rights-of-way, we have determined that the impact would not be significant because the increase in width of the rights-of-way would be difficult to discern, and given the parcels crossed are predominately large, privately owned tracts, there would be few observers of the change. RB Pipeline would allow scrub-shrub land and forested wetlands to revert to pre-construction conditions except for the maintained portion of the right-of-way, although it could require years to reach that stage, resulting in long-term visual impacts in those areas.

In addition to clearing of vegetation, construction of the pipelines and associated facilities would require the presence of personnel, large construction equipment, and vehicles, all of which could be visible in areas accessible to the public, such as at roadways crossed by the route and near residences. No planned or permitted residential or commercial developments were identified within 0.25 mile of the Pipeline System. Two residences are within 50 feet of existing roads proposed for use during construction of the Pipeline System (see section 4.8.1.3). Visual impacts in these areas due to the presence of construction equipment and personnel would be temporary; therefore, we have determined that those visual impacts would not be significant.

As described in section 2.3, RB Pipeline would complete the installation of Pipeline 1 before installing Pipeline 2. Similarly, the compressor stations would be installed in increments to correspond to the compression capacity required to support the portion of the Pipeline System in place at that time. This phased construction approach would allow RB Pipeline to utilize a smaller construction workforce. While this approach would result in a longer construction period, impacts associated with the visual presence of construction-related traffic would be minimized.

Following construction, all disturbed areas would be restored, and areas outside of the permanent rights-of-way would be returned to pre-construction conditions in compliance with federal, state, and local permits; the Project-specific Plan and Procedures; landowner agreements; and RB Pipeline's lease requirements, with the exception of aboveground facility sites. As described throughout this EIS, implementation of these requirements would generally

minimize, and to some extent mitigate, potential impacts on resources and as such would mitigate impacts on visual receptors.

Compressor Station 1

RB Pipeline would lease a 37-acre parcel of land within a rural area of Kleberg County to accommodate construction and operation of Compressor Station 1. As described in section 4.8.1.2, the areas that would be cleared and graded predominantly consist of open land, which would be converted to industrial/commercial land. Initial construction-related impacts, including the presence of equipment and workers, would be temporary and limited to the 12-month construction period; however, additional compression would be added during discrete periods during subsequent stages of the Project (see table 2.3-1).

Based on the proximity to Highway 281 (over 4 miles away), it is unlikely that these facilities would be visible to passing motorists. Construction and operation of Compressor Station 1 would take place on land within King Ranch, which is discussed in sections 4.8.1.4 and 4.10.1. The closest residence to the site is about 5.5 miles to the west (see table 4.11.2-12). Given the lack of visual receptors in proximity to this compressor station and existing commercial infrastructure just northwest of the site, visual impacts would be permanent, but minor.

Compressor Station 2

Construction of Compressor Station 2 would take place within a rural area of Kenedy County on a 28.6-acre parcel that RB Pipeline would lease. As with Compressor Station 1, initial construction would occur over a 12-month period with additional compressors being added in stages. As described in section 4.8.1.2, the areas that would be cleared and graded consist exclusively of open land, which would be converted to industrial/commercial land. During both construction and operation, Compressor Station 2 could be visible to passing motorists traveling along U.S. Highway 77. However, construction and operation of the compressor station would not affect any designated visual resources, and the closest residence is 2.9 miles to the south (see table 4.11.2-13). Given the limited number of visual receptors in proximity to this site, we find that visual impacts associated with this compressor station would be permanent, but minor.

Booster Station 1 and 2

The proposed interconnect booster stations would be constructed on predominately open land in Kenedy County, and each would be collocated with an associated metering site. RB Pipeline would lease two 10-acre sites (MPs 19.6 and 25.4) to accommodate these facilities. These sites would be cleared and graded, resulting in a permanent conversion to industrial/commercial land. Passing motorists traveling along U.S. Highway 77 would be able to see the sites during both construction and operation. The closest residences to these sites are about 1.7 and 2.4 miles away, respectively (see table 4.11.2-12). Given the limited number of visual receptors in proximity to these sites, visual impacts would be permanent, but minor.

Metering Sites

Of the eight metering sites that would be constructed for the Pipeline System, four would be constructed within the footprint of an associated compressor or interconnect booster station, and are discussed above, and four would be stand-alone facilities constructed on open land. The four stand-alone metering sites would be on individual parcels, for a total of 6.9 acres of open land that would be converted to industrial/ commercial land. Vegetation cover, which could potentially minimize the visibility of these facilities, is generally limited at these locations; however, these areas include large tracts of land in a rural setting with no residences within 50 feet of any of the metering sites. Visual receptors at these sites would include motorists on nearby roadways who may be able to view construction workers and equipment as well as the stations themselves during operation; however, their view would be short in duration. Overall, the metering sites would result in short-term (during construction) or permanent (during operations) localized visual impacts during construction and a permanent but minor impact during operations.

Other Aboveground Facilities

RB Pipeline would install 12 MLVs at 6 locations along the Pipeline System (MPs 18.0, 35.1, 48.9, 83.6, 100.5, and 119.5). In general, the impacts on visual resources resulting from the construction and operation of the MLVs would be minimal as each site is small (typically less than 0.1 acre) and would be within the pipeline operational right-of-way or within an aboveground facility (e.g., compressor or metering site). MLVs along the operational right-of-way would be enclosed in a security fence. Pig launchers and pig receivers would be constructed within the compressor station boundaries.

4.8.3 Coastal Zone Management

The CZMA calls for the “effective management, beneficial use, protection, and development” of the nation’s coastal zone and promotes active state involvement in achieving those goals. As a means to reach those goals, the CZMA requires participating states to develop management programs that demonstrate how those states will meet their obligations and responsibilities in managing their coastal areas. For oil and gas projects, the Texas CZMA is administered by the RRC through the Texas CZMP. Activities or development affecting land within Texas’ coastal zone are evaluated by the RRC for compliance with the CZMA through a process called “federal consistency.” The Rio Grande LNG Terminal and the majority of pipeline facilities in Willacy and Cameron Counties from MP 69.8 to the LNG Terminal would be within the designated coastal zone.

RG Developers have requested a CZMA determination for the Project as part of the COE Section 10/404 permitting process, and submitted a revised application for determination of consistency with the Texas CZMP to the COE March 30, 2018, and to the RRC on April 10, 2018. The applications are still under review, and a Section 10/404 permit has not been issued. Further, the RB Pipeline has not submitted an application for water quality certification for the Pipeline System. As a result, RG Developers have not received a consistency determination from the RRC; therefore, **we recommend that:**

- **Prior to construction of the Project, RG Developers should file with the Secretary a determination from the RRC that the Project is consistent with the laws and rules of the Texas Coastal Zone Management Program.**

4.9 SOCIOECONOMICS

Construction and operation of the Rio Grande LNG Project could impact socioeconomic conditions, either adversely or positively, in the general Project vicinity. These potential impacts include alteration of population levels or local demographics, increased employment opportunities, increased demand for housing and public services, increased traffic on area roadways and waterways, and an increase in state and local government revenues associated with sales and payroll taxes.

The socioeconomic analysis for the proposed Project examines data from Cameron, Hidalgo, Willacy, Kenedy, Kleberg, and Jim Wells Counties. Of these, the greatest socioeconomic impacts would occur in Cameron County, where the Rio Grande LNG Terminal would be located. None of the Project components would be constructed in Hidalgo County, but it is included in the socioeconomic analysis because it would likely experience an influx in population from non-local workers relocating to the area due to the relatively short commute distance to the Rio Grande LNG Terminal. For the purposes of our socioeconomic analysis, Cameron, Hidalgo, and Willacy Counties make up the affected area for the Rio Grande LNG Terminal; and Cameron, Willacy, Kenedy, Kleberg, and Jim Wells Counties make up the affected area for the pipeline facilities.

4.9.1 Population

Table 4.9.1-1 provides a summary of selected population and demographic information for the affected areas.

Table 4.9.1-1 Existing Socioeconomic Conditions in the Affected Areas							
State / County	2010 Population	2015 Population (est.)	2010 Population Density (per square mile)	2015 Per Capita Income	2015 Civilian Labor Force	2015 Unemployment Rate (%)	Top Industries
Texas	25,145,561	27,469,114	96	26,999	13,006,330	7.0	C, F, D
Cameron	406,220	422,156	456	15,105	164,483	10.0	C, F, B
Hidalgo	774,769	842,304	493	14,689	330,963	9.9	C, F, D
Willacy	22,134	21,903	37	44,413	6,062	11.5	C, A, E
Kenedy	416	407	<1	14,251	185	0.0	A, E, C
Kleberg	32,061	31,857	36	18,722	15,256	11.7	C, B, A
Jim Wells	40,838	41,382	47	21,798	17,859	6.6	C, A, F
LNG Terminal Affected Area^a	1,203,123	1,286,363	329 ^b	24,736 ^c	501,508	10.5 ^d	C, F, D, B, A, E
Pipeline Facilities Affected Area^c	501,669	517,705	115 ^c	22,858 ^d	203,845	8.0 ^e	C, A, F, E, B
Sources: U.S. Census Bureau 2010a, 2010b, 2015a, and 2015c.							
^a Includes Cameron, Willacy, and Hidalgo Counties.							
^b Average population density for the affected counties.							
^c Average per capita income for the affected counties.							
^d Average unemployment rate for the affected counties.							
^e Includes Cameron, Willacy, Kenedy, Kleberg, and Jim Wells Counties.							
Industries:							
A Agriculture, forestry, fishing and hunting, and mining							
B Arts, entertainment, recreation, and accommodation and food services							
C Educational services, health care and social assistance							
D Professional, scientific, management, administrative, and waste management services							
E Public administration							
F Retail trade							

4.9.1.1 LNG Terminal

In 2015, the total population of the three-county affected area for the LNG Terminal site was about 1.3 million, with a population density of 329 persons per square mile. Of the three-county area, Hidalgo County has the largest population, including 842,304 residents in 2015 and a population density of 493 persons per square mile (U.S. Census Bureau 2010a, 2010b 2015a). In comparison, the 2015 population of the State of Texas was about 27.5 million residents. Construction of the LNG Terminal would take place over a 7-year period; RG LNG originally anticipated beginning construction in 2018; however, the actual start of construction is dependent on the issuance of all relevant permits and authorizations.

Construction workers would be onsite throughout the duration of the construction period, with an average monthly construction workforce of 2,950 workers. During a 17-month period (spanning Years 4 and 5 of construction), the construction workforce at the LNG Terminal site would exceed 5,000 workers, with a maximum workforce of about 5,225. The anticipated monthly construction workforce at the LNG Terminal site is depicted in figure 4.9.1-1.

Although the estimated years are no longer completely accurate, the shape of the curve (reflecting the number of workers) would not change appreciably as the graph moves to the right to match the actual years of work.

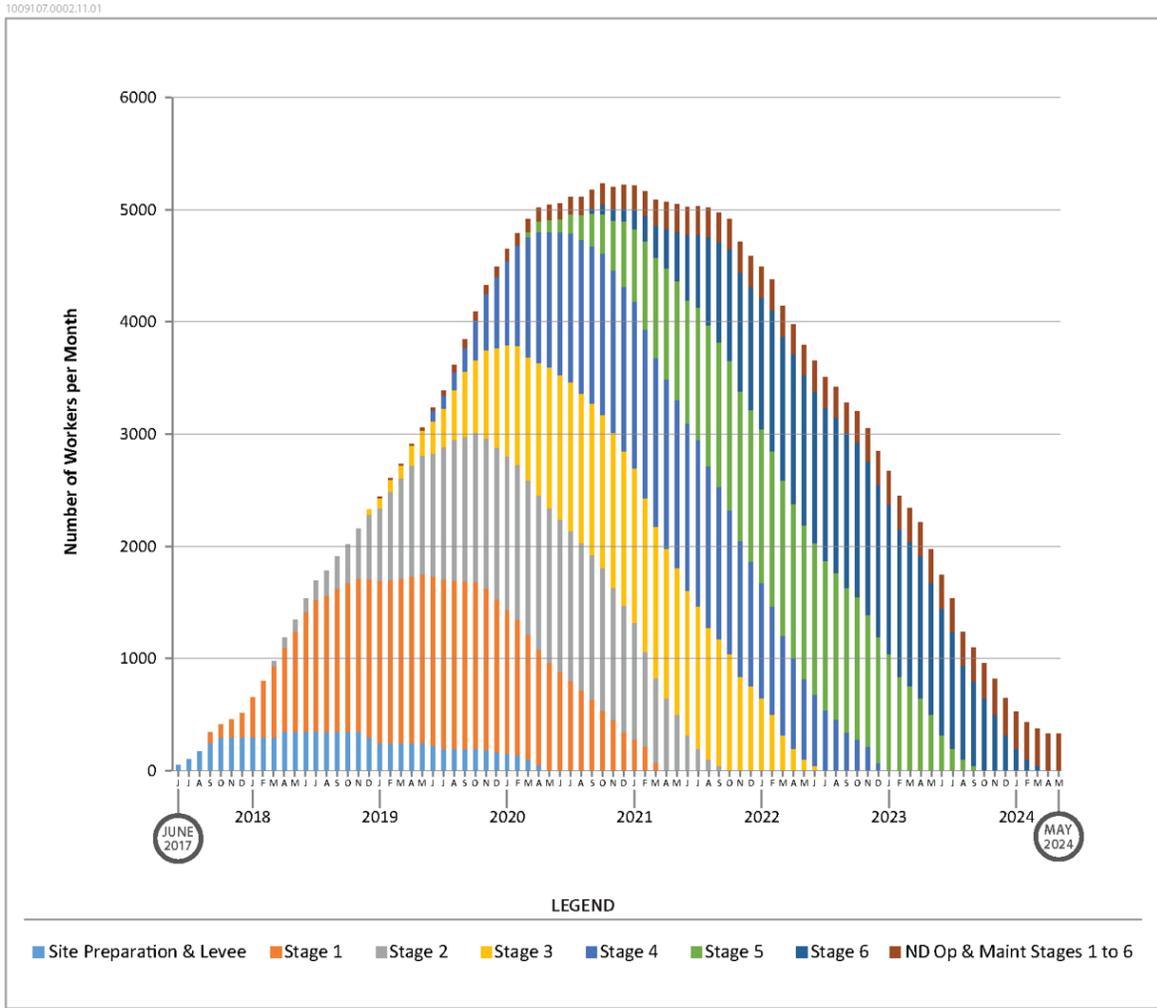


Figure 4.9.1-1 Construction Workforce Associated with the LNG Terminal Site

RG LNG estimates that about 30 percent of the workers would be hired locally, resulting in an average of 2,065 non-local workers and a maximum of 3,658 non-local workers. RG LNG assumes that about 70 percent of the non-local workers would be accompanied by family members. Based on an average family size of 3.5 persons in Texas and a peak non-local workforce of 3,658 workers, up to 10,058 non-local persons and family members could relocate to the affected area during construction of the LNG Terminal (U.S. Census Bureau 2015b). This addition would represent a 0.8 percent increase in the total population within Cameron, Willacy, and Hidalgo Counties over the 2015 census data.

After construction, RG LNG anticipates that 270 workers would be employed at the LNG Terminal site, of which 108 are expected to be non-local hires who would relocate to the Project area. The influx of these workers and their families would represent a minor but permanent increase in the population in the vicinity of the LNG Terminal site. In addition to the LNG Terminal operational staff, RG LNG anticipates hiring about 60 staff to maintain the LNG terminal site; the majority of these staff members are anticipated to be local.

4.9.1.2 Pipeline Facilities

The pipeline facilities would be constructed in Cameron, Willacy, Kenedy, Kleberg, and Jim Wells Counties. Of these, Cameron County had the highest 2010 population density of about 456 persons per square mile, while Kenedy County had the lowest, with less than one person per square mile. The 2010 population densities for Willacy, Kleberg, and Jim Wells Counties were about 37, 36, and 47 persons per square mile, respectively. As shown in table 4.9.1-1, the population in these counties ranged from 407 to 422,156 people in 2015 (U.S. Census Bureau 2015a).

Header System, Pipeline 1, and the Aboveground Facilities

RB Pipeline is proposing a multi-stage construction period for the Pipeline System (see figure 4.9.1-2). The Header System, Pipeline 1, and the aboveground facilities would be constructed during Stages 1 and 2, which would extend for a 12-month period. During this construction period, the average monthly workforce would be 1,240 workers, with a peak of 1,500 workers (see figure 4.9.1-2). The workforce would be concentrated near the compressor stations with an average monthly workforce of 160 workers each (including Compressor Station 3); the remaining workers would be separated into two construction spreads along the Header System and Pipeline 1. Spread 1, with an average monthly workforce of 380 workers, would extend from MPs HS-2.4 to 65.2. Spread 2, with the same number of workers, would extend from MPs 65.2 to 135.5. Workers along each spread would continue to move down the pipeline so that active construction at any given location would generally not last longer than a few weeks.

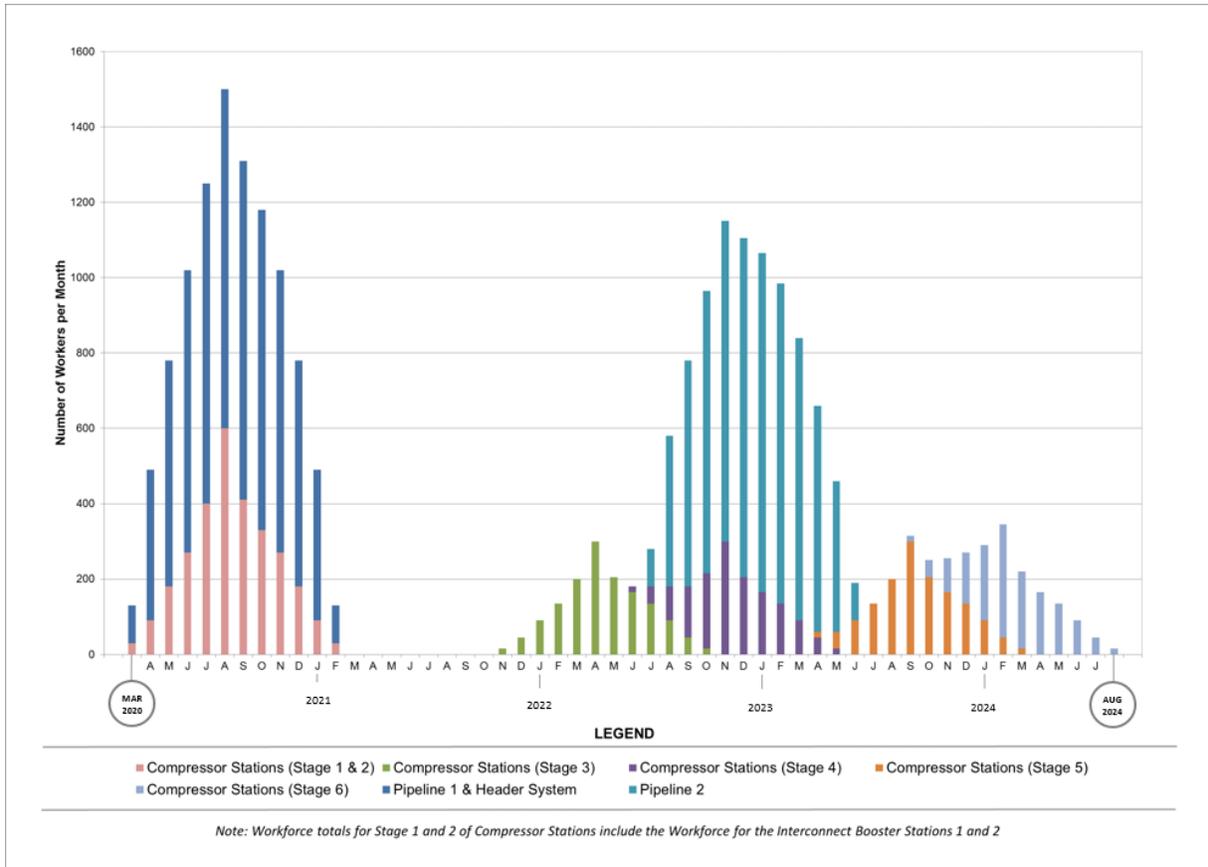


Figure 4.9.1-2 Construction Workforce Associated with the Pipeline Facilities

RB Pipeline anticipates that the majority of construction workers for the pipeline facilities (90 percent) would be hired from outside the Project area. Therefore, the estimated maximum non-local workforce during Stages 1 and 2 would be 810 workers for the construction of the Header System and Pipeline 1 (including both spreads) and 540 workers for the construction of the three Compressor Stations. This peak addition of 1,350 non-local workers would result in a negligible increase in the affected area’s population (0.003 percent).

RB Pipeline anticipates that 10 staff would be employed along the Pipeline System once Pipeline 1 became operational, including 3 to 4 staff at each compressor station. The operational staff would periodically visit the pipelines, booster stations, metering sites, and MLV sites to maintain the facilities. Assuming that all 10 workers are non-local, this would represent a negligible, but permanent, increase in the local population.

Pipeline 2

After the completion of Stage 2, there would be a period of no active construction for 8 months prior to the beginning of Stage 3 (see figure 4.9.1-2). Stages 3 through 6 would involve additional compression at each of the three compressor stations, which would require an average monthly workforce of 240 workers (peak of 300). However, as work related to Stages 3 through 6 of the compressor stations would be restricted to the facility footprints established for those

facilities during Stages 1 and 2, the majority of active construction would take place along Pipeline 2. Construction of Pipeline 2, which would occur as part of Stage 4, would require an average workforce of 760 workers (380 per spread) over a 12-month period that would begin approximately 18 months after the completion of construction for Pipeline 1.

The estimated maximum non-local workforce during Stage 3 would be 270 workers to add additional compression at the three compressor stations. Stage 4 would require a maximum of 810 non-local workers for the construction of Pipeline 2 (including both spreads) plus 270 workers for work at the three compressor stations, for a maximum non-local workforce of 1,080 workers during this stage. Finally, Stages 5 and 6 would each require a maximum non-local workforce of 270 to complete construction on the three compressor stations. Because the construction periods associated with the two pipelines would be separated by 18 months, it is unlikely that non-local workers would be accompanied by family members. RB Pipeline anticipates that 10 additional staff would be added upon full build-out of the Pipeline System, for a total of 20 permanent operational staff. These operational staff would periodically visit the pipelines, booster stations, metering sites, and MLVs to maintain the facilities. Assuming that the 20 workers employed after full build-out are non-local, this would represent a negligible, but permanent, increase in the local population.

4.9.2 Economy and Employment

The affected areas of the LNG Terminal and the pipeline facilities are generally characterized by lower per capita income and higher unemployment rates compared to the State of Texas (see table 4.9.1-1). As further discussed in section 4.9.10, many Project area residents live in poverty, with the percentage of people living in poverty ranging from 18.0 percent in Jim Wells County to 36.3 percent in Willacy County. The top industries in the affected areas include:

- educational services, and health care and social assistance;
- retail trade;
- professional, scientific, management, and administrative and waste management services;
- arts, entertainment, and recreation, and accommodation and food services;
- agriculture, forestry, fishing and hunting, and mining; and
- public administration (U.S. Census Bureau 2015c).

The economic benefits from employment opportunities for local contractors and laborers were raised during the scoping period. Construction of the Rio Grande LNG Project would stimulate the economy through an estimated \$22.4 billion in direct expenditures by RG Developers and annual operating direct expenditures of \$2.1 billion. Due to the forecasted number of jobs that would be created during construction and operation of the Project, RG Developers have been coordinating with local training organizations and school districts to

provide seminars and career talks to discuss future career opportunities for the Project. In addition, RG Developers have included career development guidance on their Project-specific website that provides links to various career development organizations. RG Developers anticipate hiring a number of unskilled or semi-skilled workers that would be trained on the job through the National Center for Construction Education and Research System.

4.9.2.1 LNG Terminal

The civilian labor force is defined as the sum of employed persons and those actively searching and available for work (U.S. Census Bureau 2010a). During construction of the LNG Terminal, about 30 percent of the peak workforce (up to 1,568 workers of the 5,225 total workers) is expected to be hired from Cameron, Hidalgo, and Willacy Counties. In 2015, the civilian labor force numbered 164,483 in Cameron County, 330,963 in Hidalgo County, and 6,062 in Willacy County. The average per capita income in Cameron and Hidalgo Counties (\$15,105 and \$14,689, respectively) was below the State of Texas' average per capita income of \$26,999, while Willacy County's average per capita income is higher than the state (\$44,413). All three counties had a higher unemployment rate than the State of Texas (see table 4.9.1-1).

Construction of the LNG Terminal would stimulate the economy through an estimated \$20.2 billion in direct expenditures by RG LNG. Of the 20.2 billion, about \$3.2 billion would be direct expenditures for materials, a portion of which may be regionally or locally sourced. Specific to the LNG Terminal, RG LNG estimates that a percentage of the \$1.9 billion construction payroll (direct and indirect/support labor) would be spent locally by both local and non-local workers for the purchase of housing, food, gasoline, and other goods, services, and entertainment in the vicinity of the LNG Terminal site. Typically, construction activities increase economic activity within an area in several ways:

- a direct effect – hiring of local construction workers and purchases of goods and services from local businesses;
- an indirect effect – the additional demand for goods and services, such as replacing inventory from the firms that sell goods and services directly to a project or to workers and their families; and
- an induced effect – the spending of disposable income by the construction workers at local businesses, which in turn order new inventory from their suppliers.

The increase in economic activity resulting from direct, indirect, and induced effects of the LNG Terminal would result in a positive economic impact on the local economy. RG Developers' economic consultant (The Perryman Group [TPG]), estimated that the production of goods and services associated with construction of the LNG Terminal would amount to \$31.7 billion dollars in total economic impact across the United States, \$22.1 billion of which would be in Texas (\$5.6 billion in Cameron County) (TPG 2015).

Anticipated operational direct expenditures for the LNG Terminal would be \$1.9 billion annually. RG Developers anticipate that a 270-person operational staff for the LNG Terminal would result in an annual payroll of \$24.3 million. The annual direct, indirect, and induced expenditures during full operation of the Rio Grande LNG Project (including the LNG Terminal and the pipeline facilities) are estimated to result in economic impacts of about \$2.3 billion across the United States, \$2.1 billion of which would be in Texas (\$1.4 billion in Cameron County) (TPG 2015). We conclude that the expenditures and permanent workforce associated with operation of the LNG Terminal would result in positive, permanent impacts on the local economy.

4.9.2.2 Pipeline Facilities

During construction of the pipeline facilities, RB Pipeline estimated that about 10 percent of the workers would be hired from Jim Wells, Kleberg, Kenedy, Willacy, and Cameron Counties. In 2015, the civilian labor force in these counties ranged from a low of 185 in Kenedy County to a high of 164,483 in Cameron County. Four counties (Jim Wells, Kleberg, Kenedy, and Cameron Counties) have lower per capita incomes than the state average of \$26,999, while Willacy County's average per capita income is higher than the state average (\$44,413). Three counties (Kleberg, Willacy, and Cameron Counties) have higher unemployment rates (11.7, 11.5, and 10.0 percent, respectively) as compared to the state average of 7.0 percent, while Kenedy and Jim Wells Counties have lower unemployment rates (0.0 and 6.6, respectively).

About \$2.2 billion in direct expenditures are anticipated during construction of the pipeline facilities. RB Pipeline anticipates that about \$800 million would be spent nationally on materials, of which \$60 million would be spent on local and regional construction materials specifically for the pipeline facilities. In addition, a portion of the estimated \$809 million in labor, including about \$165 million in payroll for pipeline facility construction workers, would be spent locally by both local and non-local workers for the purchase of housing, food, gasoline, and other goods, services, and entertainment in the Project area.

Of the estimated \$69.6 billion in direct, indirect, and induced expenditures associated with construction of the full Rio Grande LNG Project, the pipeline facilities are estimated to be \$7.4 billion dollars in total economic impact across the United States, \$4.3 billion of which would occur in Texas (\$625 million in Cameron County) (TPG 2015). The increase in economic activity resulting from construction of the pipeline facilities would result in a temporary, positive economic impact in the affected counties.

Operation of the pipeline facilities is expected to result in \$179.7 million in annual operational total capital expenditures, a portion of which would be spent in the area of affect for the Pipeline System. Based on the average annual salary, about \$1.3 million in annual operational payroll would be allocated to the 20 new operational staff. These expenditures would result in a minor, but positive permanent impact on the local economy.

4.9.3 Tourism and Recreational Fishing

4.9.3.1 Tourism

In an area characterized by high poverty rates and unemployment, tourism is an important source of employment and income for the local communities. Tourism was identified as a significant resource of concern in scoping comments, along with recreation-based commerce in the Project vicinity. Major tourist draws in the Rio Grande Valley (Cameron, Willacy, Hidalgo, and Starr Counties) include, but are not limited to, South Padre Island beaches, boating, recreational fishing, wildlife viewing (particularly bird-watching), the Palo Alto Battlefield, and the Port Isabel Lighthouse (Rio Grande Valley Texas 2016). In 2014, visitors spent an estimated \$2.2 billion in the Rio Grande Valley, with Cameron County ranking 11th out of the 254 Texas counties for visitor spending (Dean Runyan Associates 2015). That same year, the travel industry supported 24,790 jobs in the Rio Grande Valley (Dean Runyan Associates 2015).

Out of 26 metropolitan statistical areas (MSAs) in Texas, the Brownsville-Harlingen MSA (which includes Cameron County) ranks seventh in the number of days tourists spent visiting (D.K. Shifflet & Associated, Ltd. 2015). In 2014, nature-oriented activities were the most popular tourist pastime, with 56.0 percent of visitors taking part in beach and waterfront activities; visiting state, local, and national parks; or wildlife viewing. About 23.6 percent of tourist trips included participation in outdoor sports, including fishing, biking, boating, and sailing (D.K. Shifflet & Associated, Ltd. 2015). In 2011, the direct, indirect, and induced impacts of nature-oriented tourism in the Rio Grande Valley spurred \$463 million in revenues and supported about 6,613 jobs (Texas A&M University 2012).

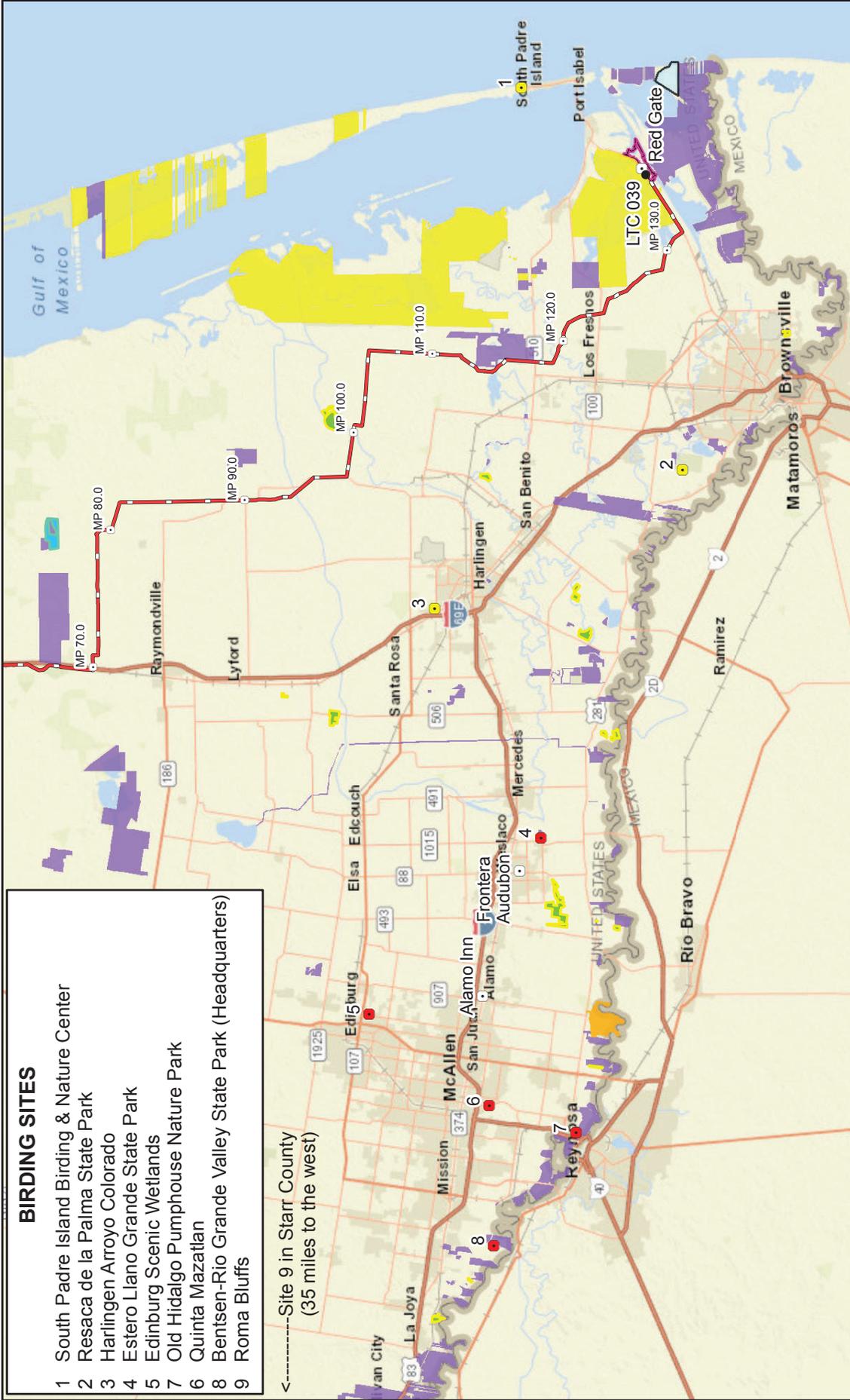
The Rio Grande Valley is cited as one of the top destinations for bird watching in the country (Mathis and Matisoff 2004, Glusac 2010, Thomas 2016). Located along the Central Flyway, the region is a major bird migration corridor for an estimated 500 bird species (see section 4.6.1). Birding destinations in the region include designated birding centers, NWRs, and local roads and landmarks. The Rio Grande Valley is home to the World Birding Center, a network of nine birding sites along a 120-mile-long corridor following the Rio Grande from the city of Roma to South Padre Island (see figure 4.9.3-1). Created through a partnership among the TPWD, FWS, and local communities, the goal of the World Birding Center is to protect native habitat while strengthening eco-tourism in the Rio Grande Valley (The World Birding Center 2016). Of the nine World Birding Center sites, the South Padre Island Nature and Birding Center is the closest to the LNG Terminal site, located about 7.8 miles away.

Additional birding sites in the Rio Grande Valley are part of the Great Texas Coastal Birding Trail, a state-designated system of 43 hiking and driving trails that includes 308 birding sites along the Texas Gulf Coast. The trail system is managed by the TPWD as part of the Great Texas Wildlife Trails and includes dozens of birding sites in the Rio Grande Valley. Birding site 039 is directly across from the proposed LNG Terminal site's western end, on the southern shore of Bahia Grande (see figure 4.9.3-1). The next closest designated birding sites include the Lower Texas Coast Site 032 in Laguna Vista, Site 033 in Port Isabel, and Site 043 at Boca Chica Beach, all more than 4 miles away. Additional detail on the Great Texas Coastal Birding Trail is provided in section 4.8.1.

BIRDING SITES

- 1 South Padre Island Birding & Nature Center
- 2 Resaca de la Palma State Park
- 3 Harlingen Arroyo Colorado
- 4 Estero Llano Grande State Park
- 5 Edinburg Scenic Wetlands
- 7 Old Hidalgo Pumphouse Nature Park
- 8 Bentsen-Rio Grande Valley State Park (Headquarters)
- 9 Roma Bluffs

<-----Site 9 in Starr County
(35 miles to the west)



Legend

- Cameron County Birding Site
- Hidalgo County Birding Site
- Other Location of Interest
- Nearest birding site to Terminal:
- Lower Texas Coast site 039, Great TX Coastal Birding Trail
- Laguna Atascosa National Wildlife Refuge
- Lower Rio Grande Valley National Wildlife Refuge
- Santa Ana National Wildlife Refuge
- Boca Chica Beach
- Las Palomas Wildlife Management Area
- El Jardin and San Perita Conservation Area
- Proposed Rio Bravo Pipeline
- Proposed LNG Terminal Boundary (Facility Footprint)

N

0 5 10

Miles

Scale: 1:575,000

Rio Grande LNG Project

Local Tourism Sites in the Vicinity of the
Proposed Rio Grande LNG Terminal

Figure 4.9.3-1

Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

LNG Terminal

Construction of the LNG Terminal could impact local tourism through an increase in noise, changes in the visual landscape, and heavier traffic along SH-48. Operations would also result in increased noise and visual effects; however, the addition of 270 permanent jobs would not significantly impact local traffic. To determine the noise and visual impacts on local recreational activities, RG Developers conducted noise and visual assessments in the vicinity of the LNG Terminal site; results of those studies are discussed in detail in sections 4.11.2 and 4.8.2, respectively, and summaries of those impacts on local tourist activities are provided below. Noise and visual impacts on beachgoers, bird-watchers, tour operators, and other visitors are expected to occur only in the immediate vicinity of the LNG Terminal site. Sound from pile-driving would be louder than typical construction noise and would be most prominent for tourist sites near the LNG Terminal site. Based upon RG LNG's anticipated construction schedule, land-based pile-driving for the first stage of construction (including LNG Train 1 and related offsite facilities) would require between 114 and 165 days; each subsequent stage of construction would require less time. In addition, pile-driving operations at the MOF would take place over a period of 3 months. Land- or water-based pile-driving at the Berth 1 jetty would occur over a 5-month period, and the timeframe for construction of the Berth 2 jetty would be similar. As such, impacts from pile-driving would be temporary and limited to the period of construction (see section 4.11.2).

During ideal visibility conditions, it would be possible to see the LNG Terminal from the top of the Port Isabel Lighthouse, which is about 4.0 miles away; however, these impacts would be negligible to minor (see section 4.8.2). Similarly, no visual impacts on South Padre Island beaches and associated tourism would occur, given that the beaches face the ocean and are 5 miles away. Charter boat trips and tours (such as dolphin watching cruises) launching from the bayside of South Padre Island would largely be unaffected by construction because the Laguna Madre or the Gulf of Mexico is the destination of most trips. Alternatively, some charter boat tours are designed expressly for the purpose of viewing maritime industries along the BSC. Visitors on these tours would see and hear LNG Terminal construction activities. The availability of lodging accommodations on the island are not expected to be impacted by the LNG Terminal construction workforce (see section 4.9.6). Charter trips or tours launching from Port Isabel could experience delays at Brazos Santiago Pass if they arrive during LNG carrier transit; however, RG LNG estimates that an LNG carrier's transit time through the pass would only be about 30 minutes. Impacts on marine transportation are further discussed in section 4.9.8.2.

Tourists may experience temporary traffic delays along SH-48 at peak commute times during the 7-year construction period of the LNG Terminal. RG LNG would implement mitigation measures during the construction period to minimize these impacts (see section 4.9.8); however, tourists may choose to go to other quieter, more scenic sites away from the LNG Terminal site, so that visitation patterns may change, but the number of visits to the Project area would likely not.

Construction of the LNG Terminal would not be expected to affect the majority of designated birding and wildlife watching locations in the area. The closest World Birding Center site to the LNG Terminal site is the South Padre Island Birding and Nature Center, which is

about 7.8 miles away. The only designated birding site within 4 miles of the LNG Terminal site is the Lower Texas Coast Site 039 of the Great Texas Coastal Birding Trail, located immediately across from the LNG Terminal site (see figure 4.9.3-1). Sounds from construction and operation of the LNG Terminal would be audible at this birding site, so that some bird-watchers would likely bypass this site in favor of birding sites farther from the LNG Terminal site. Given the multitude of other birding sites and trails available elsewhere in the Rio Grande Valley, neither construction nor operation would be expected to impact the birding tourism industry in Cameron County.

Aside from Lower Texas Coast Site 039 in the Bahia Grande portion of the Laguna Atascosa NWR, most nature tourism facilities at this NWR are about 9 miles north of the LNG Terminal site and would not be impacted by construction. Boca Chica Beach is a visitor-oriented NWR site located about 5.5 miles southeast of the LNG Terminal site; construction noise is not expected to be perceivable at this distance. Additionally, the viewshed of visitors to this beach would not be impacted because dunes line the landward side of the beach, blocking views of the LNG Terminal site.

The portion of South Bay closest to the LNG Terminal site would be exposed to noise from LNG Terminal construction, including pile-driving, that would be louder than ambient sound levels. As described in table 4.7.1.3, the composite construction sound level at designated piping plover critical habitat near the LNG Terminal site would be a maximum of 61.1 decibels, which is perceived as moderate. The distance from the LNG Terminal site to South Bay is similar, and that area would likely be exposed to a similar level of construction noise. Nature tourism at the southern extent of the Bahia Grande would be similarly exposed to construction noise that is louder than the background traffic on SH-48, given its distance from pile-driving at the MOF (about 2,500 feet).

Sound from operation of the LNG Terminal would be perceptible at the Zapata boat launch, within the Bahia Grande, and at Lower Texas Coast Site 039 (see section 4.11.2-3). Operations would run 24 hours a day, 7 days a week. Additional information regarding impacts on tourists engaging in recreational fishing in the Project area are discussed in section 4.9.3.2, below.

Representatives from the Laguna Atascosa NWR provided comments on the draft EIS, including details on the NWR's plans to create a 1-acre public parking lot, information kiosk, and contact station at its Red Gate Entrance off of SH-48. This entrance is located just across the highway from the mid-point of the LNG Terminal site. These facilities would be the access point to a new west-flowing hiking trail ending at an observation deck along the Bahia Grande, and a new hiking/biking trail going north (away from the LNG Terminal site) that leads to multiple recreational facilities. SH-48 and the LNG Terminal would be partially screened from hikers on the westbound trail due to the natural dunes and scrubby vegetation present; however, once at the observation deck, viewers looking south would likely see the LNG Terminal, and specifically Compressor Station 3, which would be about 1,600 feet away (these visual impacts would be similar to those discussed in section 4.8.2.1, for the Bahia Grande Channel KOP). The first recreational facility along the northbound hiking/biking trail would include a rest area about 3,900 feet north of the LNG facility boundary. Impacts from construction and operation of the LNG Terminal on users accessing the NWR at this location would generally be similar to those

discussed above but are dependent upon the timing of completion of the new facilities. Additional discussion of this planned access to the Laguna Atascosa NWR can be found in section 4.13.

Pipeline Facilities

Recreational areas that draw nature-oriented tourists would be crossed by the pipeline, including four Great Texas Coastal Birding Trails, a National Historic Landmark (King Ranch), the Zapata boat launch, and BND land subject to a wildlife crossing conservation easement. As discussed in 4.8.1.4, the Lower Rio Grande Valley and Laguna Atascosa NWRs would be less than 0.25 mile from the Pipeline System.

Although pipeline construction would not prohibit visitors from using recreational areas, sights and sounds of pipeline construction activities may be a nuisance to visiting tourists, and could generally interfere with or diminish the quality of their experience by affecting wildlife movement. See section 4.9.8 for a discussion of potential traffic impacts for these recreational areas. Given the number of tourism opportunities in the Project area, tourists may go to other sites within the Project area, so that visitation patterns may change, but the number of visits to the Project area would likely not.

Following construction, RB Pipeline would restore land crossed by the Pipeline System to pre-construction conditions; however, as the construction of Pipeline 2 would occur about 18 months after the installation of Pipeline 1, previously vegetated areas may not fully recover between construction stages. Lands where aboveground facilities are constructed would be permanently converted to industrial/commercial use. In general, impacts of construction of the Pipeline System on nature-oriented tourism sites would be temporary and limited to the period of active construction, which typically would last several days to several weeks in any one area. Operational impacts, including the permanent conversion of aboveground facility sites to industrial/commercial land, would result in negligible impacts on tourism based on their placement outside of main tourism areas.

We received comments raising concern for the Project's impact on jobs and businesses supported by the tourism industry. We recognize the Project's impacts on tourism above, including an increase in noise, changes in the visual landscape, and heavier traffic along SH-48. Further, impacts on recreation and special use areas, including birding trails, that are in proximity to the Project are addressed in section 4.8.1.5, and impacts on visual receptors at these areas are addressed in section 4.8.2. Overall, we find that impacts on tourism, including nature-based and eco-tourism, would generally be greatest during construction of the Project. Following construction, the LNG Terminal would be the primary source of permanent impacts on tourism as the pipelines would be buried and the associated aboveground facilities would be located in remote areas, offering limited visibility and mitigating noise impacts. To mitigate impacts on visual receptors and operational noise from the LNG Terminal, RG LNG would use ground flares, the selection of grey tank coloring, horticultural plantings, and the construction of a levee that would obstruct most construction activities and low-to-ground operational facilities from view. Further, as indicated in sections 4.5 and 4.6, overall impacts on general vegetation, wildlife, and birds from the Project would not be significant. In conclusion, as impacts on the general populations of birds and wildlife have been mitigated and with our finding that visitation

patterns may change overall, but the number of visits to the Project area would likely not, we find that employment in the tourism industry is not likely to be significantly affected.

4.9.3.2 Recreational Fishing

In the Project area, recreational fishing is most common in the coastal bays of Cameron and Willacy Counties, which form the southernmost extent of the Lower Laguna Madre Bay System. Recreational fishing was identified as a resource of concern in scoping comments. Waterbodies in the vicinity of the Project area are further described in section 4.3. During the 2013/2014 fishing season, residents and visitors spent an estimated 461,700 hours on private fishing trips and another 41,100 hours on guided fishing trips in these bays (TPWD 2015a). About 79 percent of recreational boat fishing within the entire Lower Laguna Madre Bay System takes place in the Lower Laguna Madre Bay. Less than 1 percent of recreational boat fishing is within Brazos Santiago Pass and the BSC. The Project would not cross significant recreational fisheries in Jim Wells, Kleberg, or Kenedy Counties.

Speckled seatrout, redfish, southern flounder, and sheepshead are the most commonly caught recreational species in the local bays (TPWD 2015a). Additionally, a small number of anglers and fishing guides fish for snook specifically within the BSC, where the species is known to school (Ferguson 2015). Offshore fishing in south Texas targets red snapper, king mackerel, Spanish mackerel, gray triggerfish, tuna, and billfish, but comprises only about 5.0 percent of fishing effort compared to that spent in the bays (TPWD 2015a).

In addition to boat fishing, recreational shore-based fishing occurs in the Project area. About 70 percent of shore-based fishing in the Lower Laguna Madre Bay System occurs along the Brazos Santiago Pass jetties; shore-based fishing also occurs along the BSC, and along the southern end of Bahia Grande. Shore-based anglers also fish along the banks of the 0.4-mile-long Bahia Grande Channel, although the land on both sides is owned by the BND and is not officially designated for fishing.

LNG Terminal

Construction and operation of the LNG Terminal could affect recreational fishing through restrictions in fishing access, an increase in noise, and changes in vessel traffic. Construction activities at the LNG Terminal site would not restrict fishing access to bays in the Project area or the Gulf of Mexico. Fishing along the eastern bank of the Bahia Grande Channel on the LNG Terminal site would be prohibited. To compensate for this loss, RG Developers, in coordination with relevant agencies, are exploring the potential to provide a parking and fishing area on the western bank of the Bahia Grande Channel.

As discussed in section 4.9.3.1, noise impacts from construction are expected in the immediate vicinity of the LNG Terminal site, potentially resulting in avoidance of the area by recreational fishermen. Construction noise would likely be audible at local fishing sites including the Bahia Grande Channel, portions of the Bahia Grande and South Bay, and the Zapata boat launch during the 7-year construction period. Construction activities would occur predominantly during the day, between 7:00 a.m. and 7:00 p.m., Monday through Friday. However, dredging may take place up to 24 hours per day, 7 days per week.

The Lower Laguna Madre, the most popular waterbody in the region for recreational fishing, is about 4.3 miles from the center of the LNG Terminal site, and typical construction noise is not expected to result in an audible increase in ambient sound at that distance. For additional information about noise impacts expected from Project construction and operation, see section 4.11.2. In addition to increased noise, barge deliveries would increase traffic in the BSC during the construction period; however, with the exception of excluding recreational fishing boats from the construction areas, boating activities, and vessel avoidance behaviors would not be significantly modified.

Operational noise could also result in anglers avoiding local fishing areas. RG Developers estimate that during typical operations, noise would only be audible at the south shore of the Bahia Grande and at the Zapata boat launch during lulls in SH-48 traffic. As boat-launching activities are short-term, it is unlikely that patterns of usage for the launch itself would change based on the presence of the LNG Terminal; however, a perceived increase in ambient noise and visual impacts could result in a change in usage of the fishing pier by recreational anglers. Given the amount of recreational fishing opportunities in the Project area, anglers may visit other nearby sites, so that visitation patterns immediately adjacent to the LNG Terminal site may change, but the number of visits to the general Project area for recreational fishing would not.

During operation, up to 312 LNG carriers would call on the LNG Terminal per year, or about 6 per week. Due to potential safety/security zone exclusions, vessels would likely not be permitted to pass an LNG carrier transiting the BSC or maneuvering in the turning basin; however, the exact navigation protocol would be determined by the Coast Guard. Recreational fishing boats that begin trips from Port Isabel or South Padre Island could experience delays at Brazos Santiago Pass if they arrive during LNG carrier transit; however, RG LNG estimates that an LNG carrier's transit time through the pass would be about 30 minutes. The maximum estimated delay for fishing vessels in the BSC during inbound LNG carrier transits would be about 3 hours. The planned transit times of LNG carriers would be communicated to the Coast Guard and Port of Brownsville Harbor Master, to allow for the issuance of advisories to mariners. Impacts on marine transportation are further discussed in section 4.9.8.2, below. Overall, the Project would result in direct, minor impacts on recreational fishing resulting from delays during LNG carrier transit.

Pipeline Facilities

Sights and sounds of Pipeline System construction activities may be a nuisance to people fishing in the Project vicinity, including at the Zapata boat launch, but pipeline construction would not prohibit visitors from using these areas. In general, impacts of construction of the Pipeline System on recreational fishing would be temporary and limited to the period of active construction, which typically would last several days to several weeks in any one area, with the exception of the Zapata boat launch, which would be crossed by an HDD that could last up to 10 weeks. The Zapata boat launch would be about 1,500 feet from the HDD exit point and over 3,000 feet from the HDD entry point; at these distances, the sound level from HDD construction would be perceived as moderate to quiet. Recreational fishing is not known to occur in the inland rivers and streams that would be crossed by the pipeline facilities.

4.9.4 Commercial Industries

4.9.4.1 Commercial Fishing

In 2014, the Port of Brownsville and Port Isabel together ranked as the second largest fishing port by value along the Gulf of Mexico (National Ocean Economics Program 2016). Shrimp, for food or bait, are the top commercial species in the region, most of which are caught offshore (Fisher 2015). About 12.1 million pounds of commercial fish were landed at the two ports in 2014, valued at \$69.1 million (National Ocean Economics Program 2016b). A majority of this commercial fishery is based on offshore shrimping and fishing; however, some commercial fishing occurs in the Lower Laguna Madre System.

Commercial fishing in the Lower Laguna Madre and nearby bays is dominated by bait fisheries (including shrimp) and black drum. In addition, trawlers harvest bait shrimp from the BSC (Fisher 2016). The live weight and landed value of commercial fish caught in the Lower Laguna Madre off the coasts of Cameron and Willacy Counties in 2013 was 724,345 pounds and \$1.2 million, respectively (TPWD 2015b). None of the reported fishery catch were oysters; commercial oyster landings have not been documented in the Lower Laguna Madre since 1992 (Gulf States Marine Fisheries Commission 2012). South Bay supports an oyster population, but does not currently support a commercial fishery (Bozka 2003, Fisher 2016). The Project would not cross commercial fisheries in Jim Wells, Kleberg, or Kenedy Counties.

The Port of Brownsville Fishing Harbor, about 4.8 miles west of the LNG Terminal site, houses up to 500 fishing vessels (Port of Brownsville 2016a). The total shrimp fleet was about 350 vessels in the 1990s, but decreased to 160 by the late 2000s due, in part, to competition from imported shrimp (Nelsen 2008). A smaller number of bay shrimping vessels (about 50) dock in the Port Isabel region (Bearden 2015).

LNG Terminal

Public scoping comments expressed concern for impacts on commercial fisheries from construction and operation of the LNG Terminal. During construction, barge deliveries would increase traffic in the BSC. Fishing boats would avoid cargo ships and barges making deliveries to the LNG Terminal during construction in a manner similar to the way they currently maneuver around commercial deep-draft ships and barge traffic into and out of the Port. Dredging would occur within the boundaries of the BSC, which would temporarily reduce the area of the BSC available for vessel transit, but would not preclude vessel transit due to the width of the navigable waterway. Impacts on marine transportation due to dredging are addressed in section 4.9.8 and, because dredging would be limited to Stage 1 of construction, impacts would be temporary and minor. Therefore, vessel operators would have the ability to safely navigate and avoid construction activities. Use of dredging vessels, tugs, and barges would be coordinated with the BND, Coast Guard, and the Pilots Association. Marine traffic is further discussed in section 4.9.8.2.

During operation, up to 312 LNG carriers would call on the LNG Terminal per year, or about 6 per week. Due to potential safety/security zone exclusions, shrimping and other fishing vessels would likely not be permitted to pass an LNG carrier transiting the BSC or maneuvering

in the turning basin; however, the exact navigation protocol would be determined by the Coast Guard. The estimated delay for fishing vessels during inbound LNG carrier transits would be about 3 hours. Fishing vessels could follow behind outbound LNG carriers, as long as they traveled at an approved distance from the LNG carrier. The Project would result in direct, minor impacts on commercial fishery vessel operators resulting from delays during LNG carrier transit. Further, as described in sections 4.6.2 and 4.6.3, impacts on aquatic resources would be minor and, with implementation of required mitigation, impacts on EFH and the species and life stages that utilize EFH would be permanent, but minor. Therefore, the Project is not expected to impact the yield of commercial fisheries in the Project area.

Pipeline Facilities

Fish are not harvested commercially in the inland rivers and streams crossed by the RB Pipeline. No impacts on commercial fisheries are anticipated as a result of construction or operation of the pipeline facilities.

4.9.4.2 Ports

There are two active ports located along the BSC: the Port of Brownsville, about 8 miles west of the LNG Terminal site, and Port Isabel, which is 4 miles east of the terminal site on the Texas coast. The Port of Brownsville, which is managed by the BND along with the land adjacent to the BSC itself, serves as the primary marina for Gulf shrimping vessels that operate out of Cameron County. The port is one of the largest steel importers on the Gulf Coast and it supports industries related to marine cargo transport and ship and oil rig repair (BND 2013, Port of Brownsville 2013). The Port of Brownsville is one of about 256 U.S. foreign-trade zones, areas that benefit manufacturers and distributors by the legal ability to defer import duties on raw goods and materials and pay reduced duties on finished products (Foreign-Trade Zones Board 2013). In 2015, the Port of Brownsville handled about 9.1 million metric tons of cargo, the highest tonnage that had passed through the Port in 10 years (Port of Brownsville 2016).

Port Isabel's primary maritime function is to serve as a dock site for out-of-service industrial vessels until they are put back into commission, and it therefore generates far less vessel traffic when compared to Port of Brownsville-generated traffic (Bearden 2015). During 2014, Port Isabel handled about 13,000 tons of cargo (Bearden 2015).

LNG Terminal

Construction and operation of the LNG Terminal would generate increased economic activity within the Port of Brownsville and support maritime workers and businesses co-located in the BND. The BND would receive direct payments and other financial benefits from RG LNG, such as lease payments and dockage and wharf fees. A portion of capital expenditures would be paid to local maritime suppliers and service-oriented businesses that regularly do business with BND industries and are equipped to serve the needs of LNG Terminal construction and operation. For example, LNG Terminal operations would benefit tug suppliers due to its investment in tugboat services for escorting LNG carriers transiting the BSC.

Procedures developed as part of the WSA process would ensure that traffic along the BSC remains safe and efficient for all users when LNG Terminal operations begin (see section

4.9.8.1). On January 19, 2018, the Coast Guard's LOR was filed in the Project docket indicating that the BSC is suitable for Project use. RG LNG would also work with stakeholders, such as the pilots, the BND, and the Coast Guard, to ensure that clear guidance on shipping through the BSC is established and communicated.

Pipeline Facilities

A portion of the pipeline between MPs 131.6 and 135.5 would be constructed within existing right-of-way adjacent to SH-48. Potential impacts on port facilities from construction of the pipeline in this area would be limited to congestion on SH-48 and other roads in the vicinity of the ports (see section 4.9.8.1).

4.9.5 Local Taxes and Government Revenue

Public comments also express concern over loss of tax revenue from tax abatement opportunities afforded by Cameron County to LNG companies. RG Developers anticipate spending about \$4.0 billion on construction materials across the nation, a portion of which would be spent in Cameron County and other Texas locations, resulting in the generation of local, state, and federal sales tax revenues. Local, state, and federal governments would also tax the \$2.1 billion in workforce payroll associated with Project construction. Expenditures on goods and services by the construction workers and their families would also generate increased tax revenues through indirect and induced effects. Of the \$4.0 billion spent nationwide on construction materials for the full Project, an estimated \$60 million would be spent on local and regional construction materials and fuel during construction of the pipeline facilities. Due to this spending, a total of \$4.6 million in sales tax revenues would be generated for the State of Texas and local taxing authorities. Tax revenues during construction would be a moderate, temporary, and positive impact on tax revenue within the Project area.

In 2018, property taxes were assessed at about 1.76 percent of the property value (Tax-Rates.org). Per Texas state tax code chapter 312, a portion or all of the increase in property value may be abated per the terms of a specific agreement between a taxpayer and the taxing unit (Comptroller.Texas.Gov 2018). During operation, RG LNG estimates that the LNG Terminal would generate about \$92.9 million in property taxes in the affected counties over the first 22 years of operation. The estimated tax benefits assume the Project would receive tax abatements comparable to those recently granted for other LNG and major refining and petrochemical facilities along the Texas Gulf Coast.

To offset a portion of the forgone taxes associated with the abatement, RG LNG has committed to annual payments of \$2.7 million during the first ten years of operation and will donate \$10 million to aid in the funding of community projects (LNG World News 2017). Operation of the LNG Terminal would also result in minor, long-term increases in sales tax revenue from expenditures on materials, goods, and services. RB Pipeline estimates that tax revenues (general property, sales/use, and other miscellaneous taxes) in the counties crossed by the Pipeline System would range from \$5.2 to \$117.0 million.

4.9.6 Housing

The number of housing units (permanent and temporary) varies across the affected areas, largely based on county population and the presence or absence of a major city. Table 4.9.6-1 provides data on the rental and other temporary living options in the affected areas. Based on the 2015 American Community Survey, Hidalgo County has the greatest number of available housing units (34,105), and also has the greatest number of residents (842,304) within the affected areas (U.S. Census Bureau 2015a, 2015d). In contrast, Kenedy County has both the lowest population (407) and number of available housing units (102) within the affected areas. The median rental housing cost per month for the six Project-area counties ranges from about \$498 in Willacy County to about \$745 in Kleberg County (U.S. Census Bureau 2015d).

County	Vacant Housing Units^a	Estimated Vacant Hotel / Motel Rooms^b	Estimated Vacant RV and Mobile Home Park Sites^c	Total Available Units	Average Workforce Demand of Available Units (%)	Peak Workforce Demand of Available Units (%)
Cameron ^d	24,097	1,339	4,990	30,426	--	--
Hidalgo	34,105	2,524	6,506	43,135	--	--
Willacy	1,549	108	185	1,842	--	--
Kenedy	102	256 ^e	118 ^e	476	--	--
Kleberg	2,089	223	412	2,724	--	--
Jim Wells	2,377	190	177	2,744	--	--
LNG Terminal Affected Area^f	--	--	--	75,403	2.7	4.9
Pipeline Facilities Affected Area^g	--	--	--	38,212	2.8	3.5

Sources: U.S. Census Bureau 2015d, Office of the Governor 2014, and University of Texas-Pan American 2014.

^a Includes single- and multi-family units and mobile homes.

^b Estimated from the hotel/motel rooms and vacancy rates for each geographic area per the Office of the Governor (2014).

^c Assumes that each RV/Mobile Home park has 193 sites. Also assumes that the vacancy rates are 31.4 percent in Cameron and Willacy Counties (to account for winter Texans) and 50 percent for the remaining counties.

^d Excludes vacancies on South Padre Island, which is a resort destination.

^e Total includes accommodations in Encino and Falfurrias cities in neighboring Brooks County, about 20 miles from the pipeline route.

^f Includes accommodations shown in this table for Willacy, Hidalgo, and Cameron Counties.

^g Includes accommodations shown in this table for Jim Wells, Kleberg, Kenedy, Willacy, and Cameron Counties.

Public scoping comments expressed concern regarding impacts on the availability of housing for communities in the Project area during the construction phases. Several factors impact the feasibility of housing options for the Project construction workforce, including proximity to the work sites and seasonal fluctuations in availability. For example, a seasonal population of retired visitors migrate to the Rio Grande Valley each winter for an average of 4.4 months (University of Texas-Pan American 2014). A study conducted by the University of Texas-Pan American estimated that these “Winter Texans” occupy about 68.6 percent of

recreational vehicle (RV) and mobile home parks in the Rio Grande Valley from November through February. Based on a Winter Texan occupancy rate of 68.6 percent, the number of available RV and mobile home sites would be reduced considerably during the winter months. Additionally, lodging accommodations on South Padre Island are not expected to be used by the LNG Terminal construction workforce because they are resort destinations with higher rental rates. Table 4.9.6-1 estimates available housing for non-local Project construction workers based on these criteria.

4.9.6.1 LNG Terminal

As stated previously, local residents would make up about 30 percent of the workers hired for construction of the LNG Terminal. An average workforce of 2,065 non-local residents would be expected to move to the affected area, with a peak of 3,658 workers. Within the affected area, a total of 75,403 housing units would be available for rent to the workforce, including hotel and motel rooms, vacant housing units, and RV sites. Based on this availability, the average non-local workforce and their family members would occupy about 2.7 percent of the currently available housing, up to a peak of 4.9 percent, indicating there would be sufficient lodging units to accommodate the non-resident workers and their family members.

Operation of the LNG Terminal would result in about 108 non-local workers and their families relocating to the affected area. Because an adequate number of housing units are available in the affected area, we anticipate that this would have a negligible but permanent impact on the local housing market.

4.9.6.2 Pipeline Facilities

Local residents would make up about 10 percent of the workers hired for construction of the pipeline facilities. Therefore, during the first 12 months of construction, an estimated peak of 1,350 workers would temporarily move into the affected area for construction of the pipeline facilities. Following construction of the Header System, Pipeline 1, and the aboveground facilities, there would be an 8-month period of little to no construction activity along the pipeline facilities where the non-local workers may choose to return to their homes. Upon reinitiating construction for Stages 3 through 6, a maximum of 1,080 workers would migrate into, or back into, the affected counties (see section 4.9.1.2).

Within the affected area, a total of 38,212 housing units would be available for rent to the workforce, including hotel and motel rooms, vacant housing units, and RV sites. Based on this availability, the average and peak non-local workforce would occupy about 2.8 and 3.5 percent of the currently available housing, indicating sufficient lodging units would be available to accommodate the non-resident workers, resulting in minor and temporary impacts on the availability of housing units. Following construction, RB Pipeline anticipates a permanent workforce of up to 20 workers for daily operations of the pipeline facilities. This would represent a permanent but negligible impact on the local housing market.

4.9.7 Public Services

Public scoping comments highlighted the need to assess Project impacts on public services. Table 4.9.7-1 provides an overview of public services available in the Project area, including public schools, police departments and sheriff’s offices, fire departments, and hospitals.

Table 4.9.7-1 Public Services in the Affected Areas					
County	Public Schools^a	Police Departments and Sheriff’s Offices	Fire Departments	Hospitals^b	Hospital Beds
Cameron	156	11	13	8	1,314
Hidalgo	336	18	20	17	2,423
Willacy	14	2	7	0	0
Kenedy	1	1	4	1	0
Kleberg	15	2	2	1	96
Jim Wells	21	3	6	0	135
LNG Terminal Affected Area^c	506	31	40	25	3,737
Pipeline Facilities Affected Area^d	207	19	32	10	1,545
Sources: Texas Education Agency 2014, USA Cops 2015, Texas A&M Forest Service 2015, Texas Department of State Health Services 2015.					
^a Includes public charter schools.					
^b Only includes hospitals licensed with the Texas Department of State Health Services.					
^c Includes accommodations shown in this table for Willacy, Hidalgo, and Cameron Counties.					
^d Includes accommodations shown in this table for Jim Wells, Kleberg, Kenedy, Willacy, and Cameron Counties.					

4.9.7.1 LNG Terminal

To understand potential impacts on schools, assumptions have been made based on anticipated workforce. RG LNG estimates that the maximum number of non-local hires during peak construction of the LNG Terminal is expected to be 3,658 workers. As discussed in section 4.9.1.1, should 70 percent of the non-local workers be accompanied by family members, and based on an average family size of 3.5 persons in Texas, up to 10,058 non-local persons could relocate to the affected area during the 7-year construction period. This would represent an increase of 0.8 percent in the population of the three-county affected area for the LNG Terminal.

Based on the average family size of 3.5 persons in Texas, we conservatively assumed that each of the 2,561 non-local families would bring two school-aged children to the LNG Terminal area of effect. RG LNG estimates the number of students at schools in the area of affect to be 330,102 students; the addition of up to 5,121 children during peak construction would increase the current student enrollment by 1.6 percent and change the student-to-teacher ratio from 15.7 to 15.9 students per teacher. If the peak non-local workforce with school-aged children all moved to Cameron County, they would increase the existing 103,416-person student body by 4.9 percent and change the student-to-teacher ratio from 15.4 to 16.1 students per teacher. This

increase could result in a minor and temporary impact on public schools in the LNG Terminal area of effect, or a minor to moderate impact on public schools in Cameron County (if all children attended schools in Cameron County). However, these impacts could be mitigated, in part or whole, by using the increased tax revenues generated from construction of the Project to hire additional teachers during the construction period.

Construction of the LNG Terminal would have little or no short-term impact on the availability of public safety services such as police, fire, and medical because the non-local workforce would be small relative to the current population. If all non-local workers and family members moved to the three affected counties, they would represent about a 0.8 percent increase over the existing population during peak construction. Further, RG LNG would train a portion of the construction and operation workforces as emergency responders and provide access to first-aid kits. In addition, onsite security would be provided through a third-party contractor. Therefore, we conclude that impacts on public services during construction of the LNG Terminal would be temporary and minor.

In 2014, the LNG Terminal affected area had about 3,737 beds in licensed general and special hospitals. During peak construction, the non-local workers and family members could increase the ratio of residents to hospital beds from 341 to 343 residents per bed, a 0.6 percent increase. This temporary, minor increase would not have a significant adverse effect on the ability of the general and special hospitals to serve the population in the LNG Terminal affected area.

RG LNG anticipates that 108 non-local workers would be employed at the LNG Terminal during operation. This addition of 108 families would represent a negligible increase in the local population. Therefore, we conclude that local public services would not be affected during operations.

4.9.7.2 Pipeline Facilities

To understand potential impacts on local services, assumptions have been made based on anticipated workforce. RB Pipeline estimates that the maximum number of non-local hires during construction of Pipeline 1 would be 1,350 workers; Pipeline 2 would have a maximum of 1,080 non-local hires. As each pipeline would take about 12 months to complete with an 18-month gap between, it is unlikely that the non-local workers would be accompanied by family members. The addition of 1,350 non-local workers would represent a negligible increase in the population of the pipeline's affected area (0.3 percent); therefore, negligible impacts on public services (i.e., schools, police departments, fire departments, and hospitals) would also be negligible.

The 20 new permanent positions would represent a negligible increase in the local population. Therefore, we conclude that local public services would not be affected during operations.

4.9.8 Transportation

Several potential impacts on vehicular and marine traffic may result from the construction and operation of the Project. Potential impacts on vehicular traffic would generally

be related to the influx of construction workers commuting to and from the LNG Terminal and pipeline facilities, as well as the transport of construction materials. Marine traffic impacts would result from the increase in large vessel movements in the BSC during construction and operation of the LNG Terminal.

4.9.8.1 Roadway Transportation

LNG Terminal

Access for transporting equipment, materials, and personnel to the LNG Terminal site would be available through the use of existing roadways. The approach to the LNG Terminal would be along SH-48, which is an asphalt, divided highway with two northbound lanes, two southbound lanes, and 4- to 8-foot shoulders. RG LNG would construct three driveways at the LNG Terminal site with a left-turn lane on westbound SH-48 and temporary traffic signals at each driveway for direct vehicular access to SH-48.

Public comments expressed concern for increased traffic volume, especially during evacuations, and road degradation due to loss of tax revenue from tax abatement opportunities. Impacts on local taxes and government revenue are addressed in section 4.9.5. Impacts on local users of the roadway network due to construction of the LNG Terminal would include potential delays from increased worker traffic and reduced roadway capacity. To identify, quantify, and recommend mitigation for traffic impacts on area roadways during construction of the Project, RG Developers commissioned a *Traffic Impact Analysis* (Aldana Engineering and Traffic Design, LLC 2016a, as updated in 2019). Traffic count data conducted in January 2016 indicated that about 12,000 vehicles travel along SH-48 between SH-550 and SH-100 every day; in January 2019, this number was about 5 percent less (11,370 vehicles). As January is considered the low season for local tourism, RG Developers also reviewed general travel trends from the peak tourism month (July) and determined that traffic counts are about 40 percent higher than that observed in January; therefore, about 17,000 vehicles per day are anticipated to travel along SH-48 during the peak season (MS2 2016). RG LNG estimates that construction worker commutes would result in a maximum of 4,600 roundtrips (9,200 transits total) per day, based on a peak workforce of 5,225 construction workers; however, the number of roundtrips would be related to the number of workers over time, as depicted in figure 4.9.2-1. This estimate assumes that 10 percent of the workers would carpool to and from work, and 2 percent of workers would be absent on any given day.

In addition, material truck traffic would generate up to 150 roundtrips to the LNG Terminal per day. As the capacity of the roadway is 40,000 vehicles per day, and about 12,000 (winter season) to 17,000 (summer season) vehicles are estimated to travel on this roadway every day, the roadway has sufficient capacity available to accommodate the additional traffic generated for construction of the LNG Terminal.

The *Traffic Impact Analysis* revealed that improvements would be necessary to safely accommodate peak hour traffic flows at each of the three proposed driveways. Before peak

construction, and in coordination with the TxDOT, RG LNG has agreed to implement the following measures recommended in the analysis:

- add an additional left-turn lane on westbound SH-48 at its intersections with SH-100 and at each LNG Terminal driveway;
- optimize traffic signal timing at the intersection of SH-48 and SH-100;
- provide an acceleration and deceleration lane at each LNG Terminal driveway intersection;
- provide temporary traffic signals at each LNG Terminal driveway;
- create median openings across from LNG Terminal driveway 1;
- create a temporary median opening on SH-48 across from any temporary offsite parking site, including the proposed Port of Brownsville temporary storage/parking area, and install a temporary traffic signal;
- schedule deliveries of construction materials to avoid the expected arrival and departure of the workforce; and
- stagger shifts to avoid all workers arriving and leaving at the same time, if congestion occurs at the LNG Terminal driveways.

In addition to the above mitigation measures recommended by the traffic analysis, RG LNG has committed to hiring off-duty police officers to direct traffic during peak commuting hours and installing roadway warning signs to notify travelers of construction activities. Additionally, RG LNG plans to provide onsite parking for workers during peak construction months. When onsite parking becomes limited by the constructed LNG facilities, offsite parking would be provided at a 25-acre Port of Brownsville temporary storage area located on the south side of SH-48, where workers would be bused to and from the LNG Terminal site. With the implementation of the proposed measures, and considering that SH-48 would remain at about 65.9 percent capacity during peak tourist season with the addition of Project-related traffic, we have determined that impacts from construction of the LNG Terminal would have temporary and minor impacts on local users of the roadway network.

Operation of the LNG Terminal would result in an average of 300 roundtrips to the site per day associated with worker commutes and truck deliveries. The Traffic Impact Analysis determined SH-48 would continue to provide ample capacity with this increase in traffic (Aldana Engineering and Traffic Design, LLC 2016a). We have determined that operation of the Rio Grande LNG Terminal would have permanent but negligible impacts on roadway transportation. As discussed in section 4.12, RG Developers would have ERPs with the appropriate entities, which would identify emergency response routes.

Pipeline Facilities

The pipeline right-of-way is primarily routed through undeveloped land. Construction of the pipeline facilities may temporarily affect roadway traffic due to increased vehicle traffic associated with construction workforce commutes and the delivery of equipment and materials to the construction work area. Construction of the pipeline facilities is not expected to impact marine transportation. Construction-related traffic on area roads would be highest during the first year of the 4-year construction period, with an estimated 1,950 roundtrips per day. During the subsequent years, RB Pipeline estimates a maximum of 1,356 roundtrips per day, which would occur during Stage 4 with the construction of Pipeline 2.

To minimize impacts on traffic, RB Pipeline would provide adequate parking for workers to ensure that parking on the shoulders of major roads is avoided and install warning signs on roadways to notify travelers of construction activities. If traffic congestion occurs during construction, RB Pipeline would consider implementing additional measures, including, but not limited to, scheduling truck deliveries between peak commuting times, re-routing truck traffic to avoid busy roadways, and implementing temporary traffic signals. Results of the *Traffic Impact Analysis* found that each roadway assessed was operating at a Level-of-Service (LOS) B or better. Avoidance of the segment of farm-to-market road (FM) 106 in Cameron County that crosses the Arroyo River was recommended to avoid potential deterioration to a LOS D (Aldana Engineering and Traffic Design, LLC 2016b).

RB Pipeline has stated that it would use FM 106 to access the Project area and that it would monitor use of all roadways evaluated in the *Traffic Impact Analysis*, including FM 106. However, as RB Pipeline has not identified specific protocols for determining when traffic congestion along the pipeline route would warrant additional measures or how a change in LOS would be monitored to ensure that these roadways do not fall below a LOS C, **we recommend that:**

- **Prior to construction of the Rio Bravo Pipeline, RB Pipeline should file with the Secretary, for review and written approval by the Director of OEP, traffic mitigation procedures, developed in consultation with applicable transportation authorities, to monitor LOS on roadways proposed for use during construction of the Pipeline System. These procedures should describe mitigation measures that would be implemented for a resultant LOS of C or below, including alternative routes if necessary.**

Any section of road damaged by Pipeline System construction would be repaired to pre-construction conditions or better after construction, unless otherwise agreed upon by the landowner and approved by the FERC. Given that the total number of workers would be spread out along the 137.9-mile-long Pipeline System, and the mitigation that would be implemented should traffic congestion occur, including our recommendation to develop traffic mitigation procedures, we find that construction of the pipeline facilities would result in minor and temporary impacts on local traffic. RB Pipeline anticipates that 20 workers would be hired for operation of the three compressor stations. The pipelines and metering sites would be unmanned during operation, with and only occasional site visits by operations personnel for maintenance.

Given the low number of operational personnel for the pipeline facilities, impacts on traffic or roadways resulting from operation of the pipeline facilities would be negligible.

4.9.8.2 Marine Transportation

LNG Terminal

RG LNG would primarily use truck transport to deliver construction materials to the LNG Terminal site, with marine barge transportation serving in a supplementary role. Vessel traffic in the BSC averaged about 1,057 vessels per year between 2012 and 2014, which equates to about 88 vessels per month, including 61 barges (BND 2015). Over the 7-year construction period for the LNG Terminal, RG LNG anticipates about 880 barge deliveries for the LNG Terminal site. Some equipment would be transported a short distance from the Port of Brownsville or Port Isabel, while other equipment would be transported directly from the vendor. Marine deliveries would be highest during the first 5 years of construction, where deliveries would be expected 15 times per month. Although these additional trips would represent an increase of about 25 percent in current barge traffic, they would not result in significant impacts on the channel, as the barges would not block small vessel traffic, the pilots and the Brownsville Harbor Master would manage commercial vessel traffic, and the additional vessels would not result in an exceedance of the channel's traffic capacity. In addition to increased vessel traffic during construction, dredging for the marine facilities would temporarily reduce the area of the BSC available for vessel transit. RG LNG would restrict vessels from passing over areas of active dredging, and would coordinate with local authorities so that dredging activity would not restrict large vessels from transiting the BSC. Because dredging would be limited to Stage 1 of construction, impacts would be temporary and minor.

The 160 shrimp fleets housed at the Port of Brownsville Fishing Harbor use the BSC to assess offshore fishing areas. In addition, the BSC currently experiences about six large vessels per week (i.e., about two transits per day) calling at the Port of Brownsville, including cargo vessels, tankers, and ocean barges. During operations, about 312 LNG carriers would call on the LNG Terminal per year (about 6 per week). With the addition of six LNG carriers calling at the LNG Terminal per week (about two transits per day), existing large vessel traffic levels would double; however, the channel would still function at about one-third of its theoretical capacity for large vessel traffic (about 12 large vessel transits daily, assuming a 2-hour transit time). Based on RG LNG's anticipated number of port calls and its navigation simulation study, RG LNG determined that LNG carriers calling at the LNG Terminal would be transiting in the BSC for a combined duration of 30 hours per week (about 18 percent of the week). According to the Port of Brownsville Harbor Master, all large vessel traffic is one-way except for the occasional barge passing with pilot approval; therefore, a one-direction regime would be in place during LNG carrier transits.

In a letter dated December 26, 2017, the Coast Guard issued the LOR for the Project, which stated that the BSC is considered suitable for LNG marine traffic in accordance with the guidance in the Coast Guard's NVIC 01-2011. The WSA review focused on the navigation safety and maritime security aspects of LNG carrier transits along the BSC. The WSA itself is designated Sensitive Security Information as defined in 49 CFR 1520. Because any

unauthorized disclosure of these details could be employed to circumvent the proposed security measures, they are not releasable to the public.

In accordance with 33 CFR 165.30, the Coast Guard has the authority to establish moving security zones for LNG carriers during. LNG carriers would reach the LNG Terminal using existing shipping channels, with the exception of the recessed turning basin at the Rio Grande LNG Terminal itself. Inbound LNG carriers would be piloted by a local pilot affiliated with the Brazos Santiago Pilots Association; the pilot boarding station is at the Entrance Channel at BSC markers 2 and 3. To minimize impacts on other users of the BSC, it is anticipated that LNG carriers would follow required mandates put forth in the LNG Terminal Manual, including the requirement to notify LNG Terminal managers and relevant authorities of the expected arrival of an LNG carrier four days in advance to ensure that the timing of LNG carrier channel transits are aligned with other shipping schedules.

Based on the Coast Guard's LOR for the Project, the expected doubling in large vessel traffic, and the potential to preclude vessel traffic 30 hours per week, we have determined that operation of the LNG Terminal would result in a permanent and moderate increase in marine traffic within the BSC based on current conditions.

Additional detail on potential impacts on boating and fishing in the vicinity of the LNG Terminal site is provided in section 4.9.3 and 4.9.4. Additional discussion of marine traffic and transportation as it relates to marine safety, including potential cryogenic/thermal impacts along the LNG carrier transit route, is provided in section 4.12.

Pipeline Facilities

As the proposed pipelines would cross marine waterways via HDD, no impacts on marine transportation would result from construction or operation of the pipeline facilities.

4.9.9 Property Values

Potential impacts on the value of a tract of land depends on many factors, including size, the value of adjacent properties, the presence of other industrial facilities or pipelines, the current value of the land, and the extent of development and other aspects of current land use. A potential purchaser would make an offer to purchase based on his or her own values, which may or may not take the presence of the LNG Terminal or pipeline facilities into account.

4.9.9.1 LNG Terminal

The proposed location of the LNG Terminal site is just outside the city limits of Brownsville and Port Isabel on land owned by the BND that is zoned for commercial and industrial use. The nearest residences are about 2.2 miles away in Port Isabel. A literature study that compiled 25 previous investigations of industrial developments' effects on property values found that adverse impacts on property values decreased steadily with distance from the industrial development (Farber 1998). A few of the investigations in the study predicted adverse effects on property values beyond 2 miles of the industrial development, and the study concluded that housing markets are sensitive to real or perceived hazard risks from industrial development (Farber 1998). As discussed in section 4.12, the LNG Terminal would be subject to regulations

that strictly control all aspects of the development's construction and operation, with risks largely confined within the LNG Terminal site property boundaries.

Visibility of the LNG Terminal site, which would include four 175-foot-high LNG storage tanks, could potentially affect values of residential properties. As discussed in section 4.8.2, it would be possible to see the LNG Terminal from some vantage points in Port Isabel and Laguna Heights, in particular at elevated sites such as the Port Isabel Lighthouse; however, the distance to the LNG Terminal site limits its visibility and as such it would not be a prominent feature in the viewshed for these residences. In summary, visibility impacts and the public's perception of risk of the LNG Terminal are factors that could affect residential property values in the Project area. These potential impacts would be attenuated by the distance of more than 2 miles between residential areas and the LNG Terminal site.

4.9.9.2 Pipeline Facilities

The pipeline facilities would be located primarily on agricultural land and open land. As shown in table 4.8.1-2, 11 structures would be within 50 feet of the construction work area; however, only two of those structures are residential, each of which would be within 50 feet of existing access roads that are proposed for use without modification. The pipeline facilities include the Header System, Pipelines 1 and 2, and associated aboveground facilities, three compressor stations, two booster stations, eight metering sites, and additional appurtenant facilities. Impacts from Compressor Station 3 are discussed above, as it would be within the boundaries of the LNG Terminal site. The remaining aboveground facilities would be constructed on open land, agricultural land, and barren land.

RB Pipeline would compensate the landowners for new easements at the aboveground facilities, as well as the temporary loss of land use associated with construction workspaces and any damages. The easement acquisition process is designed to provide fair compensation to the landowner for the right to use the property for facility construction and operation. The pipeline facilities are not expected to adversely impact property values outside of the pipeline right-of-way or aboveground facility boundaries.

Property values are generally based on the actual use of the land. Construction and operation of the Pipeline System would not change the general use of the land, but would preclude the construction of aboveground structures within the permanent easements. Because the Pipeline System would be located primarily within agricultural land, we have concluded that use of the land, and the associated property value, would likely not be negatively affected by the Pipeline System.

4.9.10 Environmental Justice

For projects with major aboveground facilities, FERC regulations (18 CFR 380.12(g)(1)) direct us to consider the impacts on human health or the environment of the local populations, including impacts that would be disproportionately high and adverse for minority and low-income populations. Additionally, during Project scoping, we received comments raising concerns about the impacts of the Rio Grande LNG Project on minority and low-income populations.

The EPA's Environmental Justice Policies (which are directed, in part, by Executive Order 12898: *Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations*) focus on enhancing opportunities for residents to participate in decision making. The EPA (2011) states that Environmental Justice involves meaningful involvement so that: "(1) potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that would affect their environment and/or health; (2) the public's contributions can influence the regulatory agency's decision; (3) the concerns of all participants involved would be considered in the decision-making process; and (4) the decision-makers seek out and facilitate the involvement of those potentially affected." CEQ also has called on federal agencies to actively scrutinize a number of important issues with respect to environmental justice (CEQ 1997a).

As part of our NEPA review, we have evaluated potential environmental justice impacts related to the Rio Grande LNG Project taking into account the following:

- the racial and economic composition of affected communities;
- health-related issues that may amplify effects to minority or low-income individuals; and
- public participation strategies, including community or tribal participation in the NEPA process (CEQ 1997a).

The EPA provides guidance on determining whether there is a minority or low-income community to be addressed in a NEPA analysis. According to this guidance, minority population issues must be addressed when they comprise over 50 percent of an affected area or when the minority population percentage of the affected area is substantially greater than the minority percentage in the larger area of the general population. According to USC 689(3), low-income populations are defined as a geographic area represented by a census tract or equivalent county division where the poverty rate is 20 percent or greater, among other indicators.

In accordance with these guidelines, we prepared an environmental justice analysis for the Project. Public scoping comments expressed concern for impacts on low-income and minority populations. To develop a more accurate understanding of the racial and ethnic characteristics of the communities in the immediate vicinity of the LNG Terminal site and pipeline facilities, data were used from census block groups that intersect a 2-mile radius around the LNG Terminal site and the pipeline facilities, as opposed to the larger geographic areas included in census tract and county level data. In this analysis, the minority and low-income population percentages in the State of Texas and the Project-area counties were compared to the respective percentages within the census blocks groups. Table 4.9.10-1 identifies the racial composition and economic status of the affected block groups, counties, and the State of Texas for the LNG Terminal and pipeline facilities.

Table 4.9.10-1 Demographics and Economic Statistics in the Vicinity of the Rio Grande LNG Project								
State/County/ Block Group/ Tract	White, not Hispanic or Latino	African- American	Hispanic or Latino	Asian	American Indian and Alaskan Native	Native Hawaiian and Pacific Islander	Two or More Races	Population Below Poverty (%)
TEXAS	43.8	11.6	38.4	4.2	0.2	0.1	1.5	13.4
LNG TERMINAL								
Cameron	11.5	0.4	88.5	0.6	0.4	0.0	0.2	29.6
<i>Block Group 1</i>								
Tract 123.05	74.6	0.0	25.4	0.0	0.0	0.0	0.0	26.7
Tract 142 ^a	1.0	0.0	99.0	0.0	0.0	0.0	0.0	37.5
<i>Block Group 2</i>								
Tract 123.04 ^b	30.3	0.0	66.0	0.0	0.0	0.0	0.0	22.1
Tract 127 ^a	23.1	0.0	76.9	0.0	0.0	0.0	0.0	15.6
PIPELINE FACILITIES								
Cameron	11.5	0.4	88.5	0.6	0.4	0.0	0.2	29.6
<i>Block Group 1</i>								
Tract 101	17.0	0.0	82.5	0.0	0.5	0.0	0.0	20.0
Tract 102.01	13.1	0.0	86.9	0.0	0.0	0.0	0.0	26.7
Tract 122	16.2	0.0	83.7	0.0	0.0	0.0	0.1	16.8
Tract 123.01	37.4	1.7	54.1	4.6	0.0	0.0	0.6	23.9
Tract 142	1.0	0.0	99.0	0.0	0.0	0.0	0.0	37.5
<i>Block Group 2</i>								
Tract 127	23.1	0.0	76.9	0.0	0.0	0.0	0.0	15.6
Tract 142	21.1	0.7	78.2	0.0	0.0	0.0	0.0	39.2
<i>Block Group 3</i>								
Tract 101	4.6	0.0	95.4	0.0	0.0	0.0	0.0	47.6
<i>Block Group 4</i>								
Tract 101	68.5	0.0	29.9	0.0	0.0	0.0	1.6	16.8
Tract 122	11.4	0.0	88.5	0.0	0.2	0.0	0.0	35.5
<i>Block Group 5</i>								
Tract 122	2.2	0.8	94.7	1.1	0.0	0.0	1.3	41.0
Willacy	10.4	1.6	87.5	0.1	0.0	0.0	0.4	36.3
<i>Block Group 1</i>								
Tract 9506	17.0	0.0	82.0	0.0	0.9	0.0	0.0	35.4
Tract 9507	10.4	0.0	83.6	0.0	0.0	0.0	6.1	9.6
<i>Block Group 2</i>								
Tract 9505	10.5	0.0	89.5	0.0	0.0	0.0	0.0	18.3
Tract 9507	11.7	0.0	87.6	0.0	0.1	0.2	0.0	26.4
Kenedy	33.6	0.0	66.2	0.2	0.0	0.0	0.0	20.0
<i>Block Group 1</i>								
Tract 9501	33.6	0.0	66.2	0.2	0.0	0.0	0.0	20.0

Table 4.9.10-1 (continued) Demographics and Economic Statistics in the Vicinity of the Rio Grande LNG Project								
State/County/ Block Group/ Tract	White, not Hispanic or Latino	African- American	Hispanic or Latino	Asian	American Indian and Alaskan Native	Native Hawaiian and Pacific Islander	Two or More Races	Population Below Poverty (%)
Kleberg	21.9	3.9	71.3	2.0	0.1	0.0	0.6	19.7
<i>Block Group 1</i>								
Tract 201	39.5	0.0	58.2	1.1	0.0	0.0	0.3	4.2
<i>Block Group 2</i>								
Tract 201	26.4	2.1	70.2	1.3	0.0	0.0	0.0	10.6
Jim Wells	19.0	0.5	79.5	0.4	0.1	0.1	0.4	18.0
<i>Block Group 1</i>								
Tract 9504	11.7	2.5	85.9	0.0	0.0	0.0	0.0	5.2
<i>Block Group 3</i>								
Tract 9502	35.9	0.0	63.3	0.8	0.0	0.0	0.0	10.0
<i>Block Group 4</i>								
Tract 9507	25.8	0.0	74.2	0.0	0.0	0.0	0.0	5.3
Sources: Sources: U.S. Census Bureau 2015e, 2015f, 2015g, EPA 2016c.								
^a The block group is within 1 mile of the LNG Terminal site and pipeline facilities.								
^b About 3.7 percent reported their race as “Some other race alone.”								

4.9.10.1 LNG Terminal

Three of the four block groups near the LNG Terminal site have minority populations greater than the general EPA guideline of 50 percent, comprised predominately of Hispanic or Latino people. Additionally, all four block groups have poverty rates that exceed 20 percent, indicating that these are low-income communities. According to the EPA guidelines stated above, these are environmental justice populations.

The FERC and RG Developers have made documents and notices about the Project available to the public, and FERC held public scoping and comment meetings, as described in section 1.3, where materials were provided in both English and Spanish to accommodate the local Hispanic or Latino population. In addition, during the public scoping and comment meetings in Port Isabel, both English and Spanish-speakers were present to converse one-on-one with stakeholders in attendance. Further, RG Developers made Project information available to the public via an internet website (www.riograndelng.com), phone hotline, and via community and stakeholder meetings in the Project area. RG Developers used the FERC’s Pre-filing Process (see section 1.3). One of the major goals of this process is to increase public awareness and encourage public input regarding every aspect of a project (e.g., design, siting, routing, environmental concerns and impacts) before an application is filed. As part of this process, FERC staff participated in RG Developers’ open houses and hosted FERC scoping sessions to receive input from the public about the Project. Interested parties have had opportunities to participate in the NEPA review process. This included the opportunity to participate in the public scoping meetings within the Project area to identify concerns and issues that should be covered in the EIS, and the opportunity to submit written comments about the Project to the

FERC, and the opportunity to review the draft EIS and provide comments directly to the FERC staff in person (during scheduled comment sessions) or in writing via mail or internet.

Contractors working on the Project would be required to comply with applicable equal opportunity and non-discrimination laws and policies. The criteria for all positions would be based upon qualifications and in accordance with applicable, federal, state, and local employment laws and policies. The impacts of constructing and operating the LNG Terminal on the natural and human environments are identified and discussed throughout section 4.0 of this document. The nearest residential areas are about 2.2 miles from the proposed LNG Terminal site. Potential pollution emissions from the LNG Terminal site, when considered with background concentrations, would be below the National Ambient Air Quality Standards (NAAQS), which are designated to protect public health. Therefore, the Project would not have significant adverse air quality impacts on the low-income or minority populations in the Project area. Air quality impacts are discussed in more detail within section 4.11.1.

Area residents may be impacted by traffic delays during construction on SH-48. However, as shown in the traffic analysis (see section 4.9.8), impacts would be minor and short-term, and RG LNG has committed to implementing mitigation measures to alleviate any potential road congestion during peak construction months (see section 4.9.8). Another potential impact to area residents pertains to subsistence fishing that could occur along the BSC. About 1.5 miles of the 17-mile-long shoreline of the channel would be developed for the LNG Terminal site. However, fishing opportunities would still exist along the remainder of the undeveloped channel shoreline, as well as in nearby public areas, including the Zapata boat launch and pier over San Martin Lake and the south end of Bahia Grande. Also, as discussed above RG Developers, in coordination with relevant agencies, are exploring the potential to provide a parking and fishing area on the western bank of the Bahia Grande Channel to compensate for the lost fishing area near the LNG Terminal.

If all of the peak non-local construction workers and their families including school-aged children, temporarily relocated to Cameron County, this would result in an increase to the existing student enrollment by 4.9 percent and would change the student-to-teacher ratio from 15.4 to 16.1 students per teacher. This increase could result in a minor, temporary impact on public schools in the LNG Terminal affected area, and a minor to moderate impact on public schools in Cameron County. However, these impacts could be mitigated, in part or whole, by using the increased tax revenues generated from construction of the Project to hire additional teachers during the construction period.

The LNG Terminal site was chosen to be at least 1.5 miles from populated areas. Furthermore, the LNG Terminal is expected to generate economic benefits to local residences by stimulating economic growth and employment (see section 4.9.2.1) and by increasing the local tax base (see section 4.9.5), which may in turn benefit public services. There would be minor and temporary traffic delays and potential impacts on public schools during construction, but these impacts would apply to everyone and not be focused on or targeted to any particular demographic group. We conclude that the LNG Terminal would not have disproportionate adverse effects on minority and low-income residents in the area.

4.9.10.2 Pipeline Facilities

Similar to the block groups surrounding the LNG Terminal site, all block groups and counties near the pipeline facilities, with the exception of two block groups (block group 1, tract 123.05 and block group 4, tract 101) in Cameron County, have predominantly Hispanic or Latino minority populations greater than the general EPA guideline of 50 percent. Also, the majority of the block groups have poverty rates higher than 20 percent, indicating that they are low-income communities. All five counties in the study area have higher poverty rates than the State of Texas overall.

The entire Header System and the majority of the Pipeline System are routed through agricultural land or grassland with few residences, and no existing residences are located closer than 50 feet from the pipeline right-of-way. As described above, FERC and RG Developers have made documents and notices about the Project available to the public. The impacts of constructing and operating the pipeline facilities on the natural and human environments are identified and discussed throughout section 4 of this document. Aside from temporary, minor traffic delays during peak construction times, the pipeline facilities are not expected to have disproportionate, adverse effects on minority and low-income residents in the area. Overall, construction of the Rio Grande LNG Project would result in temporary, minor to moderate impacts on socioeconomic factors. Although the increase in construction activities and workers would result in an overall increase in roadway traffic, and possibly school-aged children, in the area surrounding the LNG Terminal, these increases would be within planned and sustainable levels of usage on roads and local schools. Similarly, operation of the Project would result in mostly minor, but permanent, impacts on socioeconomic factors. However, the introduction of increased tax revenues from the Project would result in monetary benefits for the affected counties. As the number of non-local workers and family members would decrease as operation of the LNG Terminal progresses, any increase in usage of local services that may have resulted from the presence of the construction workforce would return to near pre-construction levels.

4.10 CULTURAL RESOURCES

Section 106 of the NHPA requires the FERC to take into account the effects of its undertakings on properties listed, or eligible for listing, on the NRHP, and to afford the ACHP an opportunity to comment. RG Developers, as non-federal parties, are assisting the FERC in meeting our obligations under Section 106 by preparing the necessary information, analyses, and recommendations, as authorized by 36 CFR 800.2(a)(3). Section 800.10 of 36 CFR 800 provides special requirements for protecting National Historic Landmarks.

Construction and operation of the Rio Grande LNG Project could have the potential to affect historic properties (i.e., cultural resources listed, or eligible for listing, on the NRHP). Cultural resources include archaeological sites, districts, buildings, structures, and objects that are at least 50 years old, as well as locations with traditional value to Native Americans or other groups. Historic properties are cultural resources that possess one or more criteria specified in 36 CFR 60.4, and generally must possess integrity of location, design, setting, workmanship, feeling, and association.

4.10.1 Cultural Resources Surveys

4.10.1.1 LNG Terminal Site

RG LNG completed archaeological surveys of a 1,000-acre parcel for the LNG Terminal site, including the natural landforms (lomas) that are considered to have a high potential for containing archaeological sites, the locations of proposed geotechnical bore holes, and the locations of previously recorded archaeological sites. The survey included surface inspection and the excavation of 144 shovel test units. Many areas within the LNG Terminal site are comprised of dredged materials that were deposited during the channelization of the BSC; these areas possess little to no potential for containing cultural resources and were therefore not subject to shovel testing. The study area for indirect effects was defined as a 0.5-mile buffer around aboveground proposed structures, extended to a distance of up to 12 miles depending on topography and vegetation. The resulting report (Stotts and Carpenter, June 1, 2015) was provided to the FERC and the Texas SHPO. On March 30, 2016, the SHPO indicated a submerged survey was not necessary for the Project.

No new cultural resources were identified within the surveyed 1,000-acre area. Three previously recorded archaeological sites (41CF8, 41CF135, and 41CF191) were revisited during surveys. Site 41CF8 had previously been listed on the NRHP; however, no intact deposits were identified in the Project area, and therefore this portion of the site was recommended as non-contributing to NRHP eligibility. Sites 41CF135 and 41CF191 had no previous NRHP eligibility recommendations. No cultural materials were encountered at the locations of either site, and both sites were recommended as not eligible for the NRHP. RG LNG recommended no further work within the surveyed area. In a May 15, 2015 letter, the SHPO concurred with the survey results. We also concur.

Research identified no known architectural resources located within 0.5 mile of the LNG Terminal facility; however, two National Historic Landmarks are within or near the extended 12-mile study area. The Palmito Ranch Battlefield is approximately 4.1 miles from the LNG Terminal site boundary (about 5.4 miles from the LNG Terminal site center). The Palo Alto Battlefield is approximately 12 miles from the boundary of the LNG Terminal site (about 14 miles from the LNG Terminal site center). RG Developers conducted viewshed and noise impacts assessments for these two National Historic Landmarks. RG Developers concluded that due to distance and topography, visual impacts to the battlefields would be moderate and minor, respectively, and noise impacts from construction and operation would not be audible. See sections 4.8.2 and 4.11.1 for further discussion of the viewshed and noise, respectively. On March 19, 2018, the SHPO commented that visibility of the Project from identified historic resources in the area is limited, and that proposed lighting design should help limit the Project impact on the Palmito Ranch Battlefield. No comments have yet been received from the NPS on the assessments.

Subsequently, RG Developers completed supplemental surveys of 4.5 miles of the non-jurisdictional Brownsville Navigation District Utility Corridor, 2.9 miles of SH-48 turning lanes, and the two offsite storage/parking areas, as well as the 1.3-mile-long section of the formerly proposed 1.8-mile-long temporary haul road outside the LNG Terminal site (this haul road is no longer being proposed for use). The resulting addendum report (Neilson, August 17, 2016) was

provided to the FERC and SHPO. No new archaeological sites or architectural resources were identified. Two previously recorded archaeological sites (41CF99 and 41CF159) were revisited. No evidence of the sites was identified; therefore, the sites were recommended as not eligible for the NRHP in the Project area. No survey of the Port Isabel dredge pile was recommended due to its disturbed nature. In a December 1, 2016 letter, the SHPO concurred with these recommendations, and indicated no further work was required. We concur with the SHPO.

4.10.1.2 Pipeline Facilities

RB Pipeline conducted archaeological resources surveys for a 200-foot-wide corridor for the pipelines, a 100-foot-wide corridor for access roads, as well as ATWS, aboveground and temporary facilities, and offsite facilities. The survey included surface inspection and the excavation of 1,778 shovel test units. The study area for architectural resources included the area located within 0.5 mile of proposed aboveground facilities. Surveys conducted through 2016 cover about 56 percent of the current pipeline facilities (including the pipeline route, access roads, aboveground facilities, and contractor/pipe yards). Some areas along pipeline reroutes have been surveyed since that time, but landowner access for surveys along the entire Project has not been granted. Surveys for the remaining areas will be conducted once access is available; this includes approximately 30 miles of the Project which crosses the King Ranch National Historic Landmark. Further, some ATWS, aboveground and temporary facilities, and access roads remain to be surveyed. The resulting report (Nielsen et al., June 29, 2016) was provided to the FERC and SHPO.

As a result of the surveys, 15 cultural resources were identified. These included one newly recorded archaeological site (41WY152), a newly recorded historic railroad bed (41CF224), three previously recorded archaeological sites (41KN1, 41WY2, and 41WY73), one historic ranch (Armstrong Ranch), one historic architectural resource (Bell Airfield), three historic drainage districts (Cameron County Drainage Districts 1, 3, and 4), three historic irrigation districts (Cameron County Irrigation Districts 2 and 6, and Bayview 11), one historic water improvement district (Cameron County Water Improvement District 10), and one historic drainage system (Rio Grande Floodway). In addition, one previously recorded archaeological site (41CF195) could not be inspected due to denied access.

Sites 41CF224, 41WY152, and the Bell Airfield were recommended as not eligible for the NRHP. No cultural materials were encountered at the locations of previously recorded sites 41WY2, 41WY73, and 41KN1; therefore, these sites were recommended as not eligible for the NRHP. Further assessment of site 41CF195 was recommended as access becomes available. The Armstrong Ranch has been previously determined eligible for the NRHP, and avoidance of any contributing components was recommended. RG Developers indicated that as currently designed, the Project would not impact any contributing portions. Cameron County Irrigation Districts 2 and 6 have been previously determined eligible for the NRHP. The remaining irrigation resources have not been fully evaluated and remain undetermined for NRHP eligibility. Avoidance of any contributing components was recommended. RB Pipeline indicated it was evaluating avoidance of the larger historic waterways by HDD, but design details had not yet been finalized. On September 6, 2016, the SHPO concurred with the recommendations in the report. RB Pipeline has since modified its Project to include HDD crossings of drainage canals, where practicable.

In addition, the Port of Brownsville and BSC was identified as a potential historic district that has been unevaluated, but upon recommendation of the SHPO, is treated as eligible for the NRHP. The Project parallels the shipping channel, but does not impact the channel. RG Developers provided information regarding the channel to the SHPO on August 16, 2017. RG Developers have not yet filed the SHPO's comments on the information.

Subsequently, RB Pipeline completed supplemental surveys of 6.7 miles of pipeline corridor; Contractor/Pipe Yard 2; a booster station; and 35.2 miles of access roads. The resulting addendum report (Carter, September 12, 2016) was provided to the FERC and SHPO. No new archaeological sites were identified. Two previously recorded archaeological sites (41CF195 and 41WY74) were revisited. No evidence of the sites was identified; therefore, the sites were recommended as not eligible for the NRHP in the Project area. One previously recorded architectural resource (Armstrong Ranch, noted above), and one new resource (an isolated, weathered iron cross) were identified. Components of the Armstrong Ranch identified during the survey consist of a corral complex within the boundaries of a contractor yard. The iron cross could possibly indicate a burial or memorial marker. Avoidance was recommended for both resources. In a November 30, 2016 letter, the SHPO concurred with these recommendations. RB Pipeline indicated it would avoid the corral complex and install signage to clearly mark the contractor yard, and maintain a 75-foot buffer to protect the iron cross. Since surveys were completed, RB Pipeline relocated proposed Compressor Station 2; survey results for the currently proposed location will be provided when available.

4.10.2 Unanticipated Discovery Plan

RG Developers provided a plan addressing the unanticipated discovery of cultural resources or human remains during construction to the FERC and SHPO. We and the SHPO requested revisions to the plan. RG Developers submitted a revised plan which we find acceptable. The SHPO concurred with the plan on November 10, 2016.

4.10.3 Native American Consultation

Between March 2015 and February 2016, RG Developers submitted requests for Native American tribal consultations to the following seven federally recognized Native American tribes, and also conducted letter and email follow-ups: the Alabama-Coushatta Tribe of Texas; the Comanche Nation of Oklahoma; the Tonkawa Tribe of Oklahoma; the Kickapoo Tribe of Oklahoma; the Kickapoo Traditional Tribe of Texas; the Apache Tribe of Oklahoma; and the Fort Sill Apache Tribe of Oklahoma. Additionally, two state-recognized tribes, the Lipan Apache Tribe of Texas and the Tap Pilam Coahuiltecan Nation, were also contacted in 2015.

Four of the tribes contacted responded. On April 2, 2015, the Comanche Nation of Oklahoma inquired whether the state site files had been reviewed. RG Developers provided the tribe with the results of the site files review. On July 21, 2015, the tribe was also furnished with a copy of the final survey report for the LNG Terminal. On July 22, 2015, the Comanche Nation of Oklahoma indicated that the Project would have "no effect." On April 15, 2015, the Tonkawa Tribe of Texas indicated there were no designated historical or cultural sites identified in the Project area, but requested notification should construction activities identify unanticipated

cultural or human remains; RG Developers confirmed consultations would continue, as requested.

On July 9, 2015, the Lipan Apache Tribe of Texas indicated it had no sacred sites in the Project area that it knew of, but requested to be contacted in the event that human remains are discovered during construction activities. On October 22, 2016, the Alabama-Coushatta Tribe of Texas indicated that “no known impacts to cultural assets of the Alabama-Coushatta Tribe of Texas are anticipated” from the Project. No other responses have been received.

We sent our NOI and follow-up letters to the same seven federally recognized tribes. No responses to our NOI or letters have been received.

4.10.4 Other Parties Contacted

RG Developers also contacted and followed-up with historical commissions and local museums to determine the potential presence of cultural resources or areas of historical significance. Groups contacted included the Brownsville Historical Association; Cameron County Historical Commission; Jim Wells County Historical Commission; John E. Conner Museum; Kenedy Ranch Museum; King Ranch Museum; King Ranch Corporate Office; Kleberg County Historical Commission; Port Isabel Historical Museum; Preservation Texas; Southern Texas Archaeological Association; Texas Historical Foundation; and Willacy County Historical Museum. The John E. Conner Museum responded and provided additional contact information. The Texas Historical Foundation indicated it did not comment on Section 106 compliance review. The Kleberg County Historical Commission indicated it did not know of any historical sites along the pipeline route in Kleberg County. No other responses have been received and no areas of concern were expressed as a result of these contacts.

4.10.5 Compliance with the National Historic Preservation Act

RG Developers have not yet completed cultural resources surveys for the Project. Once cultural resources surveys are complete, if any historic properties would be adversely affected by the Project, a treatment plan would be prepared. To ensure that cultural resources studies and consultation are completed and the FERC’s responsibilities under Section 106 of the NHPA are met, **we recommend that:**

- **RG Developers should not begin construction of facilities or use of staging, storage, or temporary work areas and new or to-be-improved access roads until:**
 - a. **RG Developers file with the Secretary:**
 - i. **outstanding SHPO comments on reports, plans, special studies, or information provided to date, as well as any NPS comments, as applicable;**
 - ii. **any outstanding updates, reports, plans, or special studies, and the SHPO’s comments on these, as well as any NPS comments, as applicable; and**

- iii. any necessary treatment plans or site-specific avoidance/ protection plans, and the SHPO's comments on the plans.
- b. The ACHP is afforded an opportunity to comment if historic properties would be adversely affected; and
- c. The FERC staff reviews and the Director of OEP approves all cultural resources survey reports and plans, and notifies RG Developers in writing that construction may proceed.

All material filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "**CUI/PRIV – DO NOT RELEASE.**"

4.11 AIR QUALITY AND NOISE

4.11.1 Air Quality

Construction and operation of the proposed Project would result in impacts on local and regional air quality. Public scoping comments expressed concern regarding impacts on air quality due to construction and operation emissions associated with the Project. This section summarizes federal and state air quality regulations that are applicable to the proposed facilities. The section also characterizes the existing air quality and describes potential impacts the facilities may have on air quality regionally and locally. The term *air quality* refers to relative concentrations of pollutants in the ambient air. The subsections below describe well-established concepts that are applied to characterize air quality and to determine the significance of increases in air pollution.

This includes metrics for specific air pollutants known as criteria pollutants; Ambient Air Quality Standards (AAQS), regional designations to manage air quality known as Air Quality Control Regions (AQCR); and efforts to monitor ambient air concentrations. Combustion of natural gas would produce criteria air pollutants such as ozone, carbon monoxide (CO), sulfur dioxide (SO₂), and inhalable particulate matter (PM [PM_{2.5} and PM₁₀]). PM_{2.5} includes particles with an aerodynamic diameter less than or equal to 2.5 micrometers, and PM₁₀ includes particles with an aerodynamic diameter less than or equal to 10 micrometers. Combustion of fossil fuels also produces volatile organic compounds (VOC), a large group of organic chemicals that have a high vapor pressure at room temperature; and oxides of nitrogen (NO_x). VOCs react with nitrogen oxides, typically on warm summer days, to form ozone. Other byproducts of combustion are greenhouse gases (GHG) and hazardous air pollutants (HAP). HAPs are chemicals known to cause cancer and other serious health impacts.

GHGs produced by fossil-fuel combustion are CO₂, methane (CH₄), and nitrous oxide (N₂O). The status of GHGs as a pollutant is not related to toxicity. GHGs are non-toxic and non-hazardous at normal ambient concentrations. GHG emissions due to human activity are the primary cause of increased levels of all GHG since the industrial age. These elevated levels of GHGs are the primary cause of warming of the global climate system since the 1950s. These existing and future emissions of GHGs, unless significantly curtailed, will cause further warming

and changes to the local, regional, and global climate systems. Emissions of GHGs are typically expressed in terms of CO₂ equivalents (CO₂e).

Other pollutants, not produced by combustion, are fugitive dust and fugitive emissions. Fugitive dust is a mix of PM_{2.5}, PM₁₀, and larger particles thrown up by vehicles, earth movement, or wind erosion. Fugitive emissions, in the context of this EIS, would be fugitive emissions of methane from operational pipelines and aboveground facilities.

4.11.1.1 Regional Climate

The Project area climate – humid subtropical – is significantly influenced by its location in the Texas Coastal Zone (i.e., proximity to the Gulf of Mexico). In general, the Port Isabel area has very short, mild winters and long, hot summers, although the sea breeze can help moderate peak temperatures. Climate data obtained from NOAA for the period 1981 to 2010 show an annual average temperature of 74 °F. Daily average high temperatures range from 68 °F during January to 91 °F during August. Daily average low temperatures range from 52 °F during January to 77 °F during July and August. The record minimum and maximum temperatures are 17 °F and 103 °F, respectively (NOAA 2018a).

The region experiences relatively high dew point values (about 75 °F in summer), resulting in higher relative humidity for the June through September period (NOAA 2018b). Near the northern extent of the pipeline facilities in Corpus Christi, monthly temperature trends are similar; however, the daily average high temperatures range from 67 °F during January to 94 °F in August, and daily average low temperatures range from 57 °F during January to 85 °F in August (NOAA 2018a).

Monthly total rainfall tends to be highest (greater than 2 inches) during the early summer and autumn months across the Project area. The annual average precipitation in Port Isabel amounts to approximately 29 inches, with a monthly maximum of 6.3 inches in September (NOAA 2018). In Corpus Christi, the annual average precipitation is about 30 inches, with a monthly maximum of 5.0 inches in September. Much of this precipitation comes from thunderstorm activity, although the majority of days that receive precipitation experience light rain. Tropical storms or hurricanes, although uncommon, can also enhance summer and autumn rainfall in this region.

The overall predominant wind pattern for the year in the extreme southern Texas Coastal Zone is southeasterly winds, with northwesterly winds dominating at times in the cooler part of the year, particularly December. The annual average wind speed is approximately 10 miles per hour (mph), with the highest average monthly wind speeds occurring during spring (NOAA 2018b). The prevailing southeast wind is further enhanced during spring and early summer by thermal winds which develop when the air over the heated land further west from the coast is warmer than the air over the relatively cooler waters of the Gulf of Mexico.

4.11.1.2 Existing Air Quality

Ambient Air Quality Standards

The EPA has established NAAQS for six criteria pollutants: SO₂, CO, ozone, nitrogen dioxide (NO₂), PM₁₀, PM_{2.5}, and lead. There are two classifications of NAAQS, primary and secondary standards. Primary standards set limits the EPA believes are necessary to protect human health including sensitive populations such as children, the elderly, and asthmatics. Secondary standards are set to protect public welfare from detriments such as reduced visibility and damage to crops, vegetation, animals, and buildings.

Individual state air quality standards cannot be less stringent than the NAAQS. The federal NAAQS for criteria pollutants are the same as the state standards established by the TCEQ in accordance with Section 30 of the TAC (30 TAC), Part 101.21. The TCEQ has also established 30-minute average property line standards for SO₂ and H₂S in 30 TAC Part 112. The federal NAAQS and Texas-specific standards (referenced as net ground-level concentrations) are summarized in table 4.11.1-1.

As with any activity that involves combustion of fossil fuels and processing of natural gas, the Project would contribute GHG emissions. The principle GHGs that would be produced by the Project are CO₂, CH₄, and N₂O. The GHG CO₂e unit of measure takes into account the global warming potential (GWP) of each GHG. The GWP is a ratio relative to CO₂ that is based on the particular GHG's ability to absorb solar radiation as well its residence time within the atmosphere. Based on this definition, and per EPA reporting requirements defined in 40 CFR 98, CO₂ has a GWP of 1, CH₄ has a GWP of 25, and N₂O has a GWP of 298. To obtain the CO₂e quantity, the mass of the particular GHG compound is multiplied by the corresponding GWP, the product of which is the CO₂e for that compound. The CO₂e value for each of the GHG compounds is summed to obtain the total CO₂e GHG emissions.

Existing Air Quality

AQCRs are established by the EPA and local agencies for air quality planning purposes, in which State Implementation Plans describe how the NAAQS would be achieved and maintained. Each AQCR, or portion(s) of an AQCR, is classified as either attainment, nonattainment, or maintenance with respect to the NAAQS. The LNG Terminal site would be located in Cameron County, which is within the Brownsville-Laredo Intrastate AQCR. Vessel transit along the BSC would occur within the same AQCR. The pipeline facilities would be within the Corpus Christi-Victoria Intrastate AQCR (Jim Wells, Kenedy, and Kleberg Counties) and the Brownsville-Laredo Intrastate AQCR (Cameron and Willacy Counties). Areas where air quality data are not available are considered to be unclassifiable and are treated as attainment areas. All components of the Rio Grande LNG Project would be in areas classified as in attainment for all criteria pollutants.

Table 4.11.1-1 Ambient Air Quality Standards				
Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	Texas Net Ground-Level Concentration
Ozone	8-hour (2015) ^a	0.070 ppm	0.070 ppm	-
CO	1-hour ^b	35 ppm	-	-
	8-hour ^b	9 ppm	-	-
NO ₂	1-hour ^c	100 ppb	-	-
	Annual ^d	53 ppb	53 ppb	-
PM _{2.5}	24-hour ^e	35 µg/m ³	35 µg/m ³	-
	Annual ^f	12 µg/m ³	15 µg/m ³	-
PM ₁₀	24-hour ^g	150 µg/m ³	150 µg/m ³	-
Lead	3-month ^h	0.15 µg/m ³	0.15 µg/m ³	-
SO ₂	1-hour ^{i,j}	75 ppb	-	-
	3-hour ^b	-	0.5 ppm	-
	30-minute	-	-	0.4 ppm ^k
H ₂ S	30-minute	-	-	0.08/0.12 ppm ^l

ppb = parts per billion; µg/m³ = micrograms per cubic meter.

^a Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.

^b Not to be exceeded more than once per year.

^c The 98th percentile of daily maximum 1-hour average concentrations, averaged over 3 years.

^d Annual arithmetic mean.

^e The 98th percentile of 24-hour concentrations, averaged over 3 years.

^f Annual arithmetic mean, averaged over 3 years.

^g Not to be exceeded more than once per year on average over 3 years.

^h Not to be exceeded.

ⁱ The 99th percentile of daily maximum 1-hour concentrations, averaged over 3 years.

^j The 24-hour and annual SO₂ NAAQS were revoked in 2010 (75 Federal Register 35520); however, standards remain in effect until 1 year after an area is designated attainment or nonattainment for the 1-hour standard, except in areas designated nonattainment for the 1971 standard, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

^k Net ground-level concentration not to be exceeded at the property boundary.

^l Net ground-level concentration of 0.08 ppm not to be exceeded on property normally occupied by people and net ground-level concentration of 0.12 ppm not to be exceeded on property that are not normally occupied by people.

In addition, there are no nonattainment or maintenance areas through which LNG carriers would transit en route to the LNG Terminal site. Although the EPA maintains jurisdiction over portions of the outer continental shelf within the Gulf of Mexico (40 CFR 55), attainment status does not apply in offshore areas. Therefore, LNG carriers transiting the Gulf of Mexico would not pass through nonattainment or maintenance areas.

Transport of construction materials associated with the Project could occur within the Houston-Galveston-Brazoria (HGB) area, which is a marginal nonattainment area for the 2015 8-hour ozone standard. Construction emissions from Project elements within the HGB area would not be expected to result in an exceedance of applicable general conformity thresholds for the HGB area.

Air Quality Monitoring and Background Concentrations

Ambient air monitoring operations in Texas are the responsibility of the TCEQ, which has developed a statewide network of stationary monitoring stations to collect direct measurements of air pollutant concentrations. Data from these air monitoring sites are available through the EPA's AIRDATA database, which collects air monitoring data from all over the country.

Ambient air quality monitoring data from the 3-year period of 2012 to 2014 and, for some pollutants, 2014 to 2016, are summarized in table 4.11.1-2 for those monitors that were nearest or most representative of the proposed Project facilities. Because not all pollutants are monitored at all stations, multiple monitor locations were used and are representative of conditions at the Rio Grande LNG Terminal and along the pipeline route; ambient air quality monitor locations were identified in coordination with the TCEQ, as provided in RG Developers' Air Quality Modeling Protocol and Air Quality Modeling Analysis Report for the LNG Terminal and Compressor Station 3.⁴⁰

Pollutant	Averaging Time	Monitor Location	Year	Rank	Monitor Value	NAAQS	Unit
CO	1-hour	Brownsville ^a	2014	2nd high	1.6	35	ppm
	8-hour		2014	2nd high	0.8	9	
NO ₂	1-hour	Lake Jackson ^b	2014-2016	98th percentile	18.8	100	ppb
	Annual		2016	Mean	2.0	53	
PM _{2.5}	24-hour	Isla Blanca ^c	2014-2016	98th percentile	25.7	35	µg/m ³
	Annual		2014-2016	Mean	9.5	12	
PM ₁₀	24-hour	Brownsville ^a	2012-2014	2nd high	49	150	µg/m ³
Ozone	8-hour	Brownsville ^a	2014-2016	4th high	57.3	70	ppb
Lead	Quarterly	N/A	N/A	Maximum	N/A	0.15	µg/m ³
SO ₂	1-hour	Corpus Christi West ^d	2012-2014	99th percentile	5.3	75	ppb
	3-hour		2014	2nd high	3.2	500	
^a	344 Porter Drive, Brownsville, Texas (monitor no. 48-061-0006).						
^b	109B Brazoria Hwy 322 West, Lake Jackson, Texas (monitor no. 48-039-1016).						
^c	Lot B 69 ½, South Padre, Texas (monitor no. 48-061-2004).						
^d	902 Airport Blvd., Corpus Christi, Texas (monitor no. 48-355-0025).						

⁴⁰ RG Developers' Air Quality Modeling Protocol and Air Quality Modeling Analysis Report are available on FERC's eLibrary website, located at <http://www.ferc.gov/docs-filing/elibrary.asp>, by searching Docket Number CP16-454 or CP16-455 and accession numbers 20161202-5213 and 20180301-5019.

The concentrations listed in table 4.11.1-2 are maximum or near maximum values for the identified monitors. As such, they are not necessarily representative of current actual air quality in the immediate vicinity of the proposed facilities. For each monitor, table 4.11.1-2 lists the applicable concentrations such as annual mean concentration in each year and/or a near maximum short-term concentration, which are comparable to the applicable NAAQS. As shown in the table, each of the measured concentrations are below or equivalent to the applicable NAAQS for the pollutant and averaging period, thus indicating attainment with the standard.

Regulatory Requirements for Air Quality

State air quality rules govern the issuance of air permits for construction and operation of a stationary emission source. The TCEQ has the primary jurisdiction over air emissions produced by stationary sources associated with the Project. The TCEQ's air quality regulations are codified in the 30 TAC. The regulations incorporate federal program requirements listed in 40 CFR 50-99 and establish permit review procedures for all facilities that can emit pollutants to the ambient air. New facilities are required to obtain an air permit prior to construction. For larger facilities subject to major New Source Review (NSR) review, and approval at the federal level may be required.

Federal Air Quality Requirements

New Source Performance Standards

Section 111 of the CAA authorized the EPA to develop technology-based standards that apply to specific categories of stationary sources. These standards, referred to as New Source Performance Standards (NSPS), are found in 40 CFR 60. The NSPS apply to new, modified, and reconstructed affected facilities in specific source categories. We have determined that the following NSPS would be applicable to one or more of the proposed facilities.

Subpart A – General Provisions. The general provisions listed in Subpart A include broader definitions of applicability and various methods for maintaining compliance with requirements listed in subsequent subparts of 40 CFR 60. Subpart A also specifies the state agencies to which the EPA has delegated authority to implement and enforce standards of performance. The TCEQ has been delegated authority for all 40 CFR 60 standards promulgated by the EPA. Equipment at the LNG Terminal, compressor stations, or booster stations subject to any of the NSPS subparts listed below would all be subject to Subpart A.

Subpart IIII – Standards of Performance for Stationary Compression Ignition Internal Combustion Engines. Subpart IIII applies to owners and operators of stationary compression ignition internal combustion engines (CI ICE) that commence construction after July 11, 2005 where the stationary CI ICE are: 1) manufactured after April 1, 2006, and are not fire pump engines, or 2) are manufactured as a certified NFPA fire pump engine after July 1, 2006. Subpart IIII specifies emission standards, fuel requirements, compliance requirements, and testing requirements for CI ICE, some of which vary by model year, engine power, and displacement, and also specifies notification, reporting, and recordkeeping requirements for owners and operators of CI ICE subject to this subpart. CI ICE in the form of essential generators and firewater pumps at the LNG Terminal would be subject to NSPS Subpart IIII.

Subpart JJJJ – Standards of Performance for Spark Ignition Internal Combustion Engines. Subpart JJJJ provides requirements for stationary spark ignition internal combustion engines that are constructed, modified, or reconstructed after June 12, 2006. The two natural gas backup generators located at Compressor Stations 1, 2, and 3 and the interconnect booster stations would be subject to the requirements of Subpart JJJJ for emergency natural gas-fired engines greater than or equal to 130 hp.

Subpart KKKK – Standards of Performance for Stationary Combustion Turbines. Subpart KKKK applies to owners and operators of stationary combustion turbines with a heat input peak load equal to or greater than 10 British thermal units per hour that commenced construction, modification, or reconstruction after February 18, 2005. Subpart KKKK regulates emissions of NO_x and SO₂. Subject turbines must meet the applicable emission limits and operational requirements as well as recordkeeping and reporting requirements of this subpart. The turbines at the LNG Terminal, Compressor Stations 1 and 2, and two booster stations would be subject to NSPS KKKK.

Subpart OOOO – Standards of Performance for Crude Oil and Natural Gas Industry. Subpart OOOO applies to owners and operators of crude oil and natural gas production, transmission, and distribution facilities. Subpart OOOO regulates emissions of VOCs and SO₂ from affected facilities that commenced construction, modification, or reconstruction after August 23, 2011, and on or before September 18, 2015. Therefore, NSPS OOOO is not applicable to the Project.

Subpart OOOOa – Standards of Performance for Crude Oil and Natural Gas Industry. Subpart OOOOa applies to owners and operators of crude oil and natural gas production, transmission, and distribution facilities. Subpart OOOO regulates emissions of VOCs and methane. RG Developers anticipate that NSPS OOOOa would apply to the compressor stations. The LNG units and fugitive emissions at Compressor Station 3 within the LNG Terminal site would be subject to NSPS OOOOa. In addition, fugitive emissions at Compressor Station 1, Compressor Station 2, and the two booster stations would be subject to NSPS OOOOa. RG Developers would monitor fugitive emissions at these facilities.

Subpart Kb – Standards of Performance for Volatile Organic Liquid Storage Vessels. Subpart Kb applies to owners and operators of storage vessels with a capacity greater than or equal to 75 m³ and that are used to store volatile organic liquids for which construction, reconstruction, or modification is commenced after July 23, 1984. The condensate tanks at the LNG Terminal site would be subject to NSPS Kb, and would follow all monitoring, recordkeeping, and reporting requirements of this subpart.

National Emissions Standards for Hazardous Air Pollutants

Section 112 of the CAA authorized the EPA to develop technology-based standards that apply to specific categories of stationary sources that emit HAPs. These standards are referred to as National Emission Standards for Hazardous Air Pollutants (NESHAP) and are found in 40 CFR 61 and 63. Eight hazardous substances are regulated per 40 CFR 61, including asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. NESHAP can apply to major and/or area (minor) sources of HAPs. The EPA develops

national priorities for NESHAPs that focus on significant environmental risks and noncompliance patterns.

The 1990 CAA Amendments established a list of 189 HAPs, resulting in the promulgation of Part 63, also known as the Maximum Achievable Control Technology standards. Part 63 regulates HAPs from major sources of HAPs and specific source categories emitting HAPs. Some NESHAPs may apply to area (minor) sources of HAPs. Major source thresholds for NESHAPs are 10 tons per year (tpy) of any single HAP or 25 tpy of total HAPs. The LNG Terminal, including Compressor Station 3, would be a major source of HAPs, as potential total emissions of HAPs would be greater than 25 tpy, and emissions of individual HAPs would have the potential to exceed 10 tpy. Total potential HAPs emissions at Compressor Station 1, Compressor Station 2, and the two booster stations are all less than 10 tpy, and would therefore be considered area sources of HAPs. The following NESHAPs would be applicable to one or more of the proposed facilities.

Subpart A – NESHAP General Provisions. The general provisions listed in Subpart A include broader definitions of applicability and various methods for maintaining compliance with requirements listed in subsequent subparts of 40 CFR 63. This subpart also addresses the delegation of NESHAP authority to the states.

Subpart YYYY – NESHAP for Stationary Combustion Turbines. Subpart YYYY regulates HAP emissions from stationary combustion turbines located at major sources of HAP emissions. The gas-fired stationary combustion turbines proposed with the LNG Terminal would be required to comply with the requirements for initial notification established in 40 CFR 63.6145(d), but no further requirements from this subpart.

Subpart ZZZZ – NESHAP for Stationary Reciprocating Internal Combustion Engines. Subpart ZZZZ regulates HAP emissions from reciprocating internal combustion engines. Based on the potential to emit for HAPs, the LNG Terminal would be a major source. The reciprocating internal combustion engines proposed for the LNG Terminal include the engines used for the essential generators, the fire water pumps, and the natural gas generator at Compressor Station 3. Although area sources based on their potential to emit for HAPs, Subpart ZZZZ would also apply to the backup generators at Compressor Stations 1 and 2, and the two booster stations. In accordance with Subpart ZZZZ, compliance with would be achieved through compliance with NSPS IIII and JJJJ.

Mandatory Greenhouse Gas Reporting

Subpart W of 40 CFR 98 requires petroleum and natural gas facilities that emit 25,000 metric tons or more of CO₂e per year to report annual emissions of specified GHGs from various processes within the facility. LNG storage and LNG import and export equipment are considered part of the source category regulated by Subpart W. The LNG Terminal (including Compressor Station 3) would be required to report GHG emissions because estimated annual emissions of GHGs would be above 25,000 metric tpy.

Compressor stations are also subject to GHG reporting requirements under Subpart W. Reporting is required for CO₂e from reciprocating compressor rod packing venting, centrifugal

compressor venting, transmission storage tanks, blowdown vent stacks, natural gas pneumatic device venting, and equipment leaks from valves, connectors, open ended lines, pressure relief valves, and meters. Because the estimated annual emissions of GHGs for Compressor Stations 1 and 2 and Booster Stations 1 and 2 would be above 25,000 metric tpy, these facilities would be included in the GHG reporting.

General Conformity

A General Conformity applicability analysis is required for any part of the Project occurring in nonattainment or maintenance areas for criteria pollutants. Section 176(c) of the CAA requires federal agencies to ensure that federally approved or funded projects conform to the applicable approved State Implementation Plan. Such activities must not:

- cause or contribute to any new violation of any standard in any area;
- increase the frequency or severity of any existing violation of any standard in any area; or
- delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

All counties that would be affected by the Project are classified as in attainment or unclassifiable for all NAAQS; therefore, General Conformity requirements do not apply. However, barges traveling to the LNG Terminal site for the delivery of Prefabricated Electrical Substations would originate from the HGB area, which is classified as marginal nonattainment for the 2015 8-hour ozone standard. As described in section 4.11.1.3, below, construction emissions from the Project occurring within the HGB area are not expected to result in an exceedance of applicable general conformity thresholds.

New Source Review – Prevention of Significant Deterioration

Congress established the NSR pre-construction permitting program as part of the 1977 CAA Amendments. Federal pre-construction review under NSR is conducted under separate procedures for sources in attainment areas and sources in nonattainment areas. Nonattainment New Source Review applies to sources in nonattainment areas. Because no Project components would be in nonattainment areas, this process does not apply and is not discussed further.

PSD permitting applies to new major sources or major modifications at existing sources located in attainment areas or in areas that are unclassifiable. PSD is intended to keep new air emission sources from causing the existing air quality to deteriorate beyond acceptable levels. Under PSD, any new major source or major modification of an existing source of air pollutants is required to obtain an air quality permit before beginning construction. The definition of a PSD major source of air pollutants as applicable to the Project is any stationary source which emits, or has the potential to emit, 250 tpy of a regulated criteria pollutant (40 CFR 51.166(b)(1)(i)(b)). Table 4.11.1-3 lists the major source emission thresholds applicable to the LNG Terminal and pipeline facilities.

Table 4.11.1-3 Major Stationary Source and Prevention of Significant Deterioration Emission Thresholds		
Air Pollutant	Major Stationary Source Threshold (tpy)	PSD Significant Emission Rates (tpy)
NO _x	250	40
CO	250	100
VOCs	250	40
PM	250	25
PM ₁₀	250	15
PM _{2.5}	250	10
SO ₂	250	40
GHG (as CO ₂ e)	75,000	N/A

The aggregated emissions of the LNG Terminal and Compressor Station 3 would exceed PSD major source thresholds for NO_x, CO, PM_{2.5}, PM₁₀, SO₂, and GHG; thus, RG Developers would be required to obtain a PSD major source permit. RG Developers submitted a PSD Air Permit Application⁴¹ for the LNG Terminal and Compressor Station 3 to the TCEQ in May 2016; revised applications were submitted on November 30, 2016, and March 21, 2017, and the TCEQ issued an Order granting the PSD permit on December 17, 2018. Compressor Stations 1 and 2 and the booster stations would all require minor source permits, which were submitted to the TCEQ on March 24, 2017, and were approved in June 2017. RB Pipeline also obtained a minor source Permit by Rule for Compressor Station 3, so that it has a permit addressing only those emissions sources for which it is responsible.

Once a facility is subject to PSD, the following requirements apply:

- installation of Best Available Control Technology (BACT);
- air quality monitoring and modeling analyses to ensure that a Project's incremental increase of emissions would not cause or contribute to a violation of any NAAQS or PSD air quality increment;
- notification to the federal land manager of nearby Class I areas and modeling if applicable;

⁴¹ RG LNG's PSD Air Permit Applications are available on FERC's eLibrary website, located at <http://www.ferc.gov/docs-filing/elibrary.asp>, by searching Docket Number CP16-454 or CP16-455 and accession numbers 20170403-5621 and 20170407-5193.

- a growth, soil and vegetation, and visibility analysis; and
- public comment on the permit.

BACT is an emissions limitation that is based on the maximum degree of control that can be achieved. It is a case-by-case decision that considers energy, environmental, and economic impact. BACT can be add-on control equipment or modification of the production processes or methods. This includes fuel cleaning or treatment and innovative fuel combustion techniques. BACT may be a design, equipment, work practice, or operational standard if imposition of an emissions standard is infeasible (TCEQ 2011). RG Developers completed a BACT assessment for the LNG Terminal, including Compressor Station 3, as part of a PSD application for CO, NO_x, VOC, PM₁₀, PM_{2.5}, and GHGs, the results of which were incorporated into subsequent facility emission calculations.

The air quality monitoring and modeling analysis involves an assessment of existing air quality, which may include ambient monitoring data and air quality dispersion modeling results, and predictions, using dispersion modeling, of ambient concentrations that would result from the proposed LNG Terminal and associated future growth (TCEQ 2015b).

There are three air quality classifications within an attainment area for purposes of PSD permitting review: Class I areas are designated as pristine natural areas or areas of natural significance and receive special protections under the CAA based on good air quality. Class III areas are heavily industrialized zones that are established only on request and must meet all requirements outlined in 40 CFR 51.166. The remainder of the United States is designated as Class II. The LNG Terminal site and pipeline facilities would be located in Class II areas (40 CFR 81).

If a new source or major modification of an existing source is subject to the PSD permitting requirements and is within 62 miles of a Class I area, the facility is required to notify appropriate federal officials and assess the impacts of the proposed Project on the Class I area. The closest Class I area to the LNG Terminal site is Big Bend National Park, which is more than 400 miles from the site.

Air quality monitoring includes additional evaluations of the LNG Terminal impacts (including Compressor Station 3), including a growth, soil and vegetation, and visibility analysis. RG Developers filed a final air quality modeling report developed as part of the TCEQ permitting process that includes these additional evaluations. The final report was submitted to the TCEQ in January 2018. The visibility analysis for the LNG Terminal site includes an assessment of the visual air quality impacts of emissions from the terminal on Palo Alto Battlefield, 12 miles northwest of the LNG Terminal site.

Title V Operating Permit

The Part 70 Operating Permit program, as described in 40 CFR 70, requires major stationary sources of air emissions to obtain a federally enforceable operating permit. Part 70 operating permits are more commonly referred to as “Title V” permits. The EPA has delegated

the authority to issue Title V permits to the TCEQ, which has incorporated the program in 30 TAC Chapter 122.

The threshold levels for determining the applicability for a Title V permit are:

- 100 tpy of any criteria air pollutant;
- 10 tpy of any individual HAP; or
- 25 tpy of any combination of HAPs.

Estimated potential emissions of CO, NO_x, VOC, PM₁₀, and PM_{2.5} during operation of the LNG Terminal and Compressor Station 3 would be greater than 100 tpy. Additionally, the 10 tpy threshold for individual HAPs and 25 tpy threshold for aggregate HAPs would be exceeded. Therefore, the LNG Terminal and Compressor Station 3 would be subject to the Title V Operating Permit Program.

For new sources (such as the ones proposed here), applications for Title V permits are due prior to commencing operation. RG Developers plan to submit the Title V permit application for the LNG Terminal and Compressor Station 3 prior to beginning construction.

Estimated potential emissions for both Compressor Stations 1 and 2 would also be expected to exceed the 100 tpy threshold for both NO_x and CO. These facilities would also be subject to the Title V Operating Permit Program. RG Developers plan to submit the Title V permit applications for Compressor Stations 1 and 2 prior to commencing operations. Operation of the booster stations would not require a Title V Operating Permit.

Texas Air Quality Requirements

The Project would be subject to state standards, codified in Title 30 of the TAC. The regulations listed below would apply to the new facilities associated with the Project, including turbines, thermal oxidizers, flares, generators, fire water pumps, and fugitive emissions:

- 30 TAC Chapter 101, Subchapter A – General Rules. This chapter includes provisions related to circumvention, nuisance, traffic hazards, sampling and sampling ports, emissions inventory requirements, sampling procedures and terminology, compliance with EPA standards, inspection and emission fees, and emission events and scheduled maintenance, start-up, and shutdown activities.
- 30 TAC Chapter 106 – Permits by Rule. This chapter outlines the permitting requirements for facilities that meet specific emissions limits, and that do not qualify as major sources (see 30 TAC Chapter 116, below). RB Pipeline plans to obtain a minor source Permit by Rule for Compressor Station 3, so that it has a permit addressing only those emissions sources for which it is responsible. The booster stations would also require minor source permits authorized as Permits by Rule.
- 30 TAC Chapter 111 – Control of Air Pollution from Visible Emissions and Particulate Matter. This chapter outlines the allowable visible emission (i.e., opacity)

requirements and total suspended particulate emission limits based on calculated emission rates.

- 30 TAC Chapter 112 – *Control of Air Pollution from Sulfur Compounds*. This chapter outlines emission limits and monitoring, reporting, and recordkeeping requirements. This chapter also lists net ground-level concentration standards at the property line for certain sulfur compounds.
- 30 TAC Chapter 113 – *Standards of Performance for Hazardous Air Pollutants and for Designated Facilities and Pollutants*. Chapter 113 incorporates by reference the NESHAP source categories (40 CFR 63).
- 30 TAC Chapter 114 – *Control of Air Pollution from Motor Vehicles*. This chapter addresses inspection requirements and maintenance and operation of air pollution control systems/devices for motor vehicles owned and/or operated at the Project facilities. This chapter applies to use of construction- and operations-related vehicles.
- 30 TAC Chapter 116, Subchapter B – *Control of Air Pollution by Permits for New Construction or Modification*. This chapter outlines the permitting requirements for the construction of new sources. As described above under Federal Air Quality Requirements, the aggregated emissions of the LNG Terminal and Compressor Station 3 would exceed PSD major source thresholds for NO_x, CO, PM_{2.5}, PM₁₀, and SO₂; and RG Developers would be required to obtain a PSD major source permit. Compressor Stations 1 and 2 would require minor source permits authorized under the TCEQ *Standard Permits* regulations (30 TAC Chapter 116, Subchapter F).
- 30 TAC Chapter 118 – *Control of Air Pollution Episodes*. This chapter outlines the requirements relating to generalized and localized air pollution episodes.
- 30 TAC Chapter 122 – *Federal Operating Permits Program*. This chapter outlines the requirements for complying with the federal operating permits program.

RG Developers have outlined the methods and measures by which they would comply with the requirements of each applicable TCEQ air quality regulation in their permit applications. It is expected that the TCEQ would include permit conditions in the respective permits to ensure compliance with these regulations.

4.11.1.3 Impacts and Mitigation

During construction, a reduction in ambient air quality would result from emissions and fugitive dust generated by construction equipment. Fugitive dust and other emissions from construction activities generally do not result in a significant increase in regional pollutant levels, although local pollutant levels could intermittently increase during the lengthy construction period. Air pollutant emissions during construction of the LNG Terminal would result from the operation of construction vehicles, marine traffic, and vehicles driven by construction workers commuting to and from work sites. Emissions during construction of the pipeline facilities would also result from the operation of construction vehicles and vehicles driven by construction

workers. In addition, particulate emissions would result from fugitive dust generated by construction-related activities, the quantity of which would depend on several factors, including:

- the size of area disturbed;
- the nature and intensity of construction activity;
- surface properties (such as the silt and moisture content of the soil);
- the wind speed; and
- the speed, weight, and volume of vehicular traffic.

The Project would result in emissions from operation of the LNG Terminal, compressor stations, and booster stations, as well as fugitive emissions from pipe flanges, valves, and valve stems. Emissions estimates for each facility are included below.

LNG Terminal

Construction

Construction of the LNG Terminal would be continuous over a 78-month period, beginning upon receipt of all applicable permits. The first LNG train is expected to be completed by Year 4, with construction of the final LNG train expected to be complete in Year 7. In addition, emissions from worker commutes associated with commissioning the Project would occur in Year 8. Construction of Compressor Station 3 would also begin the first quarter of Year 3, with additional compression installed periodically through Year 7, as subsequent LNG trains are brought online. The construction emissions estimate includes emissions from operation of construction equipment, operation of the onsite concrete batch plants, deliveries of supplies, worker commutes, and land disturbance. Annual emissions estimates for activities associated with construction of the LNG Terminal and Compressor Station 3 are summarized in table 4.11.1-4. To estimate construction emissions, RG LNG developed an inventory of non-road equipment, vessels, on-road vehicles, off-road vehicles, and expected activity levels (either hours of operation or miles traveled) that would be used during construction at the LNG Terminal site. The level of activity for each piece of construction equipment was combined with the relevant emission factors to determine estimates of annual construction emissions.

Two concrete batch plants would be established at the site, mixing a total of about 200,000 tons of cement, 400,000 tons of sand, and 600,000 tons of aggregate to produce concrete for construction of the LNG Terminal. Onsite batching facilities would implement fugitive dust suppression equipment and filters as required by the TCEQ.

**Table 4.11.1-4
Estimated Construction Emissions for the Rio Grande LNG Terminal and Compressor Station 3
(tpy)^{a,b}**

Facility and Year	NO _x	CO	SO ₂	PM ₁₀	PM _{2.5}	VOC	Total HAPs	CO _{2e}
Rio Grande LNG Terminal								
Year 1	12.0	18.6	2.0	589.4	60.0	0.7	0.2	653.8
Year 2	69.7	111.4	11.8	1,199.5	125.8	4.2	1.2	9,711.0
Year 3	127.8	174.3	23.5	1,146.6	125.8	6.4	1.7	15,835.2
Year 4	59.3	118.5	10.6	91.4	14.2	3.6	1.0	9,046.0
Year 5	45.0	106.7	8.0	56.1	9.2	2.9	0.8	7,532.0
Year 6	39.0	70.2	7.1	26.9	5.8	2.1	0.5	6,310.0
Year 7	1.2	10.4	0.0	13.9	1.4	0.1	<0.1	1,054.0
Year 8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	13.8
Compressor Station 3								
Year 3	1.3	10.3	<0.1	10.6	1.1	0.3	<0.1	1,371.5
Year 4	0.1	0.7	<0.1	0.7	<0.1	<0.1	<0.1	114.8
Year 5	0.7	6.5	<0.1	0.2	<0.1	<0.1	<0.1	933.9
Year 6	0.7	5.8	<0.1	0.4	<0.1	<0.1	<0.1	831.5
Year 7	0.4	4.4	<0.1	0.5	<0.1	<0.1	<0.1	642.8
^a	Emission estimates include construction emissions from on- and off-road vehicle activity, truck deliveries, vessel activity, worker commutes, and fugitive dust. HAPs were not estimated by RG LNG for vessel activity; however, they were estimated using emission factors for commercial marine vessels identified by the EPA in the 2014 National Emissions Inventory.							
^b	Additional fill material may be obtained from the Port Isabel dredge pile for the Project; RG LNG is currently conducting an analysis of the barge transport alternative for feasibility of use (see section 3.4). If used, RG LNG would obtain the fill via barge. RG LNG estimated annual fugitive emissions from use of the temporary haul road originally proposed for use on the Project; because the haul road is no longer part of the Project, but the transport of material by barge may not be required, we have included use of the haul road as a conservative estimate for annual fugitive construction emissions.							

Construction materials would be delivered to the site by barge and by truck. Tugboats would be used for barge deliveries of construction material and equipment. RG LNG estimates that 878 marine deliveries would occur over a 5-year period during construction. Emissions associated with transportation of construction material would be expected to continue until Year 7. Other vessel emissions during LNG Terminal construction would result from dredging of the marine facilities and surveys to map underwater topography.

Fugitive dust emissions would be generated throughout the construction period and are included in the annual emissions estimates. Fugitive dust emissions would include contributions from general site construction work (acreage impacted), earth-moving fugitive dust emissions (quantity of soil moved), and unpaved road travel (distance of travel and weight of vehicles). Fugitive dust would be produced primarily during the site preparation activities, when the site would be cleared of debris, leveled, and graded, including at proposed offsite facilities.

RG LNG would minimize vehicular exhaust from construction worker commutes by providing bus transportation during construction of Stages 4, 5, and 6 of the LNG Terminal when offsite parking areas are in use. RG LNG would use recent models of construction equipment, conduct regular inspections and emissions testing of construction vehicles, and limit idling of heavy equipment to less than 5 minutes to the extent practicable. In addition, RG LNG would implement the measures in its Terminal Construction Fugitive Dust Control Plan to minimize fugitive dust, including the following:

- a water truck would be available at all times during construction. Based on weather and site conditions, the water truck would spray Project areas as needed, including designated site entrances, access roads, staging areas, material stockpiles, laydown areas, construction workspace, and parking areas. Once available, the permanent water supply for the LNG Terminal may be used for dust control near the LNG trains and tanks;
- crushed rock would be placed on high traffic temporary roads, and sprayed with asphalt binding material to mitigate fugitive dust emissions. Roadways would be regularly monitored and cleaned or watered as necessary;
- parking areas would be paved to reduce fugitive dust generation;
- speed limits would be enforced in construction work areas, including restricting speed limits to 20 miles per hour on unsurfaced roads;
- dump trucks and off-road trucks would be covered while traveling; and
- tire washing pools would be used to remove material clinging to tires.

The EI and RG LNG's Site Construction Management would be responsible for ensuring that dust control measures are implemented. To ensure that the fugitive dust plan is adequate to minimize fugitive dust during the 78-month construction period of the LNG Terminal, and per our recommendation in section 4.2.2.1, RG LNG would submit a final Terminal Construction Fugitive Dust Control Plan to FERC prior to construction. Because construction emissions would be limited to the construction period, standard EPA emission permitting thresholds do not apply. General Conformity applicability thresholds do not apply at the LNG Terminal site because the Project area is in attainment for all the NAAQS. We conducted a General Conformity applicability determination for marine emissions associated with barge traffic in the HGB area, which is a marginal nonattainment area for the 2015 8-hour ozone standard. As shown in table 4.11.1-5, these emissions would not exceed the NO_x and VOC emissions conformity determination thresholds of 100 tpy for marginal nonattainment areas; NO_x and VOCs are precursors to ozone. Therefore, a General Conformity determination does not apply to the Project.

Table 4.11.1-5 Estimated Marine Vessel VOC and NO_x Emissions in the Houston-Galveston-Brazoria Area (tpy)		
Year	NO_x	VOC
Year 2	6.99	0.28
Year 3	8.21	0.33
Year 4	7.30	0.29
Year 5	6.69	0.27
Year 6	0.91	0.04

The construction activities proposed in association with the LNG Terminal are comparable to other types of infrastructure projects or industrial facilities. As indicated in table 4.11.1-4, there may be localized minor to moderate elevated levels of fugitive dust and tailpipe emissions near construction areas during the 78-month construction period associated with the LNG Terminal site.

The construction emissions' impact on ambient air quality would vary with time due to the construction schedule, the mobility of the sources, and the variety of emission sources. Fugitive dust and other emissions due to construction activities generally do not pose a significant increase in regional pollutant levels; however, local pollutant levels would increase during the construction period. Considering these factors, we determine that construction of the Project would impact local air quality. However, construction emissions would not have a long-term, permanent effect on air quality in the area.

Operation

Commissioning and Start-up Emissions

Commissioning of the LNG trains and start-up of the LNG Terminal is expected to result in emissions between Year 4 and Year 7, during start-up of each train. Ground flares would be used to control start-up emissions. These emissions would be staged in conjunction with construction at the LNG Terminal site, and would begin in Year 4 with LNG Train 1 commissioning, emissions from LNG Tanks 1 and 2 cooldown, and cooldown at Marine Jetty 1 and associated LNG loading lines. Train 2 commissioning and start-up emissions would begin in Year 5. Emissions from commissioning of Trains 3 and 4, cooldown of LNG Tank 3, Jetty 2, and the loading lines would begin in Year 6. Finally, emissions from start-up and commissioning of LNG Trains 5 and 6 and cooldown of LNG Tank 4 would begin in Year 7. A summary of these additional emissions is provided in table 4.11.1-6.

Table 4.11.1-6 Estimated Emissions from LNG Train Commissioning and Start-Up (tpy)									
Year	NO _x	CO	SO ₂	H ₂ SO ₄	PM ₁₀	PM _{2.5}	VOC	Total HAPs	CO _{2e}
Year 4	332	674	0.2	0.01	4.4	4.4	1,087	0.1	462,041
Year 5	236	485	0.1	0.01	3.0	3.0	782	0.1	358,314
Year 6	467	940	0.3	0.02	6.0	6.0	1,538	0.2	708,882
Year 7	463	910	0.3	0.02	6.0	6.0	1,512	0.2	701,271

H₂SO₄ = Sulfuric acid

Routine Operation

Air emissions for routine operation and maintenance at the LNG Terminal site include those associated with the LNG Terminal and Compressor Station 3. The emission sources associated with the LNG Terminal are expected to operate continuously following commissioning. The six LNG trains would include the following continuous emissions sources:

- 12 gas turbines (2 per LNG train; 1 per LNG train would be equipment with a waste heat recovery unit);
- six thermal oxidizers (one per LNG train);
- two condensate tanks; and
- fugitive emissions from pipe flanges, valves, and valve stems.

The LNG Terminal would also contain the following emission sources, which would operate on an intermittent or as-needed basis:

- six diesel fired emergency generators;
- two emergency diesel drive firewater pumps;
- one LNG tank and BOG low-pressure vent;
- three wet/dry ground flares to control emissions during maintenance, start-up, and shutdown events;
- up to 312 LNG carriers per year (about 6 per week), and their attendant tugs, pilot boats, and security escort vessels;
- trucking facilities for LNG and condensate transport; and
- miscellaneous mobile sources.

Once fully built, Compressor Station 3 would have six electric compressor units which would operate on a continuous basis and would not contribute to operating emissions. One condensate tank would be kept onsite. Two backup natural gas fueled generator sets would be constructed in order to temporarily provide electricity in the event of a power outage. Additionally, intermittent emissions would be generated from maintenance activities such as pigging, blowdowns, flaring, and from start-up/shutdown. Emissions from both Compressor Station 3 and the LNG Terminal would also result from fugitive emissions from piping components, such as valves and seals. Power for the LNG Terminal and Compressor Station 3 would be provided via a connection to a local public electrical network, and (with the exception of backup generators), power generation would not contribute to operation emissions at the LNG Terminal site (see section 2.2.1).

Annual emissions by source for the LNG Terminal and Compressor Station 3 and a summary of total annual emissions are provided in table 4.11.1-7. In addition to the stationary sources at the LNG Terminal, table 4.11.1-7 shows the mobile emissions from worker commutes, truck LNG distribution, and LNG carriers and tugboats associated with LNG Terminal operations. Emission estimates include proposed control technologies, based on the completion of RG Developers' BACT assessment for CO, NO_x, VOC, PM₁₀, PM_{2.5}, and GHGs. In addition to total HAPs, the individual HAPs with the greatest contribution to total HAPs emitted by the Project are presented in table 4.11.1-7. These include formaldehyde and the group of VOCs known collectively as BTEX (benzene, toluene, ethyl-benzene, and xylene). The estimates represent emissions associated with full build-out of the Project, and with all six LNG trains operating at maximum capacity. Operation emissions would be lower in Year 4, when the first LNG train and associated facilities would be commissioned, and would reach the values in table 4.11.1-7 after completion of the final stage of construction and commissioning Train 6 and associated facilities in Year 7.

The LNG Terminal and Compressor Station 3 would be a PSD major source for NO_x, CO, PM₁₀, PM_{2.5}, VOCs, and GHG (as CO_{2e}). The facility would be considered a major source of HAP emissions. As described in section 4.11.1.3, because emissions at the LNG Terminal site would be above the PSD significant emission rates (see table 4.11.1-3) for NO_x, CO, PM₁₀, PM_{2.5}, VOC, and CO_{2e}, these pollutants would be subject to both federal and state permitting and compliance requirements. RG Developers would be required to show compliance with the NAAQS and PSD increment requirements for NO_x, CO, SO₂, PM₁₀, and PM_{2.5}. In addition, RG Developers would be required to show compliance with the ozone NAAQS and to comply with the federal requirements for major sources of CO_{2e}. Compliance with these requirements are discussed below.

**Table 4.11.1-7
Summary of Estimated Emissions from Routine Operation of the LNG Terminal and Compressor Station 3 (tpy)^{a,b}**

Equipment	NO _x	CO	SO ₂	H ₂ SO ₄	PM ₁₀	PM _{2.5}	VOC	HAPs						CO _{2e}
								Formaldehyde	Benzene	Toluene	Ethylbenzene	Xylene	Total HAPs	
LNG TERMINAL														
Stationary Emissions Sources from the LNG Terminal														
Gas turbines (12)	1,702.9	2,628.0	1.7	0.1	367.9	367.9	94.6	36.1	0.6	6.6	1.6	3.3	50.8	6,080,096.0
Thermal oxidizers (6)	213.2	149.2	28.2	2.2	13.5	13.5	9.8	0.1	<0.1	0.0	<0.1	0.0	3.3	1,924,414.0
Ground flare system (2)	14.0	120.0	<0.1	<0.1	0.0	0.0	102.5	0.0	0.0	0.0	0.0	0.0	0.0	30,446.0
Ground flare system (use during maintenance / start-up / shutdown)	114.0	228.0	0.3	0.0	0.0	0.0	390.0	0.0	0.0	0.0	0.0	0.0	0.0	102,662.0
Essential generators (6)	12.7	7.0	<0.1	-	0.4	0.4	-	<0.1	<0.1	<0.1	0.0	<0.1	<0.1	1,428.0
Emergency firewater pumps (2)	0.7	0.4	<0.1	-	<0.1	<0.1	-	<0.1	<0.1	<0.1	0.0	<0.1	<0.1	76.0
LNG tank and BOG low-pressure vent with ignition package	1.1	9.4	0.0	0.0	0.0	0.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	4,650.0
Fugitives	-	-	-	-	-	-	3.1	0.0	<0.1	<0.1	<0.1	<0.1	0.1	5,626.0
Subtotal	2,058.6	3,142.0	30.2	2.3	381.8	381.8	604.4	36.2	0.6	6.6	1.6	3.3	54.2	8,149,398.0
Mobile Emissions Sources from the LNG Terminal														
Worker commute ^e	<0.1	0.3	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	47.0
Truck LNG distribution and NGL export ^e	1.6	0.7	<0.1	-	0.1	0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1,287.0
LNG carriers and tugboats ^d	927.3	88.0	13.9	-	28.5	27.7	38.5	1.7	0.2	<0.1	<0.1	0.1	5.7	44,034.0

Table 4.11.1-7 (continued)
Summary of Estimated Emissions from Routine Operation of the LNG Terminal and Compressor Station 3 (tpy)^{a,b}

Equipment	NO _x	CO	SO ₂	H ₂ SO ₄	PM ₁₀	PM _{2.5}	VOC	HAPs						CO ₂ e		
								Formaldehyde	Benzene	Toluene	Ethylbenzene	Xylene	Total HAPs			
<i>Subtotal</i>	<i>928.9</i>	<i>89.0</i>	<i>13.9</i>	-	<i>28.6</i>	<i>27.8</i>	<i>38.6</i>	<i>1.7</i>	<i>0.2</i>	<i><0.1</i>	<i><0.1</i>	<i><0.1</i>	<i><0.1</i>	<i><0.1</i>	<i><0.1</i>	<i>45,368.0</i>
LNG Terminal Total	2,987.5	3,231.0	44.1	2.3	410.4	409.6	643.0	37.9	0.8	6.6	1.6	3.4	59.9	8,194,766.0		
COMPRESSOR STATION 3																
Backup generators (2)	0.1	0.3	0.0	0.0	0.0	0.0	0.1	<0.1	<0.1	<0.1	0.0	0.0	<0.1	<0.1	45.0	
Condensate tank (1)	-	-	-	-	-	-	3.7	0.0	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	52.0	
Pigging activities	-	-	-	-	-	-	0.2	0.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	392.0	
Fugitives ^c	-	-	-	-	-	-	0.7	0.0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	63.0	
<i>Subtotal</i>	<i>0.1</i>	<i>0.3</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>0.0</i>	<i>4.7</i>	<i><0.1</i>	<i><0.1</i>	<i><0.1</i>	<i><0.1</i>	<i><0.1</i>	<i><0.1</i>	<i>0.3</i>	<i>552.0</i>	
Total	2,987.6	3,231.3	44.1	2.3	410.4	409.6	647.7	38.0	0.8	6.6	1.6	3.4	60.2	8,195,318.0		

^a The numbers in this table have been rounded for presentation purposes. As a result, the totals may not reflect the sum of the addends.

^b Project estimates are for the LNG Terminal and Compressor Station 3 after all stages of construction are completed. Estimates are for routine operation.

^c Speciated HAPs were not provided by RG LNG for worker commutes, or truck LNG distribution and NGL export for the LNG Terminal. Because total HAPs for these sources are <0.1 tpy, a conservative assumption that each individual HAP would be emitted at a rate of <0.1 tpy was included.

^d HAPs were not estimated by RG LNG for LNG carrier and tugboat emissions; however, they were estimated using emission factors for commercial marine vessels identified by the EPA in the 2014 National Emissions Inventory.

^e Speciated HAPs were not provided by RG LNG for fugitive compressor station emissions; the emissions were estimated based on the ration of individual HAP weight percentage to the total VOC weight percentage for the gas analysis for the King Ranch Gas Plant provided by RG LNG.

Ambient Impacts

Several public scoping comments expressed concern regarding the dispersion of pollutants during operation of the LNG Terminal, and requested that RG Developers mitigate potential impacts. RG Developers conducted a PSD Screening Analysis, NAAQS Analysis, and PSD Increment Analysis for stationary sources at the LNG Terminal and Compressor Station 3 in accordance with the TCEQ's permitting requirements. In addition to the modeling required by the TCEQ, FERC requested that RG Developers conduct the requisite modeling for the LNG Terminal to include the mobile LNG carrier and support vessel emissions in order to fully assess the impacts of the LNG Terminal operations. The modeling presented herein includes the mobile LNG carriers and support vessels. The PSD Screening Analysis included a Significance Analysis, Area of Impact Analysis, and Pre-construction Monitoring Analysis. The Significance Analysis considers the emissions associated with only the proposed LNG Terminal, LNG mobile emissions, and Compressor Station 3 to determine if operation of these facilities would have a significant impact on the surrounding area. The modeled ground-level concentrations are compared to the corresponding significant impact levels (SIL), also known as modeling significance levels, to determine if any predicted concentrations at any receptor locations would be "significant." If the Significance Analysis reveals that modeled ground-level concentrations for a particular pollutant and averaging period are greater than the applicable SIL, a full impact analysis, which considers emissions from regional sources within the Area of Impact Analysis, is performed at the significant receptors. Air quality models evaluated pollutant concentrations from the facility fence line; therefore, the recreation areas near the LNG Terminal are included in the assessment.

The Area of Impact Analysis is defined as the area in which a particular pollutant and averaging time are greater than the applicable SIL. If the predicted Significance Analysis impacts for a particular pollutant are below the applicable SIL(s), then no further analyses (e.g., NAAQS Analysis and PSD Increment Analysis) are required for that pollutant. Results from the significance analysis also dictate if pre-construction ambient monitoring is required.

In accordance with the modeling requirements outlined above, RG Developers performed a PSD Significance Analyses for those pollutants that exceeded the PSD significant emission rates. These included NO₂, CO, PM₁₀, PM_{2.5}, VOCs, and CO_{2e}. The results of these analyses for stationary sources are summarized in table 4.11.1-8, along with the associated SIL for each pollutant. As stated above, FERC requested that RG Developers conduct modeling to include the mobile LNG carrier and support vessel emissions; the results of the PSD Significance Analysis for stationary and mobile sources are presented in table 4.11.1-9.

Table 4.11.1-8 Summary of Air Dispersion Modeling of Stationary Sources at the Rio Grande LNG Terminal, Significant Impact Levels for Air Quality Impacts in Class II Areas				
Air Pollutant	Averaging Period	Modeled Impact (µg/m³)^a	SIL (µg/m³)	Full Impact Analysis Required? (Yes / No)
NO ₂	1-hour	13.89	7.5	Yes
	Annual	1.2	1	Yes
CO	1-hour	364.6	2,000	No
	8-hour	228.8	500	No
PM _{2.5}	24-hour	1.05	1.2	No
	Annual	0.26	0.3	No
PM ₁₀	24-hour	1.05	5	No
SO ₂	1-hour	1.53	7.8	No
	24-hour	0.38	5	No
	Annual	0.09	1	No
^a Modeled impacts include the maximum predicted ground-level concentration for stationary sources only as required by the TCEQ, as included in RG LNG's air quality analysis modeling report.				

Table 4.11.1-9 Summary of Air Dispersion Modeling of Stationary and Mobile Sources at the Rio Grande LNG Terminal, Significant Impact Levels for Air Quality Impacts in Class II Areas				
Air Pollutant	Averaging Period	Modeled Impact (µg/m³)^a	SIL (µg/m³)	SIL Exceedance (Yes / No)
NO ₂	1-hour	212.42	7.5	Yes
	Annual	4.03	1	Yes
CO	1- hour	658.8	2,000	No
	8- hour	236.2	500	No
PM _{2.5}	24- hour	2.59	1.2	Yes
	Annual	0.30	0.3	Yes
PM ₁₀	24- hour	3.24	5	No
SO ₂	1- hour	3.85	7.8	No
	24- hour	1.11	5	No
	Annual	0.11	1	No
^a Modeled impacts include stationary sources and LNG carriers at the LNG Terminal.				

The results of RG Developers' PSD Significance Analyses conducted for the TCEQ indicate that the associated emissions of NO₂ for stationary sources (1-hr and annual) would exceed the SIL. Because the results of RG Developers' PSD Significance Analyses indicated an exceedance of the SIL for NO₂ a NAAQS analysis was required by the TCEQ for each averaging period. A cumulative modeling assessment of NO₂ emissions of nearby stationary sources (within 31 miles) is also required for the Project. RG LNG completed modeling in coordination with the TCEQ and the cumulative modeling did not indicate any exceedances of relevant thresholds. The TCEQ modeling results do not include mobile sources; therefore, we conducted a cumulative analysis including the emissions for the three LNG terminals proposed along the BSC (see section 4.13.2).

In the event that a potential NAAQS violation is identified, a source is not considered to have caused or contributed to the violation if its own impact from the modeling significance analysis is not significant (e.g., modeled impact is less than the SIL) at the violating receptor at the time of the predicted violation. If no simultaneous exceedance of the SIL and the NAAQS is found in this process, the modeling analysis demonstrates that the proposed LNG Terminal would not cause or contribute to the potential NAAQS exceedance.

In addition to NO₂, the analysis of air dispersion modeling for stationary sources and LNG carriers indicated that emissions of PM_{2.5} would meet or exceed the SIL. Table 4.11.1-10 shows the results of this NAAQS assessment for stationary and mobile (LNG carrier) sources for pollutants with a SIL exceedance (see tables 4.11.1-8 and 4.11.1-9). The modeled concentrations at the LNG Terminal and mobile sources with the inclusion of background concentrations would not exceed the NAAQS.

Because the emissions from stationary and mobile sources would not exceed the NAAQS, the results of the NAAQS analysis required by the TCEQ (which only includes stationary sources at the LNG Terminal site, resulting in lower emissions estimates, and only addresses NO₂ emissions) are not included herein. Therefore, we conclude that the LNG Terminal and Compressor Station 3 would not cause or significantly contribute to an exceedance of the NAAQS.

Air Pollutant	Averaging Period	Maximum Impact (µg/m³)^a	Background + Modeled Impact (µg/m³)^{a,b}	SIL (ug/m³)	NAAQS (µg/m³)	NAAQS Exceedance? (Yes / No)
NO ₂	1-hour	136.5	171.8	7.5	188	No
	Annual	4.03	7.83	1	100	No
PM _{2.5}	24-hour	1.98	27.68	1.2	35	No
	Annual	0.30	9.80	0.3	12	No
^a Modeled impacts include stationary sources and LNG carriers at the LNG Terminal site. The pollutants included are those that exceed the SIL as presented in tables 4.11.1-8 and 4.11.1-9. ^b Background concentrations based upon available background levels presented in table 4.11.1-2.						

Secondary air quality standards are set under the CAA for the protection of public welfare, including protection against decreased visibility and damage to animals and vegetation, including crops. The NAAQS analysis demonstrated that the LNG Terminal would comply with applicable secondary NAAQS; therefore, any impacts on vegetation, animals, and other public welfare concerns would not be significant. In Texas, if a facility complies with visibility and opacity requirements specified in 30 TAC Chapter 111, no additional visibility impact analyses are required. RG LNG would comply with visibility and opacity requirements specified in 30 TAC Chapter 111.

Given the close proximity of the LNG Terminal site to the Palo Alto Battlefield, about 14.0 miles west of the LNG Terminal site, and Padre Island National Seashore, about 36.0 miles northeast of the LNG Terminal site, RG LNG prepared an assessment demonstrating maximum modeled ground-level concentrations for pollutants in relation to the NAAQS at the Palo Alto Battlefield at the request of the NPS. The results of this comparison are provided in table 4.11.1-11. Based on the NAAQS analysis in table 4.11.1-10 above, it is anticipated that no NAAQS exceedance would occur at Padre Island National Seashore from operation of the Project.

Table 4.11.1-11 Summary of NAAQS Full Impact Analysis, Palo Alto Battlefield Receptors					
Air Pollutant	Averaging Period	Maximum Modeled Result ($\mu\text{g}/\text{m}^3$)^a	Background Value ($\mu\text{g}/\text{m}^3$)^b	Modeled Result + background concentration ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)
NO ₂	1-hr	5.16	35.3	40.46	188
	Annual	0.05	3.8	3.85	100
CO	1-hr	41.77	1,257.6	1,299.37	40,000
	8-hr	13.08	800.3	813.38	10,000
PM _{2.5}	24-hr	0.09	25.7	25.79	35
	Annual	0.01	9.5	9.51	12
PM ₁₀	24-hr	0.66	49.0	49.66	150
SO ₂	1-hr	0.24	13.2	13.44	196
	24-hr	0.06	3.7	3.76	365
	Annual	0.002	0.08	0.08	80
^a Modeled impacts include stationary sources and LNG carriers at the LNG Terminal site.					
^b Background concentrations based upon available background levels presented in table 4.11.1-2.					

An additional visibility screening model was prepared using VISCREEN to assess potential visibility impacts on the Palo Alto Battlefield, since sources of air pollution can cause visible plumes if PM and NO_x emissions are large enough. The VISCREEN model was run using site-specific meteorological data and background visibility conditions from the Galveston

Airport in Galveston County due to a similar location on the coast of the Gulf of Mexico with nearby industrial sites.

The results of the model are compared to criteria established for Class I areas (see section 4.11.1.2) to assess the visibility of a plume due to contrast with the viewing background. The results of the VISCREEN analysis indicate that Class I area thresholds would not be exceeded at the Palo Alto Battlefield during the day when the park is open for visitors.

The State of Texas also requires a State Property Line Analysis for major sources and listed minor sources to demonstrate compliance with state standards for net ground-level concentrations of SO₂. Results of this analysis are provided in table 4.11.1-12, and show that operation of the Project would not result in the exceedance of any relevant standards. Public scoping comments and comments on the draft EIS expressed concern regarding impacts of operational emissions from the LNG Terminal on public health. The State of Texas requires a State Health Effects air quality analysis comparing predicted emissions of non-criteria pollutants with effects screening levels, which are used to evaluate potential effects as a result of exposure to air emissions. The pollutants assessed for the Project include benzene (a VOC), hexane, heptane, iso-butane, and n-butane. The results of RG LNG’s State Health Effects modeling evaluation indicate that the Project emissions are below applicable effects screening levels, and therefore adverse health effects are not expected.

Table 4.11.1-12 SO₂ NAAQS Analysis Modeling Results for the Rio Grande LNG Terminal		
Averaging Period	Maximum Concentration (µg/m³)^a	State Property Line Standard (µg/m³)
30-minute SO ₂	5.1	1,021
1-hour H ₂ SO ₄	0.16	50
24-hour H ₂ SO ₄	0.04	15
^a Modeled results include stationary sources and LNG carriers.		

Regional Ozone Impacts

Because the Rio Grande LNG Terminal is a major source of NO_x and VOC emissions, which are precursors to ozone, the potential ozone impact of the LNG Terminal and Compressor Station 3 was analyzed. RG LNG conducted photochemical modeling to determine the potential 8-hour ozone impact from LNG Terminal operations using the Comprehensive Air Quality Model with Extensions (CAMx) in accordance with the EPA’s July 2015 Draft Single Source Ozone Guidance. RG LNG also assessed potential ozone impacts in accordance with the two-step screening process established by the TCEQ.

The CAMx model was run using a “base case” scenario of emissions; a “future year” scenario that would be representative of baseline conditions in Year 7, the year before the LNG Terminal would be fully operational; and an emissions scenario that included the Project (added to the future year scenario), thus allowing for a comparison of ozone levels before and after the

Project is permitted and at full build-out. In accordance with the TCEQ screening process, RG LNG used national emissions inventory data to determine the ratio of NO_x to VOC in Cameron County, and found that the ambient air surrounding the LNG Terminal is NO_x limited for creation of ozone. Based on TCEQ guidance, RG LNG performed NO_x modeling to estimate the maximum predicted 8-hour concentration of ozone resulting from Project operations and found that the maximum 8-hour ozone impacts of the LNG Terminal and Compressor Station 3 were estimated to be 2.3 parts per billion (ppb) of ozone, which, when considered with the background ozone concentration of 57 ppb, would not result in an exceedance of 8-hour ozone standard of 70 ppb. Since issuance of the draft EIS, and as identified in a comment issued by the Sierra Club, the TCEQ issued a Construction Permit Source Analysis & Technical Review for the Project as part of its review and issuance of air quality permits. In that analysis, the TCEQ conducted a conservative analysis of ozone levels based on guidance provided by the EPA Region 6. Based on the revised analysis by the TCEQ, the 8-hour maximum predicted increase of ozone would be 11.6 ppb which, when considered with the background ozone concentration of 57 ppb, would not result in an exceedance of the 8-hour ozone standard. Cameron County is currently in attainment for the ozone standard, and the Project is not expected to result a violation of the ozone standard or re-designation.

Staged Emissions Impacts

As described in section 2.3, the Project has been proposed in six staged construction phases where the LNG Terminal site would be developed over the course of about 7 years, with the first LNG train becoming operational in Year 4 of construction. Therefore, construction, commissioning and start-up, and operations would take place simultaneously and result in concurrent emissions of air pollutants. Using the air emissions estimates provided by RG Developers for routine operation of all six LNG Trains and Compressor Station 3 compressor units, we have estimated the staged operational emissions during each year that commissioning and construction would also take place. Table 4.11.1-13 summarizes the combined construction, commissioning, and operational emissions for the Rio Grande LNG Terminal, by year.

Based on the schedule provided by RG Developers, the emissions for Years 1 through 3 would be construction only with commissioning activities for the first LNG train beginning in Year 4. Each subsequent year (Years 5 through 7) results in emissions for construction, and commissioning and start-up, of each stage. Concurrent construction and commissioning and start-up emissions would be greater than full build-out operational emissions of NO_x and CO in Year 7, during which construction would be ongoing for Stage 6, while Stages 1 through 5 would be operational beginning in the first quarter of the year. Similarly, concurrent VOC emissions, primarily due to commissioning and start-up emissions, would be greatest during Years 4 through 7. These concurrent emissions would temporarily impact local air quality during the staged construction, commissioning and start-up, and operations of the LNG Terminal, and could result in exceedances of the NAAQS in the immediate vicinity of the LNG Terminal during these construction years. However, these exceedances would not be persistent at any one time during these years due to the dynamic and fluctuating nature of construction activities within a day, week, or month. Further, construction emissions would be highly localized, and the nearest residential areas are about 2.2 miles from the LNG Terminal site. Because pollutant concentrations would decrease with distance from the LNG Terminal site, concurrent emissions would be unlikely to exceed the NAAQS in residential areas. Therefore, these concurrent

emissions would not have a long-term, permanent effect on air quality in the area. Further, the full build-out operational emissions from the LNG Terminal, as described above, would not result in an exceedance of the NAAQS.

Table 4.11.1-13 Combined Construction, Commissioning and Start-up, and Operational Emissions for the Rio Grande LNG Terminal and Compressor Station 3 (tpy) ^{a,b}								
Year	NO _x	CO	SO ₂	PM ₁₀	PM _{2.5}	VOC	Total HAPs	CO _{2e}
Rio Grande LNG Terminal								
Year 1 ^c	12.0	18.6	2.0	589.4	60.0	0.7	0.2	653.8
Year 2 ^c	69.7	111.4	11.8	1,199.5	125.8	4.2	1.2	9,711.0
Year 3 ^c	129.1	184.6	23.5	1,157.2	126.9	6.7	1.7	17,206.7
Year 4	519.8	928.1	12.6	113.6	35.7	1,117.6	3.6	813,988.2
Year 5	1,430.3	1,811.6	24.5	213.4	166.0	1,027.9	23.5	3,449,204.0
Year 6	2,391.3	3,036.7	34.7	290.0	268.0	1,944.9	38.3	5,843,844.5
Year 7	3,207.2	3,887.1	40.4	396.7	383.0	2,105.8	55.4	8,216,659.2
Year 8 ^d	2,987.7	3,231.2	43.7	410.5	409.7	647.6	60.2	8,195,333.8
^a Annual construction emissions are presented in table 4.11.1-4; annual commissioning and start-up emissions are presented in table 4.11.1-6. ^b Annual operations emissions for full build-out are presented in table 4.11.1-7, and annual operations emissions were estimated based on the schedule presented in table 2.3-1. We have assumed the following timeframes for full operations of each stage: Stage 1 in Q4 of Year 4; Stage 2 in Q1 of Year 5; Stage 3 in Q4 of Year 5; Stage 4 in Q2 of Year 6; Stage 5 in Q1 of Year 7; Stage 6 in Q3 of Year 7. ^c Construction emissions only; no commissioning, start-up, or operations would take place. ^d Full build-out operations emissions and emissions from worker commutes associated with commissioning the Project would occur in Year 8.								

Greenhouse Gas Emissions

Based upon the emission estimates summarized in table 4.11.1-7, the LNG Terminal and Compressor Station 3 would be a PSD major source of GHG emissions; therefore, RG Developers' PSD permit application included a BACT assessment for GHG emissions from the facility. RG Developers have committed to complying with the GHG BACT requirements, which would mitigate GHG emissions to the extent practicable. Public comments expressed concern over the level of GHGs that would be emitted by the Project, as well as impacts on climate change. Climate change is addressed in section 4.13.2.

Operational LNG Emissions Impact Conclusion

Based upon the entirety of our analysis, we conclude that operation of the LNG Terminal would not cause, or significantly contribute to, an exceedance of the NAAQS. During operation, we have determined that the Project would have minor impacts on the local and regional air quality, but would not result in regionally significant impacts on air quality. Concurrent emissions would temporarily impact local air quality during the staged construction, commissioning and start-up, and operations of the LNG Terminal, and could result in exceedances of the NAAQS in the immediate vicinity of the LNG Terminal during these construction years. These exceedances

would not be persistent at any one time during these years due to the dynamic and fluctuating nature of construction activities within a day, week, or month.

Pipeline Facilities

Pipeline System

Construction

Construction of the Pipeline System would result in a temporary increase in emissions due to the combustion of fuel in vehicles and equipment, dust generated from excavation, grading and fill activities, and general construction activities (e.g., painting and welding). Construction emissions associated with pipeline construction would be minimal and localized to the construction area, which would predominantly occur in sparsely populated areas. Construction for Pipelines 1 and 2 would be expected to occur between Years 3 and 6. There would be an 18-month period between the end of construction on Pipeline 1 (expected to be complete in Year 4), and the start of construction on Pipeline 2 in Year 5. The Header System would be constructed at the same time as Pipeline 1. Construction emissions are summarized in table 4.11.1-14.

Table 4.11.1-14 Estimated Construction Emissions for the Pipeline System (tpy)^a								
Facility and Year	NO_x	CO	SO₂	PM₁₀	PM_{2.5}	VOC	Total HAPs	CO_{2e}
Pipeline 1 and Header System^b								
Year 3	9.2	38.1	<0.1	804.7	80.6	0.9	0.4	4,600.4
Year 4	4.2	11.8	<0.1	637.9	63.9	0.5	0.2	2,628.4
Pipeline 2								
Year 5	5.6	18.6	<0.1	717.2	71.9	0.6	0.3	4,048.8
Year 6	3.8	16.7	<0.1	717.1	71.7	0.4	0.2	3,482.5
^a	Emissions estimates include construction emissions from on- and off-road vehicle activity, truck deliveries, worker commutes, and fugitive dust.							
^b	The MLV sites and metering sites are included in the emission calculations for Pipelines 1 and 2 and the Header System.							

To minimize construction air emissions, RB Pipeline would use the most fuel-efficient construction equipment available, and would use buses where feasible to minimize emissions from worker commutes. Further, RB Pipeline would use recent models of construction equipment, conduct regular inspections and emissions testing of construction vehicles, and limit idling of heavy equipment to less than 5 minutes to the extent practicable. To minimize fugitive dust emissions associated with construction of the pipeline facilities, RB Pipeline would implement the measures described in its draft Pipeline System Fugitive Dust Control Plan, including the following:

- applying water and/or a non-toxic chemical dust suppressant, alone or in combination with mulches, to areas of disturbance;
- using wind fences, berms, or covering material (e.g., gravel or textiles) on disturbed areas;
- using existing public and private roads and pipeline right-of-way for access during construction wherever possible;
- restricting speed in construction work areas, including restricting speed limits to 20 miles per hour on unsurfaced roads; and
- washing, wetting down, treating, or covering hauling equipment when necessary.

To ensure that the fugitive dust plan is adequate to minimize fugitive dust during the construction of both pipelines, and per our recommendation in section 4.2.2.1, RB Pipeline would provide its final Pipeline System Fugitive Dust Control Plan prior to commencing construction of the Pipeline System. Fugitive dust emissions would occur during the construction period and would subside once construction activities for any given Project component are complete. With the implementation of the measures described above and our recommendation, we have determined that fugitive dust emissions associated with construction of the Pipeline System are not expected to contribute to degradation of the NAAQS. Construction of the Pipeline System would occur over a much shorter duration than the LNG Terminal. While elevated emissions may occur near construction areas, impacts would be short-term and minor.

Operation

Fugitive emissions in the form of minor leaks from flanges, valves, and connectors could occur along the length of the pipeline route during operation. Fugitive emissions would be staged and increase over time as construction of the Project and equipment progressed. At full build-out, the Pipeline System would emit 2.7 tpy of VOC and 337.6 tpy of CO_{2e}. Emissions from the pipelines would be minor and dispersed over the entirety of the pipeline length. Therefore, we conclude that operation of the pipelines would not cause or significantly contribute to an exceedance of the NAAQs.

Aboveground Facilities

Construction

Construction of Compressor Stations 1 and 2 and Booster Stations 1 and 2 would result in a temporary increase in emissions due to combustion of fuel in vehicles and equipment, dust generated from excavation, grading and fill activities, and general construction activities (e.g., painting and welding). Emissions associated with construction of the metering sites and MLVs are included in emissions estimates for the pipeline facilities. All ground disturbance, grading, and fill activities associated with construction of the compressor stations and booster stations

would be completed during Stage 1 of construction. Therefore, the highest construction emissions for the aboveground facilities would occur during Year 3.

Construction of Compressor Stations 1 and 2 would be expected to take place between the first quarter of Year 3 and the third quarter of Year 7. Construction of the compressor stations would occur intermittently, with compressor units being added at each station in coordination with the staged construction at the LNG Terminal site. Booster Stations 1 and 2 would be constructed between the first quarter of Year 3 and the first quarter of Year 4. Estimated emissions associated with the construction of each compressor station and booster station are summarized in table 4.11.1-15.

Table 4.11.1-15 Estimated Construction Emissions for the Aboveground Facilities (tpy)^a								
Facility and Year	NO_x	CO	SO₂	PM₁₀	PM_{2.5}	VOC	Total HAPs	CO_{2e}
Compressor Station 1								
Year 3	1.3	10.3	<0.1	3.8	0.4	0.3	<0.1	1,371.5
Year 4	0.1	0.7	<0.1	0.1	<0.1	<0.1	<0.1	114.8
Year 5	0.7	6.5	<0.1	0.4	<0.1	<0.1	<0.1	933.9
Year 6	0.7	5.8	<0.1	1.9	0.2	<0.1	<0.1	831.5
Year 7	0.4	4.4	<0.1	0.7	<0.1	<0.1	<0.1	642.8
Compressor Station 2								
Year 3	1.3	10.3	<0.1	3.5	0.4	0.3	<0.1	1,371.5
Year 4	0.1	0.7	<0.1	0.1	<0.1	<0.1	<0.1	114.8
Year 5	0.7	6.5	<0.1	0.4	<0.1	<0.1	<0.1	933.9
Year 6	0.7	5.8	<0.1	2.3	0.2	<0.1	<0.1	831.5
Year 7	0.4	4.4	<0.1	0.8	<0.1	<0.1	<0.1	642.8
Booster Station 1								
Year 3	1.3	10.3	<0.1	2.5	0.2	0.3	<0.1	1,371.5
Year 4	0.1	0.7	<0.1	0.1	<0.1	<0.1	<0.1	98.5
Booster Station 2								
Year 3	1.3	10.3	<0.1	2.5	0.2	0.3	<0.1	1,371.5
Year 4	0.1	0.7	<0.1	0.1	<0.1	<0.1	<0.1	98.5
^a Emissions estimates include construction emissions from on- and off-road vehicle activity, truck deliveries, worker commutes, and fugitive dust.								

As previously referenced, standard EPA emission thresholds do not apply to construction emissions, and General Conformity applicability thresholds do not apply at the aboveground facility sites because the area is in attainment for all the NAAQS. The construction activities proposed in association with the facilities are comparable to other types of infrastructure projects or industrial facilities and would represent a small portion of the overall annual emissions in the region. Therefore, the construction emissions would not have a long-term effect on air quality in the area, although they would result in temporary impacts in the vicinity of active construction.

Operation

Compressor Stations 1 and 2 would be constructed in stages, with additional compressor units being brought online over time in conjunction with development at the LNG Terminal. Once fully built, Compressor Stations 1 and 2 would each include six, 30,000-hp gas-fired compressor units with low NO_x burners which would operate on a continuous basis. One condensate tank would be kept on each site. Two backup natural gas fueled generator sets would be constructed at both facilities in order to temporarily provide electricity in the event of a power outage. Emissions would also result from fugitive losses associated with piping components, such as valves and seals.

Additionally, intermittent emissions would be generated from maintenance activities at the facilities such as pigging, blowdowns, and start-up/shutdowns. Fugitive emissions would be staged and increase over time as construction of the Project and equipment progressed. Potential fugitive emissions that would be emitted for full build-out of each of the compressor stations would be 7.1 tpy of VOCs and 15,811 tpy of CO_{2e}.

Based on the emission estimates provided in table 4.11.1-16, Compressor Stations 1 and 2 would each be Title V major sources for CO and NO_x, with both exceeding the major source threshold of 100 tpy. The facilities would be considered a minor source of all other criteria pollutants, as well as HAP emissions. The individual HAPs with the greatest contribution to total HAPs emitted by the Project are presented in table 4.11-16 for reference; these include formaldehyde and the group of VOCs known collectively as BTEX (benzene, toluene, ethyl-benzene, and xylene). Though Title V major sources for CO and NO_x, emissions would be below the NSR major source thresholds (see table 4.11.1-3). An ambient full impact analysis was performed for CO, NO_x, PM₁₀, PM_{2.5}, and SO₂ in comparison to the NAAQS for Compressor Stations 1 and 2. As identified in table 4.11.1-17, the modeled impacts with included background concentrations would not cause a NAAQS exceedance.

**Table 4.1.1.1-16
Compressor Stations 1 and 2 Estimated Annual Emission Rates (tpy)^a**

Equipment	NO _x	CO	SO ₂	PM ₁₀	PM _{2.5}	VOC	HAPs						CO _{2e}
							Formaldehyde	Benzene	Toluene	Ethylbenzene	Xylene	Total HAPs	
Compressor Station 1													
Gas turbines (6)	190.6	193.8	20.5	11.5	11.5	12.7	4.3	0.1	0.8	0.2	0.4	6.0	669,784
Backup generators (2)	0.6	0.6	0.0	<0.1	<0.1	0.1	0.1	0.0	<0.1	0.0	0.0	0.1	225
Condensate tank (1)	-	-	-	-	-	3.7	0.0	<0.1	<0.1	<0.1	<0.1	0.2	52
Fugitive emissions ^b	-	-	-	-	-	7.1	0.0	<0.1	<0.1	<0.1	<0.1	<0.1	15,811
Pig receiving	-	-	-	-	-	-	-	-	-	-	-	-	-
Start-up / shutdown (including blowdowns)	1.7	13.6	-	-	-	33.1	0.0	<0.1	<0.1	<0.1	<0.1	0.49	75,532
Compressor Station 1 Total	192.9	208.0	20.5	11.5	11.5	56.7	4.4	0.1	0.8	0.2	0.4	6.8	761,404
Compressor Station 2													
Gas turbines (6)	190.6	193.8	20.5	11.5	11.5	12.7	4.3	0.1	0.8	0.2	0.4	6.0	669,784
Backup generators (2)	0.6	0.6	0.0	<0.1	<0.1	0.1	0.1	0.0	<0.1	0.0	0.0	0.1	225
Condensate tank (1)	-	-	-	-	-	3.7	0.0	<0.1	<0.1	<0.1	<0.1	0.2	52
Fugitive emissions ^b	-	-	-	-	-	6.7	0.0	<0.1	<0.1	<0.1	<0.1	<0.1	15,779
Pig receiving	-	-	-	-	-	0.2	0.0	<0.1	<0.1	<0.1	<0.1	<0.1	392.0
Start-up / shutdown (including blowdowns)	1.7	13.6	-	-	-	33.1	0.0	<0.1	<0.1	<0.1	<0.1	0.5	75,532
Compressor Station 2 Total	192.9	208.0	20.5	11.5	11.5	56.5	4.4	0.1	0.8	0.2	0.4	6.8	761,764

^a The numbers in this table have been rounded for presentation purposes. As a result, the totals may not reflect the sum of the addends.

^b Speciated HAPs were not provided by RG LNG for fugitive compressor station emissions; the emissions were estimated based on the ration of individual HAP weight percentage to the total VOC weight percentage for the gas analysis for the King Ranch Gas Plant provided by RG LNG

**Table 4.11.1-17
Summary of Air Dispersion Modeling at Compressor Stations 1 and 2 and Comparison to NAAQS**

Equipment	Averaging Time	Maximum Modeled Result ($\mu\text{g}/\text{m}^3$)	Background Value ^a ($\mu\text{g}/\text{m}^3$)	Modeled Result + Background Concentration ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)
Compressor Station 1					
NO ₂	1-hour	38.71	35.3	74.0	188.7
	Annual	2.74	3.8	6.5	100
CO	1-hour	49.71	1,257.6	1,307.3	40,000
	8-hour	38.91	800.3	839.2	10,000
PM _{2.5}	24-hour	2.28	25.7	28.0	35
	Annual	0.40	9.5	9.9	12
PM ₁₀	24-hour	3.36	49.0	52.4	150
SO ₂	1-hour	4.16	13.2	17.4	196
	24-hour	2.90	3.7	6.6	365
	Annual	0.29	0.08	0.4	80
Compressor Station 2					
NO ₂	1-hour	10.0	35.3	45.3	188.7
	Annual	1.25	3.8	5.1	100
CO	1-hour	96.69	1,257.6	1,354.3	40,000
	8-hour	68.32	800.3	868.6	10,000
PM _{2.5}	24-hour	0.52	25.7	26.2	35
	Annual	0.18	9.5	9.7	12
PM ₁₀	24-hour	0.67	49.0	49.67	150
SO ₂	1-hour	1.08	13.2	14.3	196
	24-hour	0.51	3.7	4.2	365
	Annual	0.13	0.08	0.2	80

^a Background concentrations are based upon available background levels presented in table 4.11.1-2.

Booster Stations 1 and 2 would each include a single 30,000-hp natural gas turbine-driven compressor. One condensate tank would be constructed on each site. Emissions would also result from fugitive losses associated with piping components, such as valves and seals. Additionally, intermittent emissions would be generated from intermittent sources in the form of a backup natural gas-fired generator and blowdown vent at each facility. Based on the emission estimates provided in table 4.11.1-18, Booster Stations 1 and 2 would not be Title V major sources, and all emissions at each facility would be below the PSD significant emission rates (see table 4.11.1-3). An ambient full impact analysis was performed for CO, NO_x, PM₁₀, PM_{2.5}, and SO₂ in comparison to the NAAQS at Booster Stations 1 and 2. As identified in table 4.11.1-19, the modeled impacts with included background concentrations would not cause an exceedance of the NAAQS. Therefore, we conclude that neither booster station would cause or significantly contribute to an exceedance of the NAAQS.

Elevated levels of air pollutants would occur during the period of construction, primarily from fugitive dust. However, through implementation of construction work practices and our recommendation in section 4.2.2.1 to finalize the Pipeline System Fugitive Dust Control Plan prior to construction, analysis of the estimated emissions from construction and operation, and an analysis of the modeled air quality impacts from operation of the pipeline facilities, we find there would be no significant impacts on air quality.

While construction of the Rio Grande LNG Project would result in localized minor to moderate elevated levels of fugitive dust and combustion emissions near the construction areas, impacts related to construction of the facilities would be limited to the construction period for the Project. Based upon the entirety of our analysis, we conclude that operation of the Rio Grande LNG Project would not cause, or significantly contribute to, an exceedance of the NAAQS. During operation, we have determined that the Project would have minor impacts on the local and regional air quality, but would not result in regionally significant impacts on air quality.

**Table 4.11.1-18
Booster Stations 1 and 2 Estimated Annual Emission Rates (tpy)^a**

Equipment	NO _x	CO	SO ₂	PM ₁₀	PM _{2.5}	VOC	HAPs						CO _{2e}
							Formaldehyde	Benzene	Toluene	Ethylbenzene	Xylene	Total HAPs	
Booster Station 1													
Gas turbine (1)	31.8	32.3	3.4	1.9	1.9	2.1	0.7	<0.1	0.1	<0.1	0.1	1.0	111,631
Backup generators (1)	0.3	0.3	0.0	<0.1	<0.1	0.1	0.1	0.0	<0.1	0.0	0.0	0.1	112
Condensate tank (1)	-	-	-	-	-	3.7	0.0	<0.1	<0.1	<0.1	<0.1	0.2	52
Fugitive emissions ^b	-	-	-	-	-	7.1	0.0	<0.1	<0.1	<0.1	<0.1	<0.1	15,811
Start-up/shutdown (including blowdowns)	0.3	2.3	-	-	-	5.5	0.0	<0.1	<0.1	<0.1	<0.1	0.1	12,589
Booster Station 1 Total	32.4	34.9	3.4	1.9	1.9	18.4	0.8	<0.1	0.1	<0.1	0.1	1.3	140,195
Booster Station 2													
Gas turbine (1)	31.8	32.3	3.4	1.9	1.9	2.1	0.7	<0.1	0.1	<0.1	0.1	1.0	111,631
Backup generators (1)	0.3	0.3	0.0	<0.1	<0.1	0.1	0.1	0.0	<0.1	0.0	0.0	0.1	112
Condensate tank (1)	-	-	-	-	-	3.7	0.0	<0.1	<0.1	<0.1	<0.1	0.2	52
Fugitive emissions ^b	-	-	-	-	-	7.1	0.0	<0.1	<0.1	<0.1	<0.1	<0.1	15,811
Start-up/shutdown (including blowdowns)	0.3	2.3	-	-	-	5.5	0.0	<0.1	<0.1	<0.1	<0.1	0.1	12,589
Booster Station 2 Total	32.4	34.9	3.4	1.9	1.9	18.4	0.8	<0.1	0.1	<0.1	0.1	1.3	140,195

^a The numbers in this table have been rounded for presentation purposes. As a result, the totals may not reflect the sum of the addends.

^b Speciated HAPs were not provided by RG LNG for fugitive compressor station emissions; the emissions were estimated based on the ration of individual HAP weight percentage to the total VOC weight percentage for the gas analysis for the King Ranch Gas Plant provided by RG LNG.

Table 4.11.1-19 Summary of Air Dispersion Modeling at Booster Stations 1 and 2 and Comparison to NAAQS					
Equipment	Averaging Time	Maximum Modeled Result (µg/m³)	Background Value^a (µg/m³)	Modeled Result + Background Concentration (µg/m³)	NAAQS (µg/m³)
Booster Station 1					
NO ₂	1-hr	2.35	35.3	37.7	188
	Annual	0.20	3.8	4.0	100
CO	1-hr	31.84	1,257.6	1,289.4	40,000
	8-hr	26.27	800.3	826.6	10,000
PM _{2.5}	24-hr	0.14	25.7	25.8	35
	Annual	0.08	9.5	9.6	12
PM ₁₀	24-hr	0.18	49.0	49.2	150
SO ₂	1-hr	0.36	13.2	13.6	196
	24-hr	0.14	3.7	3.8	365
	Annual	0.026	0.08	0.1	80
Booster Station 2					
NO ₂	1-hr	2.39	35.3	37.7	188
	Annual	0.20	3.8	4.0	100
CO	1-hr	28.40	1,257.6	1,286.0	40,000
	8-hr	24.80	800.3	825.1	10,000
PM _{2.5}	24-hr	0.25	25.7	26.0	35
	Annual	0.08	9.5	9.6	12
PM ₁₀	24-hr	0.35	49.0	49.4	150
SO ₂	1-hr	0.37	13.2	13.6	196
	24-hr	0.14	3.7	3.8	365
	Annual	0.026	0.08	0.1	80
^a Background concentrations based upon available background levels presented in table 4.11.1-2.					

4.11.2 Noise

The noise environment can be affected during both construction and operation of a project. The magnitude and frequency of environmental noise may vary considerably over the course of the day, throughout the week, and across seasons, in part due to changing weather conditions and the effects of seasonal vegetation cover. This section identifies the potential Project-related sources and magnitude of noise, and discusses the change in noise attributable to construction and operation of the Project.

Sound is a sequence of waves of pressure that propagates through compressible media such as air or water. When sound becomes excessive, annoying, or unwanted, it is referred to as noise. Public scoping comments expressed concern regarding noise associated with the Project, including potential disruptions to wildlife (see sections 4.6.1 and 4.7) and residences (see section

4.11.2.3). The ambient sound level of a region is defined by the total noise generated within the specific environment and usually comprises natural and man-made sounds.

Two measurements used by some federal agencies to relate the time-varying quality of environmental noise to its known effects on people are the equivalent sound level (L_{eq}) and the day-night sound level (L_{dn}). The preferred single value figure to describe sound levels that vary over time is L_{eq} , which is defined as the sound pressure level of a noise fluctuating over a period of time, expressed as the amount of average energy. L_{dn} is defined as the 24-hour average of the equivalent average of the sound levels during the daytime (from 7:00 a.m. to 10:00 p.m.) and the equivalent average of the sound levels during the nighttime (10:00 p.m. to 7:00 a.m.). Specifically, in the calculation of the L_{dn} , late night and early morning (10:00 p.m. to 7:00 a.m.) noise exposures are increased by 10 dB to account for people's greater sensitivity to sound during nighttime hours. In general, if the sound energy does not vary over the given time period, the L_{dn} level will be equal to the L_{eq} level plus 6.4 dB. The 6.4 dB difference between the L_{dn} and the L_{eq} is a result of the 10 dB nighttime addition for the L_{dn} calculation. In addition, the maximum sound level observed during a measurement period or noise event (L_{max}) is used to describe sound levels associated with pile-driving.

Decibels are the units of measurement used to quantify the intensity of noise. To account for the human ear's sensitivity to low level noises the decibel values are corrected to weighted values known as decibels on the A-weighted scale (dBA). The A-weighted scale is used because human hearing is less sensitive to low and high frequencies than mid-range frequencies. Table 4.11.2-1 demonstrates the relative dBA noise levels of common sounds measured in the environment and industry. A 3 dB change of sound level is considered to be barely perceivable by the human ear, a 5 or 6 dB change of sound level is considered noticeable, and a 10 dB increase is perceived as if the sound intensity has doubled.

4.11.2.1 Noise Regulations

Federal Regulations

In 1974, the EPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety* (EPA 1974). This publication evaluated the effects of environmental noise with respect to health and safety. The document provides information for state and local governments to use in developing their own ambient noise standards. The EPA has determined that, to protect the public from activity interference and annoyance outdoors in residential areas, noise levels should not exceed an L_{dn} of 55 dBA. We have adopted this criterion (18 CFR 157.206(b)(5)) for new compression and associated pipeline facilities, and it is used here to evaluate the potential noise effects from construction and operation of the LNG Terminal and pipeline facilities. An L_{dn} of 55 dBA is equivalent to a continuous noise level of 48.6 dBA for facilities that operate at a constant level of noise. Additionally, Section 380.12(k)(4)(v)(B) of FERC's regulations indicates new compressor stations or modifications of existing stations shall not result in a perceptible increase in vibration at any NSA.

Table 4.11.2-1 Sound Levels and Relative Loudness			
Noise Source or Activity	Sound Level (dBA)	Subjective Impression	Relative Loudness (perception of different sound levels)
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain	64 times as loud
Loud rock concert near stage	120	Uncomfortably loud	16 times as loud
Jet takeoff (2,000 feet)	100	Very loud	4 times as loud
Garbage disposal / food blender (2 feet)	80	Loud	Reference loudness
Vacuum cleaner (10 feet)	70	Moderate	1/2 as loud
Light auto traffic (100 feet)	50	Quiet	1/8 as loud
Quiet library, soft whisper (15 feet)	30	Very quiet	1/32 as loud
Wilderness with no wind or animal activity	25	Extremely quiet	--
	0	Threshold of hearing	--

Source: Barnes et al. 1977, EPA 1971.

State and Local Regulations

The State of Texas does not have any state regulations that apply to noise. Additionally, no towns near the LNG Terminal site or in counties crossed by the Pipeline System were identified to have any restricting regulations. The Project is located outside the City of Brownsville; therefore, the Brownsville Noise Ordinance (Chapter 46, Article III, Brownsville, Texas, Code of Ordinances n.d.) is not applicable to the Project.

4.11.2.2 Existing Sound Levels and Noise Sensitive Areas

RG Developers estimated baseline sound levels near the proposed LNG Terminal site, compressor stations, booster stations, and HDD entry and exit sites by conducting acoustical assessments. As Compressor Station 3 would be within the footprint of the LNG Terminal, sound produced during its construction and operation are included in the estimates for the terminal. Nearby NSAs, which include residences, hospitals, and schools, were identified to determine the Project's potential sound contribution during construction and operation. RG LNG also assessed ambient sound levels at "check point" locations that do not meet the definition of an NSA, but are potentially sensitive to sound level impacts, such as cultural sites and important wildlife areas in the Project vicinity (i.e., Palmito Ranch Battlefield, Palo Alto Battlefield, piping plover critical habitat, the wildlife corridor crossing SH-48, and the Laguna Atascosa NWR).

LNG Terminal

RG LNG conducted noise surveys in July 2015 and September 2016 to characterize the existing noise environment at the NSAs and other sensitive sites nearest to the LNG Terminal site. During surveys, two 10- to 15-minute measurements of L_{eq} were taken at each survey site: one during the daytime and one at night. The results of the ambient noise survey, as well as the distance and direction of each identified NSA from the center of the LNG Terminal site, are provided in table 4.11.2-2.

Table 4.11.2-2 Existing Sound Levels at Noise Sensitive Areas Near the Rio Grande LNG Terminal					
NSA	Distance from LNG Terminal Site (miles)^a	Direction from LNG Terminal Site	Average Daytime L_{eq} (dBA)^b	Average Nighttime L_{eq} (dBA)^c	Calculated L_{dn} (dBA)
NSA 1	4.3	South	46.9	55.5	61.3
NSA 2	3.7	Northeast	52.4	50.1	56.9
NSA 3	3.7	Northeast	45.8	44.4	51.0
NSA 4	3.9	Northeast	50.2	52.8	58.9
Palmito Ranch Battlefield ^d	5.4	Southwest	44.2	41.2	48.2
Palo Alto Battlefield ^e	14.0	West	50.0	41.0	50.4
Laguna Atascosa NWR	0.5	West	56.7	52.5	59.8
Piping Plover Critical Habitat	0.5	South	54.9	45.2	55.0
Wildlife Corridor	2.4	Southwest	67.8	60.2	68.9
^a	Measurements were taken at multiple locations; the nearest to the LNG Terminal site center is presented here.				
^b	The L_{eq} is the average of measured daytime hourly noise levels between 7:00 a.m. and 10:00 p.m.				
^c	The L_{eq} is the average of measured nighttime hourly noise levels between 10:00 p.m. and 7:00 a.m.				
^d	The measurement location for the Palmito Ranch Battlefield is the observation area within the National Historic Landmark.				
^e	Due to restricted nighttime access, daytime measurements were collected at the Palo Alto Battlefield observation area, and nighttime measurements were collected at the entrance to the site.				

NSA 1 is a residence about 4.3 miles southeast of the center of the LNG Terminal site. NSA 2 is Port Isabel High School, which is adjacent to the Laguna Heights residential area, located about 3.7 miles northeast of the center of the LNG Terminal site. NSA 3 includes residences in Port Isabel, about 3.7 miles northeast of the Terminal site, and NSA 4 includes residences on Long Island, about 3.8 miles east of the center of the LNG Terminal site. The observation platform at the Palmito Ranch Battlefield, located about 5.4 miles southwest of the LNG Terminal site, and the observation area at the Palo Alto Battlefield, about 14.0 miles west of the LNG Terminal site center, were calculation point locations also considered for the analysis. These sites are described in more detail in section 4.10.2. RG LNG also assessed noise impacts for calculation point locations that provide wildlife and threatened and endangered

species habitat, including the Laguna Atascosa NWR, the wildlife corridor, and designated critical habitat; impacts on wildlife and threatened and endangered species, including noise impacts, are further addressed in sections 4.6.1 and section 4.7, respectively. NSA and calculation point locations are depicted on figure 4.11.2-1.

Pipeline Facilities

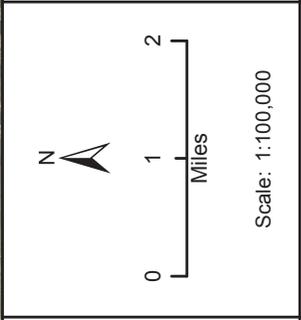
RB Pipeline conducted noise surveys in September 2016 and January 2018 to characterize the existing noise environment at the NSAs nearest to each compressor station and booster station site. Ambient sound levels measured at the NSAs identified near the compressor and booster stations are provided in table 4.11.2-3.

Table 4.11.2-3 Existing Sound Levels at Noise Sensitive Areas Near Compressor Stations and Booster Stations					
NSA	Distance from Station (miles)	Direction from Station	Average Daytime L_{eq} (dBA)^a	Average Nighttime L_{eq} (dBA)^b	Existing Ambient L_{dn} (dBA)
Compressor Station 1^c					
NSA 2	5.5	West	38.3	46.4	52.3
Compressor Station 2					
NSA 1	2.9	South	63.3	60.8	67.7
Booster Station 1					
NSA 1	1.7	East	60.0	61.3	67.5
Booster Station 2					
NSA 1	2.4	North	31.9	50.1	55.9
^a	The L_{eq} is the average of measured daytime hourly noise levels between 7:00 a.m. and 10:00 p.m.				
^b	The L_{eq} is the average of measured nighttime hourly noise levels between 10:00 p.m. and 7:00 a.m.				
^c	NSA 1 is identified in the vicinity of Compressor Station 1. During initial assessments, a site was identified as NSA 1; however, the site is a hunting lodge and is not a permanent residence; therefore, the site does not meet the definition of an NSA and was removed from analysis.				

Similarly, RB Pipeline conducted noise surveys in September 2016 and January and February 2018 to measure ambient sound levels at the NSAs nearest to each proposed HDD. Table 4.11.2-4 includes the ambient sound levels at the nearest NSAs to each HDD entry and exit site. Several HDDs have no NSAs within 0.5 mile; at those locations, ambient sound levels are estimated at the nearest NSAs.



Rio Grande LNG Project
 Noise Sensitive Areas Near
 the Rio Grande LNG Terminal



Legend

- Noise Sensitive Areas
- Check Points
- Proposed LNG Terminal Boundary (Facility Footprint)
- BSC Dredge Areas
- LNG Terminal Site (Leased Parcel)
- Proposed Rio Bravo
- Pipeline

AERIAL IMAGERY: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP) 2014 - <http://data.gatewayhrcs.usda.gov/>



Figure 4.11.2-1

**Table 4.11.2-4
Existing Sound Levels at Noise Sensitive Areas Near HDD Construction**

NSA	Distance from HDD Entry Point (miles)	Direction from HDD Entry Point	Average Daytime L_{eq} (dBA)^a	Average Nighttime L_{eq} (dBA)^b	Existing Ambient L_{dn} (dBA)
Los Olmos Creek HDD (MP 18.8)					
NSA 1	1.5	Northwest	60.0	61.3	67.5
Unnamed waterbody SS-T10-011 HDD (MP 77.6)					
NSA 1	0.8	Southeast	47.6	50.7	56.8
NSA 2	0.9	Southwest	60.0	40.7	58.3
Unnamed waterbody SS-T10-010 HDD (MP 79.0)					
NSA 1	1.0	Southwest	47.6	50.7	56.8
NSA 2	1.1	Southwest	44.8	45.8	52.1
East Main Drain SS-T10-003 HDD (MP 82.0)					
NSA 1	1.0	South	56.6	44.1	55.8
NSA 2	1.4	Southwest	56.4	42.6	55.3
Donna Drain HDD (MP 86.5)					
NSA 1	1.1	West	49.3	44.4	51.9
NSA 2	1.5	Southwest	49.1	55.0	60.9
Unnamed waterbody SS-T04-005 HDD (MP 92.0)					
NSA 1	0.8	Southeast	67.8	55.1	67.0
NSA 2	0.9	Southeast	55.0	32.7	53.1
North Floodway SS-T02-004 HDD (MP 93.0)					
NSA 1	0.2	Northwest	59.4	57.1	63.9
NSA 2	0.2	Northeast	62.9	40.3	61.0
Unnamed waterbody SS-T04-008 HDD (MP 94.6)					
NSA 1	1.1	Southwest	43.7	49.1	55.0
NSA 2	1.8	Northwest	53.4	48.9	56.3
Unnamed waterbody SS-T04-006 HDD (MP 98.7)					
NSA 1	1.2	Southeast	51.2	43.8	52.4
Arroyo Colorado HDD (MP 99.8)					
NSA 1	0.5	Northeast	50.5	38.5	49.9
NSA 2	0.6	South	38.7	36.8	43.5
Unnamed waterbody SS-T14-004 HDD (MP 101.2)					
NSA 1	0.2	West	69.4	55.1	68.2
NSA 2	0.5	North	47.1	29.9	45.5
San Vicente Drainage SS-T08-001 Ditch HDD (MP 102.0)					
NSA 1	0.5	Northeast	47.3	47.1	53.5
NSA 2	0.9	Southwest	41.1	36.6	44.0

Table 4.11.2-4 (continued)					
Existing Sound Levels at Noise Sensitive Areas Near HDD Construction					
NSA	Distance from HDD Entry Point (miles)	Direction from HDD Entry Point	Average Daytime L_{eq} (dBA)^a	Average Nighttime L_{eq} (dBA)^b	Existing Ambient L_{dn} (dBA)^c
Unnamed waterbody SS-T04-007 HDD (MP 115.6)					
NSA 1	0.9	Southwest	74.0	58.2	72.6
NSA 2	1.0	Southwest	69.1	61.0	69.9
Unnamed waterbody SS-T05-003 HDD (MP 116.4)					
NSA 1	0.8	West	69.1	36.7	67.1
NSA 2	0.9	West	67.0	58.0	67.4
Resaca de los Cuates HDD (MP 118.7)					
NSA 1	0.7	East	46.9	45.2	51.9
NSA 2	0.8	Southwest	38.0	38.0	44.4
Unnamed waterbody SS-T09-008 HDD (MP 124.0)					
NSA 1	0.6	North	47.1	52.4	58.3
NSA 2	1.2	Northwest	61.4	59.3	66.1
Unnamed waterbody SS-T09-001 HDD (MP 130.5), Channel to San Martin Lake HDD (MP 132.9), Channel to Bahia Grande HDD (MP 134.5)^c					
NSA 1 (Palmito Ranch Battlefield) ^c	2.6	South	44.2	41.2	48.2
^a	The L _{eq} is the average of measured daytime hourly noise levels between 7:00 a.m. and 10:00 p.m.				
^b	The L _{eq} is the average of measured nighttime hourly noise levels between 10:00 p.m. and 7:00 a.m.				
^c	The exit point for the Channel to San Martin Lake HDD is the nearest HDD entry or exit point to the NSA.				

4.11.2.3 Impacts and Mitigation

LNG Terminal

Construction

RG LNG anticipates that construction activities at the LNG Terminal site would be staggered, occurring over the course of 7 years. Construction would take place predominantly during the day, between 7:00 a.m. and 7:00 p.m., Monday through Friday, and site preparation and some other activities (including pile-driving) would be limited to daytime hours. However, dredging may take place up to 24 hours per day, 7 days per week. Construction activities at the LNG Terminal site would include clearing and grading associated with site preparation; materials and equipment delivery; installation of the facility foundations (e.g., pile-driving) and LNG trains; construction of the loading and ship berthing facilities, LNG storage tanks and processing facilities, and LNG truck loading facilities; and site restoration, as described in detail in section 2.5.1. In addition, activities associated with the construction of Compressor Station 3 are included in the sound level impacts at the LNG Terminal site.

The most prevalent noise-generating equipment and activity during construction of the LNG Terminal is anticipated to be pile-driving, although internal combustion engines associated with general construction equipment and dredging would also produce sound that would be perceptible in the vicinity of the site. The various types of construction activities proposed at the LNG Terminal site and associated noise levels are described below.

Dredging Activities

Dredging activities would occur in two different phases. Prior to construction of the LNG Terminal, the MOF would be dredged using a single, small-sized cutter suction dredge attached to one tugboat. Dredging during this phase would be expected to last about 2 weeks, and would be conducted 24 hours per day, 7 days a week. RG LNG has estimated that sound levels associated with dredging activities at the MOF would be about 83.5 dBA at a distance of 50 feet. Predicted sound levels at the nearest NSA to the MOF (NSA 3) would be about 34.3 dBA, which is below existing ambient sound levels. Given the predicted noise levels and the distance to the nearest NSAs, we do not expect that noise associated with dredging of the MOF would be perceptible at the nearest NSAs.

For construction of Berths 1 and 2 and the Turning Basin, RG LNG plans to use one large cutter suction dredge and two tugboats; however, if conditions require, RG LNG may utilize clamshell mechanical dredges. RG LNG's Dredged Material Management Plan is being developed, and the proposed dredging methods would be finalized in consultation with the BND and federal and state agencies. These dredging activities would be conducted over a period of 14 months. RG LNG has estimated sound levels associated with use of one large size cutter suction dredge and two associated tugboats to be 90.5 dBA at 50 feet, and about 36.8 dBA at the nearest NSA to the marine berths and turning basin (NSA 1). The sound level associated with two tugboats and clamshell mechanical dredges operating simultaneously would be about 85.8 dBA at 50 feet, and 34.1 dBA at NSA 1. Given the predicted noise levels and the distance to the nearest NSAs, and because the estimated sound level at the nearest NSAs would be below existing ambient sound levels, noise associated with dredging activities is not expected to be perceptible. The sound contributions from hydraulic dredging are included in the facility construction activity estimates provided in table 4.11.2-6.

Pile-driving Activities

RG LNG anticipates conducting pile-driving operations to support the land-based structures (liquefaction trains and related facilities), as well as during construction of the MOF, Berth 1 jetty and associated fixed aid to navigation, and Berth 2 jetty. The majority of pile-driving would be conducted on land; however, the sheet piling associated with the MOF and a total of four piles would be driven in water (two at the MOF and two for the fixed aid to navigation at the Berth 1 jetty). Steel pipe piles and concrete piles would be driven with impact hammers; however, RG LNG has committed to using vibratory hammers to reduce noise attenuation in the water and air for driving sheet pilings at the MOF. Impact hammers produce an impulsive (short, intense) noise source, while vibratory hammers produce continuous noise, but typically lower levels. Pile-driving would take place primarily on dry land, with only the MOF and fixed aid to navigation structure requiring minimal aquatic operations (see section 2.5.1.3).

RG LNG estimates that L_{max} for three pile-drivers operating simultaneously would be 99 dBA at 50 feet; this value is adjusted by a usage factor to account for the intermittent use of equipment during construction. Based upon the construction schedule provided by RG LNG (see table 2.3-1 and section 2.5.1.3), land-based, impact pile-driving operations for the first stage of construction (including LNG Train 1 and related offsite utilities) would require between 114 and 165 days; each subsequent stage of construction would require less time. In addition, impact pile-driving at the MOF would occur over a period of 3 months. Construction of the Berth 1 jetty would require about 35 days of pile-driving that would take place over a 5-month period; the timeframe for pile-driving at the Berth 2 jetty would be similar. RG LNG anticipates that in-water pile-driving at the MOF and fixed aid to navigation structure would take 2 days each. Table 4.11.2-5 provides estimates of pile-driving noise based upon the various proposed pile-driving scenarios using an impact pile-driver.

All pile-driving operations are scheduled to occur over 8- to 10-hour shifts, during the daytime, 5 days a week. During pile-driving at the Berth 1 jetty, and later at the Berth 2 jetty, the highest expected sound level would occur at nearby NSA 3 when three impact pile-driving platforms are simultaneously in use (56.4 dBA L_{max}). This level corresponds to a quiet-to-moderate sound level (similar to light auto traffic at 100 feet) on the Relative Loudness Scale presented in table 4.11.2-1, and would result in an 11 dB increase over ambient sound levels at NSA 3, a perceived doubling of noise. However, this level is a conservative estimate, since it is unlikely that the strikes from three pile-drivers would be simultaneous, and it is not adjusted for a usage factor. Construction equipment, particularly impact activities such as pile-driving, also generates vibrations that can pass through the ground and cause damage to structures. Vibration levels detectable to humans generally do not extend beyond about 500 feet from pile-driving activities (Maekawa 1994). As described above, the nearest NSAs range is from about 2.8 miles to 4.9 miles from the proposed pile-driving locations. No structures are present within 500 feet of the proposed pile-driving sites, and structural effects are not anticipated from vibration during construction.

**Table 4.11.2-5
Pile-driving Noise Estimates for Impact-driven Piles During Construction of the Rio Grande LNG Terminal**

Location	Existing Average Daytime L_{eq} (dBA)	Pile-driving at the Marine Berths and Turring Basin			Pile-driving at the MOF			Pile-driving for Foundations at the LNG Terminal Site		
		Distance (miles) ^a	Sound Level (dBA) L_{max}^b	Expected Increase over Ambient (dB)	Distance (miles) ^a	Sound Level (dBA) L_{max}^b	Expected Increase over Ambient (dB)	Distance (miles) ^a	Sound Level (dBA) L_{max}^b	Expected Increase over Ambient (dBA)
NSA 1	46.9	4.3	52.6	6.7	3.6	54.0	7.9	4.1	53.0	7.0
NSA 2	52.4	3.7	53.9	3.8	4.5	52.3	2.9	3.6	54.0	3.9
NSA 3	45.8	2.8	56.4	11.0	4.7	51.8	7.0	3.7	53.8	8.6
NSA 4	50.2	2.9	56	6.8	4.9	51.4	3.7	3.9	53.4	4.9

^a Distance to the NSA is based on the distance from the proposed pile-driving for each facility, and therefore differs from the distance between the NSA and the LNG Terminal site center presented in table 4.11.2-2.
^b L_{max} has been calculated assuming three simultaneous pile-driving operations, the maximum proposed.

Construction of the LNG Terminal, particularly pile-driving, would also result in the generation and propagation of underwater sound energy. Pile-driving impacts on aquatic organisms and monitoring and mitigation for underwater sound are discussed in section 4.6.2; impacts on marine mammals and associated mitigation are addressed in section 4.7.2.2. To ensure that actual noise from pile-driving is not significantly greater than predicted noise, and because sound from pile-driving is expected to result in an increase of more than 10 dBA over daytime L_{eq} ambient levels at NSA 3, **we recommend that:**

- **RG LNG should monitor pile-driving activities, and file weekly noise data with the Secretary following the start of pile-driving activities that identify the noise impact on the nearest NSAs. If any measured noise impacts (L_{max}) at the nearest NSAs are greater than 10 dBA over the L_{eq} ambient levels, RG LNG should:**
 - a. **cease pile-driving activities and implement noise mitigation measures; and**
 - b. **file with the Secretary evidence of noise mitigation installation and request written notification from the Director of OEP that pile-driving may resume.**

Site Preparation and Building Construction Activities

Noise levels resulting from construction would vary over time and would depend upon the number and type of equipment operating, the level of operation, and the distance between sources and receptors. RG LNG estimated the composite noise levels for site preparation (clearing and grading) and facility construction (which would occur after clearing and grading) based on construction equipment needs for these two activities. A composite noise level is typically used to describe the overall noise generated by multiple noise-generating units operating at the same time. Table 4.11.2-6 estimates the calculated combined ambient and construction-related sound levels at each NSA and in the vicinity of the LNG Terminal site. Sound pressure levels are measured on a logarithmic scale; therefore, although the construction noise would, at times, be perceptible at the NSAs, it would not be substantially above existing daytime noise levels. Further, a usage factor was used for each planned activity (including pile-driving) to account for the intermittent use of equipment during construction.

The nearest NSAs to the LNG Terminal site, NSAs 2 and 3, are about 3.7 miles to the northeast. During site preparation activities, the composite noise level at the NSAs 2 and 3 are estimated to be 50.2 dBA and 46.1 dBA, respectively; during facility construction, the composite noise level at the NSAs 2 and 3 are estimated to be 52.2 dBA and 37.1 dBA. The current daytime noise level at NSAs 2 and 3, respectively, are 52.4 dBA and 45.8 dBA (see table 4.11.2-2). As stated above, site preparation and construction activities would be limited to daytime hours.

**Table 4.11.2-6
Estimated Noise Level Contributions for Site Preparation and Construction of the Rio Grande LNG Terminal at Nearby Noise Sensitive Areas**

Location	Distance from LNG Terminal Site (miles)	Direction from LNG Terminal Site	Existing Daytime Ambient (dBA)	Contribution L _{max} (dBA)		Combined Existing and Construction Noise Level L _{max} (dBA)		Expected Increase (dBA)	
				Site Preparation	Construction	Site Preparation	Construction	Site Preparation	Construction
NSA 1	4.3	South	46.9	48.9	50.9	51.0	52.3	4.1	5.4
NSA 2	3.7	Northeast	52.4	50.2	52.2	54.4	55.3	2.0	2.9
NSA 3	3.7	Northeast	45.8	46.1	37.1	48.9	46.3	3.1	0.5
NSA 4	3.9	Northeast	50.2	45.7	36.7	51.5	50.4	1.3	0.2
Palmito Ranch Battlefield	5.4	Southwest	44.2	42.9	33.9	46.6	44.6	2.4	0.4
Palo Alto Battlefield	14.0	West	50.0	34.7	25.7	50.1	50.0	0.1	0.0

RG LNG also evaluated the potential for noise effects on the Palmito Ranch Battlefield and the Palo Alto Battlefield resulting from the construction of the LNG Terminal. Results indicate that construction and operational sound would not be audible at the Palo Alto Battlefield, given the distance from the terminal site (about 14.0 miles). However, a minor increase above the ambient sound level (0.2 dB or less) during construction would occur at the Palmito Ranch Battlefield, which is about 5.4 miles from the terminal site. The sound level increase at the Palmito Ranch Battlefield would be below 3 dB and would not likely be perceptible.

Based upon the construction noise estimates provided by RG LNG, the maximum noise levels generated by construction activities would increase the existing daytime noise at the nearest NSAs; however, with the exception of construction at NSA 2, combined ambient and construction sound levels would not exceed the 55 dBA L_{dn} threshold. The increased sound from construction at NSA 2 would be less than 3 dB, and therefore would not be perceptible. We have included a recommendation to address the potential for pile-driving activities to exceed the 55 dBA L_{dn} threshold at the NSAs. However, due to the predicted 0.2- to 5.4-dB increases estimated during construction, we conclude that impacts on residents and the surrounding communities would be minor to moderate during construction of the LNG Terminal.

Operation

Operation of the LNG Terminal would produce noise on a continual basis. RG Developers modeled sound levels that would be generated by operation of the LNG Terminal using sound level data for the proposed equipment that were obtained through vendors or from measurements at other LNG facilities. Major noise producing sources include air-cooled heat exchangers, compressors and associated components, pumps, and aboveground piping. Intermittent noise could also occur due to flaring.

A list of estimated equipment quantities and sound power levels used in the modeling is provided in table 4.11.2-7. Table 4.11.2-8 presents the results of the modeling, along with a comparison with the existing ambient sound level, the expected sound level during operation of the LNG Terminal and Compressor Station 3 compared to the ambient sound level, and the resulting increase in ambient sound level due to operation of the LNG Terminal. Based on these estimates, the noise generated by the operation of the LNG Terminal is likely to be imperceptible at nearby NSAs and the Palmito Ranch and Palo Alto Battlefield calculation points, with noise level increases ranging between 0.1 and 0.4 dB. Figure 4.11.2-2 depicts sound contours for operation of the LNG Terminal.

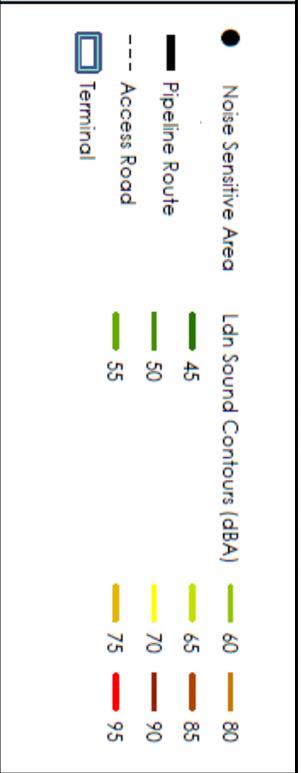
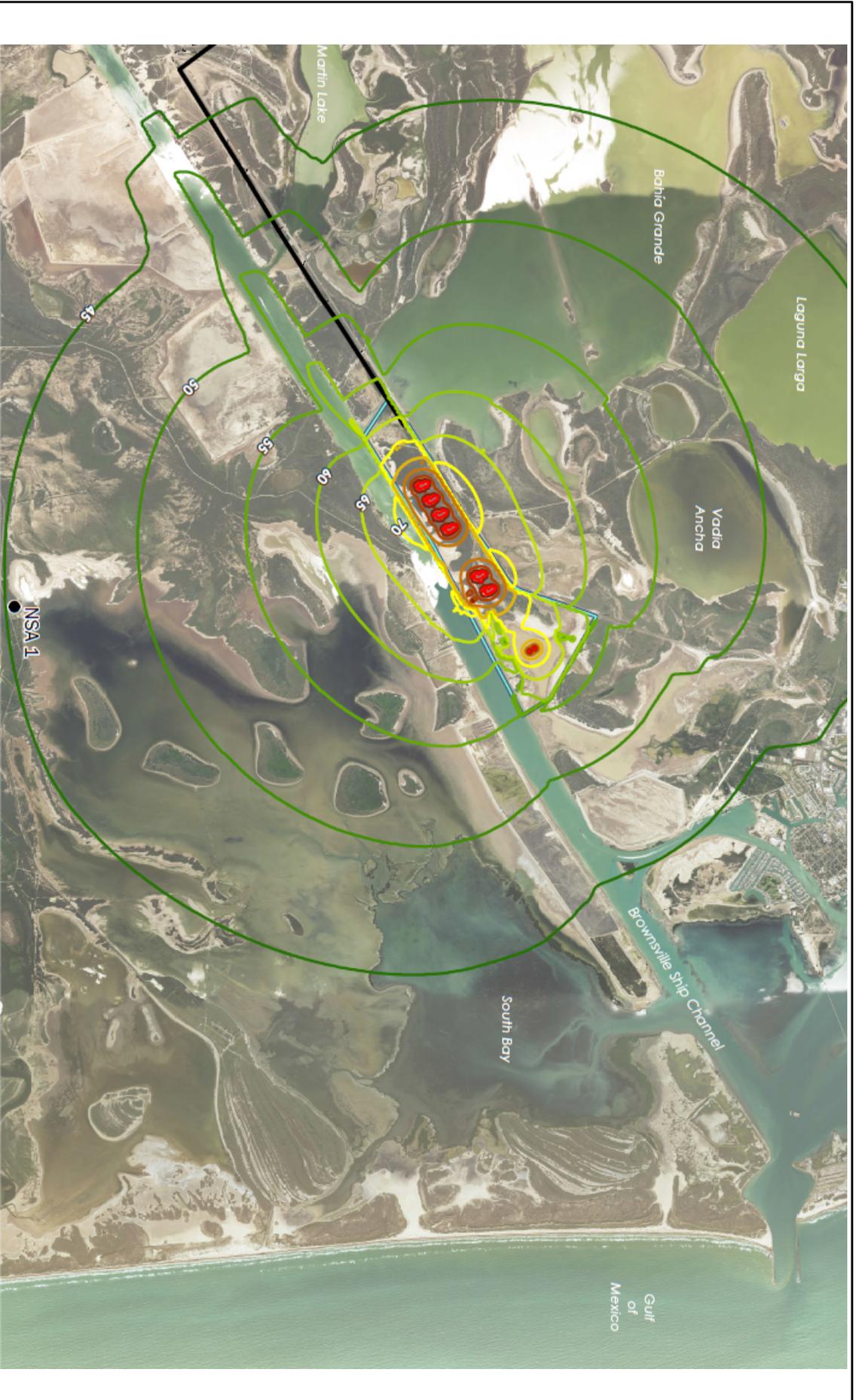
Equipment	Quantity	Sound Power Level Per Item (dBA)
Air-cooled heat exchanger	1,068	102 - 105
Compressors and associated components	216	97 - 113
Pumps	24	95 - 106
Piping segments	204	98 - 150

NSA	Distance (miles) and Direction from LNG Terminal	Existing Ambient L _{dn} (dBA)	Predicted LNG Terminal Contribution L _{dn} (dBA)	Ambient + LNG Terminal L _{dn} (dBA) ^a	Predicted Increase in Ambient Sound Level (dBA)
NSA 1	4.3 south	61.3	45.2	61.4	0.1
NSA 2	3.7 northeast	56.9	46.5	57.3	0.4
NSA 3	3.7 northeast	51.0	37.2	51.2	0.2
NSA 4	3.9 northeast	58.9	36.6	58.9	0.0
Palmito Ranch Battlefield	5.4 southwest	48.2	36.3	48.5	0.3
Palo Alto Battlefield	14.0 west	50.4	18.9	50.4	0.0

^a Sound pressure levels are measured on a logarithmic scale; therefore, the predicted increase in ambient sound level at the NSAs during operation of the LNG Terminal would not be the sum of the two noise levels.

The results of the noise impact analysis indicate that the noise attributable to construction and operation of the LNG Terminal would be lower than the FERC sound level requirement of 55 dBA L_{dn} at the nearest NSA, and the predicted increases in ambient noise would be below perceptible levels. Since the time it conducted the noise impact analysis, RG LNG has modified the specifications for its air-cooled heat exchanges to mitigate some noise operational levels. Further, we recognize that actual results may be different from those obtained from modeling. To ensure that NSAs are not significantly affected by noise during operation of the LNG Terminal and Compressor Station 3, and to keep noise at an acceptable level of an L_{dn} of 55 dBA or less, we recommend that:

- **RG LNG should file a full power load noise survey with the Secretary for the LNG Terminal no later than 60 days after each liquefaction train is placed into service. If the noise attributable to operation of the equipment at the LNG Terminal and Compressor Station 3 exceeds an L_{dn} of 55 dBA at the nearest NSA, within 60 days RG LNG should modify operation of the liquefaction facilities or install additional noise controls until a noise level below an L_{dn} of 55 dBA at the NSA is achieved. RG LNG should confirm compliance with the above requirement by filing a second noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**



Rio Grande LNG Project
 Sound Contours for Operation of
 the Rio Grande LNG Terminal

Figure 4.11.2-2

In addition, we recommend that:

- **RG LNG should file a noise survey with the Secretary no later than 60 days after placing the entire LNG Terminal, including the Compressor Station 3, into service. If a full load condition noise survey is not possible, RG LNG should provide an interim survey at the maximum possible horsepower load within 60 days of placing the LNG Terminal and Compressor Station 3 into service and provide the full load survey within 6 months. If the noise attributable to operation of the equipment at the LNG Terminal and Compressor Station 3 exceeds an L_{dn} of 55 dBA at the nearest NSA under interim or full horsepower load conditions, RG LNG should file a report on what changes are needed and should install the additional noise controls to meet the level within 1 year of the in-service date. RG LNG should confirm compliance with the above requirement by filing an additional noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**

RG LNG anticipates that flaring events would occur at the LNG Terminal site about four times per year. Each of these events would be associated with depressurization of a liquefaction train and routing the gas to the ground flare. The purpose of a flare system is to safely and reliably protect plant systems from overpressure during start-up, shutdown, plant upsets, and emergency conditions. The flaring creates noise with a low-pitched ‘roaring’ character. RG LNG has estimated the peak sound pressure level for a high-pressure flare at 1,500 feet to be 80 dBA. The sound pressure level at one of the closest NSAs (NSA 2), was estimated to be 59 dBA; the sound pressure level at NSA 3 is expected to be similar. This would result in a 4.2 dB increase above ambient levels and would constitute a moderate impact. However, RG LNG anticipates that flaring would occur only during daytime hours and for short periods (typically 15 minutes). Emergency flaring events are expected to be rare, but may occur at any time, either day or night. Blowdown events associated with the compressor stations are discussed below.

LNG carrier-loading at the LNG Terminal site would also be a source of sound. The LNG Terminal site would be able to receive and load up to two vessels at a time, with a maximum of nine LNG pumps operating at any time. In addition, sound would be generated from the LNG carriers during the loading process. RG LNG expects that sound from the pumps would not contribute to overall operational sound level impacts since the pumps would be completely submerged in LNG and encased in concrete tanks. Vessel traffic associated with operation of the LNG Terminal would also generate sounds. Noise above water would be similar to other large vessel traffic along the waterway and would result in temporary and minor noise impacts along the vessel transit route.

During operations, RG LNG would conduct maintenance dredging of its berthing area and turning basin, as described in section 2.6.1. Maintenance dredging is conducted by the COE for ongoing maintenance of the navigable channel within the BSC. Noise levels from maintenance dredging would be similar to those described for dredging during construction of the LNG Terminal, would be consistent with ongoing activity in the Project area, and are not expected to be perceptible at nearby NSAs.

Based on RG LNG's estimate that operation of the LNG Terminal will not result in a perceptible increase in sound levels at the nearest NSAs, and given our recommendation for measurement of operational sound levels, noise impacts would be minor at the NSAs in the vicinity of the LNG Terminal.

Pipeline Facilities

Construction

Construction activities associated with the Pipeline System would transpire over a 3-year period, with construction of both Pipeline 1 (including the Header System) and Pipeline 2 expected to take 12 months each. Construction of Pipeline 2 would begin about 18 months after the completion of Pipeline 1. Initial construction of the compressor stations and booster stations would occur in Year 3; however, activities at the compressor stations would continue through the third quarter of Year 7. A construction schedule is included in section 2.3. Construction activities would take place predominantly during the day, between the hours of 7:00 a.m. and 7:00 p.m., Monday through Saturday, though 24-hour construction may be necessary for specialized construction (such as at HDDs, operation of pumps at dry-ditch waterbody crossings, hydrostatic testing, and tie-ins). Construction activities associated with the pipeline facilities would involve clearing and grading associated with site preparation; trenching and HDD activities; materials and equipment delivery; installation of the pipelines; and construction of aboveground facilities. If, during construction, RB Pipeline determines that nighttime construction is warranted for activities beyond those identified above (such as at HDDs, operation of pumps at dry-ditch waterbody crossings, hydrostatic testing, and tie-ins), it would be required to submit a variance request for review and written approval by the Director of OEP including certain details such as projected noise, dust, and light pollution impacts, and identify the measures that it would be implemented to mitigate these impacts.

Pipeline System

The most prevalent sound-generating equipment and activity during routine construction of the Header System and Pipelines 1 and 2 would be the operation of internal combustion engines associated with general construction equipment. Sound levels resulting from construction would vary over time and would depend upon the number and types of equipment operating, the level of operation, and the distance between sources and receptors. Construction equipment would be operated on an as-needed basis, and receptors near the construction areas may experience an increase in perceptible noise, but the effect would be temporary and local. The worst-case sound level from all construction equipment operating simultaneously would be 91 dBA at 50 feet, as indicated in table 4.11.2-9. Sound from construction activities near noise sensitive receptors along the pipeline route could be either intermittent or continuous, but would occur over a limited duration at any one location; with construction near residences limited to the shortest timeframe possible to safely install the facilities.

Table 4.11.2-9 Estimated Sound Levels for Construction of the Pipeline System	
Distance from Right-of-Way or Property Line (feet)	Pipeline Construction Sound Level (dBA L_{max}^a)
50	91
250	77
500	71
1,000	65
1,500	61
^a Pipeline construction sound levels presented in this table do not include HDD operations.	

HDD construction techniques would be used for pipeline crossings of sensitive resource areas, such as those occupied by waterbodies, wetlands, or areas with construction restrictions. HDD construction techniques differ from those proposed by RB Pipeline for typical pipeline construction, in that they would generate greater sound levels and could occur up to 24 hours a day, 7 days a week, for up to 10 weeks at each site. A total of 19 locations were proposed for HDD construction (see section 2.5.2.1). Composite sound level estimates for equipment operating at HDD locations are detailed in table 4.11.2-10. The results of the HDD construction acoustical impact assessment indicated that L_{dn} sound levels for 24-hour operations would be above the FERC criterion of 55 dBA L_{dn} at NSAs in the vicinity of seven HDDs, and that the increases over ambient sound levels for some of these NSAs would result in a sound level increase greater than 10 dB. While RB Pipeline provided an assessment of impacts at additional NSAs, expected noise impacts at representative NSAs in the vicinity of 15 of the 19 proposed HDDs are presented for analysis in table 4.11.2-11.⁴² In response to our recommendation in the draft EIS, RB Pipeline revised ATWSs for HDD construction near MPs 115.6 and 116.4 to avoid surface impacts within the boundary of the Lower Rio Grande Valley NWR; the modified ATWS is adjacent to the previously identified construction workspace and is not expected to cause a significant noise impact at nearby NSAs.

Table 4.11.2-10 Horizontal Directional Drill Construction Sound Estimates		
Distance from Right-of-Way or Property Line (feet)	HDD Entry Point Sound Level (dBA L_{max})	HDD Exit Point Sound Level (dBA L_{max})
50	87	86
100	81	80
250	73	72
500	67	66
1,000	61	60
2,500	53	52

⁴² RB Pipeline's full noise impact assessment for NSAs in the vicinity of the Pipeline System is available on FERC's eLibrary website, located at <http://www.ferc.gov/docs-filing/elibrary.asp>, by searching Docket Number CP16-454 or CP16-455 and accession numbers 20161229-5149 and 20180301-5019.

**Table 4.11.2-11
Ambient and Construction Sound Levels at Representative NSAs near HDDs**

NSA ^{a, b}	Distance from HDD Entry (miles)	Existing Ambient		Entry				Exit		
		L _{dn} (dBA)	HDD L _{dn} Contribution (dBA)	Combined HDD and Existing L _{dn} (dBA)	Sound Level Increase (dB)	HDD L _{dn} Contribution (dBA)	Combined HDD and Existing L _{dn} (dBA)	Sound Level Increase (dB)		
Los Olmos Creek HDD (MP 18.8)										
NSA 1	1.5	67.5	53.6	67.7	0.2	50.2	67.6	0.1		
Unnamed waterbody SS-T10-011 HDD (MP 77.6)										
NSA 1	0.8	56.8	50.7	57.8	1.0	52.9	58.3	1.5		
NSA 2	0.9	58.3	49.7	58.9	0.6	47.5	58.6	0.3		
Unnamed waterbody SS-T10-010 HDD (MP 79.0)										
NSA 1	1.0	56.8	48.8	57.4	0.6	49.5	57.5	0.7		
NSA 2	1.1	52.1	47.5	53.4	1.3	47.0	53.3	1.2		
East Main Drain SS-T10-003 HDD (MP 82.0)										
NSA 1	1.0	55.8	48.3	56.5	0.7	55.3	58.6	2.8		
NSA 2	1.4	55.3	45.7	55.7	0.4	47.8	56.0	0.7		
Unnamed waterbody SS-T04-005 HDD (MP 92.0)										
NSA 1	0.8	67.0	65.0	69.1	2.1	67.4	70.2	3.2		
NSA 2	0.9	53.1	63.0	63.4	10.3	65.4	65.6	12.5		
North Floodway SS-T02-004 HDD (MP 93.0)										
NSA 1	0.2	63.9	65.0	67.5	3.6	50.0	64.1	0.2		
NSA 2	0.2	61.0	63.0	65.1	4.1	51.5	61.5	0.5		
Unnamed waterbody SS-T04-008 HDD (MP 94.6)										
NSA 1	1.1	55.0	47.4	55.7	0.7	46.4	55.6	0.6		
NSA 2	1.8	56.3	43.2	56.5	0.2	44.8	56.6	0.3		

Table 4.11.2-11 (continued)
Ambient and Construction Sound Levels at Representative NSAs near HDDs

NSA ^{a, b}	Distance from HDD Entry (Miles)	Existing Ambient		Entry			Exit		
		L _{dn} (dBA)	HDD L _{dn} Contribution (dBA)	Combined HDD and Existing L _{dn} (dBA)	Sound Level Increase (dB)	HDD L _{dn} Contribution (dBA)	Combined HDD and Existing L _{dn} (dBA)	Sound Level Increase (dB)	
Unnamed waterbody SS-T04-006 HDD (MP 98.7)									
NSA 1	1.2	52.4	47.0	53.5	1.1	47.8	53.7	1.3	
Arroyo Colorado HDD (MP 99.8)									
NSA 1	0.5	49.9	65.1	65.3	15.4	61.9	62.2	12.3	
NSA 2	0.6	43.5	57.2	57.4	13.9	54.7	55.1	11.6	
Unnamed waterbody SS-T14-004 HDD (MP 101.2)									
NSA 1	0.2	68.2	62.5	69.2	1.0	54.6	68.4	0.2	
NSA 2	0.5	45.5	54.5	55.1	9.6	54.2	54.8	9.3	
San Vicente Drainage SS-T08-001 Ditch HDD (MP 102.0)									
NSA 1	0.5	53.5	55.1	57.4	3.9	54.7	57.2	3.7	
NSA 2	0.9	44.0	49.9	50.9	6.9	52.1	52.8	8.8	
Unnamed waterbody SS-T04-007 HDD (MP 115.6)									
NSA 1	0.9	72.6	49.3	72.6	0.0	48.3	72.6	0.0	
NSA 2	1.0	69.9	49.0	69.9	0.0	47.8	69.9	0.0	
Unnamed waterbody SS-T05-003 HDD (MP 116.4)									
NSA 1	0.8	67.1	50.0	67.2	0.1	50.0	67.2	0.1	
NSA 2	0.9	67.4	49.8	67.5	0.1	50.1	67.5	0.1	
Resaca de los Cuates HDD (MP 118.7)									
NSA 1	0.7	51.9	56.0	57.5	5.6	67.7	67.8	15.9	
NSA 2	0.8	44.4	55.7	56.0	11.6	51.0	51.8	7.4	
Unnamed waterbody SS-T09-008 HDD (MP 124)									
NSA 1	0.6	58.3	53.0	59.4	1.1	52.8	59.4	1.1	
NSA 2	1.2	66.1	46.8	66.2	0.1	44.9	66.1	0.0	

^a No NSAs are within 1 mile of the Donna Drain HDD (MP 86.5), Unnamed waterbody SS-T09-001 HDD (MP 130.5), Channel to San Martin Lake HDD (MP 132.9), or Channel to Bahia Grande HDD (MP 134.5). HDD construction is not expected to exceed FERC noise criteria at these locations.

^b Where the data for an NSA are presented in italicized font, the noise attributable to HDD construction is estimated to exceed 55 dBA L_{dn} or would result in a 10 dB or greater increase in sound levels over ambient conditions.

No NSAs are within 1 mile of the Donna Drain HDD (MP 86.5), unnamed waterbody SS-T09-001 HDD (MP 130.5), Channel to San Martin Lake HDD (MP 132.9), or Channel to Bahia Grande HDD (MP 134.5). HDD construction is not expected to exceed FERC noise criteria at these locations, and no further analysis is presented. RB Pipeline has proposed the following mitigation at HDD locations that would exceed the FERC noise criterion of an L_{dn} of 55 dBA at NSAs:

- use of temporary sound barriers around the HDD workspace;
- use of sound barriers or an acoustical enclosure around the drilling mud cleaning system; and
- offering temporary housing to residents in the vicinity of HDD operation.

However, RB Pipeline has not identified the site-specific mitigation measures that would be implemented at each HDD location, and, as identified in table 4.11.2-11, noise levels from seven of the HDDs are estimated to exceed FERC's noise criterion of an L_{dn} of 55 dBA at the nearest NSAs. Therefore, **we recommend that:**

- **Prior to construction of HDDs at MPs 82.0, 92.0, 93.0, 99.8, 101.2, 102.0, and 118.7, RB Pipeline should file with the Secretary, for review and written approval by the Director of OEP, a HDD noise mitigation plan to reduce noise levels attributable to the proposed drilling operations. The noise mitigation plan should identify all reasonable measures RB Pipeline would implement to reduce noise levels attributable to the proposed drilling operations to no more than an L_{dn} of 55 dBA at NSAs, and the resulting noise levels at each NSA with mitigation.**

Aboveground Facilities

Construction of the compressor and booster stations would take place between the first quarter of Year 3 and the third quarter of Year 7. Initial construction for each compressor station is expected to take a total of about 12 months; the installation of additional compressors would transpire in stages from the fourth quarter of Year 4 through the third quarter of Year 7 in conjunction with the staged construction of the LNG Terminal. RB Pipeline has stated that construction activities would predominantly take place during the day, from 7:00 a.m. through 7:00 p.m., Mondays through Saturdays; but depending on schedule, 24-hour construction may be necessary at times.

Construction activities associated with the compressor and booster stations would involve clearing and grading associated with site preparation; materials and equipment delivery; placing fill; and construction of foundations, equipment settings, ancillary equipment, piping, and structures (see section 2.5.2.2). Similar to pipeline construction, the most prevalent sound-generating equipment and activity during construction of the compressor stations is anticipated to be the operation of internal combustion engines associated with general construction equipment. Sound levels resulting from construction would vary over time and would depend upon the number and type of equipment operating, the level of operation, and the distance between sources and receptors. RB Pipeline estimated equipment needs for construction of the

compressor stations as well as the resulting composite sound level from construction activities. Table 4.11.2-12 provides the estimated composite sound levels from construction of the compressor stations at various distances from the property boundary or right-of-way. Similar sound levels would be expected for construction of other aboveground facilities, including the booster stations and metering sites, which are not within 1 mile of any NSAs.

Table 4.11.2-12 Composite Construction Sound Estimates for Compressor Stations 1 and 2		
Distance from Right-of-Way or Property Line (feet)	Site Preparation Sound Level (dBA L_{max}^a)	Facility Construction Sound Level (dBA L_{max}^a)
50	98	89
250	84	75
500	78	69
1,000	72	63
1,500	68	59

The nearest NSA (NSA 2) to Compressor Station 1 would be about 5.5 miles away. During construction activities, the composite sound level at NSA 2 is estimated to be 42.7 L_{eq} (dBA). The current daytime sound level at this NSA is 38.3 dBA L_{eq}, and the combined ambient and construction sound levels would be 44.1 dBA, a 5.8 dB increase above ambient levels. Noise levels would be below the FERC criterion of 55 dBA. In response to concerns expressed by the NPS regarding indirect effects on the King Ranch National Historic Landmark, RB Pipeline also assessed sound level impacts on the King Ranch Visitor Center, located approximately 9.7 miles northeast of Compressor Station 1.

Using ambient sound levels measured at NSA 2, RB Pipeline determined that construction of Compressor Station 1 would not impact sound levels at the King Ranch Visitor Center. Additional detail regarding potential impacts on the King Ranch are provided in section 4.8.

The nearest NSA to the proposed site for Compressor Station 2 (NSA 2) is about 2.9 miles away. During construction activities, the composite sound level at NSA 2 is estimated to be 42.2 dBA L_{eq}. The current daytime sound level at this NSA is 63.3 dBA L_{eq}, and the combined ambient and construction sound levels would not result in an increase above ambient levels. To minimize impacts from construction sound, RB Pipeline would implement mitigation measures that may include installation of temporary acoustic barriers, limiting construction to daytime hours as feasible, and offering temporary housing to residents in the vicinity construction.

The sound levels generated by construction activities at Compressor Station 1 would increase the existing daytime noise at the nearest NSA. However, due to the predicted minor increases and temporary nature of construction, we conclude that impacts on residents and the surrounding communities would be minor during construction of the aboveground facilities.

Operation

RB Pipeline’s sources of operational sound would include daily operation of the aboveground facilities. There are no NSAs within 1 mile of any of the stand-alone metering sites, and potential sound level impacts associated with the operation of these metering sites would be minor and are not expected to be perceptible at any NSAs.

Noise would be associated with the compressor stations and booster stations on a continuous basis from operation of compressors, pumps, and cooling fans. Metering equipment at the facilities is expected to be much lower in volume in comparison to operating compressors. RB Pipeline used models to calculate the potential sound level impact of both Compressor Stations 1 and 2, as well as Booster Stations 1 and 2, on nearby NSAs. Sound level data from the proposed equipment were obtained from vendor information and typical noise control applications. Table 4.11.2-13 presents the results of the modeling, along with a comparison to the existing ambient sound levels. Based on these estimates, noise generated by Compressor Station 1 and the two booster stations would not result in a perceptible increase in ambient sound levels. In addition, operation of Compressor Station 1 would not result in an increase in sound levels at the King Ranch Visitor Center. The noise generated by Compressor Station 2 would result in slight increases in ambient sound levels at NSAs 1 and 2, but the overall sound level would remain below an L_{dn} of 55 dBA.

The compressor units at Compressor Stations 1 and 2 would be housed in compressor buildings. If necessary, RB Pipeline stated that it would use noise-insulated buildings to ensure that sound attributable to the compressor stations does not exceed 55 dBA L_{dn} at the nearest NSA. In addition, RB Pipeline would use centrifugal rotating equipment, rather than reciprocating engines, to ensure that operation of the compressor and booster stations would not result in increased perceptible vibration at nearby NSAs.

Table 4.11.2-13 Composite Sound Levels at Nearby Noise Sensitive Areas from Aboveground Facilities^a					
NSA	Distance (miles) and Direction from Facility	Existing Ambient L_{dn} (dBA)	Predicted Facility Contribution L_{dn} (dBA)	Ambient + Facility L_{dn} (dBA)	Predicted Increase in Ambient Sound Level (dBA)
Compressor Station 1					
NSA 2	5.5, west	52.3	21.8	52.3	0.0
Compressor Station 2					
NSA 1	2.9, south	67.7	28.6	67.7	0.0
Booster Station 1					
NSA 1	1.7, west	67.5	26.8	67.5	0.0
Booster Station 2					
NSA 1	2.4, south	55.9	23.3	55.9	0.0
^a There are no NSAs within 1 mile of any of the stand-alone metering sites, and potential sound level impacts associated with the operation of these metering sites would be minor and are not expected to be perceptible at any NSAs.					

The results of the sound level impact analysis indicate that the sound attributable to operation of the aboveground facilities would be in compliance with the FERC sound level requirement of 55 dBA L_{dn} at the nearest NSA. We recognize, however, that actual results may be different from those obtained from modeling. Also, two compressor units at each compressor station would be installed during Stages 1 and 2 of LNG Terminal construction; one compressor unit at each compressor station would come online as each LNG train would commence service during subsequent stages of construction. The two interconnect booster stations would each include one compressor unit, installed during the first stage of construction. Therefore, to ensure that NSAs are not adversely impacted by the phased operation of the compressor stations, we **recommend that:**

- **RB Pipeline should file a noise survey with the Secretary no later than 60 days after each set of compressor units at Compressor Stations 1 and 2, and Booster Stations 1 and 2 are placed in service. If a full load condition noise survey is not possible, RB Pipeline should provide an interim survey at the maximum possible horsepower load within 60 days of placing the phased station into service and provide the full load survey within 6 months. If the noise attributable to the operation of all of the equipment at any of the facilities under interim or full horsepower load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, RB Pipeline should file a report on what additional noise controls are needed and should install the additional noise controls to meet the level within 1 year of the in-service date. RB Pipeline should confirm compliance with the above requirement by filing an additional noise survey with the Secretary no later than 60 days after it installs the additional noise controls.**

In compliance with the recommendation above, RB Pipeline would need to complete several noise surveys to ensure that the phased-in compressor units are below an L_{dn} of 55 dBA at the nearest NSAs. A total of five noise surveys would be completed each at Compressor Stations 1 and 2 as each set of compressor units are placed in-service for each stage of construction. If the noise levels reported in any of the noise surveys are over an L_{dn} of 55 dBA at the nearest NSAs, RB Pipeline would need to implement the required mitigation to reduce the noise impacts on the nearest NSAs within the time specified in the recommendation.

In addition, blowdown events would also generate noise during operation of the pipeline facilities. RB Pipeline anticipates that one planned and one unplanned blowdown event would occur annually at each compressor and booster station. Planned blowdown events can happen during commission/decommissioning of a compressor station or during maintenance. Unplanned blowdown events are necessary in the event of an emergency and could occur at any time. Pipeline blowdown events are typically infrequent and of short duration; however, the frequency and length of the blowdown events depend upon the extent of the maintenance activity or type of emergency release. RB Pipeline would install silencers on all blowdown sources to minimize sound associated with blowdowns. Based on RB Pipeline's proposed mitigation and our recommendation, noise impacts from operation of the aboveground facilities would be minor.

While construction of the Rio Grande LNG Project would result in localized minor to moderate elevated noise levels near construction areas, impacts would be limited to the construction period for the Project. During operations, noise impacts would be minor at the

aboveground facilities along the Pipeline System and at the NSAs in the vicinity of the LNG Terminal.

4.12 RELIABILITY AND SAFETY

4.12.1 LNG Terminal

4.12.1.1 LNG Facility Reliability, Safety, and Security Regulatory Oversight

LNG facilities handle flammable and sometimes toxic materials that can pose a risk to the public if not properly managed. These risks are managed by the companies owning the facilities, through selecting the site location and plant layout as well as through suitable design, engineering, construction, and operation of the LNG facilities. Multiple federal agencies share regulatory authority over the LNG facilities and the operator's approach to risk management. The safety, security, and reliability of the Rio Grande LNG Project would be regulated by the DOT, the Coast Guard, and the FERC.

In February 2004, the DOT, the Coast Guard, and the FERC entered into an Interagency Agreement to ensure greater coordination among these three agencies in addressing the full range of safety and security issues at LNG terminals and LNG marine vessel operations, and maximizing the exchange of information related to the safety and security aspects of LNG facilities and related marine operations. Under the Interagency Agreement, the FERC is the lead federal agency responsible for the preparation of the analysis required under NEPA for impacts associated with LNG terminal construction and operation. The DOT and the Coast Guard participate as cooperating agencies but remain responsible for enforcing their regulations covering LNG facility siting, design, construction, operation, and maintenance. All three agencies have some oversight and responsibility for the inspection and compliance during the LNG Terminal's operation.

The DOT establishes and has the authority to enforce the federal safety standards for the location, design, installation, construction, inspection, testing, operation, and maintenance of onshore LNG facilities under the Federal Pipeline Safety Laws (49 USC 60101 *et seq.*). The DOT's LNG safety regulations are codified in 49 CFR 193, which prescribes safety standards for LNG facilities used in the transportation of gas by pipeline that are subject to Federal Pipeline Safety Laws (49 USC 60101 *et seq.*), and 49 CFR 192. On August 31, 2018, the DOT and FERC signed a MOU regarding methods to improve coordination throughout the LNG permit application process for FERC-jurisdictional LNG facilities. In the MOU, the DOT agreed to issue a LOD stating whether a proposed LNG facility would be capable of complying with location criteria and design standards contained in Subpart B of Part 193. The Commission committed to rely upon the DOT determination in conducting its review of whether the facilities would be in the public interest. The issuance of the LOD does not abrogate the DOT's continuing authority and responsibility over a proposed project's compliance with Part 193 during construction and future operation of the facility. The DOT's conclusion on the siting and hazard analysis required by Part 193 would be based on preliminary design information which may be revised as the engineering design progresses to final design. DOT regulations also contain requirements for the design, construction, installation, inspection, testing, operation, maintenance, qualifications and training of personnel, fire protection, and security for LNG

facilities as defined in 49 CFR 193, which would be completed during later stages of the Project. If the Project is authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, would be subject to the DOT's inspection and enforcement programs to ensure compliance with the requirements of 49 CFR 193.

The Coast Guard has authority over the safety of an LNG terminal's marine transfer area and LNG marine vessel traffic, as well as over security plans for the entire LNG terminal and LNG marine traffic. The Coast Guard regulations for waterfront facilities handling LNG are codified in 33 CFR 105 and 33 CFR 127. As a cooperating agency, the Coast Guard assists the FERC staff in evaluating whether an applicant's proposed waterway would be suitable for LNG marine vessel traffic and whether the waterfront facilities handling LNG would be operated in accordance with 33 CFR 105 and 33 CFR 127. If the facilities are constructed and become operational, the facilities would be subject to the Coast Guard inspection program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

The FERC authorizes the siting and construction of LNG terminals under the NGA and delegated authority from the DOE. The FERC requires standard information to be submitted to perform safety and reliability engineering reviews. FERC's filing regulations are codified in 18 CFR 380.12 (m) and (o), and requires each applicant to identify how its proposed design would comply with the DOT's siting requirements of 49 CFR 193 Subpart B. The level of detail necessary for this submittal requires the applicant to perform substantial Front End Engineering Design (FEED) of the complete project. The design information is required to be site-specific and developed to the extent that further detailed design would not result in significant changes to the siting considerations, basis of design, operating conditions, major equipment selections, equipment design conditions, or safety system designs. As part of the review required for a FERC order, we use this information from the applicant to assess whether the proposed facilities would have a public safety impact and to suggest additional mitigation measures for the Commission to consider for incorporation as conditions in the order. If the facilities are approved and the suggested mitigation measures are incorporated into the order as conditions, FERC staff would review material filed to satisfy the conditions of the order and conduct periodic inspections throughout construction and operation.

In addition, the EPO Act of 2005 requires FERC to coordinate and consult with the U.S. Department of Defense (DOD) on siting, construction, expansion, and operation of LNG terminals that would affect the military. On November 21, 2007, the FERC and the DOD (<http://www.ferc.gov/legal/mou/mou-dod.pdf>) entered in a MOU formalizing this process. In accordance with the MOU, the FERC sent a letter to the DOD on June 25, 2015 requesting their comments on whether the planned Project could potentially have an impact on the test, training, or operational activities of any active military installation. On June 4, 2018, the FERC received a response letter from the DOD Siting Clearinghouse stating that the Rio Grande LNG Terminal would have a minimal impact on military training and operations conducted in Cameron County, Texas.

4.12.1.2 DOT Siting Requirements and 49 CFR 193 Subpart B Determination

Siting LNG facilities as defined in 49 CFR 193, with regard to ensuring that the proposed site selection and location would not pose an unacceptable level or risk to public safety is required by DOT's regulations in 49 CFR 193 Subpart B. The Commission's regulations under 18 CFR 380.12 (o) (14) require RG LNG to identify how the proposed design complies with the siting requirements in DOT's regulations under 49 CFR Part 193 Subpart B. The scope of DOT's siting authority under 49 CFR 193 applies to LNG facilities used in the transportation of gas by pipeline subject to the Federal Pipeline Safety Laws and 49 CFR 192.⁴³

The regulations in 49 CFR 193 Subpart B require the establishment of an exclusion zone surrounding an LNG facility in which an operator or government agency must exercise legal control over the activities where specified levels of thermal radiation and flammable vapors may occur in the event of a release for as long as the facility is in operation. Approved mathematical models must be used to calculate the dimensions of these exclusion zones.

The siting requirements specified in NFPA 59A (2001), an industry consensus standard for LNG facilities, are incorporated into 49 CFR 193 Subpart B by reference, with regulatory preemption in the event of conflict. The following sections of 49 CFR 193 Subpart B specifically address siting requirements:

- Section 193.2051, Scope, states that each LNG facility designed, replaced, relocated or significantly altered after March 31, 2000, must be provided with siting requirements in accordance with Subpart B and NFPA 59A (2001). In the event of a conflict with NFPA 59A (2001), the regulatory requirements in Part 193 prevail.
- Section 193.2057, Thermal radiation protection, requires that each LNG container and LNG transfer system have thermal exclusion zones in accordance with section 2.2.3.2 of NFPA 59A (2001).
- Section 193.2059, Flammable vapor-gas dispersion protection, requires that each LNG container and LNG transfer system have a dispersion exclusion zone in accordance with sections 2.2.3.3 and 2.2.3.4 of NFPA 59A (2001).
- Section 193.2067, Wind forces, requires that shop fabricated containers of LNG or other hazardous fluids less than 70,000 gallons must be designed to withstand wind forces based on the applicable wind load data in American Society of Civil Engineers (ASCE) 7 (2005). All other LNG facilities must be designed for a sustained wind velocity of not less than 150 mph unless the DOT Administrator finds a lower wind speed is justified or the most critical combination of wind velocity and duration for a 10,000-year mean return interval.

⁴³ 49 CFR 193.2001 (b) (3), Scope of part, excludes any matter other than siting provisions pertaining to marine cargo transfer systems between the LNG marine vessel and the last manifold or valve immediately before a storage tank.

As stated in 49 CFR 193.2051, LNG facilities must meet the siting requirements of NFPA 59A (2001), Chapter 2, and include but may not be limited to:

- NFPA 59A (2001) section 2.1.1 (c) requires consideration of protection against forces of nature;
- NFPA 59A (2001) section 2.1.1 (d) requires that other factors applicable to the specific site that have a bearing on the safety of plant personnel and surrounding public be considered, including an evaluation of potential incidents and safety measures incorporated in the design or operation of the facility;
- NFPA 59A (2001) section 2.2.3.2 requires provisions to minimize the damaging effects of fire from reaching beyond a property line, and requires provisions to prevent a radiant heat flux level of 1,600 British thermal units per square foot per hour (Btu/ft²-hr) from reaching beyond a property line that can be built upon. The distance to this flux level is to be calculated with LNGFIRE3 or with models that have been validated by experimental test data appropriate for the hazard to be evaluated and that have been approved by DOT; and
- NFPA 59A (2001) section 2.2.3.4 requires provisions to minimize the possibility of any flammable mixture of vapors from a design spill from reaching a property line that can be built upon and that would result in a distinct hazard. Determination of the distance that the flammable vapors extend is to be determined with DEGADIS or approved alternative models that take into account physical factors influencing LNG vapor dispersion.⁴⁴

Taken together, 49 CFR 193 Subpart B and NFPA 59A (2001) require that flammable LNG vapors from design spills do not extend beyond areas in which the operator or a government agency legally controls all activities. Furthermore, consideration of other hazards which may affect the public or plant personnel must be evaluated as prescribed in NFPA 59A (2001) section 2.1.1 (d).

⁴⁴ DOT has approved two additional models for the determination of vapor dispersion exclusion zones in accordance with 49 CFR 193.2059: FLACS 9.1 Release 2 (October 7, 2011) and PHAST-UDM Version 6.6 and 6.7 (October 7, 2011).

Title 49 CFR 193 Subpart B and NFPA 59A (2001) also specify three radiant heat flux levels which must be considered for LNG storage tank spills for as long as the facility is in operation:

- 1,600 Btu/ft²-hr - This level can extend beyond the plant property line that can be built upon but cannot include areas that are used for outdoor assembly by groups of 50 or more persons;⁴⁵
- 3,000 Btu/ft²-hr - This level can extend beyond the plant property line that can be built upon but cannot include areas that contain assembly, educational, health care, detention or residential buildings or structures;⁴⁶ and
- 10,000 Btu/ft²-hr - This level cannot extend beyond the plant property line that can be built upon.⁴⁷

The requirements for design spills from process or transfer areas are more stringent. For LNG spills, the 1,600 Btu/ft²-hr flux level cannot extend beyond the plant property line onto a property that can be built upon. In addition, section 2.1.1 of NFPA 59A (2001) requires that factors applicable to the specific site with a bearing on the safety of plant personnel and surrounding public must be considered, including an evaluation of potential incidents and safety measures incorporated into the design or operation of the facility. DOT has indicated that potential incidents, such as vapor cloud explosions and toxic releases should be considered to comply with Part 193 Subpart B.⁴⁸

In accordance with the August 31, 2018 MOU, the DOT issued an LOD to FERC on the 49 CFR 193 Subpart B regulatory requirements.⁵⁰ The LOD provides PHMSA's analysis and conclusions regarding 49 CFR 193 Subpart B regulatory requirements for the Commission to

⁴⁵ The 1,600 Btu/ft²-hr flux level is associated with producing pain in less than 15 seconds, first degree burns in 20 seconds, second degree burns in approximately 30-40 seconds, 1 percent mortality in approximately 120 seconds, and 100 percent mortality in approximately 400 seconds, assuming no shielding from the heat, and is typically the maximum allowable intensity for emergency operations with appropriate clothing based on average an 10-minute exposure.

⁴⁶ The 3,000 Btu/ft²-hr flux level is associated with producing pain in less than 5 seconds, first degree burns in 5 seconds, second degree burns in approximately 10-15 seconds, 1 percent mortality in approximately 50 seconds, and 100 percent mortality in approximately 180 seconds, assuming no shielding from the heat, and is typically the critical heat flux for piloted ignition of common building materials (e.g., wood, polyvinyl chloride, fiberglass, etc.) with prolonged exposures.

⁴⁷ The 10,000 Btu/ft²-hr flux level is associated with producing pain in less than 1 seconds, first degree burns in 1 seconds, second degree burns in approximately 3 seconds, 1 percent mortality in approximately 10 seconds, and 100 percent mortality in approximately 35 seconds, assuming no shielding from the heat, and is typically the critical heat flux for unpiloted ignition of common building materials (e.g., wood, polyvinyl chloride, fiberglass) and degradation of unprotected process equipment after approximate 10-minute exposure and to reinforced concrete after prolonged exposure.

⁴⁸ PHMSA's "LNG Plant Requirements: Frequently Asked Questions" item H1, <https://www.phmsa.dot.gov/pipeline/liquified-natural-gas/lng-plant-requirements-frequently-asked-questions>, accessed August 2018.

⁵⁰ March 26, 2019 letter "Re: Rio Grande LNG Project, Docket No. CP16-454-000, 49 CFR, Part 193, Subpart B, Siting – Letter of Determination" from Massoud Tahamtani to Rich McGuire. Filed in Docket Number CP16-454-000 on March 27, 2019. FERC eLibrary accession number 20190327-3003.

consider in its decision to authorize, with or without modification or conditions, or deny an application.

4.12.1.3 Coast Guard Safety Regulatory Requirements and Letter of Recommendation

LNG Marine Vessel Historical Record

Since 1959, ships have transported LNG without a major release of cargo or a major accident involving an LNG marine vessel. There are more than 370 LNG marine vessels in operation routinely transporting LNG between more than 100 import/export terminals currently in operation worldwide. Since U.S. LNG terminals first began operating under FERC jurisdiction in the 1970s, there have been thousands of individual LNG marine vessel arrivals at terminals in the U.S. For more than 40 years, LNG shipping operations have been safely conducted in U.S. ports and waterways.

A review of the history of LNG maritime transportation indicates that there has not been a serious accident at sea or in a port which resulted in a spill due to rupturing of the cargo tanks. However, insurance records, industry sources, and public websites identify a number of incidents involving LNG marine vessels, including minor collisions with other marine vessels of all sizes, groundings, minor LNG releases during cargo unloading operations, and mechanical/equipment failures typical of large vessels.

Some of the more significant occurrences, representing the range of incidents experienced by the worldwide LNG marine vessel fleet, are described below:

- **El Paso Paul Kayser** grounded on a rock in June 1979 in the Straits of Gibraltar during a loaded voyage from Algeria to the United States. Extensive bottom damage to the ballast tanks resulted; however, no cargo was released because no damage was done to the cargo tanks. The entire cargo of LNG was subsequently transferred to another LNG marine vessel and delivered to its U.S. destination.
- **Tellier** was blown by severe winds from its docking berth at Skikda, Algeria in February 1989 causing damage to the loading arms and the LNG marine vessel and shore piping. The cargo loading had been secured just before the wind struck, but the loading arms had not been drained. Consequently, the LNG remaining in the loading arms spilled onto the deck, causing fracture of some plating.
- **Mostefa Ben Boulaid** had an electrical fire in the engine control room during unloading at Everett, Massachusetts on February 5, 1996. The LNG marine vessel crew extinguished the fire and the ship completed unloading.
- **Khannur** had a cargo tank overfill into the LNG marine vessel's vapor handling system on September 10, 2001, during unloading at Everett, Massachusetts. Approximately 100 gallons of LNG were vented and sprayed onto the protective decking over the cargo tank dome, resulting in several cracks. After inspection by the Coast Guard, the Khannur was allowed to discharge its LNG cargo.

- **Mostefa Ben Boulaid** had LNG spill onto its deck during loading operations in Algeria in 2002. The spill, which is believed to have been caused by overflow rather than a mechanical failure, caused significant brittle fracturing of the steelwork. The LNG marine vessel was required to discharge its cargo, after which it proceeded to dock for repair.
- **Norman Lady** was struck by the USS Oklahoma City nuclear submarine while the submarine was rising to periscope depth near the Strait of Gibraltar in November 2002. The 87,000 m³ LNG marine vessel, which had just unloaded its cargo at Barcelona, Spain, sustained only minor damage to the outer layer of its double hull but no damage to its cargo tanks.
- **Tenaga Lima** grounded on rocks while proceeding to open sea east of Mopko, South Korea due to strong current in November 2004. The shell plating was torn open and fractured over an approximate area of 20 by 80 feet, and internal breaches allowed water to enter the insulation space between the primary and secondary membranes. The LNG marine vessel was refloated, repaired, and returned to service.
- **Golar Freeze** moved away from its docking berth during unloading on March 14, 2006, in Savannah, Georgia. The powered emergency release couplings on the unloading arms activated as designed, and transfer operations were shut down.
- **Catalunya Spirit** lost propulsion and became adrift 35 miles east of Chatham, Massachusetts on February 11, 2008. Four tugs towed the LNG marine vessel to a safe anchorage for repairs. The Catalunya Spirit was repaired and taken to port to discharge its cargo.
- **Al Gharrafa** collided with a container ship, Hanjin Italy, in the Malacca Strait off Singapore on December 19, 2013. The bow of the Al Gharrafa and the middle of the starboard side of the Hanjin were damaged. Both ships were safely anchored after the incident. No loss of LNG was reported.
- **Al Oraiq** collided with a freight carrier, Flinterstar, near Zeebrugge, Belgium on October 6, 2015. The freight carrier sank, but the Al Oraiq was reported to have sustained only minor damage to its bow and no damage to the LNG cargo tanks. According to reports, the Al Oraiq took on a little water but was towed to the Zeebrugge LNG terminal where its cargo was unloaded using normal procedures. No loss of LNG was reported.
- **Al Khattiya** suffered damage after a collision with an oil tanker off the Port of Fujairah on February 23, 2017. Al Khattiya had discharged its cargo and was anchored at the time of the incident. A small amount of LNG was retained within the LNG marine vessel to keep the cargo tanks cool. The collision damaged the hull and two ballast tanks on the Al Khattiya, but did not cause any injury or water pollution. No loss of LNG was reported.

- **Assem** collided with a very large crude carrier (VLCC) Shinyo Ocean off the Port of Fujairah on March 26, 2019. The VLCC suffered severe portside hull height breach and Aseem had damage to its bow. Both marine vessels were unloaded at the time of the collision and subsequently no LNG or oil was released. Aseem was moved to port for anchorage and Shinyo Ocean was relocated to another point of anchorage.

LNG Marine Vessel Safety Regulatory Oversight

The Coast Guard exercises regulatory authority over LNG marine vessels under 46 CFR 154, which contains the United States safety standards for self-propelled marine vessels transporting bulk liquefied gases. The LNG marine vessels visiting the proposed facility would also be constructed and operated in accordance with the IMO *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* and the *International Convention for the Safety of Life at Sea*. All LNG marine vessels entering U.S. waters are required to possess a valid IMO Certificate of Fitness and either a Coast Guard Certificate of Inspection for U.S. flag vessels or a Coast Guard Certificate of Compliance for foreign flag vessels. These documents certify that the LNG marine vessel is designed and operating in accordance with both international standards and the U.S. regulations for bulk LNG marine vessels under 46 CFR 154.

The LNG marine vessels which would deliver or receive LNG to or from the proposed Project would also need to comply with various U.S. and international security requirements. The IMO adopted the *International Ship and Port Facility Security Code* in 2002. This code requires both ships and ports to conduct vulnerability assessments and to develop security plans. The purpose of the code is to prevent and suppress terrorism against ships; improve security aboard ships and ashore; and reduce the risk to passengers, crew, and port personnel on-board ships and in port areas.

All LNG marine vessels, as well as other cargo vessels (e.g., 500 gross tons and larger), and ports servicing those regulated vessels, must adhere to the IMO standards. Some of the IMO requirements for ships are as follows:

- marine vessels must develop security plans and have a Vessel Security Officer;
- marine vessels must have a ship security alert system to transmit ship-to-shore security alerts identifying the ship, its location, and indication that the security of the ship is under threat or has been compromised;
- marine vessels must have a comprehensive security plan for international port facilities, focusing on areas having direct contact with ships; and
- marine vessels may have equipment on-board to help maintain or enhance the physical security of the ship.

In 2002, the Maritime Transportation Security Act (MTSA) was enacted by the U.S. Congress and aligned domestic regulations with the maritime security standards of the *International Ship and Port Facility Security Code* and the *Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* and the *International Convention for the*

Safety of Life at Sea. The Coast Guard's regulations in 33 CFR 104 require marine vessels to conduct a vessel security assessment and develop a vessel security plan that addresses each vulnerability identified in the vessel security assessments. All LNG marine vessels servicing the facility would have to comply with the MTSA requirements and associated regulations while in U.S. waters.

The Coast Guard also exercises regulatory authority over LNG facilities that affect the safety and security of port areas and navigable waterways under Executive Order 10173; the Magnuson Act (50 USC Section 191); the Ports and Waterways Safety Act of 1972, as amended (33 USC Section 1221, et seq.); and the MTSA of 2002 (46 USC Section 701). The Coast Guard is responsible for matters related to navigation safety, LNG marine vessel engineering and safety standards, and all matters pertaining to the safety of facilities or equipment located in or adjacent to navigable waters up to the last valve immediately before the receiving tanks. The Coast Guard also has authority for LNG facility security plan review, approval, and compliance verification as provided in 33 CFR 105.

The Coast Guard regulations in 33 CFR 127 apply to the marine transfer area of waterfront facilities between the LNG marine vessel and the last manifold or valve immediately before the receiving tanks. Title 33 CFR 127 applies to the marine transfer area for LNG of each new waterfront facility handling LNG and to new construction in the marine transfer areas for LNG of each existing waterfront facility handling LNG. The scope of the regulations includes the design, construction, equipment, operations, inspections, maintenance, testing, personnel training, firefighting, and security of the marine transfer area of LNG waterfront facilities. The safety systems, including communications, emergency shutdown, gas detection, and fire protection, must comply with the regulations in 33 CFR 127. Under 33 CFR 127.019, RG LNG would be required to submit two copies of its Operations and Emergency Manuals to the Coast Guard Captain of the Port (COTP) for examination.

Both the Coast Guard regulations under 33 CFR 127 and FERC regulations under 18 CFR 157.21, require an applicant who intends to build an LNG terminal facility to submit a LOI to the Coast Guard no later than the date that the owner/operator initiates pre-filing with FERC, but, in all cases, at least 1 year prior to the start of construction. In addition, the applicant must submit a Preliminary WSA to the COTP with the LOI. The Preliminary WSA provides an initial explanation of the port community and the proposed facility and transit routes. It provides an overview of the expected impacts LNG operations may have on the port and the waterway. Generally, the Preliminary WSA does not contain detailed studies or conclusions. This document is used by the COTP to begin his or her evaluation of the suitability of the waterway for LNG marine traffic. The Preliminary WSA must provide an initial explanation of the following:

- port characterization;
- characterization of the LNG facility and the LNG marine vessel route;
- risk assessment for maritime safety and security;
- risk management strategies; and

- resource needs for maritime safety, security, and response.

A Follow-on WSA must be provided no later than the date the owner/operator files an application with FERC, but in all cases at least 180 days prior to transferring LNG. The Follow-on WSA must provide a detailed and accurate characterization of the LNG facility, the LNG marine vessel route, and the port area. The Follow-on WSA provides a complete analysis of the topics outlined in the Preliminary WSA. It should identify credible security threats and navigational safety hazards for the LNG marine traffic, along with appropriate risk management measures and the resources (i.e., federal, state, local, and private sector) needed to carry out those measures. Until a facility begins operation, applicants must also annually review their WSAs and submit a report to the COTP as to whether changes are required. This document is reviewed and validated by the Coast Guard and forms the basis for the agency's LOR to the FERC.

In order to provide the Coast Guard COTPs/Federal Maritime Security Coordinators, members of the LNG industry, and port stakeholders with guidance on assessing the suitability of a waterway for LNG marine traffic, the Coast Guard has published a Navigation and Vessel Inspection Circular – *Guidance on Assessing the Suitability of a Waterway for Liquefied Natural Gas (LNG) Marine Traffic* (NVIC 01-11).

NVIC 01-11 directs the use of the three concentric Zones of Concern, based on LNG marine vessels with a cargo carrying capacity up to 265,000 m³, used to assess the maritime safety and security risks of LNG marine traffic. The Zones of Concern are:

- Zone 1 – impacts on structures and organisms are expected to be significant within 500 meters (1,640 feet). The outer perimeter of Zone 1 is approximately the distance to thermal hazards of 37.5 kilowatts per square meter (kW/m²) (12,000 Btu/ft²-hr) from a pool fire.
- Zone 2 – impacts would be significant but reduced, and damage from radiant heat levels are expected to transition from severe to minimal between 500 and 1,600 meters (1,640 and 5,250 feet). The outer perimeter of Zone 2 is approximately the distance to thermal hazards of 5 kW/m² (1,600 Btu/ft²-hr) from a pool fire.
- Zone 3 – impacts on people and property from a pool fire or an un-ignited LNG spill are expected to be minimal between 1,600 meters (5,250 feet) and a conservative maximum distance of 3,500 meters (11,500 feet or 2.2 miles). The outer perimeter of Zone 3 should be considered the vapor cloud dispersion distance to the lower flammability limit from a worst-case un-ignited release. Impacts to people and property could be significant if the vapor cloud reaches an ignition source and burns back to the source.

Once the applicant submits a complete Follow-on WSA, the Coast Guard reviews the document to determine if it presents a realistic and credible analysis of the public safety and security implications from LNG marine traffic both in the waterway and when in port. As required by its regulations (33 CFR 127.009), the Coast Guard is responsible for issuing a LOR

to the FERC regarding the suitability of the waterway for LNG marine traffic with respect to the following items:

- physical location and description of the facility;
- the LNG marine vessel's characteristics and the frequency of LNG shipments to or from the facility;
- waterway channels and commercial, industrial, environmentally sensitive, and residential areas in and adjacent to the waterway used by LNG marine vessels en route to the facility, within 25 kilometers (15.5 miles) of the facility;
- density and character of marine traffic in the waterway;
- locks, bridges, or other man-made obstructions in the waterway;
- depth of water;
- tidal range;
- protection from high seas;
- natural hazards, including reefs, rocks, and sandbars;
- underwater pipes and cables; and
- distance of berthed LNG marine vessels from the channel and the width of the channel.

The Coast Guard may also prepare an LOR Analysis, which serves as a record of review of the LOR and contains detailed information along with the rationale used in assessing the suitability of the waterway for LNG marine traffic.

RG LNG's Waterway Suitability Assessment

In a letter to the Coast Guard dated March 18, 2015, RG LNG submitted a LOI and a Preliminary WSA to the COTP, Sector Corpus Christi to notify the Coast Guard that it proposed to construct an LNG export terminal. In order to assess the safety and security aspects of this Project, the COTP Sector Corpus Christi consulted various safety and security working groups, including representatives from Port of BND, Port Isabel Navigation District, local facility security, the Brazos Santiago Pilots Association, and Signet Maritime. In addition, the Coast Guard participated in meetings with the working group listed above, and other federal, state, and local agencies. RG LNG submitted the Follow-on WSA to the Coast Guard on December 17, 2015.

LNG Marine Vessel Routes and Hazard Analysis

An LNG marine vessel's transit to the terminal would begin when it enters the U.S. Exclusive Economic Zone from well-established shipping lanes through the Gulf of Mexico.

The LNG marine vessel would then enter the U.S. Territorial Sea limit (State Waters) to arrive at the Brazos Santiago Pass ocean buoy. At the Santiago Pass ocean buoy, pilots would board the LNG marine vessel before entering the BSC. From here, the LNG marine vessel transit would be executed with tug support at limiting speeds of 5 to 10 knots until it reaches the terminal. An LNG marine vessel port time with pilotage would normally be less than three hours for inbound transits (this includes time needed to turn the LNG marine vessel around and safely moor the LNG marine vessel along one of the two berths) and no more than two hours for outbound transits.

Pilotage is compulsory for foreign marine vessels and U.S. marine vessels under registry in foreign trade when in U.S. waters. All deep-draft marine vessels currently entering the shared waterway would employ a U.S. pilot. The National Vessel Movement Center in the U.S. would require a 96-hour advance notice of arrival for deep-draft marine vessels calling on U.S. ports. During transit, LNG marine vessels would be required to maintain voice contact with controllers and check in on designated frequencies at established way points.

NVIC 01-11 references the “Zones of Concern” for assisting in a risk assessment of the waterway. As LNG marine vessels proceed along the intended transit route, Hazard Zone 1 would encompass coastal areas along South Padre Island, Port Isabel and the BND, including a public boat ramp and approximately 30 RV hook-ups on South Padre Island, and the marine facilities associated with the proposed Texas LNG and Annova LNG Projects. Commercial vessels, recreational and fishing vessels may also fall within Zone 1, depending on their course. Transit of such vessels through a Zone 1 area of concern can be avoided by timing and course changes, if conditions permit. Zone 2 would cover a wider swath of coastal areas along South Padre Island, Port Isabel, and the BND, including the Coast Guard Station at South Padre Island, multiple residential buildings, commercial buildings, industrial buildings, a church, a university lab building, Schlitterbahn Water Park, and Long Island. Zone 3 would span larger portions of South Padre Island, Port Isabel and the BND, including the Port Isabel Police and Fire Departments, multiple residential, commercial, and industrial buildings, 9 churches, 2 elementary schools, and the causeway between Port Isabel and South Padre Island.

The areas impacted by the three different hazard zones are illustrated for accidental events in figure 4.12.1.3-1. The areas impacted by the three different hazard zones are illustrated for intentional events in figure 4.12.1.3-2.

4.12.1.4 Coast Guard Letter of Recommendation and Analysis

In a letter dated December 26, 2017, the Coast Guard issued an LOR and LOR Analysis to FERC stating that the BSC would be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project. The LOR also considered impacts related to the nearby SpaceX rocket launch facility. As part of its assessment of the safety and security aspects of this Project, the COTP Sector Corpus Christi consulted a variety of stakeholders including representatives from Port of Brownsville Navigation District, Port Isabel Navigation District, local facility security, the Brazos Santiago Pilots Association, and Signet Maritime. The LOR was based on full implementation of the strategies and risk management measures identified by the Coast Guard to RG LNG in its WSA.

Although RG LNG has suggested mitigation measures for responsibly managing the maritime safety and security risks associated with LNG marine traffic, the necessary vessel traffic and/or facility control measures may change depending on changes in conditions along the waterway. The Coast Guard regulations in 33 CFR 127 require that applicants annually review WSAs until a facility begins operation and submit a report to the Coast Guard identifying any changes in conditions, such as changes to the port environment, the LNG facility, or the LNG marine vessel route, that would affect the suitability of the waterway for LNG marine traffic.

The Coast Guard's LOR is a recommendation, regarding the current status of the waterway, to the FERC, the lead agency responsible for siting the onshore LNG facility. Neither the Coast Guard nor the FERC has authority to require waterway resources of anyone other than the applicant under any statutory authority or under the ERP or the Cost-Sharing Plan. As stated in the LOR, the Coast Guard would assess each transit on a case-by-case basis to identify what, if any, safety and security measures would be necessary to safeguard the public health and welfare, critical infrastructure and key resources, the port, the marine environment, and the LNG marine vessel.

Under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA, and the Security and Accountability For Every Port Act, the COTP has the authority to prohibit LNG transfer or LNG marine vessel movements within his or her area of responsibility if he or she determines that such action is necessary to protect the waterway, port, or marine environment. If this Project is approved and if appropriate resources are not in place prior to LNG marine vessel movement along the waterway, then the COTP would consider at that time what, if any, vessel traffic and/or facility control measures would be appropriate to adequately address navigational safety and maritime security considerations.

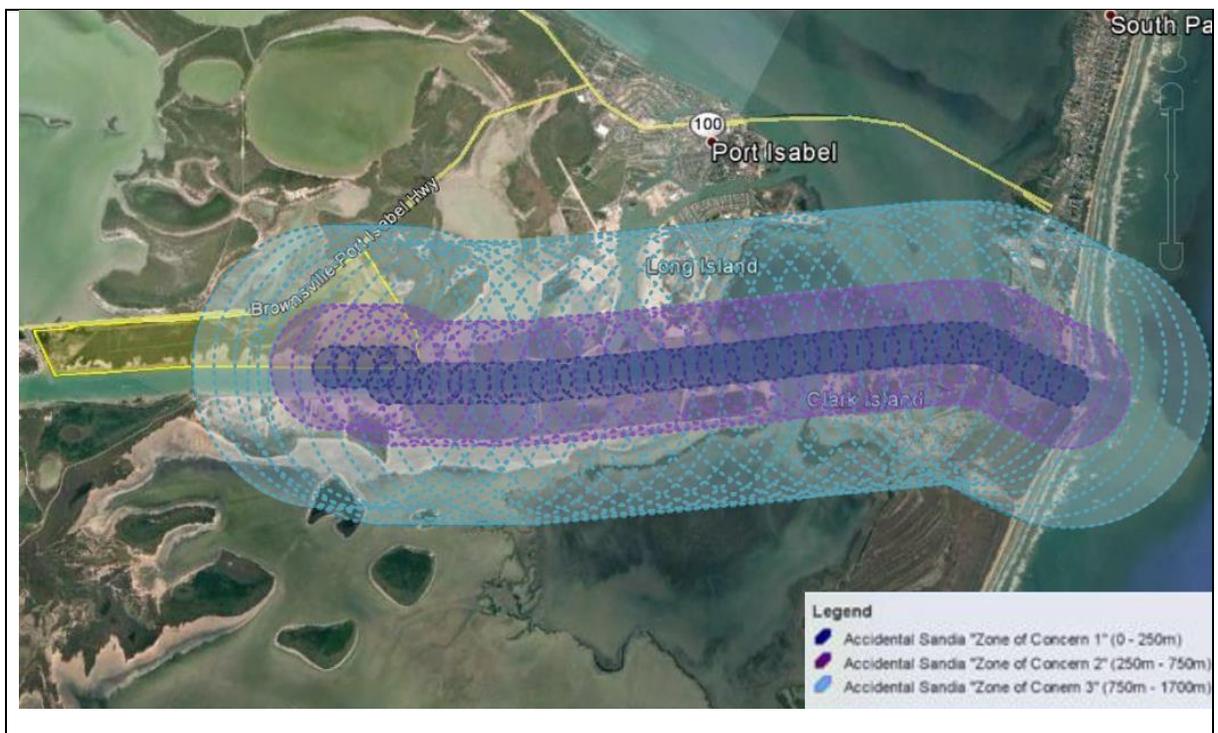


Figure 4.12.1.3-1 Accidental Hazard Zones along LNG Marine Vessel Route

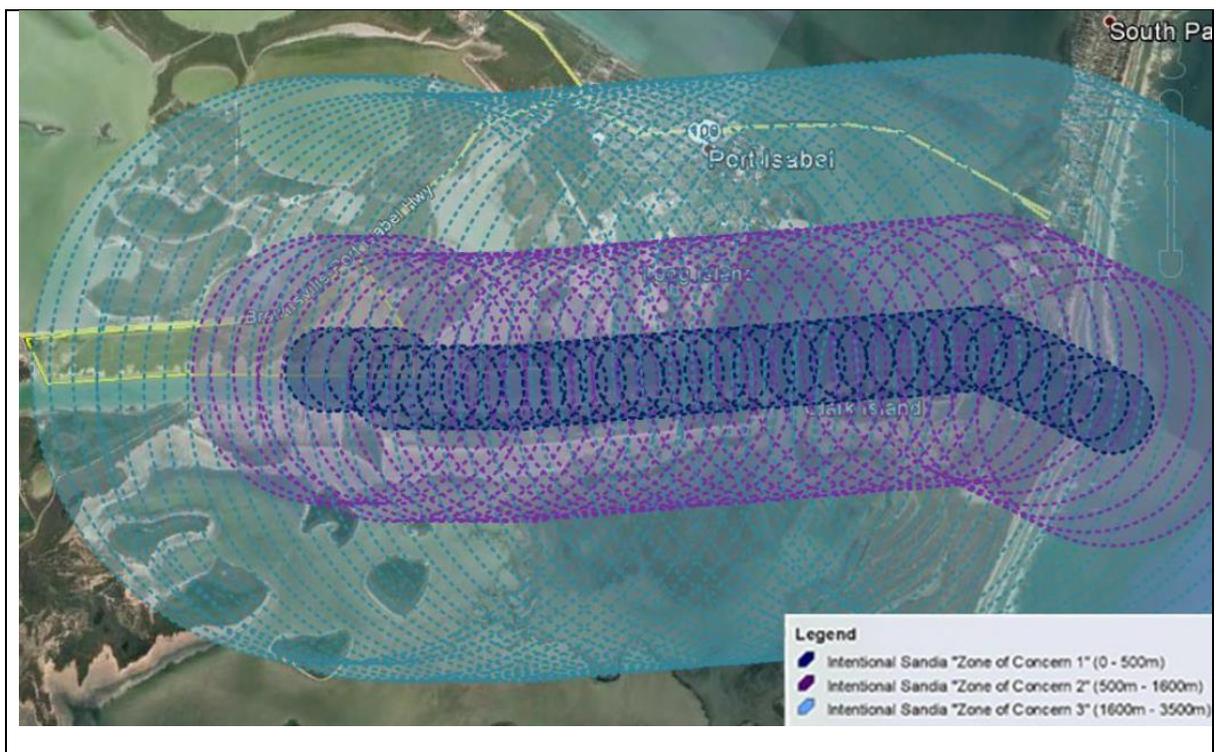


Figure 4.12.1.3-2 Intentional Hazard Zones along LNG Marine Vessel Route

4.12.1.5 LNG Facility Security Regulatory Requirements

The security requirements for the proposed Project are governed by 33 CFR 105, 33 CFR 127, and 49 CFR 193 Subpart J – Security. Title 33 CFR 105, as authorized by the MTSA, requires all terminal owners and operators to submit a Facility Security Assessment and a Facility Security Plan to the Coast Guard for review and approval before commencement of operations of the proposed Project facilities. RG LNG would also be required to control and restrict access, patrol and monitor the LNG Terminal, detect unauthorized access, and respond to security threats or breaches under 33 CFR 105. Some of the responsibilities of the applicant include, but are not limited to:

- designating a Facility Security Officer with a general knowledge of current security threats and patterns, security assessment methodology, vessel and facility operations, conditions, security measures, emergency preparedness, response, and contingency plans, who would be responsible for implementing the Facility Security Assessment and Facility Security Plan and performing an annual audit for the life of the Project;
- conducting a Facility Security Assessment to identify site vulnerabilities, possible security threats and consequences of an attack, and facility protective measures; developing a Facility Security Plan based on the Facility Security Assessment, with procedures for: responding to transportation security incidents; notification and coordination with federal, state, and local authorities; prevention of unauthorized access; measures to prevent or deter entrance with dangerous substances or devices; training; and evacuation;
- defining the security organizational structure with facility personnel with knowledge or training in current security threats and patterns; recognition and detection of dangerous substances and devices, recognition of characteristics and behavioral patterns of persons who are likely to threaten security; techniques to circumvent security measures; emergency procedures and contingency plans; operation, testing, calibration, and maintenance of security equipment; and inspection, control, monitoring, and screening techniques;
- implementing scalable security measures to provide increasing levels of security at increasing maritime security levels for facility access control, restricted areas, cargo handling, LNG marine vessel stores and bunkers, and monitoring; ensuring that the Transportation Worker Identification Credential (TWIC) program is properly implemented;
- ensuring coordination of shore leave for LNG marine vessel personnel or crew change out as well as access through the facility for visitors to the LNG marine vessel;
- conducting drills and exercises to test the proficiency of security and facility personnel on a quarterly and annual basis; and
- reporting all breaches of security and transportation security incidents to the National Response Center.

Title 33 CFR 127 has requirements for access controls, lighting, security systems, security personnel, protective enclosures, communications, and emergency power. In addition, an LNG facility regulated under 33 CFR 105 and 33 CFR 127 would be subject to the TWIC Reader Requirements Rule issued by the Coast Guard on August 23, 2016. This rule requires owners and operators of certain vessels and facilities regulated by the Coast Guard to conduct electronic inspections of TWICs (e.g., readers with biometric fingerprint authentication) as an access control measure. The final rule would also include recordkeeping requirements and security plan amendments that would incorporate these TWIC requirements. The implementation of the rule was first proposed to be in effect August 23, 2018. In a subsequent notice issued on June 22, 2018, the Coast Guard indicated delaying the effective date for certain facilities by 3 years, until August 23, 2021. On August 2, 2018, the President of the United States signed into law the Transportation Worker Identification Credential Accountability Act of 2018 (H.R. 5729). This law prohibits the Coast Guard from implementing the rule requiring electronic inspections of TWICs until after the Department of Homeland Security (DHS) has submitted a report to the Congress. Although the implementation of this rule has been postponed for certain facilities, the company should consider the rule when developing access control and security plan provisions for the facility.

Title 49 CFR 193 Subpart J also specifies security requirements for the onshore components of LNG facilities, as defined in 49 CFR 193, including requirements for conducting security inspections and patrols, liaison with local law enforcement officials, design and construction of protective enclosures, lighting, monitoring, alternative power sources, and warning signs.

If the Project is authorized, constructed, and operated, compliance with the security requirements of 33 CFR 105, 33 CFR 127, and 49 CFR 193 Subpart J would be subject to the respective Coast Guard and DOT inspection and enforcement programs.

RG LNG provided preliminary information on these security features and proposed to provide perimeter fencing, lighting, security personnel, security cameras, access control systems, identification and screening systems, intrusion detection systems, and communication systems. In response to data requests, RG LNG proposed revisions to their design that would remedy the identified concerns. We recommend in section 4.12.1.7 that RG LNG provide final design details on these security features for review and approval including: lighting coverage drawings that illustrate photometric analyses demonstrating the lux levels at the interior of the terminal are in accordance with API 540 and other federal regulations, including lighting along the perimeter fence line and along paths/roads of access and egress; camera coverage drawings that illustrate coverage areas of each camera such that the entire perimeter of the plant is covered with redundancy and the interior of plant is covered, including a camera be provided at the top of each LNG storage tank, and coverage within pretreatment areas, within liquefaction areas, within truck transfer areas, within marine transfer areas, and buildings; fencing drawings that demonstrate a fence would deter or mitigate entry along the perimeter of the entire facility and is set back from exterior structures and vegetation, and from interior hazardous piping and equipment by at least 10 feet; vehicle barrier and controlled access point drawings that demonstrate crash rated barriers are provided to prevent uncontrolled access, inadvertent entry, and impacts to components containing hazardous fluids from vehicles. Furthermore, in accordance with the February 2004 Interagency Agreement among FERC, DOT, and the Coast

Guard, FERC staff would collaborate with the DOT and the Coast Guard on the Project's security features.

4.12.1.6 FERC Engineering and Technical Review of the Preliminary Engineering Designs

LNG Facility Historical Record

The operating history of the U.S. LNG industry has been free of safety-related incidents resulting in adverse effects on the public or the environment with the exception of the October 20, 1944, failure at an LNG plant in Cleveland, Ohio. The 1944 incident in Cleveland led to a fire that killed 128 people and injured 200 to 400 more people.⁵¹ The failure of the LNG storage tank was due to the use of materials not suited for cryogenic temperatures. LNG migrated through streets and into underground sewers due to inadequate spill impoundments at the site. Current regulatory requirements ensure that proper materials suited for cryogenic temperatures are used in the design and that spill impoundments are designed and constructed properly to contain a spill at the site. To ensure that this potential hazard would be addressed for proposed LNG facilities, we evaluate the preliminary and final specifications for suitable materials of construction and for the design of spill containment systems that would properly contain a spill at the site.

Another operational accident occurred in 1979 at the Cove Point LNG plant in Lusby, Maryland. A pump electrical seal located on a submerged electrical motor LNG pump leaked causing flammable gas vapors to enter an electrical conduit and settle in a confined space. When a worker switched off a circuit breaker, the flammable gas ignited, causing severe damage to the building and a worker fatality. With the participation of the FERC, lessons learned from the 1979 Cove Point accident resulted in changing the national fire codes to better ensure that the situation would not occur again. To ensure that this potential hazard would be addressed for proposed facilities that have electrical seal interfaces, we evaluated the preliminary designs and recommend in section 4.12.1.7 that RG LNG provide, for review and approval, the final design details of the electrical seal design at the interface between flammable fluids and the electrical conduit or wiring system, details of the electrical seal leak detection system, and the details of a downstream physical break (i.e., air gap) in the electrical conduit to prevent the migration of flammable vapors.

On January 19, 2004, a blast occurred at Sonatrach's Skikda, Algeria, LNG liquefaction plant that killed 27 and injured 56 workers. No members of the public were injured. Findings of the accident investigation suggested that a cold hydrocarbon leak occurred at Liquefaction Train 40 and was introduced into a high-pressure steam boiler by the combustion air fan. An explosion developed inside the boiler firebox, which subsequently triggered a larger explosion of the hydrocarbon vapors in the immediate vicinity. The resulting fire damaged the adjacent liquefaction process and liquid petroleum gas separation equipment of Train 40, and spread to Trains 20 and 30. Although Trains 10, 20, and 30 had been modernized in 1998 and 1999, Train

⁵¹ For a description of the incident and the findings of the investigation, see "U.S. Bureau of Mines, Report on the Investigation of the Fire at the Liquefaction, Storage, and Regasification Plant of the East Ohio Gas Co., Cleveland, Ohio, October 20, 1944," dated February 1946.

40 had been operating with its original equipment since start-up in 1981. To ensure that this potential hazard would be addressed for proposed facilities, we evaluated the preliminary design for mitigation of flammable vapor dispersion and ignition in buildings and combustion equipment to ensure they would be adequately covered by hazard detection equipment that could isolate and deactivate any combustion equipment whose continued operation could add to or sustain an emergency. We also recommend in section 4.12.1.7 that RG LNG provide, for review and approval, the final design details of hazard detection equipment, including the location and elevation of all detection equipment, instrument tag numbers, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.

On March 31, 2014, a detonation occurred within a gas heater at Northwest Pipeline Corporation's LNG peak-shaving plant in Plymouth, Washington.⁵² This internal detonation subsequently caused the failure of pressurized equipment, resulting in high velocity projectiles. The plant was immediately shut down, and emergency procedures were activated, which included notifying local authorities and evacuating all plant personnel. No members of the public were injured, but one worker was sent to the hospital for injuries. As a result of the incident, the liquefaction trains and a compressor station located onsite were rendered inoperable. Projectiles from the incident also damaged the control building that was located near pretreatment facilities and penetrated the outer shell of one of the LNG storage tanks. All damaged facilities were ultimately taken out-of-service for repair. The accident investigation showed that an inadequate purge after maintenance activities resulted in a fuel-air mixture remaining in the system. The fuel-air mixture auto-ignited during start-up after it passed through the gas heater at full operating pressure and temperature. To ensure that this potential hazard would be addressed for proposed facilities, we recommend in section 4.12.1.7 that RG LNG provide a plan for purging, for review and approval, which addresses the requirements of the American Gas Association *Purging Principles and Practice* and to provide justification if not using an inert or non-flammable gas for purging. In evaluating such plans, we would assess whether the purging could be done safely based on review of other plans and lessons learned from this and other past incidents. If a plan proposes the use of flammable mediums for cleaning, dry-out or other activities, we would evaluate the plans against other recommended and generally accepted good engineering practices, such as NFPA 56, *Standard for Fire and Explosion Prevention during Cleaning and Purging of Flammable Gas Piping Systems*.

We also recommend in section 4.12.1.7 that RG LNG provide, for review and approval, operating and maintenance plans, including safety procedures, prior to commissioning. In evaluating such plans, we would assess whether the plans cover all standard operations, including purging activities associated with start-up and shutdown. Also, in order to prevent other sources of projectiles from affecting occupied buildings and storage tanks, we recommend in section 4.12.1.7 that RG LNG incorporate mitigation into their final design with supportive information, for review and approval, that demonstrates it would mitigate the risk of a pressure vessel burst or boiling liquid expanding vapor explosion (BLEVE) from occurring.

⁵² For a description of the incident and the findings of the investigation, see Root Cause Failure Analysis, Plymouth LNG Plant Incident Investigation under CP14-515.

FERC Preliminary Engineering Review

FERC requires an applicant to provide safety, reliability, and engineering design information as part of its application, including hazard identification studies and FEED information for its proposed Project. FERC staff evaluates this information with a focus on potential hazards from within and nearby the site, including external events, which may have the potential to cause damage or failure to the Project facilities, and the engineering design and safety and reliability concepts of the various protection layers to mitigate the risks of potential hazards.

The primary concerns are those events that could lead to a hazardous release of sufficient magnitude to create an offsite hazard or interruption of service. Furthermore, the potential hazards are dictated by the site location and the engineering details. In general, FERC staff considers an acceptable design to include various layers of protection or safeguards to reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public. These layers of protection are generally independent of one another so that any one layer would perform its function regardless of the initiating event or failure of any other protection layer. Such design features and safeguards typically include:

- a facility design that prevents hazardous events, including the use of inherently safer designs; suitable materials of construction; adequate design margins from operating limits for process piping, process vessels, and storage tanks; adequate design for wind, flood, seismic, and other outside hazards;
- control systems, including monitoring systems and process alarms, remotely-operated control and isolation valves, and operating procedures to ensure that the facility stays within the established operating and design limits;
- safety instrumented prevention systems, such as safety control valves and emergency shutdown systems, to prevent a release if operating and design limits are exceeded;
- physical protection systems, such as appropriate electrical area classification, proper equipment and building spacing, pressure relief valves, spill containment, and cryogenic, overpressure, and fire structural protection, to prevent escalation to a more severe event;
- site security measures for controlling access to the plant, including security inspections and patrols, response procedures to any breach of security, and liaison with local law enforcement officials; and
- onsite and offsite emergency response, including hazard detection and control equipment, firewater systems, and coordination with local first responders, to mitigate the consequences of a release and prevent it from escalating to an event that could impact the public.

The inclusion of such protection systems or safeguards in a plant design can minimize the potential for an initiating event to develop into an incident that could impact the safety of the

offsite public. The review of the engineering designs for these layers of protection is initiated in the application process and carried through to the next phase of the proposed Project in final design if authorization is granted by the Commission.

The reliability of these layers of protection is informed by occurrence and likelihood of root causes and the potential severity of consequences based on past incidents and validated hazard modeling. As a result of the continuous engineering review, we recommend mitigation measures and continuous oversight to the Commission for consideration to include as conditions in the order. If a facility is authorized and recommendations are adopted as conditions to the order, FERC staff would continue its engineering review through final design, construction, commissioning, and operation.

Process Design

In order to liquefy natural gas, most liquefaction technologies require that the feed gas stream be pre-treated to remove components that could freeze out and clog the liquefaction equipment or would otherwise be incompatible with the liquefaction process or equipment, including mercury, H₂S, CO₂, water, and heavy hydrocarbons. For example, mercury is typically limited to concentrations of less than 0.01 micrograms per normal cubic meter because it can induce embrittlement and corrosion resulting in a catastrophic failure of equipment.

The inlet gas would be conditioned to remove solids and water droplets and for pressure regulation prior to entering feed gas pretreatment processes. Once the inlet gas is conditioned, the feed gas would be routed to the acid gas removal unit where a H₂S scavenger vessel absorbs most of the H₂S in the feed gas stream. The H₂S scavenger vessel would reduce the H₂S concentration to less than 0.4 parts per million by volume. The feed gas stream would then contact an amine-based solvent solution in an absorber column to remove the remaining acid gas components (predominantly CO₂ with trace amounts of H₂S carried over from the H₂S scavenger vessel). Once the acid gas components accumulate in the amine solution, the amine solution is routed to an amine regenerator column that utilizes a reboiler to create hot amine vapor. Contact with the hot amine vapor would release the acid gas from the amine solution. The regenerated amine solution would be recycled back to the absorber column and the acid gas would be sent to a thermal oxidizer, where CO₂, any remaining traces of H₂S, and trace amounts of hydrocarbons would be incinerated.

The treated feed gas exiting the acid gas removal unit then enters the dehydration unit where water would be removed from the feed gas by using regenerative molecular sieve beds. During the mole sieve bed regeneration process, heated regeneration gas would release water from the molecular sieve beds. Water would then be separated from the regeneration gas and would be routed back into the pretreatment system. After dehydration, mercury would be removed from the gas by a mercury adsorber bed that utilizes a sulfur impregnated activated carbon adsorbent (or metal oxide) until the beds adsorb enough mercury to require replacement.

The feed gas from the mercury adsorber bed is cooled to condense NGL in the NGL extraction unit. The resulting NGL stream would be stabilized and sent to the condensate storage tank. The stabilized condensate would be removed from the site by trucks.

After removal of the heavy hydrocarbons and the other components from the natural gas feed stream, RG LNG would liquefy the natural gas. In this process, the gas would be cooled using Air Products and Chemical Incorporated's propane-precooled mixed refrigerant liquefaction process that would utilize two main refrigeration cycles. In the first cycle, propane refrigerant would be used to pre-cool the feed gas and the mixed refrigerant consisting of nitrogen, methane, ethylene/ethane, and propane. In the second cycle, the mixed refrigerant would be used to achieve the temperatures to liquefy and sub-cool the feed gas. Refrigerants required for the liquefaction process would be unloaded from trucks and stored onsite for initial filling and use, as needed, for make-up. After cooling the natural gas into its liquid form (i.e., LNG), it would be stored in four full-containment LNG storage tanks and sent out through in-tank pumps through a marine transfer line and marine transfer arms connected to LNG ships. The LNG transferred to the ships would displace vapors from the ships, which would be sent back to the LNG storage containers. Once loaded, the LNG ship would be disconnected and leave for export.

The Project would include many utilities and associated auxiliary equipment. The major auxiliary systems required for the operation of the liquefaction facility include BOG, fuel gas, hot oil, flares, instrument and utility air supply, water supply, demineralized water, diesel, nitrogen, and backup power.

Hot oil would be used to provide heat to the acid gas removal unit, NGL extraction unit, and the fuel gas system. There would be three ground flares (each ground flare would handle both dry gas and wet gas) and a vent located near the LNG tanks and ship loading area. The ground flares would be designed to handle the vent gases from the process areas associated with the pretreatment and liquefaction operations. The vent would be used during upset conditions in the LNG tank/ship loading area or to dispose of vent gas during cooldown of warm and inerted LNG marine vessels. Diesel would be stored onsite and used in the spare firewater pump and as fuel for the essential diesel generators. Nitrogen would be used to purge process equipment and as a seal gas for compressors and would be stored onsite as a liquid.

The failure of process equipment could pose potential harm if not properly safeguarded through the use of appropriate controls and operation. RG LNG would install process control valves and instrumentation to safely operate and monitor the facilities. Alarms would have visual and audible notification in the control room to warn operators that process conditions may be approaching design limits. RG LNG would design their control systems and human machine interfaces (HMI) to the International Society for Automation (ISA) Standards 5.3, 5.5, 60.1, 60.3, 60.4, and 60.6, and other standards and recommended practices. RG LNG indicated an alarm management program would be in accordance with the ISA Standard 18.2 to ensure the effectiveness of the alarms. We recommend in section 4.12.1.7 that RG LNG provide their alarm management program for review and approval.

Operators would have the capability to take action from the control room to mitigate an upset. RG LNG would develop facility operation procedures after completion of the final design; this timing is fully consistent with accepted industry practice. We recommend in section 4.12.1.7 that RG LNG provide more information, for review and approval, on the operating and maintenance procedures, including safety procedures, hot work procedures and permits, abnormal operating conditions procedures, and personnel training prior to commissioning. We

would evaluate these procedures to ensure that an operator can operate and maintain all systems safely, based on benchmarking against other operating and maintenance plans and comparing against recommended and generally accepted good engineering practices, such as American Institute of Chemical Engineers (AIChE) Center for Chemical Process Safety (CCPS) *Guidelines for Writing Effective Operating and Maintenance Procedures*, AIChE CCPS *Guidelines for Management of Change for Process Safety*, AIChE CCPS *Guidelines for Effective Pre-Startup Safety Reviews*, AGA *Purging Principles and Practices*, and NFPA 51B *Standards for Fire Prevention During Welding, Cutting, and Other Hot Work*. In addition, we recommend in section 4.12.1.7 that RG LNG tag and label instrumentation and valves, piping, and equipment and provide car-seals/locks to address human factor considerations and improve facility safety and prevent incidents.

In the event of a process deviation, emergency shutdown (ESD) valves and instrumentation would be installed to monitor, alarm, shut down, and isolate equipment and piping during process upsets or emergency conditions. The Project would have a plant-wide ESD system to initiate closure of valves and shutdown of the process during emergency situations. Safety instrumented systems would comply with International Electrotechnical Commission 61508/ISA Standard 84.00.01 and other recommended and generally accepted good engineering practices. We also recommend in section 4.12.1.7 that RG LNG file information, for review and approval, on the final design, installation, and commissioning of instrumentation and ESD equipment to ensure appropriate cause-and-effect alarm or shutdown logic and enhanced representation of the ESD system in the plant control room and throughout the plant.

In developing the FEED, RG LNG conducted a Hazard Identification - Environmental Hazard Identification (HAZID-ENVID) analysis on the Project's preliminary design based on the proposed site plan, block flow diagrams, heat and material balances, process flow diagrams, and utility flow diagrams. The HAZID-ENVID analysis identifies potential hazards or environmental issues in the early stage of the project's design that could produce undesirable consequences through the occurrence of an incident by evaluating the materials, systems, process, and plant design.

A more detailed hazard and operability review (HAZOP) analysis would be performed by RG LNG during the final design phase to identify the major hazards that may be encountered during the operation of facilities. The HAZOP study would be intended to address hazards of the process, engineering and administrative controls and would provide a qualitative evaluation of a range of possible safety, health, and environmental consequences that may result from a process hazard, and identify whether there are adequate safeguards (e.g., engineering and administrative controls) to prevent or mitigate the risk from such events. Where insufficient engineering and administrative controls are identified, recommendations to prevent or minimize these hazards would be generated from the results of the HAZOP review. We recommend in section 4.12.1.7 that RG LNG file the HAZOP study on the completed final design for review and approval. We would evaluate the HAZOP to ensure all systems and process deviations are addressed appropriately based on likelihood, severity, and risk values with commensurate layers of protection in accordance with recommended and generally accepted good engineering practices, such as the AIChE, *Guidelines for Hazard Evaluation Procedures*. We also recommend in section 4.12.1.7 that RG LNG file the resolutions of the recommendations generated by the HAZOP review for evaluation and approval by FERC staff. Once the design has been subjected

to a HAZOP review, the design development team would track, manage, and keep records of changes in the facility design, construction, operations, documentation, and personnel. RG LNG would evaluate these changes to ensure that the safety, health, and environmental risks arising from these changes are addressed and controlled based on its management of change procedures. If FERC staff's recommendations are adopted into the order, resolutions of the recommendations generated by the HAZOP review would be monitored by FERC staff. We also recommend in section 4.12.1.7 that RG LNG file all changes to their FEED for review and approval by FERC staff. However, major modifications could require an amendment or new proceeding.

If the Project is authorized and constructed, RG LNG would install equipment in accordance with its design. We recommend in section 4.12.1.7 that Project facilities be subject to construction inspections and that RG LNG provide, for review and approval, commissioning plans, procedures and commissioning demonstration tests that would verify the performance of equipment. In addition, we recommend in section 4.12.1.7 that RG LNG provide semi-annual reports that include abnormal operating conditions and planned facility modifications. Furthermore, we recommend in section 4.12.1.7 that the Project facilities would be subject to regular inspections to verify that equipment is being properly maintained and to verify basis of design conditions, such as feed gas and sendout conditions, do not exceed the original basis of design.

Mechanical Design

RG LNG provided codes and standards for the design, fabrication, construction, and installation of piping and equipment and specifications for the facility. The design specifies materials of construction and ratings suited to the pressure and temperature conditions of the process design. Piping would be designed, fabricated, assembled, erected, inspected, examined, and tested in accordance with the ASME Standards B31.3, B36.10, and 36.19. Valves and fittings would be designed to standards and recommended practices such as API Standards 594, 598, 600, 602, 603, 607, 608, and 609; ASME Standards B16.5, B16.10, B16.20, B16.25, and B16.34; and ISA Standards 75.01.01, 75.05.01, and 75.08.01. Portions of the facility regulated under 33 CFR 127 for the marine transfer system, including piping, hoses, and loading arms should also be tested in accordance with 33 CFR 127.407.

Pressure vessels must be designed, fabricated, inspected, examined, and tested in accordance with ASME Boiler and Pressure Vessel Code Section VIII per 49 CFR 193 Subparts C, D, and E and the NFPA 59A (2001). LNG storage tanks must be designed, fabricated, tested, and inspected in accordance with 49 CFR 193 Subpart D, NFPA 59A (2001 and 2006), and API Standard 620. In addition, RG LNG would design, fabricate, test, and inspect the LNG storage tanks in accordance with API Standard 625 and American Concrete Institute 376. Other low-pressure storage tanks such as the amine and condensate storage tanks, would be designed, inspected, and maintained in accordance with the API Standards 650 and 653. All LNG storage tanks would also include BOG compression to prevent the release of boil-off to the atmosphere in accordance with NFPA 59A (2001) for an inherently safer design. Heat exchangers would be designed to ASME Boiler and Pressure Vessel Code Section VIII standards; API Standards 660 and 661; and the Tubular Exchanger Manufacturers Association standards. Rotating equipment would be designed to standards and recommended practices, such as API Standards 610, 613, 614, 616, 617, 670, 671, 675, 676, and 682; and ASME Standards B73.1 and B73.2. Fired

heaters would be specified and designed to standards and recommended practices, such as API Standards 530, 535, and 556, and NFPA 85.

Pressure and vacuum safety relief valves and flares would be installed to protect the storage containers, pressure vessels, process equipment, and piping. The safety relief valves would be designed to handle process upsets and thermal expansion within piping, per NFPA 59A (2001) and ASME Section VIII; and would be designed in accordance with API Standards 520, 521, 526, 527, 537, 2000, and other recommended and generally accepted good engineering practices. In addition, the operator should verify the set pressure of the pressure relief valves meet the requirements in 33 CFR 127.407. We recommend in section 4.12.1.7 that RG LNG provide final design information on pressure and vacuum relief devices, for review and approval, to ensure that the final sizing, design, and installation of these components are adequate and in accordance with the standards reference and other recommended and generally accepted good engineering practices.

If the Project is authorized and constructed, RG LNG would install equipment in accordance with its design and FERC staff would verify equipment nameplates to ensure equipment is being installed based on approved design. In addition, FERC staff would conduct construction inspections including reviewing quality assurance and quality control plans to ensure construction work is being performed according to proposed Project specifications, procedures, codes, and standards. We recommend in section 4.12.1.7 that RG LNG provide semi-annual reports that include equipment malfunctions and abnormal maintenance and that project facilities be subject to inspections to verify that the equipment is being properly maintained during the life of the LNG Terminal.

Hazard Mitigation Design

If operational control of the facilities were lost and operational controls and emergency shutdown systems failed to maintain the Project within the design limits of the piping, containers, and safety relief valves, a release could potentially occur. FERC regulations under 18 CFR 380.12 (o) (1) through (4) require applicants to provide information on spill containment, spacing and plant layout, hazard detection, hazard control, and firewater systems. In addition, 18 CFR 380.12 (o) (7) require applicants to provide engineering studies on the design approach and 18 CFR 380.12 (o) (14) requires applicants to demonstrate how they comply with 49 CFR 193 and NFPA 59A. As required by 49 CFR 193 Subpart I and by incorporation Section 9.1.2 of NFPA 59A (2001), fire protection must be provided for all DOT-regulated LNG facilities based on an evaluation of sound fire protection engineering principles, analysis of local conditions, hazards within the facility, and exposure to or from other property. NFPA 59A (2001) also requires the evaluation on the type, quantity, and location of hazard detection and hazard control, passive fire protection, emergency shutdown and depressurizing systems, and emergency response equipment, training, and qualifications.

If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart I and would be subject to DOT's inspection and enforcement programs. However, NFPA 59A (2001) also indicates the wide range in size, design, and location of LNG facilities precludes the inclusion of detailed fire protection provisions that apply to all facilities comprehensively and includes subjective

performance-based language on where ESD systems and hazard control are required and does not provide any additional guidance on placement or selection of hazard detection equipment and provides minimal requirements on firewater. Also, the project marine facilities would be subject to 33 CFR 127, which incorporates sections of NFPA 59A (1994), which have similar performance-based guidance. Therefore, FERC staff evaluated the proposed spill containment and spacing, hazard detection, ESD and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response to ensure they would provide adequate protection of the LNG facilities as described below.

RG LNG performed a preliminary fire protection evaluation to ensure that adequate mitigation would be in place, including spill containment and spacing, hazard detection, ESD and depressurization systems, hazard control, firewater coverage, structural protection, and onsite and offsite emergency response. We recommend in section 4.12.1.7 that RG LNG provide a final fire protection evaluation for review and approval, and to provide more information on the final design, installation, and commissioning of spill containment, hazard detection, hazard control, firewater systems, structural fire protection, and onsite and offsite emergency response procedures.

Spill Containment

In the event of a release, sloped areas at the base of storage and process facilities would direct a spill away from equipment and into the impoundment system. This arrangement would minimize the dispersion of flammable vapors into confined, occupied, or public areas and minimize the potential for heat from a fire to impact adjacent equipment, occupied buildings, or public areas if ignition were to occur.

Title 49 CFR 193.2181, under Subpart C specifies that each impounding system serving an LNG storage tank must have a minimum volumetric liquid capacity of 110 percent of the LNG tank's maximum design liquid capacity for an impoundment serving a single tank, unless surge is accounted for in the impoundment design. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart C and would be subject to DOT's inspection and enforcement programs. For full-containment LNG tanks, we also consider it prudent to provide a barrier to prevent liquid from flowing to an unintended area (i.e., outside the plant property). The purpose of the barrier is to prevent liquid from flowing off the plant property and does not define containment or an impounding area for thermal radiation or flammable vapor exclusion zone calculations or other code requirements already met by sumps and impoundments throughout the site. RG LNG proposes four full-containment LNG storage tanks for which the outer tank wall would serve as the impoundment system. FERC staff verified that the LNG storage tank's outer concrete wall would have a liquid capacity of at least 110 percent of the inner LNG tank's maximum liquid capacity. In addition, RG LNG would also install a berm (i.e., storm levee with a crest elevation of 17 feet) around the Project site to prevent liquid from flowing offsite in the event of an outer tank failure.

RG LNG proposes to install curbing, paving, and trenches to direct potential LNG, MR, NGL, or refrigerant liquid releases to either the west LNG Train Spill Basin or the east LNG Train Spill Basin. LNG releases from the rundown headers and ship loading piping would be

collected in a trench and routed to one of two LNG Storage and Jetty Loading Line Basins located between the four LNG storage tanks. Releases in the refrigerant storage area would be collected in curbed areas and directed via a trench to the Refrigerant Storage Area Basin. This basin capacity would be sized to be greater than the largest refrigerant storage tank. LNG releases during truck loading would be directed via trenches to the LNG Road Tanker Spill Basin. In addition, local bunds would be provided around the solvent storage tank, refrigerant truck unloading area, BOG compressor Suction Drum, Stabilized Condensate storage tanks, Hot Oil storage tank, Diesel storage tanks, flare knockout drums, liquid nitrogen storage tank, and the Slop Oil storage tank.

Under NFPA 59A (2001) Section 2.2.2.2, the capacity of impounding areas for vaporization, process, or LNG transfer areas must equal the greatest volume that can be discharged from any single accidental leakage source during a 10-minute period or during a shorter time period based upon demonstrable surveillance and shutdown provisions acceptable to the DOT. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 Subpart C and would be subject to DOT's inspection and enforcement programs. The impoundment system design for the marine facilities would be subject to the Coast Guard's 33 CFR 127, which does not specify a spill or duration for impoundment sizing. However, we evaluate whether all hazardous liquids are provided with spill containment based on the largest flow capacity from a single pipe for 10 minutes accounting for de-inventory or the liquid capacity of the largest vessel (or total of impounded vessels) served, whichever is greater and whether providing spill containment reduces consequences from a release. In addition, we recommend in section 4.12.1.7 that RGLNG provide additional information on the final design of the impoundment systems for review and approval.

RG LNG indicated that all piping, hoses, and equipment that could produce a hazardous liquid spill would be provided with spill collection and/or spill conveyance systems. Furthermore, RG LNG indicates that the stormwater pumps would be automatically operated by level control and interlocked using low temperature detectors to prevent pumps from operating if LNG is present. These stormwater removal pumps would be proposed for the large impoundment basins described above, however RG LNG proposes to install normally-closed valves on local bunds and curbed areas to allow analysis of stormwater prior to routing it to the drainage channels.

RG LNG is consulting with DOT on the use of normally-closed valves instead of stormwater removal pumps required in 49 CFR 193 Subpart C. Therefore, we recommend in section 4.12.1.7 that RG LNG provide DOT correspondence accepting the use of normally-closed valves to remove stormwater from curbed and bunded areas. If authorized, constructed, and operated, final compliance with the requirements of 49 CFR 193 Subpart C would be subject to DOT's inspection and enforcement programs.

If the Project is authorized and constructed, RG LNG would install spill impoundments in accordance with its design and FERC staff would verify during construction inspections that the spill containment system including dimensions, and slopes of curbing and trenches, and volumetric capacity matches final design information. In addition, we recommend in section 4.12.1.7 that Project facilities be subject to regular inspections throughout the life of the facility to verify that impoundments are being properly maintained.

Spacing and Plant Layout

The spacing of vessels and equipment between each other, from ignition sources, and to the property line must meet the requirements of 49 CFR 193 Subparts C, D, and E, which incorporate NFPA 59A (2001). NFPA 59A (2001) includes spacing and plant layout requirements and further references NFPA 30, NFPA 58, and NFPA 59 for additional spacing and plant layout requirements. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs.

In addition, FERC staff evaluated the spacing to determine if there could be cascading damage and to inform what fire protection measures may be necessary to reduce the risk of cascading damage. If it was not practical for spacing to mitigate the potential for cascading damage, FERC staff evaluated whether other mitigation measures were in place and evaluated those systems in further detail as discussed in subsequent sections in section 4.12.1.6. We evaluated the spacing of buildings in line with AIChE CCPS *Guidelines for Evaluating Process Plant Buildings for External Explosions and Fires*, API 752 and API 753, which provide guidance on identifying and evaluating explosion and fire impacts to buildings and occupants resulting from events external to the buildings. In addition, FERC staff evaluated other hazards associated with releases and whether any damage would likely occur at buildings or would result in cascading damage.

To minimize the risk of cryogenic spills causing structural supports and equipment from cooling below their minimum design metal temperature, RG LNG would generally locate cryogenic equipment away from non-cryogenic process areas and would direct cryogenic releases to remote impoundment basins. In addition, RG LNG would coat these areas with materials that would be cryogenic resistant, which is discussed later.

To minimize risk for flammable or toxic vapor ingress into buildings and flammable vapors reaching areas that could result in cascading damage from explosions, RG LNG would generally locate buildings away from process areas and would generally locate fired equipment and ignition sources away from process areas. However, it is impractical to locate all fired equipment (e.g., hot oil heaters, thermal oxidizer, regeneration gas heater, etc.) and buildings (e.g., Jetty Monitor Buildings, Security Building, substations, etc.) outside of potential areas where flammable vapors may disperse upon a flammable or combustible fluid release. Therefore, we recommend in section 4.12.1.7 that RG LNG conduct a technical review of facility, for review and approval, identifying all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and verify that these areas would be adequately covered by hazard detection devices that would isolate or shut down any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency.

To minimize overpressures from vapor cloud explosions, we evaluated how flammable vapors would be prevented from accumulating within confined areas and whether any explosions would result in cascading damage. The LNG storage tanks would be located away from process equipment and process facilities are relatively unconfined and uncongested. RG LNG would also mound the refrigerant storage tanks and would design substations and local equipment

rooms to withstand blast conditions. RG LNG provided hazard analysis that shows 1 psi overpressures from vapor cloud explosions could reach the LNG storage tanks and condensate storage tanks. However, we note that the hazard analysis used modeling software for overpressure scenarios that is expected to over-predict the overpressure distances and that more refined modeling software may demonstrate lesser overpressures at the LNG storage tanks. Therefore, we recommend in section 4.12.1.7 that RG LNG file an analysis, for review and approval, to demonstrate that the side on overpressures would be less than 1 psi at the LNG storage tanks and condensate storage tanks or that the tanks would be able to withstand overpressures within the terminal.

To minimize the risk of pool fires from causing cascading damage, RG LNG would locate spill impoundments such that the radiant heats would have a minimal impact on most areas of the plant. Radiant heat from a roof top fire from an LNG storage tank would exceed 10,000 Btu/ft²-hr at an adjacent LNG storage tank. However, RG LNG provided a report to demonstrate that the full-containment LNG storage tanks would be able to withstand radiant heat up to 17,039 Btu/ft²-hr during an adjacent LNG tank roof fire event. RG LNG also noted that temperature limits on the concrete tank wall would exceed the limits noted in NFPA 59A (2016). However, these provisions were removed from later editions of NFPA 59A and performance criteria is provided based on temperatures and associated loss of strength. RG LNG also notes that NFPA 59A (2016) references American Concrete Institute (ACI) 376 that allows use of British Standard (BS) 8110-2 *Structural use of concrete. Code of practice for special circumstances*, for elevated temperature material properties. In addition, high radiant heats from a roof top fire would reach both Jetty Monitor Buildings and the LNG Storage and Loading Substation 2. Therefore, we recommend in section 4.12.1.7 that RG LNG demonstrate that radiant heat from an LNG storage tank roof fire would not result in damage to the Jetty Monitor Buildings or the LNG Storage and Loading Substation 2 and/or provide mitigation to prevent cascading damage to the buildings. In addition, RG LNG would mound the refrigerant storage vessels to mitigate the potential impacts from nearby fires.

To minimize the risk of jet fires from causing cascading damage that could exacerbate the initial hazard, RG LNG would generally locate flammable and combustible containing piping and equipment away from buildings and process areas that do not handle flammable and combustible materials. However, the jet fire distances to 1,600 Btu/ft²-hr originating from piping in the LNG storage tank or and marine areas could reach both Jetty Monitor Buildings. Jet fire distances to 4,000 Btu/ft²-hr and 4,900 Btu/ft²-hr from piping and equipment could also impact other components handling or supporting hazardous fluids. Given the radiant heats at the Jetty Monitor Buildings, they may necessitate shelter in place until the fire is isolated, extinguished, or otherwise mitigated. RG LNG would also install emergency shutdown systems that would limit the duration of a jet fire event, depressurization systems that would reduce the pressure in equipment, and would install firewater systems to cool equipment and structures. We also recommend in section 4.12.1.7 that RG LNG file calculations or test results that demonstrate the effectiveness of the passive protection in areas where pool or jet fires may result in failure of structural supports.

To minimize risk to the LNG marine vessel, 33 CFR 127 requires LNG impounding areas be located so that the heat flux from a fire over the impounding spaces does not cause structural damage to any LNG marine vessel moored or berthed at the waterfront facility handling LNG.

Similarly, 49 CFR 193 through adoption of NFPA 59A (2001), section 2.2.3.6, requires that LNG container impounding areas must be located so that the heat flux from a fire over the impounding area will not cause major structural damage to any LNG marine vessel that could prevent its movement. RG LNG indicated that a LNG storage tank roof fire would result in less than 4,900 Btu/ft²-hr radiant heat on a LNG marine vessel berthed at the jetty. DOT evaluated RG LNG's information and criteria in its LOD and determined that RG LNG complies with the requirements in 49 CFR 193 Subpart B. Furthermore, RG LNG included an ERP for LNG marine vessels berthed at the LNG Terminal and would provide quick release hooks on the breasting dolphins and mooring dolphins that would allow for a quick departure in the event of an emergency.

If the Project is authorized, RG LNG would finalize the plot plan and we recommend in section 4.12.1.7 that RG LNG provide any changes for review and approval to ensure capacities and setbacks are maintained. If facilities are constructed, RG LNG would install equipment in accordance with the spacing indicated on the plot plans. In addition, we recommend in section 4.12.1.7 that Project facilities be subject to periodic inspections during construction to verify equipment is installed in appropriate locations and the spacing is met in the field to verify flammable/toxic gas detection equipment and other mitigation is installed in heating, ventilation, and air condition intakes of buildings at appropriate locations. We also recommend in section 4.12.1.7 that Project facilities be subject regular inspections throughout the life of the facilities to verify that equipment setbacks from other equipment and ignition sources are being maintained during operation and to continue to verify that flammable/toxic gas detection equipment installed in building air intakes and other mitigation function as designed and are being maintained and calibrated.

Ignition Controls

RG LNG's plant areas would be designated with appropriate hazardous electrical classification and process seals commensurate with the risk of the hazardous fluids being handled in accordance with NFPA 59A (2001), 70, 497, and API RP 500. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs, which require compliance, by incorporation by reference, with NFPA 59A (2001) and NFPA 70 (1999). The marine facilities must comply with similar electrical area classification requirements of NFPA 59A (1994) and NFPA 70 (1993), which are incorporated by reference into the Coast Guard regulations in 33 CFR 127. Depending on the risk level, these areas would either be unclassified or classified as Class 1 Division 1, or Class 1 Division 2. Electrical equipment located in these areas would be designed such that in the event a flammable vapor is present, the equipment would have a minimal risk of igniting the vapor. FERC staff evaluated the electrical area classification drawings to determine whether RG LNG would meet these electrical area classification requirements and good engineering practices in NFPA 59A, 70, 497, and API RP 500. We recognize that RG LNG appears to meet NEPA 59A (1994 and 2001), NFPA 70 (1993 and 1999) and most of NFPA 497 and API 500, and recommend in section 4.12.1.7 that RG LNG provide final electrical area classification drawings that reflect additional hazardous classification areas where the heat transfer fluid would be processed above its flash point (e.g., near the heat medium heaters) and at areas of fuel gas piping (e.g., fired heaters),

including areas where equipment could be exposed to flammable gas during a purge cycle of a fired heater.

If the Project is authorized, RG LNG would finalize the electrical area classification drawings and would describe changes made from the FEED design. We recommend in section 4.12.1.7 that RG LNG file the final design of the electrical area classification drawings for review and approval. If facilities are constructed, RG LNG would install appropriately classed electrical equipment, and we recommend in section 4.12.1.7 that Project facilities be subject to periodic inspections during construction for FERC staff to spot check electrical equipment and verify equipment is installed per classification and are properly bonded or grounded in accordance with NFPA 70. In addition, we recommend in section 4.12.1.7 that Project facilities be subject to regular inspections throughout the life of the facility to ensure electrical equipment is maintained (e.g., bolts on explosion proof equipment properly installed and maintained, panels provided with purge, etc.), and electrical equipment are appropriately de-energized and locked out and tagged out when being serviced.

Submerged electric motor pumps and instrumentation must be equipped with electrical process seals and instrumentation in accordance with NFPA 59A (2001) and NFPA 70. We recommend in section 4.12.1.7 that RG LNG provide, for review and approval, final design drawings showing process seals installed at the interface between a flammable fluid system and an electrical conduit or wiring system that meet the requirements of NFPA 59A (2001) and NFPA 70. Furthermore, we recommend in section 4.12.1.7 that RG LNG file, for review and approval, details of an air gap or vent equipped with a leak detection device that should continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems. In addition, we recommend in section 4.12.1.7 that Project facilities be subject to regular inspections throughout the life of the facility to ensure electrical process seals for submerged pumps continue to conform to NFPA 59A and NFPA 70 and that air gaps are being properly maintained.

Hazard Detection, Emergency Shutdown, and Depressurization Systems

RG LNG would also install hazard detection systems to detect cryogenic spills, flammable and toxic vapors, and fires. The hazard detection systems would alarm and notify personnel in the area and control room to initiate an ESD, depressurization, or initiate appropriate procedures, and would meet NFPA 72, ISA 12.13.01, ISA 12.13.02, ISA 12.13.04, ISA 12.15.01, ISA 12.15.02, ISA 60079-29-1, ISA 60079-29-2, ISA 92.00.01, ISA 92.00.02, and other recommended and generally accepted good engineering practices.

FERC staff evaluated the adequacy of the general hazard detection type, location, and layout to ensure adequate coverage to detect cryogenic spills, flammable and toxic vapors, and fires near potential release sources (i.e., pumps, compressors, sumps, trenches, flanges, and instrument and valve connections). FERC staff have also reviewed the cause-and-effect matrices that show which conditions would initiate an alarm, shutdown, depressurization, or other action based on the FEED. However, RG LNG provided a table instead of a fire and gas system cause-and-effect matrices with details on how each detector would initiate an alarm, shutdown, depressurization, or conduct other action. Therefore, we recommend in section 4.12.1.7 that RG LNG provide, for review and approval, the cause-and-effect matrices for process

instrumentation, fire and gas detection system, and emergency shutdown system. In addition, RG LNG indicated that battery rooms would be equipped with hydrogen detectors, however the hydrogen detectors were not listed in the hazard detection lists or shown on the hazard detection drawings. Given the propensity of hydrogen to ignite and generate damaging overpressures, we recommend in section 4.12.1.7 that RG LNG demonstrate adequate ventilation and detection in the battery rooms to mitigate hydrogen build-up from battery off-gas and to install hydrogen detectors. Furthermore we recommend in section 4.12.1.7 that RG LNG file a hazard detection study to evaluate the effectiveness of their flammable and combustible gas detection, and flame and heat detection systems in accordance with ISA 84.00.07 or equivalent methodologies. This evaluation would need to demonstrate that 90 percent or more of releases (unignited and ignited) that could result in an offsite or cascading impact would be detected by two or more detectors and result in isolation and de-inventory within 10 minutes. The analysis should take into account the set points, voting logic, wind speeds, and wind directions. In addition, we recommend in section 4.12.1.7 that RG LNG provide additional information, for review and approval, on the final design of all hazard detection systems (e.g., manufacturer and model, elevations, set points, etc.) and hazard detection layout drawings.

If the Project is authorized, constructed, and operated, RG LNG would install hazard detectors according to its specifications, and we recommend in section 4.12.1.7 that Project facilities be subject to periodic inspections during construction to verify hazard detectors and ESD pushbuttons are appropriately installed per approved design and functional based on cause-and-effect matrices prior to introduction of hazardous fluids. In addition, we recommend in section 4.12.1.7 that Project facilities be subject to regular inspections throughout the life of the facility to verify hazard detector coverage and functionality is being maintained and are not being bypassed without appropriate precautions.

Hazard Control

If ignition of flammable vapors occurred, hazard control devices would be installed to extinguish or control incipient fires and releases, and would meet NFPA 59A (2001), 10, 17, 2001, and other recommended and generally accepted good engineering practices. FERC staff evaluated the adequacy of the number and availability of handheld, wheeled, and fixed fire extinguishing devices throughout the site based on the FEED. FERC staff also evaluated whether the spacing of the fire extinguishers would meet NFPA 10 and agent type and capacities meet NFPA 59A (2009 and later editions). The hazard control plans appeared to meet NFPA 10 travel distances to most components containing flammable or combustible fluids (Class B) for handheld fire extinguishers (30 to 50 feet) and wheeled extinguishers (100 feet) and NFPA 10 travel distance to most other components that could pose an ordinary combustible hazard (Class A) or associated electrical (Class C) hazard for handheld extinguishers (75 feet). Buildings also appear to be provided with handheld extinguishers that appear to satisfy NFPA 10 requirements, including placement at each entry/exit. The agent type (potassium bicarbonate) and agent storage capacities for wheeled (minimum 125 pounds [lb]) and for handheld extinguishers (minimum 20 lb) also appear to meet NFPA 59A requirements. In addition, travel distances, installation heights, visibility, flow rate capacities, and other requirements should be confirmed in final design and in the field where design details, such as manufacturer, obstructions, and elevations, would be better known. Therefore, we recommend in section 4.12.1.7 that RG LNG files, for review and approval, the final design of these systems (e.g.,

manufacturer and model, elevations, flowrate, capacities, etc.) demonstrating they would meet NFPA 10 and where the final design could change as a result of these details or other changes in the final design of the Project.

In addition, FERC staff evaluated whether clean agent systems would be installed in all electrical switchgear, and instrumentation buildings systems in accordance with NFPA 2001. RG LNG would install clean agent fire suppression systems in accordance with NFPA 2001 in buildings that house electrical and control equipment such as the control room, jetty monitoring buildings, and local equipment rooms. RG LNG also indicated that only carbon dioxide extinguishers would be provided in the electrical substations and it is not clear if fixed fire suppression systems would be installed in each electrical substation. Therefore, we recommend in section 4.12.1.7 that RG LNG file a design that includes a fixed fire suppression system in each electrical substation. If the Project is authorized, constructed, and operated, RG LNG would install hazard control equipment, and we recommend in section 4.12.1.7 that Project facilities be subject to periodic inspections during construction to verify hazard control equipment is installed in the field and functional prior to introduction of hazardous fluids. In addition, we recommend in section 4.12.1.7 that Project facilities be subject to regular inspections throughout the life of the facility to verify in the field that hazard control coverage and is being properly maintained and inspected.

Passive Cryogenic and Fire Protection

If cryogenic releases or fires could not be mitigated from impacting facility components to insignificant levels, passive fire protection (e.g. fireproofing structural steel, cryogenic protection, etc.) should be provided to prevent failure of structural supports of equipment and pipe racks. DOT PHMSA incorporates NFPA 59A (2001) by reference in 49 CFR 193.2101, under Subpart C for design, 49 CFR 193.2301, under Subpart D for construction, 49 CFR 193.2401, under Subpart E for equipment, 49 CFR 193.2521, under Subpart F for operational records, and 49 CFR 193.2693, under Subpart G for maintenance records. NFPA 59A (2001) section 6.4.1 requires pipe supports, including any insulation systems used to support pipe whose stability is essential to plant safety, to be resistant to or protected against fire exposure, escaping cold liquid, or both, if they are subject to such exposure. We also note that 49 CFR 193.2801, under Subpart I for fire protection only incorporates sections 9.1 through 9.7 and 9.9 of NFPA 59A (2001), which requires an evaluation of methods necessary for protection of equipment and structures from effects of fire exposure, but does not reference requirements for passive cryogenic protection. In addition, NFPA 59A (2001) does not address passive cryogenic equipment or structures other than pipe supports. Moreover, NFPA 59A (2001) does not provide the criteria anywhere for determining if pipe supports, equipment, or structures are subject to cold liquid or fire exposures or the level of protection needed to protect the pipe supports, equipment, or structures against such exposures. Therefore, FERC staff evaluated whether passive cryogenic and fire protection would be applied to pressure vessels and structural supports to facilities that could be exposed to cryogenic liquids or to radiant heats of 4,000 Btu/ft²-hr or greater from fires with durations that could result in failures⁵³ and that they are specified in

⁵³ Pool fires from impoundments are generally mitigated through use of emergency shutdowns, depressurization systems, structural fire protection, and firewater, while jet fires are primarily mitigated through the use of emergency shutdowns, depressurization systems, and firewater with or without structural fire protection.

accordance with recommended and generally accepted good engineering practices, such as ISO 20088, API 2001, API 2010A, API 2218, ASCE/SFPE 29, ASTM E 84, ASTM E 2226, IEEE 1202, ISO 22899, NACE 0198, NFPA 58, NFPA 290, OTI 95 634, UL 723, UL 1709, and/or UL 2080, with a cryogenic temperature and duration and fire protection rating commensurate to the exposure.

To minimize the risk of cryogenic spills causing structural supports and equipment from cooling below their minimum design metal temperature to a point of failure, RG LNG would specify materials of construction that would not fail when exposed to a cryogenic release or would coat structural supports and equipment with materials that would be cryogenic resistant. In addition, RG LNG would generally locate cryogenic equipment away from non-cryogenic process areas and would direct cryogenic releases to remote impoundment basins. However, additional details were not provided on exact locations or equipment that would and would not be protected from cryogenic releases or the performance characteristics of the passive cryogenic protection. Therefore, we recommend in section 4.12.1.7 that RG LNG file drawings and specifications for the cryogenic structural protection and calculations or test results (e.g., ISO 20088) that demonstrate the effectiveness of the cryogenic structural protection.

To minimize the risk of pool and jet fires causing structural supports and equipment from heating above their maximum design metal temperatures to a point of failure, RG LNG would specify materials of construction that would not fail when exposed to a fire or would install structural fire protection. In addition, RG LNG would mound the refrigerant storage tanks to prevent cascading damage (i.e., BLEVEs) by protecting the refrigerant storage tanks from excessive radiant heat from nearby jet or pool fires. RG LNG indicated the structural fire protection would meet API 2218, UL 1709, and other recommended and generally accepted good engineering practices. API 2218 requires structural fire protection in certain areas and also recommends fire envelopes be defined based on potential fire scenarios for defining where passive fire protection is needed. API 2218 also recommends the use of UL 1709 for performance requirements of passive fire protection in areas that are determined to be subjected to pool fires and provides more limited guidance on defining what jet fire scenarios to consider or the performance requirements of passive fire protection. However, API 2218 does not define the pool fire or jet fire scenarios or the radiant heats to be used to determine the extent of passive fire protection. Therefore, we recommend in section 4.12.1.7 that RG LNG file drawings and specifications for the passive fire protection and calculations or test results (e.g., ISO 22899, NFPA 290, OTI 95 634, etc.) that demonstrate the effectiveness of the passive fire protection. We also recommend that passive protection be defined based on scenarios that could lead to offsite impacts or cascading damage and that structural supports may fail as low as 4,900 Btu/ft²-

hr⁵⁴ and pressurized equipment may fail as low as 4,000 Btu/ft²-hr⁵⁵, and recognize pool fire tests under UL 1709 are for 65,000 Btu/ft²-hr (2,000°F) in 5 minutes and a 1 hour duration, which would provide thicker passive protection than may be necessary to prevent failure in some areas and thinner passive protection than may be necessary to prevent failure in other areas. We also note the application of fireproofing is sometimes prescribed in API 2218 to be 20 to 40 feet high, which may be less than or more than a pool fire height or jet fire flame length. Therefore, we also recommend in section 4.12.1.7 that RG LNG file a detailed quantitative analysis to demonstrate that adequate mitigation would be provided for each significant component within the 4,000 Btu/ft²-hr zone from pool or jet fires that could cause failure of the component. Trucks at the truck loading/unloading areas should be included in the analysis. A combination of passive and active protection for pool fires and passive and/or active protection for jet fires should be provided and demonstrate the effectiveness and reliability. Effectiveness of passive mitigation should be supported by calculations for the thickness limiting temperature rise and active mitigation should be justified with calculations demonstrating flow rates and durations of any cooling water would mitigate the heat absorbed by the vessel. In addition, we recommend in section 4.12.1.7 that RG LNG file the final design of these mitigation measures, for review and approval, to demonstrate cascading events would be mitigated.

RG LNG also indicated that electrical transformers would either be separated from other transformers or have fire rated barriers to prevent cascading damage. However, no additional details were provided. Therefore, we recommend in section 4.12.1.7 that RG LNG either separate or provide fire walls for electrical transformers in accordance with NFPA 850 or equivalent that would prevent cascading damage.

If the Project is authorized, constructed, and operated, RG LNG would install structural cryogenic and fire protection according to its design, and we recommend in section 4.12.1.7 that Project facilities be subject to periodic inspections during construction to verify structural cryogenic and fire protection is properly installed in the field as designed prior to introduction of

⁵⁴ FERC staff's heat impact preliminary analyses indicate most carbon structural steels (e.g., ASTM A36), will begin to have a noticeable loss of strength at 570°F (300°C), lose approximately 1/3 of strength at 840°F (450°C), and lose approximately 1/2 of strength at 1,000°F (540°C). These temperatures would correspond to black body radiant heats of approximately 2,000 Btu/ft²-hr (6.1 kW/m²), 4,900 Btu/ft²-hr (15.5 kW/m²), and 7,750 Btu/ft²-hr (24.5 kW/m²), respectively, and the latter radiant heats may correspond to when structural steel begins to exceed yield strengths and suffer possible structural damage based on allowable stress/strength designs in structural and mechanical design codes (e.g., ASCE 7, AISC 360, ASME B31.3, ASME BPVC, etc.), which most commonly limit stresses to 1/2 to 2/3 of yield strength. In addition, these values are in line with NFPA 59A (2016 edition and 2019 editions) that recommend similar temperature and corresponding radiant heats for steel, ABS Consulting, *Consequence Assessment Methods for Incidents Involving Release from Liquefied Natural Gas Carriers*, 2004 that reports long term exposures at approximately 8,000 Btu/ft²-hr (25 kW/m²) steel surfaces experience serious dislocation as well as paint peeling, and structural elements undergo substantial deformation according to damage resulting from thermal radiation for various materials, and Sandia National Laboratories, *Guidance on Risk Analysis and Safety Implications of a Large Liquefied Natural Gas (LNG) Spill Over Water*, 2004, that reports durations of more than 10 minutes at approximately 12,000 Btu/ft²-hr causes temperatures to rise to 980°F (530°C) and result in 25 to 40 percent loss in steel strength and damages structures.

⁵⁵ FERC staff recognize that pressurized equipment in accordance with ASME BPVC allows for pressure relief valves to pressures to rise to 1.2 times the design pressure, which would lower the pressure in the vessel to less than the bursting pressure of typically 3 to 4 times the design pressure but adds stress to the equipment above normal design conditions, and causes a reduction in temperature and subsequent reduction in radiant heat from 4,900 Btu/ft²-hr to 4,000 Btu/ft²-hr for when pressurized equipment may fail. We also recognize that 4,000 Btu/ft²-hr is a commonly used endpoint in fire analyses.

hazardous fluids. In addition, we recommend in section 4.12.1.7 that Project facilities be subject to regular inspections throughout the life of the facility to continue to verify that passive protection is being properly maintained.

Firewater Systems

RG LNG would also provide firewater systems, including remotely-operated firewater monitors, sprinkler systems, fixed water spray systems, and firewater hydrants and hoses for use during an emergency to cool the surface of storage vessels, piping, and equipment exposed to heat from a fire. These firewater systems would be designed, tested, and maintained to meet NFPA 59A (2001), 13, 14, 15, 20, 22, and 24 requirements. FERC staff evaluated the adequacy of the general firewater or foam system coverage, and the appropriateness of the associated firewater demands of those systems based on potential fire scenarios to size the firewater and foam pumps. RG LNG provided firewater coverage drawings for the firewater monitors, hydrants, and deluge systems throughout the plant that seemed to adequately cover facilities handling flammable and combustible materials with the exception of the LNG storage tank. RG LNG contends that the full-containment tanks are designed to withstand an adjacent tank roof top fire. However, there are other sources of fire that could impact the LNG storage tank, such as pool or jet fires at the base of the LNG storage tank. Therefore, we recommend in section 4.12.1.7 that RG LNG provide firewater coverage of the LNG storage tank for potential pool or jet fires that may impact the tank. In addition, the firewater design should account for obstructions such as pipe racks, tanks, vessels, or equipment that could obstruct firewater coverage. In addition, RG LNG provided firewater demand calculations based on the most demanding scenario plus a hose allowance of 1,000 gallons per minute in accordance with NFPA 59A. The scenarios were largely based on water spray system design densities and surface areas and waterflow requirements for foam systems, or an assumed number of monitors depending on the capacity of the monitor. However, RG LNG did not consider the simultaneous need for deluge systems and hose systems beyond the 1,000 gallons per minute allowance that may be needed to reach and cool equipment and did not demonstrate whether the number and capacity of the monitors would be sufficient to reach and cool exposed surfaces of equipment subject to radiant heat from a fire that could fail the equipment. Therefore, we recommend in section 4.12.1.7 that RG LNG provide sufficient firewater coverage and demand to reach and cool exposed surfaces subjected to a radiant heat from a fire that could fail the equipment based on throw distances, design densities, and surface areas that are needed to reach and cool equipment.

Other fire protection systems would also be in accordance with NFPA 59A, including a water mist system installed in gas turbine enclosures in accordance with NFPA 750, a low expansion foam system and a high expansion foam system in accordance with NFPA 11, and an onsite foam fire truck in accordance with NFPA 1901 to suppress hydrocarbon spills and fires as well as reduce vaporization rates from LNG pools. We recommend in section 4.12.1.7 that RG LNG file the final design, for review and approval, of these systems.

FERC staff also assessed whether the reliability of the firewater pumps and firewater source or onsite storage volume would be appropriate. Firewater would be supplied by electric main firewater pumps from an onsite fresh water tank and diesel backup firewater pumps with diesel day tanks provided on the ship channel if the fresh water tank is depleted and would meet NFPA 20. RG LNG indicates in its fire protection evaluation report that a dedicated firewater

tank would be provided and in its codes and standards list that it would meet NFPA 22. However, the fire water tank data sheet used for firewater supply denotes the tank would be designed to API 650, and does not make reference to NFPA 22. In addition, the fire protection evaluation report does not make reference to NFPA 22. Therefore, we recommend in section 4.12.1.7 that RG LNG design the firewater tank in accordance with NFPA 22, including, but not limited to requirements for inflow piping refilling the tank within 8 hours, higher wall thicknesses, venting, manholes, anti-vortex plates, and discharge requirements, or justify how API 650 provides an equivalent or better level of safety.

If the Project is authorized, constructed, and operated, RG LNG would install the firewater and foam systems as designed, and we recommend in section 4.12.1.7 that Project facilities be subject to periodic inspections during construction and that companies provide results of commissioning tests to verify the firewater and foam systems are installed and functional as designed prior to introduction of hazardous fluids. In addition, we recommend in section 4.12.1.7 that Project facilities be subject to regular inspections to ensure firewater and foam systems are being properly maintained and tested throughout the life of the LNG Terminal.

Geotechnical and Structural Design

RG LNG provided geotechnical and structural design information for its facilities to demonstrate the site preparation and foundation designs would be appropriate for the underlying soil characteristics and to ensure the structural design of the Project facilities would be in accordance with federal regulations, standards, and recommended and generally accepted good engineering practices. The application focuses on the resilience of the Project facilities against natural hazards, including extreme geological, meteorological, and hydrological events, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism.

Geotechnical Evaluation

FERC regulations under 18 CFR 380.12 (h) (3) require geotechnical investigations to be provided. In addition, FERC regulations under 18 CFR 380.12 (o) (14) require an applicant demonstrate compliance with regulations under 49 CFR 193 and NFPA 59A (2001). If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. DOT regulations incorporate by reference NFPA 59A (2001). NFPA 59A (2001) section 2.1.4 requires soil and general investigations of the site to determine the design basis for the facility. However, no additional requirements are set out in 49 CFR 193 or NFPA 59A on minimum requirements for evaluating existing soil site conditions or evaluating the adequacy of the foundations, therefore FERC staff evaluated the existing site conditions, geotechnical report, and proposed foundations to ensure they are adequate for the LNG facilities as described below.

RG LNG contracted Fugro Consultants, Inc. (Fugro) to conduct geotechnical investigations and report to evaluate existing soil site conditions and proposed foundation design for the Project. During the investigation, the facility was subdivided into two regions, Area 1 and Area 2. The average elevation of the existing grade in Area 1 ranged from +0.2 to +18.5 feet

NAVD 88, and Area 2 ranged from +3.9 to 9.3 feet NAVD 88. The site would be cleared, grubbed, and prepared using standard earth-moving and compaction equipment. Site preparation would result in a final grade elevation being raised to +10 to +12 feet NAVD 88 with varying amounts of fill that would be added across the site. The facility would be surrounded by a storm surge protective berm with the elevation ranging from +17 to +19 feet NAVD 88. The existing LNG Terminal site is generally flat with elevations ranging from +5 to +10 feet NAVD 88, except for piles of material dredged from the adjacent BSC and three lomas. Lomas are clay dunes that developed through wind-driven depositional processes (Bowler 1973). The elevations of these features reach +25 feet NAVD 88.

Fugro conducted 20 soil borings to depths ranging from 20 feet to 300 feet below existing grade, 35 cone penetration tests (CPTs) to depths ranging from 50 feet to 172 feet (or to refusal) below existing grade, 10 seismic cone penetration tests (SCPTs) to depths ranging from 84 feet to 165 feet below existing grade, 4 temporary piezometers to measure groundwater levels, and over 5 different tests on more than 2,800 recovered soil samples, including classification tests (water content, Atterberg liquid and plastic limits, sieve tests), compression tests, corrosion potential tests (pH, sulfate, chloride, electrical resistivity) in general accordance with pertinent ASTM standards. In addition to the initial geotechnical investigation, Fugro conducted an additional 47 geophysical borings to further investigate a fault identified during initial boring within the proposed planned site area. Geophysical borings were performed to depths ranging from 320 feet to 350 feet below existing grade.

FERC staff evaluated the geotechnical investigation to ensure the adequacy in the number, coverage, and types of the geotechnical borings, CPTs, SCPTs, and other tests, and found them to adequately cover most major facilities, including the marine facilities, liquefaction areas, pretreatment areas, flare system, buildings, power generation, and berms at the site, however, an insufficient number of borings were performed beneath the tanks and facilities. Therefore, we recommend in section 4.12.1.7 that RG LNG conduct additional borings underneath the locations of the tanks to affirm or better characterize underlying conditions and validate the use of shallow foundations. FERC staff will continue its review of the results of the geotechnical investigation to ensure foundation designs are appropriate prior to construction of final design and throughout the life of the facilities.

Based on the test borings conducted, the subsurface profile of Area 1 consists of a layer of fill material extending to a depth of approximately 18 feet below the ground surface, which is designated as Stratum 1. Stratum 1 is underlain by a layer of natural soft to very still clay soils with varying amounts of sand and silt, Stratum 2, extending to a depth of approximately 55 feet below the ground surface. Below Stratum 2, the underlying strata are: Stratum 3, a natural granular layer consisting of loose to very dense sand, clayey sand, and silty sand extending to a depth of approximately 90 feet below existing grade; Stratum 4, a natural firm to hard cohesive layer extending to a depth of approximately 120 feet; Stratum 5, a natural very dense sand and silty sand layer extending to a depth of approximately 140 feet; Stratum 6, a natural stiff to hard cohesive layer extending to a depth of approximately 150 feet. Stratum 6 in Area 1 is underlain by Stratum 7, a natural very dense sand, clayey sand, and silty sand, extending to a depth of approximately 260 feet below the ground surface. Below Stratum 7 is Stratum 8, a natural very stiff to hard cohesive layer extending to a depth of approximately 300 feet below the ground surface. Test borings in Area 2 were terminated at 150 feet below existing ground surface

consists of Stratums 1 through 6, however not all the stratums terminate at the same depths as those in Area 1. Stratum 1, 2, 3, 4, 5, and 6, terminate at depths of approximately 18 feet, 55 feet, 90 feet, 110 feet, 130 feet, and 150 feet below existing ground surface respectively. Measurements from the temporary piezometers show groundwater levels varied from -0.5 feet and +1.5 feet NAVD 88.

Based on the subsurface conditions for the LNG facility, RG LNG is proposing to support the LNG tanks and most of the facility structures on mat foundations placed on improved ground. Fugro provided considerations for ground improvement techniques including preloading, deep soil mixing or grouting, Vibro Replacement with stone columns, dynamic compaction, and Vibrofloatation. In areas where ground improvement is utilized, RG LNG is proposing to utilize deep soil mixing ranging in depth of 10 to 40 feet, depending on the foundation loading and soil suitability for ground improvement, to bring foundations capacities and settlements within acceptable limits. Structures that are located in areas that are not suitable for deep soil mixing due to specific load requirements or would perform unsatisfactorily with dynamic loads are proposed to be placed on 24-inch diameter 60 foot long auger cast-in-place piles.

Dredging would be required for the LNG ships to traverse to the terminal as well as for the construction of the marine facilities. The existing shoreline would be excavated, dredged, and sloped during construction. The post-construction shoreline would be approximately 500 feet east of the current location. To prevent slumping of the dredged slope, maintain the berthing line position, and provide structural integrity support to the landside facilities, the excavated shoreline would be reinforced with rip-rap armoring. The increase in large ship traffic within the BSC is also considered for shoreline erosion. The proposed rip-rap armoring would minimize the potential for erosion where the shoreline would be excavated.

The results of RG LNG's geotechnical investigation at the Project site indicate that subsurface conditions are suitable for the proposed facilities, if proposed site preparation, foundation design, and construction methods are implemented in addition to the satisfaction of proposed recommendations.

Structural and Natural Hazard Evaluation

FERC regulations under 18 CFR 380.12 (m) requires applicants address the potential hazard to the public from failure of facility components resulting from accidents or natural catastrophes, evaluate how these events would affect reliability, and describe what design features and procedures that would be used to reduce potential hazards. In addition, 18 CFR 380.12 (o) (14) require an applicant to demonstrate how they would comply with 49 CFR 193 and NFPA 59A. DOT regulations under 49 CFR 193 have some specific requirements on designs to withstand certain loads from natural hazards and also incorporates by reference NFPA 59A (2001 and 2006) and ASCE 7-05 and ASCE 7-93 via NFPA 59A (2001). NFPA 59A (2001) section 2.1.1 (c) also requires that RG LNG consider the plant site location in the design of the Project, with respect to the proposed facilities being protected, within the limits of practicality, against natural hazards, such as from the effects of flooding, storm surge, and seismic activities. This was covered in DOT PHMSA's LOD on 49 CFR 193 Subpart B. However, the LOD would not cover whether the facility is designed appropriately against these

hazards, which would be part of 49 CFR Part 193 Subpart C. If authorized, constructed, and operated, LNG facilities, as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. The marine facilities would be subject to 33 CFR 127, which requires if the waterfront facility handling LNG is in a region subject to earthquakes the piers and wharves must be designed to resist earthquake forces. In addition, Coast Guard regulations under 33 CFR 127 incorporates by reference certain portions of NFPA 59A (1994) and ASCE 7-88 via NFPA 59A (1994). However, Coast Guard regulations do not provide criteria for a region subject to earthquakes or the earthquake forces the piers and wharves are to withstand and NFPA 59A (1994) section referenced in 33 CFR 127 is for seismic design only and is applicable to stationary LNG containers, which would not be under 33 CFR 127. Therefore, we evaluated the basis of design for all facilities for all natural hazards under FERC jurisdiction, including those under DOT and Coast Guard jurisdiction.

If authorized, the proposed facilities would be constructed to the requirements in the 2006 International Building Code (IBC), ASCE 7-05, and ASCE 7-10 for seismic design. These standards require various structural loads to be applied to the design of the facilities, including live (i.e., dynamic) loads, dead (i.e., static) loads, and environmental loads. FERC staff also evaluated potential engineering design to withstand impacts from natural hazards, such as earthquakes, tsunamis, seiche, hurricanes, tornadoes, floods, rain, ice, snow, regional subsidence, sea level rise, landslides, wildfires, volcanic activity, and geomagnetism. In addition, we recommend in section 4.12.1.7 that RG LNG file final design information (e.g., drawings, specifications, and calculations) and associated quality assurance and control procedures with the documents stamped and sealed by the professional engineer-of-record.

If the Project is authorized, constructed, and operated, the company would install equipment in accordance with its final design. In addition, we recommend in section 4.12.1.7 that RG LNG file, for review and approval, settlement results during hydrostatic tests of the LNG storage containers and periodically thereafter to verify settlement is as expected and does not exceed the applicable criteria in API 620, API 625, API 653, and ACI 376.

Earthquakes, Tsunamis, and Seiche

FERC regulations under 18 CFR 380.12 (h) (5) requires evaluation of earthquake hazards based on whether there is potential seismicity, surface faulting, or liquefaction. Earthquakes and tsunamis have the potential to cause damage from shaking ground motion and fault ruptures. Earthquakes and tsunamis often result from sudden slips along fractures in the earth's crust (i.e., faults) and the resultant ground motions caused by those movements, but can also be a result of volcanic activity or other causes of vibration in the earth's crust. The damage that could occur as a result of ground motions is affected by the type/direction and severity of the fault activity and the distance and type of soils the seismic waves must travel from the hypocenter (or point below the epicenter where seismic activity occurs). To assess the potential impact from earthquakes and tsunamis, RG LNG evaluated historic earthquakes along fault locations and their resultant ground motions.

The Project is located within the Gulf Coast Basin geologic tectonic province. The province's sedimentary strata thickens toward the south, with salt domes and relatively shallow listric growth faults that runs parallel to the Gulf of Mexico Coastline and extended outside of

Texas. The USGS maintains a database containing information on surface and subsurface faults and folds in the United States that are believed to be sources of earthquakes of greater than 6.0 magnitude occurring during the past 1.6 million years (Quaternary Period) (USGS 2018a) RG LNG would not be near such faults, which are primarily on the West Coast. However, in the Gulf Coastal Plains, there are several hundred growth faults that are known or suspected to be active. Most of these growth faults are located within the Houston-Galveston area subsidence bowl, but many others are known to exist from Brownsville to east of New Orleans, Louisiana. Evidence of modern activity of these growth faults includes changes in elevation that can lead to damage to pavement, buildings, and other structures. Subsidence has also been recorded occurring naturally through fault movements and compaction/consolidation of Holocene deposits. Despite the evidence of movement of growth faults, movement within the fault system has been classified as a general creep as opposed to the breaking of rocks, which is often associated with earthquake events (Stevenson and McCulloh 2001).

RG LNG hired Fugro to perform a site-specific fault and seismic analysis for the Project, involving field investigations and subsequent data evaluation. The initial growth fault study identified a higher than average potential susceptibility for growth faults. This led to a more detailed fault study that mapped an identified growth fault in the southwest portion of the site. The average regional subsidence being observed is less than 0.05 feet over a 33-year study period, or 0.018 inches per year according to the Texas Department of Water Resources (TDWR). However, due to the identified growth fault, Fugro recommends accounting for additional vertical movement of up to 0.1 inch per year.

In addition, Fugro developed several recommendations for locating major structures away from the fault, designing nearby structures adjacent to the fault to take into account displacements in all three directions along the fault over time, and orienting structures perpendicular to the strike face of the fault which has a dip angle between 63 degrees. Fugro also recommended that structures within the fault hazard zone be placed on shallow foundations, establish threshold movement levels, implement a routine monitoring plan with permanent benchmarks and survey monuments, and include an action plan should threshold levels be exceeded. FERC staff agree with Fugro's recommendations and we recommend in section 4.12.1.7 that RG LNG adopt these recommendations in its design and throughout the life of the LNG Terminal.

While the presence of major tectonic faults and growth faults can require special consideration, the presence or lack of major tectonic faults identified near the site does not define whether earthquake ground motions can impact the site because ground motions can be felt large distances away from an earthquake hypocenter depending on number of factors.

To address the potential ground motions at the site, DOT regulations in 49 CFR 193.2101, under Subpart C require that field-fabricated LNG tanks must comply with NFPA 59A (2006), section 7.2.2 and be designed to continue safely operating with earthquake ground motions at the ground surface at the site that have a 10 percent probability of being exceeded in 50 years (475 year mean return interval), termed the operating basis earthquake. In addition, DOT regulations in 49 CFR 193.2101, under Subpart C require that LNG tanks be designed to have the ability to safely shutdown when subjected to earthquake ground motions which have a 2 percent probability of being exceeded in 50 years (2,475 year mean return interval) at the ground

surface at the site (termed the safe shutdown earthquake [SSE]). DOT regulations in 49 CFR 193.2101, under Subpart C also incorporate by reference NFPA 59A (2001) Chapter 6, which require piping systems conveying flammable liquids and flammable gases with service temperatures below -20 °F, be designed as required for seismic ground motions. If authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, would be subject to the DOT's inspection and enforcement programs.

In addition, FERC staff recognizes RG LNG would also need to address hazardous fluid piping with service temperatures at -20 °F and higher and equipment other than piping, and LNG storage (shop built and field-fabricated) containers. We also recognize the current FERC regulations under 18 CFR 380.12 (h) (5) continue to incorporate National Bureau of Standards Information Report 84-2833. Report 84-2833 provides guidance on classifying stationary storage containers and related safety equipment as Category I and classifying the remainder of the LNG Terminal structures, systems, and components as either Category II or Category III, but does not provide specific guidance for the seismic design requirements for them. Absent any other regulatory requirements, this guidance recommends that other LNG structures classified as Seismic Category II or Category III be seismically designed to satisfy the Design Earthquake and seismic requirements of the ASCE 7-05 in order to demonstrate there is not a significant impact on the safety of the public. ASCE 7-05 is recommended as it is a complete ANSI consensus design standard, its seismic requirements are based directly on the National Earthquake Hazards Reduction Program Recommended Provisions, and it is referenced directly by the IBC. Having a link directly to the IBC and ASCE 7 is important to accommodate seals by the engineer-of-record because the IBC is directly linked to state professional licensing laws while the Program Recommended Provisions are not.

The geotechnical investigations of the existing site performed by Fugro indicate the site is classified as Site Class E⁵⁶ based on a site average shear wave velocity that ranged between 541 and 701 feet per second in Area 1, and between 456 and 646 feet per second in Area 2 (Fugro 2015a). This is in accordance with ASCE 7-05, which is incorporated directly into 49 CFR 193 for shop fabricated containers less than 70,000 gallons and via NFPA 59A (2006) for field-fabricated containers.⁵⁷ This is also in accordance with IBC (2006). Sites with soil conditions of this type would experience significant amplifications of surface earthquake ground motions. However, due to the absence of a major fault in proximity to the site and lower ground motions, the seismic risk to the site is considered low.

Fugro performed a site-specific seismic hazard study for the site. The study concluded that the site would have an OBE PGA of 0.008 g and 0.01 g for Area 1 and 2, respectively, and a SSE PGA of 0.04 g and 0.048 g (Fugro 2015a). The study also concluded that earthquake ground motions at the ground surface of the site that have a 2 percent probability of being

⁵⁶ There are six different site classes in ASCE 7-05, A through F, that are representative of different soil conditions that impact the ground motions and potential hazard ranging from Hard Rock (Site Class A), Rock (Site Class B), Very dense soil and soft rock (Site Class C), Stiff Soil (Site Class D), Soft Clay Soil (Site Class E), to soils vulnerable to potential failure or collapse, such as liquefiable soils, quick and highly sensitive clays, and collapsible weakly cemented soils (Site Class F).

⁵⁷ Site Class E is analogous Soil Profile Type S₄ criteria in ASCE 7-93, which is incorporated into 49 CFR Part 193 via NFPA 59A (2001) for piping systems conveying flammable liquids and flammable gases with service temperatures below 20 °F.

exceeded in 50 years have a 0.2-second spectral acceleration value of 0.09 g for Area 1 and 0.11 g for Area 2, and a 1.0-second spectral acceleration at the site is 0.09 g for Area 1 and 0.09 g for Area 2.

Based on the design ground motions for the site and the importance of the facilities, the facility seismic design is assigned Seismic Design Category A in accordance with the IBC (2006) and ASCE 7-05. These ground motions are relatively low compared to other locations in the United States. FERC staff verified the ground accelerations using Applied Technology Council and USGS calculators, which indicate SSE PGA of 0.039 g (USGS 2018b, Applied Technology Council 2018).

ASCE 7-05 also requires determination of the Seismic Design Category based on the Occupancy Category (or Risk Category in ASCE 7-10 and 7-16) and severity of the earthquake design motion. The Occupancy Category (or Risk Category) is based on the importance of the facility and the risk it poses to the public.⁵⁸

FERC staff has identified the Project as a Seismic Design Category A based on the ground motions for the site and an Occupancy Category (or Risk Category) of III or IV, this seismic design categorization would appear to be consistent with the IBC (2006) and ASCE 7-05 (and ASCE 7-10).

Seismic events can also result in soil liquefaction in which saturated, non-cohesive soils temporarily lose their strength/cohesion and liquefy (i.e., behave like viscous liquid) as a result of increased pore pressure and reduced effective stress when subjected to dynamic forces such as intense and prolonged ground shaking. Areas susceptible to liquefaction may include saturated soils that are generally sandy or silty. Typically, these soils are located along rivers, streams, lakes, and shorelines or in areas with shallow groundwater. The site-specific seismic study indicates sandy layers between -45 and -85 feet below grade; however, the potential for a large enough seismic event near enough to cause soil liquefaction in the Project area is low. Also, LNG facilities at the site would be constructed on either a site improved with deep soil mixing or in some cases deep foundations, which would mitigate any potential impacts of soil liquefaction. Should soil improvement be required to counteract soil liquefaction, RG LNG would utilize ground improvement techniques (e.g., densification, cementitious strengthening) or removal and replacement of existing soils with non-liquefiable material.

⁵⁸ ASCE 7-05 defines Occupancy Categories I, II, III, and IV. Occupancy Category I represents facilities with a low hazard to human life in even of failure, such as agricultural facilities; Occupancy Category III represents facilities with a substantial hazard to human life in the event of failure or with a substantial economic impact or disruption of day to day civilian life in the event of failure, such as buildings where more than 300 people aggregate, daycare facilities with facilities greater than 150, schools with capacities greater than 250 for elementary and secondary and greater than 500 for colleges, health care facilities with 50 or more patients, jails and detention facilities, power generating stations, water treatment facilities, telecommunication centers, hazardous facilities that could impact public; Occupancy Category IV represents essential facilities, such as hospitals, fire, rescue, and police stations, emergency shelters, power generating stations and utilities needed in an emergency, aviation control towers, water storage and pump structures for fire suppression, national defense facilities, and hazardous facilities that could substantially impact public; and Occupancy Category II represents all other facilities. ASCE 7-10 changed the term to Risk Categories I, II, III, and IV with some modification.

Seismic events in waterbodies can also cause tsunamis or seiches by sudden displacement of the sea floors in the ocean or standing water. Tsunamis and seiche may also be generated from volcanic eruptions or landslides. Tsunami wave action can cause extensive damage to coastal regions and facilities. The Terminal site's low-lying position would make it potentially vulnerable were a tsunami to occur. There is little evidence to suggest that the Gulf of Mexico is prone to tsunami events, but the occurrence of a tsunami is possible. Two did occur in the Gulf of Mexico in the early 20th century and had wave heights of 3 feet or less (USGS 2014b), which is not significantly higher than the average breaking wave height of 1.5 feet (Owen 2008). Hydrodynamic modeling conducted off the coast of south Texas in 2004 indicated that the maximum tsunami run-up could be as high as 12 feet above mean sea level. No earthquake generating faults have been identified that are likely to produce tsunamis, despite recorded seismic activity in the area.

The potential for tsunamis associated with submarine landslides is more likely a source in the Gulf of Mexico and remains a focus of government research (USGS 2009). RG LNG's *Seismic and Fault Study* report included a Tsunami Hazard Assessment for the Project area. There are four main submarine landslide hazard zones in the Gulf of Mexico including the Northwest Gulf of Mexico, Mississippi Canyon and Fan, the Florida Escarpment, and the Campeche Escarpment (USGS 2009). Based on modeling and limited historical data, it is estimated that tsunamis generated from landslides would be significantly less than the hurricane design storm surge elevations discussed below, so any tsunami hazard has been considered in design.

Hurricanes, Tornadoes, and other Meteorological Events

Hurricanes, tornadoes, and other meteorological events have the potential to cause damage or failure of facilities due to high winds and floods, including failures from flying or floating debris. To assess the potential impact from hurricanes, tornadoes, and other meteorological events, RG LNG evaluated such events historically. The severity of these events are often determined on the probability that they occur and are sometimes referred to as the average number years that the event is expected to re-occur, or in terms of its mean return/recurrence interval.

Because of its location, the Project site would likely be subject to hurricane force winds during the life of the Project. RG LNG stated that the Project would be designed to ASCE 7-05 using Allowable Stress Design as opposed to the strength design. RG LNG indicates the design wind speed using ASCE 7-05 Allowable Stress Design for LNG facilities and hazardous structures, which would be categorized as Occupancy Category III and IV, would be 145 mph 3-second gust. When converting the Allowable Stress Design to a strength design, this would equate to a 183 mph 3-second gust or 150 mph sustained wind speed and be approximately equivalent to a 10,000 year mean return interval or have a 0.11 percent probability of exceedance in a 50-year period for the site. The 183 mph 3-second gust equates to a strong Category 4 Hurricane using the Saffir-Simpson scale (130-156 mph sustained winds, 166-195 mph 3-second gusts). RG LNG also indicates the design wind speed for other non-hazardous structures, which would be categorized as Occupancy Category I and II, would be 130 mph 3-second gust per ASCE 7-05 Figure 6-1A. However, FERC staff found that when reviewing Figure 6-1A of ASCE 7-05, the Project location is closest to the 140 mph 3-second gust isocontour.

FERC staff also utilized the Applied Technology Council hazard tool, which interpolates site-specific wind speed using ASCE's 3-second gust wind speed, to evaluate the ASCE 7-05 the 3-second gust wind speed and found it to be 141 mph. We also recognize ASCE 7-10 and ASCE 7-16 would require a 139 mph 3-second gust for Risk Category I non-hazardous structures and 149 mph 3-second gust for Risk Category II non-hazardous structures.

RG LNG must meet 49 CFR 193.2067, under Subpart B for wind load requirements for structures classified as LNG facilities. In accordance with the MOU, the DOT evaluated in its LOD whether RG LNG's proposed Project meets the DOT requirements under Subpart B. However, DOT has indicated structures that do not fall under the definition of LNG facilities in 49 CFR 193 would not be subject to the design wind speed requirements in 49 CFR 193.2067, under Subpart B. As a result, we recommend in section 4.12.1.7 that RG LNG specify facilities that are not covered by DOT PHMSA's LOD be designed to withstand basic wind speeds in accordance with ASCE 7-16 based on the appropriate Risk Category. If the Project is authorized, constructed, and operated, LNG facilities, as defined in 49 CFR 193, would be subject to the DOT's inspection and enforcement programs. Final determination of whether the facilities are in compliance with the requirements of 49 CFR 193 Subpart B would be made by the DOT staff.

In addition, as noted in the limitation of ASCE 7-05 section 6.5.4.3 and ASCE 7-10 section 26.5.4, tornadoes were not considered in developing basic wind speed distributions. This leaves a potential gap in potential impacts from tornadoes. Therefore, FERC staff evaluated the potential for tornadoes. Appendix C of ASCE 7-05 makes reference to American Nuclear Society 2.3 (1983 edition), *Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites*. This document has since been revised in 2011 and reaffirmed in 2016 and is consistent with NUREG/CR-4461, *Tornado Climatology of the Contiguous U.S.*, Rev. 2 (NUREG 2007). These documents provide maps of a 100,000-mean-year return period for tornadoes using 2 degree latitude and longitude boxes in the region to estimate a tornado striking within 4,000 feet of an area. Figures 5-8 and 8-1 from NUREG/CR-4461 indicate a 100,000-year maximum tornado wind speeds would be approximately 114 mph 3-second gusts for the Project site location. Later editions of ASCE 7 (ASCE 7-10 and ASCE 7-16) make reference to International Code Council 500, *Standard for Design and Construction of Storm Shelters*, for 10,000-year tornadoes. However, the International Code Council 500 maps were conservatively developed based on tornadoes striking regions and indicate a 200 mph 3-second gust for a 10,000-year event, which is higher than the 114 mph 3-second gust in American Nuclear Society 2.3 and NUREG/CR-4461.

As a result, we conclude the use of an equivalent 183 mph 3-second gust, is adequate for the LNG storage tanks and conservative from a risk standpoint for the other LNG and hazardous facilities. DOT provided a LOD on the Project's compliance with 49 CFR 193 Subpart B in regard to wind speed. This determination was provided to the Commission as further consideration to the Commission on its decision to authorize or deny the Project.

The DOT regulations in 49 CFR 193.2067, under Subpart B would require the impounding system for the LNG storage tanks to withstand impact forces from wind borne missiles. ASCE 7 also recognizes the facility would be in a wind borne debris region. Windborne debris has the potential to perforate equipment and the LNG storage tanks if not

properly designed to withstand such impacts. The potential impact is dependent on the equivalent projectile wind speed, characteristics of projectile, and methodology or model used to determine whether penetration or perforation would occur. However, no criteria are provided in 49 CFR 193 or ASCE 7 for these specific parameters. NFPA 59A (2016 and 2019) requires Comite Euro-International du Beton (CEB) 187 be used to determine projectile perforation depths. NFPA 59A (2013, 2016, and 2019) reference compliance with ACI 376, which also includes information to prevent perforation and suggested equations and references. However, none of the referenced standards include what projectiles and their characteristics should be considered. In order to address the potential impact, we recommend in section 4.12.1.7 that RG LNG provide a projectile analysis for review and approval to demonstrate that the outer concrete impoundment wall of a full-containment LNG tank could withstand wind borne projectiles prior to construction of the final design. The analysis should detail the projectile speeds and characteristics and method used to determine penetration or perforation depths. FERC staff would compare the analysis using established methods, such as CEB 187 and ACI 376 referenced documents, and compare the specified projectiles and speeds using other guidance, such as DOE and Nuclear Regulatory Commission guidance.

In addition, FERC staff evaluated historical tropical storm, hurricane, and tornado tracks in the vicinity of the Project facilities using data from the DHS Homeland Infrastructure Foundation Level Data and NOAA Historical Hurricane Tracker (DHS 2018; NOAA 2018c). Brownsville has had 30 tropical storms or hurricanes hit within 65 nautical miles since 1900, and Cameron County has been impacted by 10 hurricanes or tropical storms since 1900. The most recent major hurricane was Hurricane Bret, 1999, just north of Cameron County, which peaked as a Category (Cat) 4 hurricane with 144 mph sustained winds and made landfall as a Category 3 hurricane with 115 mph sustained winds.⁵⁹ Prior to Hurricane Bret, Cameron County was hit by Hurricane Allen (Cat 5 peak, Cat 3 landfall) in 1980, Hurricane Beulah (Cat 5 peak, Cat 5 landfall) in 1967 and two unnamed hurricanes in 1933 (Cat 5 peak, Cat 3 landfall) and 1916 (Cat 4 peak, Cat 4 landfall). Hurricanes in Cameron County have been observed to have peaked when reaching landfall with 161 mph sustained winds and to have produced storm surges up to 18 feet. The estimated return period for a major hurricane passing within 50 nautical miles of the coast of Cameron County is about 30 years (NOAA 2016b).

Potential flood levels may also be informed from the FEMA Flood Insurance Rate Maps, which identifies Special Flood Hazard Areas (base flood) that have a 1 percent probability of exceedance in 1 year to flood (or a 100-year mean return interval) and moderate flood hazard areas that have a 0.2 percent probability of exceedance in 1 year to flood (or a 500-year mean return interval). According to the FEMA National Flood Hazard Layer, portions of the Project would be located in the 100-year and 500-year floodplain. In addition, according to FEMA flood hazard maps (2017a), the 100-year flood elevation at the Site is +9.6 feet NAVD 88 and the 500-year flood elevation is +13.5 feet NAVD 88. FERC staff recognizes that a 500 year flood event has been recommended as the basis of design for critical infrastructure in publications, including ASCE 24, *Flood Resistant Design and Construction*. Therefore, we believe it is good practice to design critical energy infrastructure to withstand 500-year event from a safety and reliability

⁵⁹ A major hurricane is defined as a hurricane that has been classified as Hurricane Category 3 or higher.

standpoint for the standing water elevation (SWEL) and wave crests. Furthermore, we determined the use of intermediate values from NOAA for sea level rise and subsidence is more appropriate for design and higher projections are more appropriate for planning in accordance with NOAA 2017,⁶⁰ which recommends defining a central estimate or mid-range scenario as baseline for shorter-term planning, such as setting initial adaptation plans for the next two decades and defining upper bound scenarios as a guide for long-term adaptation strategies and a general planning envelope. RG LNG has indicated that the facility would be designed to handle a 100-year storm surge without any wave overtopping, and would be designed to accommodate the wave overtopping that would occur from a 500-year storm surge.

RG LNG has proposed to construct an earthen berm and floodwalls around the perimeter of the site to minimize impacts associated with potential storm surges. The floodwall and berm are proposed to be designed with a crest elevation ranging between +17 feet and +19 feet NAVD 88. In addition, RG LNG has indicated that it would provide an additional 4 inches over-height margin to the crest elevations (so initial crest elevations will be 17.33 and 19.33 feet) to account for initial relative sea level rise concerns. RG LNG conducted a storm surge analysis that identified the storm surge elevation for the 100-year and 500-year events. Storm surge elevations were found to be 9.6 feet and 13.5 feet, respectively. Wave run-up calculations were carried out for the proposed berm and floodwall using the EurOtop overtopping formulations Technical Advisory Committee for Water Retaining structures methodology, as applied by FEMA. Wave crest elevations, including SWEL, would range between 11.3 and 12.8 feet NAVD 88 for 100-year storms and 15.9 feet to 17.8 feet NAVD 88 for 500-year storms. Analysis of a 500-year recurrence interval storm surge with worst-case levee overtopping volumes and associated rainfall over a 24-hour period indicates a maximum flood level associated with the overtopping of 10.5 feet NAVD 88 within the confines of the levee system. This would result in general inundation of the LNG Terminal site, but maximum water elevations would be 6 inches below the top of foundations of all equipment, piping, and buildings.

FERC staff also evaluated the design against a 500-year SWEL with a 500-year wave crest and sea level rise and subsidence from the 2018 FEMA Flood Insurance Study (FIS) for Cameron County, Texas (FEMA 2018) and the maximum envelope of water (MEOW) storm surge inundation maps generated from the Sea, Lake, and Overland Surge from Hurricanes (SLOSH) model developed by NOAA National Hurricane Center. RG LNG indicated that the anticipated sea level rise and subsidence for the LNG Terminal would be approximately 0.7 feet over the life of the Project. FERC staff found that utilizing COE online tool for estimating sea level rise and subsidence, the project could be subjected to a sea level rise and subsidence value of up to approximately 1 foot. Adding the 500-year storm surge, wave crest elevations, and sea level rise and subsidence results in a total elevation of between 16.9 feet to 18.8 feet. FERC staff evaluated RG LNG's proposed 500-year flood against the 2018 FEMA FIS for Cameron County (FEMA 2018), which provides various transection lines and associated 10-, 50-, 100-, and 500-year SWELs, 500-year wave envelopes, and 500-year wave effects along the length of the transection lines. The Project intersects with transection line 38, but the eastern face of the site is

⁶⁰ *Global And Regional Sea Level Rise Scenarios for the United States*, U.S. Department Of Commerce, NOAA, National Ocean Service Center for Operational Oceanographic Products and Services, January 2017.

most likely to receive the most severe storm surge is closest to transection line 45. Transection line 45 from the FIS transects the channel-side of the proposed site and has a maximum 500-year SWEL of 12.5 feet NAVD 88 and a maximum wave height of 4.3 feet NAVD 88. Typically, FEMA computes a wave crest as 70 percent of the total wave height above the still water level; that is, the 500-year wave effect is taken as 70 percent of 3 feet, or 2.1 feet. Adding the SWEL, wave crest elevation, and sea level rise and subsidence, results in a total elevation of +15.6 feet NAVD 88.

FERC staff also evaluated the storm surge using MEOW storm surge inundation maps generated from the SLOSH models developed by NOAA National Hurricane Center, a 500-year event would equate to a Category 2 Hurricane and from 0 feet to over 9 feet MEOW with most areas between 0 and 6 feet.⁶¹ This is predominantly lower than indicated in the 500-year FEMA maps. In addition, while NOAA seems to provide higher resolution of topographic features, it limits its SLOSH maps to storm surge levels at high tide above 9 feet. As a result, FERC staff evaluated the storm surge against other sources using SLOSH maps that indicate a similar upper range of 5 to 6 feet NAVD 88 MEOW for Category 2 Hurricanes, and also indicate 8 to 10 feet NAVD 88 MEOW for Category 3 Hurricanes, 11 to 14 feet NAVD 88 MEOW for Category 4 Hurricanes, and 15 to 18 feet NAVD 88 MEOW for Category 5 Hurricanes.⁶² This data suggests that RG LNG's design could withstand a Category 3 to 4 Hurricane storm surge SWEL equivalent to approximately a 17,000-year mean return interval. In addition, using wave heights of $0.78 \times \text{SWEL}$ for controlling waves and $0.49 \times \text{SWEL}$ for significant wave heights based on FEMA estimates would result in 4.7 feet controlling wave heights and 3.9 feet significant wave heights along the BSC. We also would expect the sea level rise to be closer to the 1.01 feet intermediate projection provided by NOAA. As a result of the SLOSH data and NOAA sea level rise projections, we would expect a berm height or site elevation of at least 10.7 feet along the BSC post-settlement. As a result, we conclude that the facility would be able to withstand storm surge without damage during a 500-year storm event. Furthermore, RG LNG has committed to a periodic perimeter levee elevation survey program for the life of the facility. This program would include the monitoring of the crest elevations of the perimeter berm and remediation actions such as placing additional material on top of the berm to maintain the crest to its design elevation.

The Texas and Louisiana Gulf Coast area is experiencing the highest rates of coastal erosion and wetland loss in the United States (Ruple 1993). The average coastal erosion rates is -1.2 meters per year between 2000 and 2012 along the Texas coastal shoreline, with South Padre Island experiencing a shoreline loss rate of -1.6 meters per year between 2000 and 2012 (McKenna 2014). Shoreline erosion could occur at the Project site and along the opposite shoreline as a result of waves, currents, and vessel wakes. To prevent erosion, new revetment in the form rip-rap would be installed in the dredged marine berth and maneuvering areas. Even though shoreline erosion is a concern at the site, the proposed mitigation measures would minimize erosion and scour impacts.

⁶¹ National Ocean and Atmospheric Administration. National Hurricane Center. *National Storm Surge Hazard Maps*, <https://www.nhc.noaa.gov/nationalsurge/>. Aug 2018.

⁶² Masters, J., Weather Underground, *Storm Surge Inundation Maps for the U.S. Coast*, https://www.wunderground.com/hurricane/surge_images.asp, March 2018.

Landslides and Other Natural Hazards

Due to the low relief across the Project site, there is little likelihood that landslides or slope movement at the site would be a realistic hazard. Landslides involve the downslope movement of earth materials under force of gravity due to natural or human causes. The Project area has low relief which reduces the possibility of landslides.

Volcanic activity is primarily a concern along plate boundaries on the West Coast and Alaska and also Hawaii. Based on FERC staff review of maps from USGS (2018c) and DHS (2018) of the nearly 1,500 volcanoes with eruptions since the Holocene period (in the past 10,000 years) there are no known active or historic volcanic activity within proximity of the site with the closest being over 400 miles away across the Gulf of Mexico in Los Atlixcos, Mexico.

Geomagnetic disturbances may occur due to solar flares or other natural events with varying frequencies that can cause geomagnetically induced currents, which can disrupt the operation of transformers and other electrical equipment. The USGS provides a map of geomagnetic disturbance intensities with an estimated 100-year mean return interval (USGS 2018d). The map indicates the LNG Terminal could experience geomagnetic disturbance intensities of 70-90 nano-Tesla with a 100-year mean return interval. However, RG LNG would be designed such that if a loss of power were to occur the valves would move into a fail-safe position.

External Impact

To assess the potential impact from external events, FERC staff conducted a series of reviews to evaluate transportation routes, land use, and activities within the facility and surrounding the Project site and the safeguards in place to mitigate the risk from events, where warranted. FERC staff coordinated the results of the reviews with other federal agencies to assess potential impacts from vehicles and rail; aircraft impacts to and from nearby airports and heliports; pipeline impacts from nearby pipelines; impacts to and from adjacent facilities that handle hazardous materials under the EPA's Risk Management Plan (RMP) regulations and power plants, including nuclear facilities under Nuclear Regulatory Commission's regulations. Specific mitigation of impacts from use of external roadways, rail, helipads, airstrips, or pipelines are also considered as part of the engineering review done in conjunction with the NEPA review.

FERC staff uses a risk-based approach to assess the potential impact of the external events and the adequacy of the mitigation measures. The risk-based approach uses data based on the frequency of events that could lead to an impact and the potential severity of consequences posed to the Project site and the resulting consequences to the public beyond the initiating events. The frequency data is based on past incidents and the consequences are based on past incidents and/or hazard modeling of potential failures.

Road

FERC staff reviewed whether any truck operations would be associated with the project and whether any existing roads would be located near the site. FERC staff uses this information to evaluate whether the Project and any associated truck operations could increase the risk along

the roadways and subsequently to the public and whether any pre-existing unassociated vehicular traffic could adversely increase the risk to a project site and subsequently increase the risk to the public. In addition, if authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. DOT regulations under 49 CFR 193.2155 (a) (5) (ii), under Subpart C require that structural members of an impoundment system be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a tank truck that could reasonably be expected to cause the most severe loading if the LNG facility adjoins the right-of-way of any highway. Similarly, NFPA 59A (2001), section 8.5.4, incorporated by reference in 49 CFR 193, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, the DOT regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. FERC staff evaluated consequence and frequency data from these events to evaluate these potential impacts.

FERC staff evaluated the risk of the truck operations based on the consequences from a release, incident data from the DOT Federal Highway Administration (FHWA)⁶³, DOT National Highway Traffic Safety Administration (NHTSA)⁶⁴, DOT PHMSA⁶⁵, EPA, NOAA⁶⁶, and other reports^{67,68,69}, and frequency of trucks, and proposed mitigation to prevent or reduce the impacts of a vehicular incident.

Incident data from DOT's FHWA, NHTSA, and PHMSA, indicates hazardous material incidents are very infrequent (4e-3 incidents per lane mile per year) and nearly 75 to 80 percent of hazardous material vehicular incidents occur during unloading and loading operations while the other 20 to 25 percent occur while in transit or in transit storage. In addition, approximately 99 percent of releases are 1,000 gallons or less and catastrophic events that would spill 10,000 gallons or more make up less than 0.1 percent of releases. In addition, less than 1 percent of all reportable hazardous material incidents with spillage result in injuries and less than 0.1 percent of all reportable hazardous material incidents with spillage result in fatalities.

The EPA and NOAA report that 80 percent of fires that lead to container ruptures results in projectiles and that 80 percent of projectiles from liquefied petroleum gas (LPG) incidents, which constitute the largest product involved in BLEVEs, travel less than 660 feet. The EPA also reports that on average container ruptures would result in less than four projectiles for

⁶³ U.S. DOT FHWA, Office of Highway Policy Information, *Highway Statistics 2016*, <https://www.fhwa.dot.gov/policyinformation/statistics/2016/>, accessed March 2019.

⁶⁴ U.S. DOT NHTSA, *Traffic Safety Facts Annual Report Tables*, <https://cdan.nhtsa.gov/tsftables/tsfar.htm>, accessed March 2019.

⁶⁵ U.S. DOT PHMSA, Office of Hazardous Material Safety, *Incident Reports Database Search*, <https://hazmatonline.phmsa.dot.gov/IncidentReportsSearch/Welcome.aspx>, accessed March 2019.

⁶⁶ U.S. Environmental Protection Agency, National Oceanic and Atmospheric Administration, ALOHA®, User's Manual, The CAMEO® Software System, February 2007.

⁶⁷ Birk, A.M., BLEVE Response and Prevention Technical Documentation, 1995.

⁶⁸ American Institute of Chemical Engineers, Center for Chemical Process Safety, Guidelines for Vapor Cloud Explosion, Pressure Vessel Burst, BLEVE, and Flash Fire Hazards, Second Edition, 2010.

⁶⁹ Lees, F.P., Lees Loss Prevention in the Process Industries, Hazard Identification, Assessment, and Control, Volume 2, Second Edition, 1996.

cylindrical containers and 8.3 for spherical vessels. FERC staff evaluated other reports that affirmed the EPA estimates based on data for approximately 150 experimental and accidental pressure vessel bursts (PVB) and BLEVEs with approximately 683 total projectiles (4.6 average fragments per incident) that showed approximately 80 percent of fragments traveled 490 to 820 feet and within 6.25 times the estimated or observed fireball radius. The data also showed projectiles have traveled up to 3,900 feet for large LPG vessels and 1,200 feet for LPG rail cars. In all the documented cases, the projectiles traveled less than 15 times the fireball diameter, but one of the reports indicated up to 30 times the fireball diameter is possible albeit very rare.

Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in distances ranging from 25 to 200 feet for flammable vapor dispersion, and 75 to 175 feet for jet fires. Unmitigated consequences under worst-case weather conditions from catastrophic failures of trucks proposed at the site generally can range from 200 to 2,000 feet for flammable vapor dispersion, 275 to 350 feet for radiant heat of 5 kW/m² from jet fires, 800 to 1,050 feet to a 1 psi overpressure from a BLEVE, 850 to 1,500 feet for a heat dose equivalent to a radiant heat of 5 kW/m² over 40 seconds from 250 to 325 feet radii fireballs burning for 5 to 15 seconds from a BLEVE, and projectiles from BLEVEs possibly extending farther. Based on distribution function of the projectile distances, FERC staff estimate approximately 90 percent of all projectiles for a 10,000 gallon tanker truck would be within 0.5 mile and there is approximately a 1 percent probability they would extend beyond 1 mile and less than 0.1 percent probability they would extend 30 times the fireball diameter. These values are also close to the distances provided by the DOT FHWA⁷⁰ for designating hazardous material trucking routes (0.5 miles for flammable gases for potential impact distance) and DOT PHMSA⁷¹ for emergency response (0.5 to 1 mile for initial evacuation and 1 mile for potential BLEVEs for flammable gases).

During operation of the Project, the number of trucks would depend on market conditions for LNG and the amount of condensate in the feed gas with estimates of up to approximately 33,000 trucks or tanker trucks to transport commodities (e.g., LNG, refrigerants, diesel, hot oil, condensate product, etc.) to or from the facility each year. This total assumes maximum use of LNG and condensate truck loading facilities, which would not be likely.

SH-48 would border the northern side of the proposed site. State Highway 48 is a four-lane highway with speed limits up to 75 mph. RG LNG proposes to install a 17-foot-high storm levee (i.e., berm) that would separate SH-48 from the process equipment and piping within the LNG facility. Distances from SH-48 to the berm would be approximately 230 feet with another approximately 390 feet from the berm to equipment, 520 to 570 feet to liquefaction facilities, 1,540 feet to the LNG storage tanks, and 1,590 feet to the control building. FERC staff did not identify any other major highways or roads within close proximity to piping or equipment containing hazardous materials at the site that would not be protected by the berm to raise concerns of direct impacts from a vehicle impacting the site. Furthermore, RG LNG would install deceleration, acceleration, and turning lanes at all vehicle access points for safe vehicular access/departure. Each entrance would also have vehicular barriers and RG LNG would install

⁷⁰ U.S. DOT FHWA, Office of Highway Safety, *Guidelines for Applying Criteria to Designate Routes for Transporting Hazardous Materials*, September 1994.

⁷¹ U.S. DOT, PHMSA, *Emergency Response Guidebook*, 2016.

crash barriers, bollards, and guard posts to protect onsite process equipment to further mitigate accidental and intentional vehicle impacts. However, details of these have not been finalized. Therefore, we recommend in section 4.12.6 that RG LNG provide, for review and approval, final design details of vehicular barriers at each entrance to the site.

The facilities would also be set back farther than the hazard distances from the smaller 1,000 gallons or less releases constituting approximately 99 percent of all hazardous material incidents. In addition, these facilities would be farther than the worst-case jet fires from the 10,000 gallons or more releases constituting 1 percent of the hazardous material incidents described above. However, most of the facilities would be within range of the potential worst-case unmitigated flammable vapor dispersion and BLEVE impacts from the 10,000 gallons or more releases constituting 1 percent of the hazardous material incidents.

In total, there is approximately 4.24 miles of road within 1 mile of the RG LNG Project's 26,600,000 square feet (ft²) footprint with approximately 5,000,000 ft² constituting the liquefaction facilities, 240,000 ft² constituting the LNG storage tanks, 240,000 ft² constituting the control building and other occupied buildings, and 21,120,000 ft² constituting the ground flares, switchyard, refrigerant storage, marine facilities, and other areas. Unmitigated flammable vapors that reach onsite and ignite could impact workers, but it would not likely cause any cascading failures that would impact the public. In addition, the berm and separation distances would likely mitigate flammable vapors that disperse from an incident from reaching onsite. A fireball from a BLEVE could burn workers located onsite, but there would not likely be any cascading failures to onsite equipment that would impact the public. Projectiles from BLEVEs have the potential to impact workers located onsite and cause cascading damage that could impact the public if it were to reach and perforate the LNG storage tank. However, the closest LNG storage tank is approximately 1,540 feet away and approximately 25 percent of projectiles would be able to extend far enough to reach the closest LNG storage tank and the LNG storage tanks would constitute approximately 1 percent of a potential impact area from projectiles that could reach that far. Moreover, the LNG storage tanks would also be designed to withstand certain projectiles that would further protect it from cascading effects. In addition, RG LNG would coordinate with local emergency responders with regard to potential hazardous material vehicular incidents nearby its site.

Due to the low risk of a vehicular incident occurring that could directly impact the site, the low risk of hazardous material truck incidents, the low risk of a hazardous material truck incidents impacting the site that would cause cascading damage that could impact the public, and the proposed and recommended mitigation, we conclude the Project would not pose a significant risk or a significant increase in risk to the public from external impacts occurring on the road.

Rail

FERC staff reviewed whether any rail operations would be associated with the Project and whether any existing rail lines would be located near the site. FERC staff uses this information to evaluate whether the Project and any associated rail operations could increase the risk along the rail line and subsequently to the public and whether any pre-existing unassociated rail operations could adversely increase the risk to the RG LNG site and subsequently increase the risk to the public. In addition, if authorized, constructed, and operated, LNG facilities as

defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. DOT regulations under 49 CFR 193.2155 (a) (5) (ii), under Subpart C state if the LNG facility adjoins the right-of-way of any railroad, the structural members of an impoundment system must be designed and constructed to prevent impairment of the system's performance reliability and structural integrity as a result of a collision by or explosion of a train or tank car that could reasonably be expected to cause the most severe loading.

Section 8.5.4 of NFPA 59A (2001), incorporated by reference in 49 CFR 193, requires transfer piping, pumps, and compressors to be located or protected by barriers so that they are safe from damage by rail or vehicle movements. However, the DOT regulations and NFPA 59A (2001) requirements do not indicate what collision(s) or explosion(s) could reasonably be expected to cause the most severe loading. Therefore, FERC staff evaluated consequence and frequency data from these events to evaluate these potential impacts. There would be no rail transportation associated with the Project.

FERC staff evaluated the risk of the rail operations based on the consequences from a release, incident data from the DOT Federal Railroad Administration (FRA) and DOT PHMSA, and frequency of rail operations near the LNG Terminal site. Incident data from DOT FRA and DOT PHMSA indicates hazardous material incidents are very infrequent (6e-3 incidents per rail mile per year). In addition, approximately 95 percent of releases are 1,000 gallons or less, and catastrophic events that would spill 30,000 gallons or more make up less than 1 percent of releases. In addition, less than 1 percent of hazardous material incidents result in injuries and less than 0.1 percent of hazardous material incidents result in fatalities.

As previously discussed, the EPA and NOAA report that 80 percent of fires that lead to container ruptures results in projectiles and that 80 percent of projectiles from LPG incidents, which constitute the largest product involved in BLEVEs, travel less than 660 feet. The EPA also reports that on average container ruptures would result in less than four projectiles for cylindrical containers and 8.3 for spherical vessels. FERC staff evaluated other reports that affirmed the EPA estimates based on data for approximately 150 experimental and accidental PVBs and BLEVEs with approximately 683 total projectiles (4.6 average fragments per incident) that showed approximately 80 percent of fragments traveled 490 to 820 feet and within 6.25 times the estimated or observed fireball radius. The data also showed projectiles have traveled up to 3,900 feet for large LPG vessels and 1,200 feet for LPG rail cars. In all the documented cases, the projectiles traveled less than 15 times the fireball diameter, but one of the reports indicated up to 30 times the fireball diameter is possible albeit very rare.

Unmitigated consequences under average ambient conditions from releases of 1,000 gallons through a 1-inch hole would result in distances ranging from 25 to 200 feet for flammable vapor dispersion, and 75 to 175 feet for jet fires. Unmitigated consequences under worst-case weather conditions from catastrophic failures of rail cars containing various flammable products generally can range from 300 to 3,000 feet for flammable vapor dispersion, 450 to 575 feet for radiant heat of 5 kW/m² from jet fires, 1,225 to 1,500 feet to a 1 psi overpressure from a BLEVE, 1,250 to 2,100 feet for a heat dose equivalent to a radiant heat of 5 kW/m² over 40 seconds from 350 to 450 feet radii fireballs burning for 7 to 20 seconds from a BLEVE, and projectiles from BLEVEs possibly extending farther. Based on distribution

function of the projectile distances, FERC staff estimate approximately 80 percent of all projectiles for a 30,000 gallon rail car would be within 0.5 mile and there is approximately a 5 percent probability they would extend beyond 1 mile and less than 0.1 percent probability they would extend 30 times the fireball diameter. These values are also close to the distances provided by DOT PHMSA for emergency response (0.5 to 1 mile for initial evacuation and 1 mile for potential BLEVEs for flammable gases).

The closest rail line is located approximately 5 miles to the west of the Project site. This would be farther than the consequence distances under unmitigated worst-case weather conditions and events. Given the distance and position of the closest rail lines relative to the populated areas to the east of the LNG Terminal, we conclude that the proposed Project would not pose a significant increase in risk to the public as a result of the proximity of the Project to the rail lines.

Air

FERC staff reviewed whether any aircraft operations would be associated with the Project and whether any existing aircraft operations would be located near the site. FERC staff uses this information to evaluate whether the Project and any associated aircraft operations could increase the risk to the public and whether any pre-existing unassociated aircraft operations could adversely increase the risk to the Project site and subsequently increase the risk to the public. In addition, if authorized, constructed, and operated, LNG facilities as defined in 49 CFR 193, must comply with the requirements of 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. DOT regulations under 49 CFR 193.2155 (b), under Subpart C requires that an LNG storage tank must not be located within a horizontal distance of one mile from the ends, or 0.25 mile from the nearest point of a runway, whichever is longer and that the height of LNG structures in the vicinity of an airport must comply with FAA requirements. In addition, FERC staff evaluated the risk of an aircraft impact from nearby airports.

There would be no aircraft associated with the Project that would warrant a review that would increase in risk to the public from aircraft operations. The closest airports to the RG LNG Project site would be the Port Isabel Cameron County Airport located approximately 11 miles to the northwest and the Brownsville South Padre Airport located approximately 12 miles to the west.

FERC staff also identified 2 smaller airports within a 20-mile radius from the proposed site: Drennan Farm located approximately 13 miles away and Rancho Buena Vista Airport located approximately 16 miles away. In addition, FERC staff identified three heliports: Coast Guard Station Heliport located approximately 6 miles to the northeast, Southeastern Helicopters Heliport located approximately 8 miles to the northeast, and Columbia Valley Regional Heliport located approximately 14.5 miles to the west of the Project site.

FERC staff analyzed existing aircraft operation frequency data based on the airports identified above and their proximity to the LNG storage tanks and process areas, type and frequency of aircraft operations, takeoff and landing directions, and non-airport flight paths using the DOE Standard, DOE-STD-3014-2006, *Accident Analysis for Aircraft Crash into Hazardous Facilities*. Based upon that review, FERC staff determined the proposed Project would not pose a significant risk to the public as a result of the proximity of the Project to the airports.

The FAA regulations in 14 CFR 77 require RG LNG to provide notice to the FAA of its proposed construction. This notification should identify all equipment that are more than 200 feet above ground level or lesser heights if the facilities are within 20,000 feet of an airport (at 100:1 ratio or 50:1 ratio depending on length of runway) or within 5,000 feet of a helipad (at 100:1 ratio). In addition, mobile objects, including the LNG marine vessel that would be above the height of the highest mobile object that would normally traverse the waterway would require notification to FAA. RG LNG proposes to limit heights of permanent structures to 200 feet and has received FAA Determination of No Hazard to Air Navigation in accordance with 14 CFR 77 for the temporary construction cranes that would exceed 200 feet in height. RG LNG also indicated that a FAA notice would not be applicable for LNG marine vessels expected to tranverse the waterway after reviewing industry sources on LNG marine vessel specifications. However, no supportive data was provided. Therefore, to ensure LNG marine vessels heights would not be above the height of the highest mobile object in the BSC, we recommend in section 4.12.1.7 that RG LNG file documentation demonstrating the LNG marine vessels would be no higher than the highest mobile object that would normally traverse the waterway, or file a notice of determination of no hazard (with or without conditions) from FAA for the LNG carrier.

Comments from the public and feedback from FAA indicated potential impacts to and from the Project and the nearby SpaceX launch facility. FERC staff conducted internal analyses, utilized a third-party contractor, and requested information from the applicant on the likelihood and consequences from a potential launch failure impacting the Project. In our review of the Falcon 9 and Falcon Heavy launch vehicles, we determined while there would be debris above a threshold of $3e-5$ years, which is the failure rate level we evaluate the potential for cascading damage and the failure rates used by FAA in space launch failures prior to 2017,⁷² the cascading damage at the Project site would not impact the public. In addition, the Coast Guard would determine any mitigation measures needed on a case-by-case basis to safeguard public health and welfare from LNG marine vessel operations during rocket launch activity. However, our review determined that rocket launch failures could impact onsite construction workers and plant personnel and did not account for conceptual launch vehicles that may launch from the SpaceX launch facility such as the Big Falcon Rocket. Therefore, in the draft EIS, we recommended in section 4.12.1.7 that construction crews be positioned outside of higher risk areas during rocket launch activity and for plant personnel to monitor the rocket launches and shut down operating equipment in the event of a rocket launch failure.

However, additional comments received after the draft EIS was issued in similarly situated locations suggested that the recommendations should be revised to position onsite

⁷² FAA's 14 CFR 417.107 (b) regulations were updated from $3e-5$ casualties for three different events (in 2016 edition) to $1e-4$ casualties cumulative (in 2017 edition).

construction crews and plant personnel in areas that are unlikely to be impacted by failed rocket launch debris during initial moments of rocket launch activity from the Brownsville SpaceX facility. The comments also suggested that the Project's procedures should reference public guidance from the FAA prior to launch activity that would more accurately reflect the risk-based assessment performed by RG LNG. In addition, the comments state that the FAA will issue public notices in advance of a rocket launch to provide information about areas likely to be impacted by falling debris from a failed rocket launch. Finally, the comments contend that since it is the jurisdiction and role of the FAA to ensure public safety during rocket launches, the FAA's public guidance prior to a rocket launch would be informative in RG LNG's launch-specific assessment of the positioning of onsite construction crews and plant personnel. We agree that this approach would mitigate the potential impacts to the construction crews and plant personnel and have modified the recommendation in section 4.12.1.7 to reflect the suggested changes.

In addition, in light of comments in similarly situated locations, the draft EIS recommendation pertaining to shutting down operating equipment in the event of a rocket launch failure has been revised in section 4.12.1.7 for RG LNG to develop and implement procedures for plant personnel to monitor the rocket launches and take mitigative action before and after a rocket launch failure to minimize the potential of a release reaching offsite or resulting in cascading effects that could impact the safe operation or extend offsite. To adequately address the risk to onsite plant personnel, plant equipment, and the public, the revised recommendation would allow RG LNG to take action before a rocket launch (e.g., reducing or stopping certain operations) and after a rocket launch failure (e.g., sheltering in place, shutting down certain operations), to mitigate the risk of a larger hazardous fluid release.

In addition, the federal government indemnifies, subject to Congressional appropriations, commercial space licensees from liability for any claims above the liability insurance required under regulation. The maximum probable loss used to determine the insurance and liability uses \$3 million for each casualty from direct and indirect effects from a failed launch. Since the LNG facilities would be valued up to approximately \$25 billion, conventional LNG ships would be valued at \$200-250 million, and a peak construction workforce would total over 5,000 workers, a potential exists for the federal government to be liable for a large sum of money that could exceed the current indemnification levels by a large margin. As a result, the Project may have possible impact to the SpaceX operation due to the insurance premiums that could increase costs to SpaceX, limit the frequency and types of launches out of the Brownsville SpaceX launch site. Depending on the reliance of the National Space Program on the Brownsville SpaceX launch site, this could also have an impact on the National Space Program. There is also potential impact to the liability of the federal government due to indemnification by the federal government for losses above 3.1 billion dollars. However, the extent of these impacts would not be fully known until SpaceX submits an application requesting to launch with the FAA and whether the LNG plant is under construction or in operation.

Pipelines

FERC staff reviewed whether any pipeline operations would be associated with the Project and whether any existing pipelines would be located near the site. FERC staff uses this

information to evaluate whether the Project and any associated pipeline operations could increase the risk to the pipeline facilities and subsequently to the public and whether any pre-existing unassociated pipeline operations could adversely increase the risk to the Project site and subsequently increase the risk to the public. In addition, pipelines associated with this Project must meet DOT regulations under 49 CFR 192 and are discussed in Section 4.12.2. If authorized, constructed, and operated, pipelines and LNG facilities as defined in 49 CFR 192 and 49 CFR 193, must comply with the requirements of 49 CFR 192 and 49 CFR 193 and would be subject to DOT's inspection and enforcement programs. FERC staff evaluated the risk of a pipeline incident impacting the Project and the potential of cascading damage increasing the risk to the public based on the consequences from a release, incident data from DOT PHMSA, and proposed mitigation to prevent or reduce the impacts of a pipeline incident from RG LNG.

For existing pipelines, FERC staff identified an abandoned gas gathering pipeline within the southern border of the Project site and the nearest active gas gathering pipeline would be located approximately 1.4 miles to the west of the Project site. These pipelines would be inactive or located too far to impact the Project site in the event of an incident.

In addition, FERC staff and cooperating agencies identified Enbridge's non-jurisdictional VCP routed through the Project site's proposed 75-foot wide utility easement. The VCP is a 42-inch diameter 2.6 Bcf/d cross-border natural gas pipeline with a MAOP of 3,000 psi between Texas and Mexico that will be used for power generation and industrial customers. The VCP extends southwest from a header system in Nueces County, near the Agua Dulce Hub near Corpus Christi, to the proposed border-crossing facility, and is subject to the jurisdiction of the RRC. Two compressor stations, multiple meter stations and ancillary facilities were also constructed. Since the VCP was placed into service, it is considered a Class 1 Area assuming that the LNG Terminal is not constructed. The class location is determined under 49 CFR 192.5 based on the population density and land use within 660 feet surrounding the pipeline. The class location impacts the pipeline design, operating, and maintenance requirements, including, but not limited to: the steel pipe design factors under 49 CFR 192.111, transmission line sectionalizing block valve spacing under 49 CFR 192.179, inspection and testing of welds under 49 CFR 192.241, depth of cover of soil or consolidated rock under 49 CFR 192.327, test pressures under 49 CFR 192 Subpart J, patrol intervals under 49 CFR 192.705, and leak survey intervals under 49 CFR 192.706. In addition, the class location and the Potential Impact Radius (PIR) is used to determine whether a pipeline is within a high consequence area (HCA), which are used to determine integrity management requirements specified in 49 CFR 192 Subpart O. FERC staff, in consultation with DOT, calculated the VCP would have a PIR of 1,587 feet based on the 42-inch pipeline diameter and 3,000 psi and in accordance with 49 CFR 192.903.⁷³

⁷³ The PIR indicates the potential area impacted by approximately 5,000 Btu/ft²-hr (15.7 kW/m²), which could result in 1 percent mortality rate for an exposure of 30 seconds and ignition of buildings constructed of wood. The C-FER report that forms the basis of the PIR assumes a 30 second exposure is reasonable based on the assumptions that a person exposed to thermal radiation due to a jet fire would remain in their original position for between 1 and 5 seconds, in order to evaluate the situation, and subsequently travel at 5 mph (2.5 m/s), in the direction of shelter, and find a shelter in 200 feet.

If the Project site is approved and begins construction, the proposed Project facilities would be within the PIR with portions within 660 feet from the VCP.⁷⁴ The additional 5,000 construction workers and 270 operating personnel that may be within 660ft would require a change in class location under 49 CFR 192.609. RG LNG indicated that it anticipates that VCP would be required to change the class designation from a Class 1 Area to a Class 3 Area based number of workers estimated within 660 feet of the pipeline centerline during construction and once the facility is in operation.⁷⁵ The change in class location would impact the pipeline design, operating, and maintenance requirements. In addition, the VCP would become a HCA based on the estimated number of people within the PIR and Enbridge would be required to perform an updated HCA analysis and potentially make modifications to the design or operation of the VCP in the vicinity of the Project site.

Specifically, the design factor would change from 0.72 for Class 1 to 0.50 for Class 3, the transmission line sectionalizing block valve spacing would change from pipeline being within 10 miles of a valve for Class 1 locations to the pipeline being within 4 miles of a valve for Class 3 locations,⁷⁶ inspection and testing of welds would change from 10 percent of field butt welds having to be tested for Class 1 locations to 100 percent of field butt welds having to be tested for Class 3 locations,⁷⁷ depth of cover of soil or consolidated rock would change from 30 inches of cover under normal soil for Class 1 locations to 36 inches for Class 3 locations, test pressures would change from testing to a maximum allowable hoop stress up to 80 percent of the specified minimum yield strength for Class 1 locations to 30 or 50 percent of specified minimum yield strength (depending on test medium) for Class 3 locations, and patrol and leak survey intervals would change from 15 month (but at least once per calendar year) maximum intervals for Class 1 locations to 7.5 months (but at least twice each calendar year) for Class 3 locations. In addition, as indicated in the information filed by RG LNG on February 21, 2018, Enbridge indicated that the VCP will be incorporated into Enbridge Inc.'s existing comprehensive integrity management program (IMP). Any future revisions to Enbridge's IMP would also be applied to the VCP. Enbridge will develop and implement revisions to its existing IMP, as necessary, to comply with additional integrity management requirements specified in Texas Railroad Commission regulations. Enbridge indicated that in-line inspection (ILI) tools will be utilized for detection of metal loss and deformation anomalies, and a baseline ILI tool will be run through the pipeline within 10 years after the line goes into service.⁷⁸ Enbridge also indicated that subsequent reassessments will be done at a maximum interval of 7 calendar years.

In addition, DOT and FERC requested more information on how the VCP would be protected during the initial construction and into the operations stage of the Project. RG LNG

⁷⁴ RGLNG's Central Control Building is within approximately 575 feet of the VCP PIR and majority of other facilities are within PIR.

⁷⁵ See 49 CFR Part 192.5 Class locations.

⁷⁶ Enbridge responses to DOT questions indicate that the amount of natural gas loss in the event of leak or rupture event of the Class 1 system would be 87 million standard cubic foot (MMscf) based on pipeline isolation between the Brownsville Compressor Station and mainline valve and 2,082 MMscf based on pipeline isolation between the mainline valve at MP 146 and at a valve where the receiving pipeline comes onshore in Mexico.

⁷⁷ Unless impractical, in which case at least 90 percent.

⁷⁸ While DOT is aware that VCP has a plan for an ILI launcher facility at the Brownville Compression Station at MP 138 upstream of the LNG Terminal site, DOT is not yet clear where the ILI pigs will be received to properly conduct future instrumented ILI tool inspections in accordance with 49 CFR 192.150 (a) for the VCP to comply with IMP regulations, including a baseline ILI within 10 years of the line becoming operational.

indicated that extra protective measures would be put in place to mark and warn of the pipeline's route. For example, the VCP would be marked with flagging during construction activities and special protective crossings would be constructed to distribute vehicular loads. RG LNG indicated that the Project's access control to the utility corridor would minimize the risk of accidental damage to the VCP from external causes and any unauthorized activity on the pipeline right-of-way, thereby further managing the already very small risk of a leak or rupture of the VCP along the RG LNG Terminal. RG LNG would also place temporary board mats and fill over the utility corridor to adequately distribute the load for construction vehicle crossings. RG LNG also indicated no other heavy construction activities would occur over the VCP along the north and east sides of the LNG Terminal site. RG LNG would replace the temporary crossings with permanent crossings at facility access points that distribute the load and prevent long-term settling impacts to the VCP. In addition, adjacent construction activities, including grading, levee construction, and piling would be offset as to not produce excessive shear forces or loads that could impact the VCP. In addition, RG LNG indicated that dredging of the berths/turning basin area is not anticipated to impact the VCP because the pipeline will be HDD under the BSC. Furthermore, according to Enbridge, the VCP will be part of the "One-Call" System. The VCP pipeline will be marked at road/railroad crossing and line of sight through the Class 3 areas. Aerial patrols to identify any changes along the right-of-way or potential threats to the pipeline will be conducted more frequently than required by 49 CFR 192.705.

In addition to the potential design changes and mitigation proposed by RG LNG to protect the VCP from impacts, FERC staff evaluated the potential risk (consequences and likelihood) of incidents from the pipeline and its potential impact. The consequence and frequency of an incident will depend on the type of incident. The types of incidents that are reported to DOT PHMSA are categorized as ruptures, leaks, mechanical punctures, or other incidents, such as releases from emergency shutdown blowdowns, relief valves, or vent valves. The consequence of a rupture would be representative of a full guillotine rupture of a line and would have similar impact distances to structures as the PIR and potentially farther impact distances to people, including cascading damage to the Rio Grande LNG Terminal and potentially fatal effects to 5,000 construction workers and 270 operating personnel located onsite that are not adequately sheltered. The most probable consequences of the cascading effects would not likely extend beyond the consequences of the initiating pipeline incident and would not reach the offsite public. The consequence of leaks, mechanical punctures, and other incidents would have lesser consequences. RG LNG modeled consequences from a 2-inch release, which would be representative of many of these scenarios and the results indicated the consequences would not just reach onsite, but would not be expected to cause cascading impacts to the RG LNG facilities or likely impact workers (unless in close proximity to the incident). However, the likelihood of any pipeline incident or failure is extremely low (less than $4e-4$ per mile per year or 0.4 percent probability of occurring on any given mile in any given year). A worst-case full rupture scenario is even less likely constituting approximately 10 percent of all reported incidents with the vast majority of incidents categorized as the less consequential leaks (40 percent), mechanical punctures (10 percent), or other incidents (40 percent). In addition, RG LNG and VCP indicate the pipeline would likely be re-classified from Class 1 to Class 3, which would further reduce the likelihood of ruptures. In fact, there have been no ruptures of Class 3 interstate natural gas transmissions systems from 2010 to present and those that occurred prior to 2010 were nearly all pipelines installed prior to 1970.

RG LNG estimated the likelihood of a rupture of a 30-inch diameter or greater onshore natural gas pipeline to be $8e-6$ per mile per year. Based on DOT PHMSA data, the likelihood of an interstate natural gas transmission pipeline incident would change from $4e-5$ per mile per year for Class 1 locations to less than $1e-5$ per mile per year for Class 3 locations. While the Class 1 incident rate for ruptures is above the $3e-5$ per year that FERC staff determine as initial screening criteria for credible events to consider, the Class 3 incident rate data would be below the $3e-5$ per year that FERC staff determine as initial screening criteria for credible events to consider. As a result, we conclude the Project would not significantly increase the risk to the offsite public beyond existing risk levels that would be present from a worst-case pipeline rupture event or other incident within the vicinity of the Project site, but recognize there could be a period of time the construction workers are subject to risk associated with a Class 1 pipeline rupture until it is re-classed to a Class 3 pipeline.

In addition, the proposed Texas LNG Terminal would border the site to the east. It is anticipated that the Intrastate Pipeline for Texas LNG would also be routed within the utility corridor. It is also anticipated that the diameter as well as the design and operating pressures of the Intrastate Pipeline for Texas LNG would be less than the VCP. Therefore, the potential risk of pipeline incidents and their potential impacts discussed for the VCP would also apply to the Intrastate Pipeline for Texas LNG. However, to ensure the Project does not significantly increase the likelihood of an incident to the pipeline, we recommend in section 4.12.1.7 that RG LNG provide calculations demonstrating that the loads would be adequately distributed for the temporary crossings during initial construction activities prior to initial site preparation and for the permanent crossings prior to construction of final design.

Hazardous Material Facilities and Power Plants

FERC staff reviewed whether any EPA RMP regulated facilities handling hazardous materials and power plants were located near the site to evaluate whether the facilities could adversely increase the risk to the Project site and whether the Project site could increase the risk to the EPA RMP facilities and power plants and subsequently increase the risk to the public. There were no facilities handling hazardous materials or power plants identified adjacent to the site. The closest EPA RMP regulated facilities handling hazardous materials would be the Port Isabel Wastewater Treatment Plant located approximately 2.4 miles, Port Isabel Water Treatment Plant located approximately 2.5 miles, and Texas Pack, Inc. located approximately 2.4 miles from the site. The closest power plant identified would be Silas Ray Gas Plant approximately 18 miles away with the closest nuclear plant located over 200 miles to the northeast of the site.

In addition, the proposed Texas LNG Terminal would border the site to the east and the proposed Annova LNG Terminal would be located across the BSC. These proposals would be subject to 49 CFR Part 193 Subpart B regulatory requirements that establishes exclusion zones for safety of plant personnel and the surrounding public. Each proposal would consider potential incidents and safety measures that would need to be incorporated in the design or operation to ensure risk to surrounding public is not increased. Given the distances and locations of the facilities relative to the populated areas of the Port Isabel, South Padre Island, and Brownsville communities, we conclude that the proposed Project would not pose a significant increase in risk to the public or that the hazardous material facilities and power plants would not pose a significant risk to the Project and subsequently to the public.

Onsite and Offsite Emergency Response Plans

As part of its application, RG LNG indicated that the Project would develop a comprehensive ERP with local, state, and federal agencies and emergency response officials to discuss the facilities. RG LNG would continue these collaborative efforts during the development, design, and construction of the Project. The emergency procedures would provide for the protection of personnel and the public as well as the prevention of property damage that may occur as a result of incidents at the Project facilities. The facility would also provide appropriate personnel protective equipment to enable operations personnel and first responder access to the area.

As required by 49 CFR 193.2509, under Subpart F, RG LNG would need to prepare emergency procedures manuals that provide for: a) responding to controllable emergencies and recognizing an uncontrollable emergency; b) taking action to minimize harm to the public including the possible need to evacuate the public; and c) coordination and cooperation with appropriate local officials. Specifically, 49 CFR 193.2509 (b) (3) requires “Coordinating with appropriate local officials in preparation of an emergency evacuation plan...,” which sets forth the steps required to protect the public in the event of an emergency, including catastrophic failure of an LNG storage tank. DOT regulations under 49 CFR 193.2905, under Subpart J also require at least two access points in each protective enclosure to be located to minimize the escape distance in the event of emergency.

Title 33 CFR 127.307 also requires the development of emergency manual that incorporates additional material, including LNG release response and ESD procedures, a description of fire equipment, emergency lighting, and power systems, telephone contacts, shelters, and first-aid procedures. In addition, 33 CFR 127.207 establishes requirements for warning alarm systems. Specifically, 33 CFR 127.207 (a) requires that the LNG marine transfer area to be equipped with a rotating or flashing amber light with a minimum effective flash intensity, in the horizontal plane, of 5000 candelas with at least 50 percent of the required effective flash intensity in all directions from 1.0 degree above to 1.0 degree below the horizontal plane. Furthermore, 33 CFR 127.207 (b) requires the marine transfer area for LNG to have a siren with a minimum 1/3-octave band sound pressure level at 1 meter of 125 dB referenced to 0.0002 microbars. The siren must be located so that the sound signal produced is audible over 360 degrees in a horizontal plane. Lastly, 33 CFR 127.207 (c) requires that each light and siren be located so that the warning alarm is not obstructed for a distance of 1.6 km (1 mile) in all directions. The warning alarms would be required to be tested in order to meet 33 CFR 127. RG LNG would be required to meet the warning alarms requirements specified in 33 CFR 127.207.

In accordance with the EAct 2005, FERC must also approve an ERP covering the terminal and ship transit prior to construction. Section 3A(e) of the NGA, added by section 311 of the EAct 2005, stipulates that in any order authorizing an LNG terminal, the Commission must require the LNG terminal operator to develop an ERP in consultation with the Coast Guard and state and local agencies. The final ERP would need to be evaluated by appropriate emergency response personnel and officials. Section 3A(e) of the NGA (as amended by EAct 2005) specifies that the ERP must include a Cost-Sharing Plan that contains a description of any direct cost reimbursements the applicant agrees to provide to any state and local agencies with

responsibility for security and safety at the LNG terminal and in proximity to LNG marine vessels that serve the facility. The Cost-Sharing Plan must specify what the LNG terminal operator would provide to cover the cost of the state and local resources required to manage the security of the LNG terminal and LNG marine vessel, and the state and local resources required for safety and emergency management, including:

- direct reimbursement for any per-transit security and/or emergency management costs (for example, overtime for police or fire department personnel);
- capital costs associated with security/emergency management equipment and personnel base (for example, patrol boats, firefighting equipment); and
- annual costs for providing specialized training for local fire departments, mutual aid departments, and emergency response personnel; and for conducting exercises.

The Cost-Sharing Plan must include the LNG terminal operator's letter of commitment with agency acknowledgement for each state and local agency designated to receive resources. RG LNG described the ERP that would be developed to address emergency events and potential release scenarios described in the application. The ERP would include public notification, protection, and evacuation. As part of FEED, FERC staff evaluate the initial draft of the emergency response procedures to assure that it covers the hazards associated with the Project. In addition, we recommend in section 4.12.1.7 that RG LNG provide additional information, for review and approval, on development of updated ERPs prior to initial site preparation. We also recommend in section 4.12.1.7 that RG LNG file three-dimensional drawings, for review and approval, that demonstrate there is a sufficient number of access and egress locations.

If this Project is authorized, constructed, and operated, RG LNG would coordinate with local, state, and federal agencies on the development of an ERP and Cost-Sharing Plan. We recommend in section 4.12.1.7 that RG LNG provide periodic updates on the development of these plans for review and approval, and ensure they are in place prior to introduction of hazardous fluids. In addition, we recommend in section 4.12.1.7 that Project facilities be subject to regular inspections throughout the life of the facility and would continue to require companies to file updates to the ERP.

4.12.1.7 Recommendations from FERC Preliminary Engineering and Technical Review

Based on our preliminary engineering and technical review of the reliability and safety of the Project, we recommend the following mitigation measures as conditions to any order authorizing the Project. These recommendations would be implemented prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout the life of the facility to enhance the reliability and safety of the facility and to mitigate the risk of impact on the public.

- **Prior to initial site preparation, RG LNG should file with the Secretary documentation demonstrating LNG marine vessels would be no higher than**

existing ship traffic or it has received a determination of no hazard (with or without conditions) by DOT FAA for mobile objects that exceed the height requirements in 14 CFR 77.9.

- **Prior to initial site preparation**, RG LNG should file with the Secretary a plan to conduct a supplemental geotechnical investigation for the all four LNG Tanks and piperack along the south face of the facility, including a geotechnical investigation location plan with spacing of no more than 300 feet, a minimum of five equally distributed borings, cone penetration tests, and/or seismic cone penetration tests to a depth of at least 100 feet or refusal underneath the locations of each LNG storage tank, and field sampling methods and laboratory tests that are at least as comprehensive as the existing geotechnical investigations. In addition, the geotechnical investigations and report must demonstrate soil modifications and foundation designs would be similar to areas already investigated.
- **Prior to construction of final design**, RG LNG should file with the Secretary correspondence with DOT on the use of normally-closed valves to remove stormwater from local bunds and curbed areas.
- **Prior to construction of final design**, RG LNG should file with the Secretary the following information, stamped and sealed by the professional engineer-of-record licensed in the state where the Project is being constructed:
 - a. site preparation drawings and specifications;
 - b. LNG storage tank and foundation design drawings and calculations;
 - c. LNG terminal structures and foundation design drawings and calculations;
 - d. seismic specifications for procured Seismic Category I equipment; and
 - e. quality control procedures to be used for civil/structural design and construction.

In addition, RG LNG should file, in its Implementation Plan, the schedule for producing this information.

- **Prior to construction of final design**, RG LNG should file with the Secretary design information adopting the recommendations presented by Fugro to minimize the impacts of the identified surface growth fault in the southwestern portion of the LNG Terminal, stamped and sealed by the professional engineer-of-record registered in Texas.
- **Prior to commencement of service**, RG LNG should file with the Secretary a monitoring and maintenance plan, stamped and sealed by the professional engineer-of-record registered in Texas, for the perimeter levee which ensures the

crest elevation relative to mean sea level will be maintained for the life of the facility considering berm settlement, subsidence, and sea level rise.

Information pertaining to these specific recommendations should be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, within the timeframe indicated by each recommendation. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 833 (Docket No. RM16-15-000), including security information, should be submitted as critical energy infrastructure information pursuant to 18 CFR 388.113. See *Critical Electric Infrastructure Security and Amending Critical Energy Infrastructure Information*, Order No. 833, 81 FR 93,732 (December 21, 2016), FERC Stats. & Regs. 31,389 (2016). Information pertaining to items such as offsite emergency response, procedures for public notification and evacuation, and construction and operating reporting requirements would be subject to public disclosure. All information should be filed a minimum of 30 days before approval to proceed is requested.

- Prior to initial site preparation, RG LNG should develop and implement procedures to monitor rocket launch activity and to position onsite construction crews and plant personnel in areas that are unlikely to be impacted by rocket debris of a failed launch during initial moments of rocket launch activity from the Brownsville SpaceX facility. RG LNG's procedures for positioning of onsite construction crews and plant personnel should include reference to any guidance from the FAA to the public regarding anticipated SpaceX launches.
- Prior to initial site preparation, RG LNG should file calculations demonstrating the loads on buried pipelines and utilities at temporary crossings would be adequately distributed. The analysis should be based on API RP 1102 or other approved methodology.
- Prior to initial site preparation, RG LNG should file pipeline and utility damage prevention procedures for personnel and contractors. The procedures should include provisions to mark buried pipelines and utilities prior to any site work and subsurface activities.
- Prior to initial site preparation, RG LNG should file an overall Project schedule, which includes the proposed stages of the commissioning plan.
- Prior to initial site preparation, RG LNG should file quality assurance and quality control procedures for construction activities.
- Prior to initial site preparation, RG LNG should file procedures for controlling access during construction.
- Prior to initial site preparation, RG LNG should file its design wind speed criteria for all other facilities not covered by DOT PHMSA's LOD to be designed to withstand wind speeds commensurate with the risk and reliability associated with the facilities in accordance with ASCE 7-16 or equivalent.

- **Prior to initial site preparation**, RG LNG should develop an ERP (including evacuation) and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan should include at a minimum:
 - a. designated contacts with state and local emergency response agencies;
 - b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;
 - c. procedures for notifying residents and recreational users within areas of potential hazard;
 - d. evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;
 - e. locations of permanent sirens and other warning devices; and
 - f. an “emergency coordinator” on each LNG marine vessel to activate sirens and other warning devices.

RG LNG should notify the FERC staff of all planning meetings in advance and should report progress on the development of its ERP **at 3-month intervals**.

- **Prior to initial site preparation**, RG LNG should file a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that would be imposed on state and local agencies. This comprehensive plan should include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. RG LNG should notify FERC staff of all planning meetings in advance and should report progress on the development of its Cost-Sharing Plan **at 3-month intervals**.
- **Prior to construction of final design**, RG LNG should file calculations demonstrating the loads on buried pipelines and utilities at permanent crossings would be adequately distributed. The analysis should be based on API RP 1102 or other approved methodology.
- **Prior to construction of final design**, RG LNG should file change logs that list and explain any changes made from the front end engineering design provided in RG LNG’s application and filings. A list of all changes with an explanation for the design alteration should be provided and all changes should be clearly indicated on all diagrams and drawings.

- **Prior to construction of final design**, RG LNG should file information/revisions pertaining to RG LNG' response numbers 5, 6, 7, 8, 14, 19, 22, 24, 25, 31, and 44 of its October 20, 2016 filing, which indicated features to be included or considered in the final design.
- **Prior to construction of final design**, RG LNG should file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems.
- **Prior to construction of final design**, RG LNG should file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion.
- **Prior to construction of final design**, RG LNG should file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications should include:
 - a. Building Specifications (e.g., control buildings, electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);
 - b. Mechanical Specifications (e.g., piping, valve, insulation, rotating equipment, heat exchanger, storage tank and vessel, other specialized equipment);
 - c. Electrical and Instrumentation Specifications (e.g., power system specifications, control system specifications, safety instrument system [SIS] specifications, cable specifications, other electrical and instrumentation specifications); and
 - d. Security and Fire Safety Specifications (security, passive protection, hazard detection, hazard control, firewater).
- **Prior to construction of final design**, RG LNG should file a list of all codes and standards and the final specification document number where they are referenced.
- **Prior to construction of final design**, RG LNG should file complete specifications and drawings of the proposed LNG tank design and installation.
- **Prior to construction of final design**, RG LNG should file the design specifications and drawings for the feed gas inlet facilities (e.g., metering, pigging system, pressure protection system, compression, etc.).
- **Prior to construction of final design**, RG LNG should include up-to-date process flow diagrams and piping and instrument diagrams (P&IDs) including vendor P&IDs. The process flow diagrams should include heat and material balances. The P&IDs should include the following information:

- a. equipment tag number, name, size, duty, capacity, and design conditions;
 - b. equipment insulation type and thickness;
 - c. storage tank pipe penetration size and nozzle schedule;
 - d. valve high-pressure side and internal and external vent locations;
 - e. piping with line number, piping class specification, size, and insulation type and thickness;
 - f. piping specification breaks and insulation limits;
 - g. all control and manual valves numbered;
 - h. relief valves with size and set points; and
 - i. drawing revision number and date.
- **Prior to construction of final design**, RG LNG should file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect subsequently constructed facilities with the operational facilities.
 - **Prior to construction of final design**, RG LNG should file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs.
 - **Prior to construction of final design**, and at the onset of detailed engineering, RG LNG should complete a preliminary hazard and operability review of the proposed design. A copy of the review, a list of recommendations, and actions taken on the recommendations should be filed.
 - **Prior to construction of final design**, RG LNG should file a hazard and operability review prior to issuing the P&IDs for construction. A copy of the review, a list of the recommendations, and actions taken on the recommendations should be filed.
 - **Prior to construction of final design**, RG LNG should file an evaluation of the need for additional check valves and relief valves in the truck LNG fill line.
 - **Prior to construction of final design**, RG LNG should file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (i.e., temperature, pressures, flows, and compositions).
 - **Prior to construction of final design**, RG LNG should file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices should include alarms and shutdown functions, details of the voting and shutdown logic, and set points.

- **Prior to construction of final design**, RG LNG should file an evaluation of emergency shutdown valve closure times. The evaluation should account for the time to detect an upset or hazardous condition, notify plant personnel, and close the emergency shutdown valve(s).
- **Prior to construction of final design**, RG LNG should file an evaluation of dynamic pressure surge effects from valve opening and closure times and pump start-up and shutdown operations demonstrating that the surge effects do not exceed the design pressures.
- **Prior to construction of final design**, RG LNG should demonstrate that, for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators.
- **Prior to construction of final design**, RG LNG should file electrical area classification drawings that reflect additional hazardous classification areas where the heat transfer fluid would be processed above its flash point (e.g., near the heat medium heaters) and at areas of fuel gas piping (e.g., fired heaters), including areas where equipment could be exposed to flammable gas during a purge cycle of a fired heater.
- **Prior to construction of final design**, RG LNG should file drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A (2001).
- **Prior to construction of final design**, RG LNG should file details of an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap should vent to a safe location and be equipped with a leak detection device that should continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems.
- **Prior to construction of final design**, RG LNG should file drawings of the storage tank piping support structure and support of horizontal piping at grade including pump columns, relief valves, pipe penetrations, instrumentation, and appurtenances.
- **Prior to construction of final design**, RG LNG should include LNG storage tank fill flow measurement with high flow alarm.
- **Prior to construction of final design**, RG LNG should include BOG flow measurement from each LNG storage tank.

- **Prior to construction of final design**, RG LNG should file the structural analysis of the LNG storage tank and outer containment demonstrating they are designed to withstand all loads and combinations.
- **Prior to construction of final design**, RG LNG should file an analysis of the structural integrity of the outer containment of the full-containment LNG storage tank demonstrating it can withstand the radiant heat from a roof tank top fire or adjacent tank roof fire.
- **Prior to construction of final design**, RG LNG should file a projectile analysis to demonstrate that the outer concrete impoundment wall of the full-containment LNG tank could withstand projectiles from explosions and high winds. The analysis should detail the projectile speeds and characteristics and method used to determine penetration or perforation depths.
- **Prior to construction of final design**, RG LNG should file the sizing basis and capacity for the final design of the flares and/or vent stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks.
- **Prior to construction of final design**, RG LNG should file a drawing showing the location of the emergency shutdown (ESD) buttons. ESD buttons should be easily accessible, conspicuously labeled, and located in an area which would be accessible during an emergency.
- **Prior to construction of final design**, RG LNG should specify that all ESD valves are to be equipped with open and closed position switches connected to the Distributed Control System/Safety Instrumented System.
- **Prior to construction of final design**, and prior to injecting corrosion inhibitors into the 42-inch pipeline at any time during the life of the plant, RG LNG should provide the information used to determine that an inhibitor is required, the material data sheet for the inhibitor, the amount injected, and the schedule of injections.
- **Prior to construction of final design**, the feed gas flow to the Inlet Gas/Gas Exchanger (E-1701) should include a high temperature alarm and shutdown to protect from exposure to hot feed gas.
- **Prior to construction of final design**, the De-ethanizer (C-1701) should include an additional cryogenic manual isolation valve downstream of shutoff valve (XV-117011).
- **Prior to construction of final design**, RG LNG should equip a low-low temperature shutdown on the temperature transmitter (TT-117014) located on the de-ethanizer bottoms discharge piping to detect temperatures that may reach below the minimum design metal temperature of the discharge piping transition from

stainless to carbon steel. This shutdown should include isolation under cryogenic conditions.

- **Prior to construction of final design**, RG LNG should file an explanation and justification for the dump lines located upstream of each LNG Loading Arm.
- **Prior to construction of final design**, RG LNG should file the complete range of anti-surge recycle conditions on the LP MR Compressor to confirm that the minimum temperature conditions would not require stainless steel piping.
- **Prior to construction of final design**, RG LNG should specify the set pressure of high-pressure alarm (PAH-141002) is to be below the set pressure of regulator PCV-141005 on the Hot Oil Expansion Drum.
- **Prior to construction of final design**, RG LNG should file the design details of the shelters to verify safe access in all weather conditions.
- **Prior to construction of final design**, RG LNG should file drawings and specifications for crash rated vehicle barriers at each facility entrance for access control.
- **Prior to construction of final design**, RG LNG should file drawings of the security fence. The fencing drawings should provide details of fencing that demonstrates it would restrict and deter access around the entire facility and has a setback from exterior features (e.g., power lines, trees, etc.) and from interior features (e.g., piping, equipment, buildings, etc.) that does not allow the fence to be overcome.
- **Prior to construction of final design**, RG LNG should file security camera and intrusion detection drawings. The security camera drawings should show the locations, areas covered, and features of each camera (e.g., fixed, tilt/pan/zoom, motion detection alerts, low-light, mounting height, etc.) to verify camera coverage of the entire perimeter with redundancies, and cameras interior to the facility that would enable rapid monitoring of the terminal, including a camera at the top of each LNG storage tank, and coverage within pretreatment areas, within liquefaction areas, within truck transfer areas, within marine transfer areas, and buildings. The drawings should show or note the location of the intrusion detection to verify it covers the entire perimeter of the terminal.
- **Prior to construction of final design**, RG LNG should file lighting drawings. The lighting drawings should show the location, elevation, type of light fixture, and lux levels of the lighting system and should be in accordance with API 540 and provide illumination along the entire perimeter of the facility, process equipment, mooring points, and along paths/roads of access and egress to facilitate security monitoring and emergency response operations.
- **Prior to construction of final design**, RG LNG should evaluate the terminal alarm system and external notification system design to ensure the location of the

terminal alarms and other fire and evacuation alarm notification devices (e.g. audible/visual beacons and strobes) would provide adequate warning at the terminal and external offsite areas in the event of an emergency.

- **Prior to construction of final design**, RG LNG should file an updated fire protection evaluation of the proposed facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations should be filed. The evaluation should justify the type, quantity, and location of hazard detection and hazard control, passive fire protection, emergency shutdown and depressurizing systems, firewater, and emergency response equipment, training, and qualifications in accordance with NFPA 59A (2001). The justification for the flammable and combustible gas detection and flame and heat detection should be in accordance with ISA 84.00.07 or equivalent methodologies that would demonstrate 90 percent or more of releases (unignited and ignited) that could result in an offsite or cascading impact would be detected by two or more detectors and result in isolation and de-inventory within 10 minutes. The analysis should take into account the set points, voting logic, wind speeds, and wind directions. The justification for firewater should provide calculations for all firewater demands (including firewater coverage on the LNG storage tanks) based on design densities, surface area, and throw distance and specifications for the corresponding hydrant and monitors needed to reach and cool equipment.
- **Prior to construction of final design**, RG LNG should file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments, as well as the sizing and design of the down-comer that would transfer spills from the tank top to the ground-level impoundment system. The spill containment drawings should show containment for all hazardous fluids, including all liquids handled above their flashpoint, from the largest flow from a single line for 10 minutes, including de-inventory, or the maximum liquid from the largest vessel (or total of impounded vessels) or otherwise demonstrate that providing spill containment would not significantly reduce the flammable vapor dispersion or radiant heat consequences of a spill. In addition, RG LNG should demonstrate that the stainless steel piping spill trays at each LNG storage tank would withstand the force and shock of a sudden cryogenic release.
- **Prior to construction of final design**, RG LNG should file an analysis demonstrating the side on overpressures would be less than 1 psi at the LNG storage tanks and the condensate storage tanks, or demonstrating the tanks would be able to withstand overpressures within the terminal.
- **Prior to construction of final design**, RG LNG should file complete drawings and a list of the hazard detection equipment. The drawings should clearly show the location and elevation of all detection equipment. The list should include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment.

- **Prior to construction of final design**, RG LNG should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, propane, ethane/ethylene, and condensate.
- **Prior to construction of final design**, RG LNG should file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as natural gas liquids and hydrogen sulfide.
- **Prior to construction of final design**, RG LNG should file a technical review of facility design that:
 - a. identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and
 - b. demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices would isolate or shut down any combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency.
- **Prior to construction of final design**, RG LNG should file an analysis of the off gassing of hydrogen in battery rooms and ventilation calculations that limit concentrations below the lower flammability limits (e.g., 25 percent LFL) and should also provide hydrogen detectors that alarm (e.g., 20 to 25 percent LFL) and initiate mitigative actions (e.g., 40 to 50 percent LFL).
- **Prior to construction of final design**, RG LNG should file plan drawings and a list of the fixed and wheeled dry-chemical, handheld fire extinguishers, and other hazard control equipment. Plan drawings should clearly show the location and elevation by tag number of all fixed dry chemical systems in accordance with NFPA 17, wheeled and handheld extinguishers location travel distances are along normal paths of access and egress in accordance with NFPA 10. The list should include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units.
- **Prior to construction of final design**, RG LNG should file a design that includes clean agent systems in the instrumentation buildings and electrical substations.
- **Prior to construction of final design**, RG LNG should file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings should clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by each monitor, hydrant, hose, water curtain, deluge system, foam system, water mist system, and sprinkler. The drawings should also include piping and instrumentation diagrams of the

firewater and foam systems. In addition, firewater coverage should include the coverage of each LNG storage tank.

- **Prior to construction of final design**, RG LNG should demonstrate that the firewater tank would be in compliance with NFPA 22 or demonstrate how API 650 provides an equivalent or better level of safety.
- **Prior to construction of final design**, RG LNG should specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter. The flow transmitter and pressure transmitter should be connected to the Distributed Control System and recorded.
- **Prior to construction of final design**, RG LNG should specify the dimension ratio (DR) to be DR 7 for the high density polyethylene piping to allow consistent pressure rating requirements with the firewater system.
- **Prior to construction of final design**, RG LNG should file drawings and specifications for the structural passive protection systems to protect equipment and supports from cryogenic releases.
- **Prior to construction of final design**, RG LNG should file calculations or test results for the structural passive protection systems to demonstrate that equipment and supports are protected from cryogenic releases.
- **Prior to construction of final design**, RG LNG should file drawings and specifications for the structural passive protection systems to demonstrate the equipment and supports are protected from pool and jet fires.
- **Prior to construction of final design**, RG LNG should file a detailed quantitative analysis to demonstrate that adequate mitigation would be provided for each significant component within the 4,000 Btu/ft²-hr zone from pool and jet fires that could cause failure of the component, including the Jetty Monitor Buildings and the LNG Storage and Loading Substation 2. Trucks at the truck loading/unloading areas should be included in the analysis. A combination of passive and active protection for pool fires and passive and/or active protection for jet fires should be provided and demonstrate the effectiveness and reliability. Effectiveness of passive mitigation should be supported by calculations or test results for the thickness limiting temperature rise and active mitigation should be justified with calculations or test results demonstrating flow rates and durations of any cooling water would mitigate the heat absorbed by the vessel.
- **Prior to construction of final design**, RG LNG should file specifications and drawings demonstrating how cascading damage of transformers would be prevented (e.g., firewalls or spacing) in accordance with NFPA 850 or equivalent.
- **Prior to construction of final design**, RG LNG should file an evaluation of the voting logic and voting degradation for hazard detectors.

- **Prior to commissioning**, RG LNG should file a detailed schedule for commissioning through equipment start-up. The schedule should include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids and during commissioning and start-up. RG LNG should file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and start-up will be issued.
- **Prior to commissioning**, RG LNG should file detailed plans and procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service.
- **Prior to commissioning**, RG LNG should file the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3. The procedures should include a line list of pneumatic and hydrostatic test pressures.
- **Prior to commissioning**, RG LNG should file a plan for clean-out, dry-out, purging, and tightness testing. This plan should address the requirements of the American Gas Association's Purging Principles and Practice, and should provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing.
- **Prior to commissioning**, RG LNG should file the operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms.
- **Prior to commissioning**, RG LNG should tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves.
- **Prior to commissioning**, RG LNG should file a plan to maintain a detailed training log to demonstrate that operating, maintenance, and emergency response staff have completed the required training.
- **Prior to commissioning**, RG LNG should file the settlement results from hydrostatic testing the LNG storage containers as well as a routine monitoring program to ensure settlements are as expected and do not exceed applicable criteria in API 620, API 625, API 653, and ACI 376. The program should specify what actions would be taken after seismic events.
- **Prior to commissioning**, RG LNG should equip the LNG storage tank and adjacent piping and supports with permanent settlement monitors to allow personnel to observe and record the relative settlement between the LNG storage tank and adjacent piping. The settlement record should be reported in the semi-annual operational reports.

- **Prior to introduction of hazardous fluids**, RG LNG should complete and document all pertinent tests (e.g., Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System/Safety Instrumented System that demonstrates full functionality and operability of the system.
- **Prior to introduction of hazardous fluids**, RG LNG should develop and implement an alarm management program to reduce alarm complacency and maximize the effectiveness of operator response to alarms.
- **Prior to introduction of hazardous fluids**, RG LNG should develop and implement procedures for plant personnel to monitor the rocket launches from the Brownsville SpaceX facility and take mitigative actions before and after a rocket launch failure to minimize the potential of release reaching offsite areas or resulting in cascading effects that could extend offsite or impact safe operations.
- **Prior to introduction of hazardous fluids**, RG LNG should complete a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant should be shown on facility plot plan(s).
- **Prior to introduction of hazardous fluids**, RG LNG should complete and document a pre-startup safety review to ensure that installed equipment meets the design and operating intent of the facility. The pre-startup safety review should include any changes since the last hazard review, operating procedures, and operator training. A copy of the review with a list of recommendations, and actions taken on each recommendation, should be filed.
- RG LNG should file a request for written authorization from the Director of OEP **prior to unloading or loading the first LNG commissioning cargo**. After production of first LNG, RG LNG should file weekly reports on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports should include a summary of activities, problems encountered, and remedial actions taken. The weekly reports should also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports should include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude should be reported to the FERC within 24 hours.
- **Prior to commencement of service**, RG LNG should label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001 edition).

- **Prior to commencement of service**, RG LNG should file plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring.
- **Prior to commencement of service**, RG LNG should develop procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by RG LNG staff.
- **Prior to commencement of service**, RG LNG should notify the FERC staff of any proposed revisions to the security plan and physical security of the plant.
- **Prior to commencement of service**, RG LNG should file a request for written authorization from the Director of OEP. Such authorization would only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA of 2002, and the Security and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by RG LNG or other appropriate parties.

The following recommendations would apply **throughout the life of the Rio Grande LNG Terminal**:

- The facilities should be subject to regular FERC staff technical reviews and site inspections on at least an **annual basis** or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, RG LNG should respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted annual report, should be submitted.
- **Semi-annual** operational reports should be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied quantities, boil-off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities should include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boil-off rates. Adverse weather conditions and the effect on the facility also should be reported. Reports should

be submitted within 45 days after each period ending June 30 and December 31. In addition to the above items, a section entitled “Significant Plant Modifications Proposed for the Next 12 Months (dates)” should be included in the semi-annual operational reports. Such information would provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities.

- In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission should be notified within 24 hours and procedures for corrective action should be specified.
- Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases; fires; explosions; mechanical failures; unusual over pressurization; and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) should be reported to the FERC staff. In the event that an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification should be made immediately, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification should be made to the FERC staff within 24 hours. This notification practice should be incorporated into the LNG facility’s emergency plan. Examples of reportable hazardous fluids-related incidents include:
 - a. fire;
 - b. explosion;
 - c. estimated property damage of \$50,000 or more;
 - d. death or personal injury necessitating in-patient hospitalization;
 - e. release of hazardous fluids for 5 minutes or more;
 - f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;
 - g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;
 - h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure-limiting or control devices;

- i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;**
- j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;**
- k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;**
- l. safety-related incidents from hazardous fluids transportation occurring at or en route to and from the LNG facility; or**
- m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.**

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow up in the upcoming semi-annual operational report. All company follow-up reports should include investigation results and recommendations to minimize a reoccurrence of the incident.

4.12.1.8 Conclusions on LNG Facility and Carrier Reliability and Safety

As part of the NEPA review, Commission staff assessed the potential impact to the human environment in terms of safety and whether the proposed facilities would operate safely, reliably, and securely.

As a cooperating agency, the DOT advises the Commission whether RG LNG's proposed design would meet the DOT's 49 CFR 193 Subpart B siting requirements. On March 26, 2019, the DOT provided an LOD on the Project's compliance with 49 CFR 193 Subpart B. This determination was provided to the Commission for consideration in its decision on the Project application. If the Project is authorized, constructed, and operated, the facility would be subject to the DOT's inspection and enforcement program; final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the DOT staff.

Furthermore, DOT's 49 CFR 192 requirements would apply to the VCP that is routed through the northern part of the LNG Terminal site. FERC staff has evaluated the potential risk and impact from an incident on the VCP. Based on DOT PHMSA's incident data, the likelihood of a pipeline incident or failure would be low and a worst-case pipeline rupture scenario would be even less likely. If a pipeline incident were to occur, the likely consequences from these cascading effects would not reach the public. To protect the VCP during construction and

operation of the Project, RG LNG has identified extra protective measures and we have made additional recommendations regarding temporary and permanent crossings. Therefore, we conclude that the proposed Project would not significantly increase the risk to offsite public.

As a cooperating agency, the Coast Guard also assisted the FERC staff by reviewing the proposed LNG Terminal and the associated LNG marine carrier traffic. The Coast Guard reviewed a WSA submitted by RG LNG that focused on the navigation safety and maritime security aspects of LNG marine vessel transits along the affected waterway. On December 26, 2017, the Coast Guard issued a LOR to FERC staff indicating the BSC would be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project, based on the WSA and in accordance with the guidance in the Coast Guard's NVIC 01-11. If the Project is authorized, constructed, and operated, the facility would be subject to the Coast Guard's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

As a cooperating agency, the FAA assisted FERC staff in evaluating impacts on and from the SpaceX rocket launch facility in Cameron County. Specific recommendations are included to address potential impacts from rocket launch failures on the Project. However, the extent of impacts on SpaceX operations, the National Space Program, and to the federal government would not fully be known until SpaceX submits an application with the FAA requesting to launch and whether the LNG Terminal is under construction or in operation at that time.

FERC staff conducted a preliminary engineering and technical review of the RG LNG design, including potential external impacts based on the site location. Based on this review, we recommend a number of mitigation measures and continuous oversight prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout life of the LNG Terminal, in order to enhance the reliability and safety of the terminal to mitigate the risk of impact on the public. With the incorporation of these mitigation measures and oversight, we conclude that RG LNG's Terminal design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

4.12.2 Pipeline Facilities

Natural gas pipeline transmission carries risks to workers and the public that result from the potential for unintended gas release. Although rare, risks primarily include fire and/or explosion after a gas pipeline leak or rupture. Potential hazards to the safe construction and operation of natural gas pipelines include corrosion, equipment malfunction, and external forces such as third-party line strikes and natural forces including lightning, flooding, tornadoes, and earthquakes.

Methane is the primary constituent of natural gas. The gas is colorless, odorless, and tasteless. It is not considered poisonous but poses a low inhalation hazard that could result in asphyxiation. Methane is light and will quickly disperse in areas where there is sufficient air flow. However, if released in enclosed, poorly ventilated areas and consumed in high doses, injuries and fatalities are possible. In concentrations between 5 percent and 15 percent, methane

is flammable and will automatically ignite at 1,000 °F. These properties of methane and the potential for pipeline ruptures require that natural gas transmission pipelines be carefully regulated.

4.12.2.1 Pipeline Safety Standards

Public scoping comments expressed concern regarding the safety of the RB Pipeline; additional detail and responses to these scoping comments are addressed in section 4.12.2.3. The DOT regulates natural gas transmission pipelines and pipeline facilities as specified in 49 USC 60101 et seq. The DOT's PHMSA administers the national regulatory program to ensure the safe transportation of natural gas and other hazardous materials by pipeline. It develops safety regulations and other approaches to risk management that ensure safety in the design, construction, testing, operation, maintenance, and emergency response of pipeline facilities. Many of the regulations are written as performance standards which set the level of safety to be attained and allow the pipeline operator to use various technologies to achieve safety. PHMSA's safety mission is to ensure that people and the environment are protected from the risk of pipeline incidents.

PHMSA's workload is shared by agencies at all government levels. States that participate in the federal pipeline safety program have agreed to adopt the minimum pipeline safety regulations. In addition, they may pass more stringent regulations through their own legislating bodies. Participating states are authorized to oversee safety programs and to enforce federal safety standards for intrastate pipeline facilities under Section 5(a) of the Natural Gas Pipeline Safety Act. Section 5(b) only permits a state agency that does not participate under Section 5(a) to conduct inspection and monitoring procedures of intrastate natural gas facilities. For interstate facilities, states are also authorized to act of agents of the DOT to inspect the facilities within its state boundaries, though only the DOT may enforce regulations. Texas has adopted the minimum federal pipeline safety regulations as authorized by PHMSA under Section 5(a) to assume all aspects of the safety program intrastate, but not interstate, facilities (PHMSA 2016a). In Title 16 of the TAC, Texas has also instituted multiple more stringent safety requirements beyond the federal standards. The RRC is charged with overseeing the state's safety program for intrastate natural gas facilities.

Under a Memorandum of Understanding on Natural Gas Transportation Facilities (Memorandum) dated January 15, 1993, between the DOT and the FERC, the DOT has the exclusive authority to promulgate federal safety standards used in the transportation of natural gas. Section 157.14(a)(9)(vi) of the FERC's regulations require that an applicant certify that it will design, install, inspect, test, construct, operate, replace, and maintain the facility for which a Certificate is requested in accordance with federal safety standards and plans for maintenance and inspection. Alternatively, an applicant must certify that it has been granted a waiver of the requirements of the safety standards by the DOT in accordance with Section 3(e) of the Natural Gas Pipeline Safety Act. The FERC accepts this certification and does not impose additional safety standards. If the Commission becomes aware of an existing or potential safety problem, there is a provision in the Memorandum to promptly alert DOT. The Memorandum also provides for referring complaints and inquiries made by state and local governments and the general public involving safety matters related to pipelines under the Commission's jurisdiction. The FERC also participates as a member of the DOT's Technical Pipeline Safety Standards

Committee which determines if proposed safety regulations are reasonable, feasible, and practicable.

RB Pipeline must design, construct, operate, and maintain the pipelines and aboveground facilities in accordance with the safety standards prescribed in 49 CFR 192. Federal safety standards include area classifications that are based on population density in proximity to natural gas pipelines. More stringent safety requirements are imposed around populated areas. Class location units are assigned based on the evaluation of populated areas within 660 feet of both sides of a pipeline centerline. The class location units are defined below:

- Class 1: location with 10 or fewer buildings intended for human occupancy;
- Class 2: location with more than 10 but less than 46 buildings intended for human occupancy;
- Class 3: location with 46 or more buildings intended for human occupancy or where the pipeline would be located within 100 yards of any building or small well-defined outside area used for recreation or public assembly that is occupied by 20 or more people at least 5 days per week for 10 weeks in a 12-month period; and
- Class 4: location where buildings with four or more stories aboveground are prevalent.

Class locations representing more populated areas require higher safety factors in pipeline design, testing, and operation. For instance, pipelines constructed on land in Class 1 locations must be installed with a minimum depth of cover of 30 inches in normal soil and 18 inches in consolidated rock. Class 2, 3, and 4 locations, as well as drainage ditches of public roads and railroad crossings, require a minimum cover of 36 inches in normal soil and 24 inches in consolidated rock.

The class designations determine the need for additional safety regarding pipeline depth of cover, pipe wall thickness, the distance between MLVs, hydrostatic test pressure, and MAOP. In addition, the number of pipeline welds and inspection surveys are also governed by class location unit assignments along a pipeline. RB Pipeline would adhere to the pipeline design requirements based on class assignments along the proposed route.

RB Pipeline has completed a class location study for its Pipeline System. The results indicate that the entire system between MPs 0.0 and 135.5 may be assigned to Class 1. The pipeline would be routinely surveilled by air to determine whether changes to the class assignment are necessary. If a subsequent increase in population density adjacent to the right-of-way results in a change in class location for the pipeline, RB Pipeline would reduce the MAOP or replace the segment with pipe of sufficient grade and wall thickness, if required to comply with the DOT requirements for the new class location.

The DOT Pipeline Safety Regulations require operators to develop and follow a written IMP that contain all the elements described in 49 CFR 192.911 and address the risks on each transmission pipeline segment. The rule establishes an IMP which applies to all HCAs and includes requirements for pipeline inspections, record keeping, and a communication plan with

procedures to address safety concerns raised by the DOT and other pipeline authorities. The DOT has published rules that define HCAs where a gas pipeline accident could do considerable harm to people and their property and requires an IMP to minimize the potential for an accident. This definition satisfies, in part, the Congressional mandate for DOT to prescribe standards that establish criteria for identifying each gas pipeline facility in a high-density population area. HCAs are defined by using the techniques described in one of the following two ways:

1) An area defined as:

- a Class 3 or Class 4 location; or
- any area in a Class 1 or 2 location where the PIR⁷⁹ is greater than 660 feet and contains 20 or more buildings within the impact circle⁸⁰ intended for human occupancy; or
- any area in a Class 1 or 2 location where the potential impact circle contains an identified site.

2) The area within a potential impact circle containing:

- 20 or more buildings intended for human occupancy; or
- an identified site.

An identified site, as defined by 49 CFR 192.903, is an outside area or structure occupied by 20 or more people for at least 50 days in any 12-month period; a building that is occupied by 20 or more persons on at least 5 days a week for any 10 weeks in any 12-month period; or a facility that is occupied by persons who are confined, are of impaired mobility, or would be difficult to evacuate. Once HCAs have been identified, the operator must implement its IMP in those areas. The Pipeline Safety Improvement Act of 2002 requires RB Pipeline to conduct risk analyses of identified HCAs, baseline assessments of all pipeline segments and schedule inspections using designated methods. The IMP must include a plan to conduct inspections of the pipeline within HCAs every 7 years. The completed analysis for HCAs near the Pipeline System indicates the presence of one identified site about 300 feet from the pipeline near MP 37.0 and does not impact the pipeline class designation.

RB Pipeline must develop an operations and maintenance plan in addition to its ERP as required under Subpart L of 49 CFR 192. These plans must include specific procedures necessary to minimize potential pipeline hazards during normal operations and in the event of an emergency. Aspects of RB Pipeline's Operations and Maintenance Plan and ERP would be compliant with federal requirements and include procedures for the following:

⁷⁹ The potential impact radius is calculated as the product of 0.69 and the square root of: the MAOP of the pipeline in pounds per square inch gauge multiplied by the square of the pipeline diameter in inches.

⁸⁰ The potential impact circle is a circle of radius equal to the potential impact radius.

- responses to emergency incidents including gas leaks, fires, explosions and, natural disaster;
- communications with local law enforcement officials including fire and police departments as well as emergency medical personnel;
- keeping trained RB Pipeline staff supplied with proper equipment at emergency sites;
- ensuring that life, property and the environment are safe in hazardous situations; and
- safely shutting down and restoring service to the Pipeline System in emergencies.

Operators are required to keep liaisons with appropriate emergency responders and public authorities to establish roles and responsibilities in the event of a natural gas pipeline emergency. The applicant would review the ERP with local emergency agencies and would provide them with Project mapping of all facilities including access roads. In addition, facility-specific training would be provided to emergency responders. RB Pipeline must also develop continuing education programs. In accordance with the API's Recommended Practice 1192, RB Pipeline would establish a Public Awareness and Damage Prevention Program that requires information regarding pipeline safety be disseminated to landowners, local residents, excavators and first responders. The program would include holding meetings with the public and emergency personnel. Materials would also be mailed about the properties of natural gas, how to recognize a pipeline marker and right-of-way, who to call in an emergency and the role of emergency responders during an emergency. Additional measures for maintaining the safety of the public from potential hazards may be divided into three categories: passive protection, active protection, and procedural controls. RB Pipeline would include components of each protective measure category.

Passive Protection Measures

Passive protection measures are intended to minimize hazards through design and process features. RB Pipeline would implement the following passive protection measures:

- design, construction, operations, and maintenance would exceed PHMSA's regulations as specified in 49 CFR 192;
- pipe materials would meet or exceed the minimum API 5L requirements;
- pipe bends would exceed federal standards would be factory bent and fittings including elbows would be factory-manufactured;
- external pipe coating materials would comply with federal standards (girth welds would be field-coated using factory-equivalent coating materials to retain integrity);
- "One-Call" or "Call Before You Dig" system would be implemented to identify buried utilities before beginning excavations; and

- pipeline markers would be placed at frequent intervals along the right-of-way and where streets, highways, railroads and other major intersections.

Active Protection Measures

Active protection measures (or engineering controls) include procedures or tools such as valves, pigs, automated monitoring, and shutdown systems that are engineered to prevent or detect potential hazards. RB Pipeline would exceed the federal requirement for pipeline burial in Class 1 zones by burying the pipelines with a minimum of 36 inches of cover, except in areas with consolidated rock, which would include a minimum of 24 inches depth of cover. In addition, RB Pipeline would implement the following active protection measures:

- the use of soil cover or matting when working over existing in-service pipelines;
- testing of all pipeline by x-ray, ultrasonic testing, or a combination of both under the supervision of a trained RB Pipeline welding inspector;
- hydrostatically pressure testing pipeline sections above MAOP to meet federal regulations;
- sand padding may be used in rocky ditches to protect the bottom of the pipe;
- 24-hour monitoring by RB Pipeline's gas control office and routine patrols of the right-of-way by operations personnel;
- installation of cathodic protection systems to prevent external corrosion;
- routine use of ILI tools such as smart pigs and caliper pigs to check the pipeline for anomalies such as corrosion or dents;
- maintenance of safe traffic flow in the vicinity of construction activities through placement of warning signs and the use of flagmen in compliance with local and state requirements;
- use of SCADA systems to monitor the Pipeline System, provide alerts, and control facility equipment;
- automatic override systems designed to shut down the pipeline and facilities in the event of an emergency; and
- video surveillance, security fencing, and gate access control to aboveground facilities.

Procedural Control Measures

Procedural control measures (or administrative controls) include the use of procedures including a worker training program, inspections and monitoring to prevent incidents or to minimize the effects of pipeline incidents. As previously discussed, RB Pipeline would implement the procedural measures as detailed in its Operations and Maintenance Plan, ERP,

and Public Awareness and Damage Prevention Program. RB Pipeline would adhere to its pipeline safety monitoring program that includes the following PHMSA-required procedural control measures:

- training of operations personnel in equipment use and first-aid;
- inspection of all factory produced equipment and the inspection of welds and pipe coatings during construction;
- annual overflight inspections or routine pipeline right-of-way walkover patrols and leak surveys by trained operations personnel;
- prior notifications regarding the need for heavy machinery, grading, or excavations over or near existing rights-of-way;
- inspection of rectifiers at least six times per year;
- annual testing of the cathodic protection system; and
- annual inspection and maintenance of the MLVs.

4.12.2.2 Pipeline Accident Data

Significant pipeline incidents include pipeline leaks that result in death or injury that requires a hospital stay. Liquid releases resulting in fire or explosion and incidents that result in property damages greater than \$50,000 (in 1984 dollars)⁸¹ are also considered significant. According to 49 CFR 191, all significant pipeline incidents must be reported to the DOT within 20 days. During the 20-year period from 1996 through 2015, a total of 1,310 significant incidents were reported on the more than 300,000 total miles of natural gas transmission pipelines nationwide. Additional insight into the nature of service incidents may be found by examining the primary factors that caused the failures. Table 4.12.2-1 provides a distribution of the causal factors as well as the number of each incident by cause.

⁸¹ \$50,000 in 1984 dollars is approximately \$112,955.73 as of May 2015 (CPI, Bureau of Labor Statistics, 2015).

Table 4.12.2-1 Onshore Natural Gas Transmission Pipeline Significant Incidents by Cause 1996-2015		
Cause^a	Number of Incidents	Percentage
Pipeline material, weld or equipment failure	354	27.0
Corrosion	311	23.7
Excavation	210	16.0
All other causes ^b	165	12.6
Natural force damage ^c	146	11.1
Outside force ^d	84	6.4
Incorrect operation	40	3.1
Total	1,310	--
^a	All data gathered from PHMSA Significant Incident files, February 2016, http://www.phmsa.dot.gov/pipeline/library/data-stats/pipelineincidenttrends (PHMSA 2016b).	
^b	All other causes includes miscellaneous, unspecified, or unknown causes.	
^c	Natural forces damage includes earth movement, heavy rain, floods, landslides, mudslides, lightning, temperature, high winds, and other natural force damage.	
^d	Outside force damage includes previous mechanical damage, electrical arcing static electricity, fire/explosion, fishing/maritime activity, intentional damage, and vehicle damage (not associated with excavation).	

The data presented in table 4.12.2-1 include natural gas transmission system failures of all magnitudes with widely varying consequences. The dominant causes of pipeline incidents are corrosion; and pipeline material, weld, or equipment failure, together which constitute 50.7 percent of all significant incidents. The pipelines included in the data set in table 4.12.2-1 vary widely in terms of age, diameter, and level of corrosion control. Each variable influences the incident frequency that may be expected for a specific segment of pipeline. The frequency of significant incidents is strongly dependent on pipeline age. Older pipelines have a higher frequency of corrosion incidents and material failure, because corrosion and pipeline stress/strain are a time-dependent process.

The use of both an external protective coating and a cathodic protection system,⁸² required on all pipelines installed after July 1971, significantly reduces the corrosion rate compared to unprotected or partially protected pipe. Outside force, excavation, and natural forces are the cause in 33.5 percent of significant pipeline incidents. These result from the encroachment of mechanical equipment such as bulldozers and backhoes; earth movements due to soil settlement, washouts, or geologic hazards; weather effects such as winds, storms, and thermal strains; and willful damage. Table 4.12.2-2 provides a breakdown of external force incidents by cause.

⁸² Cathodic protection is a technique to reduce corrosion (rust) of the natural gas pipeline through the use of an induced current or a sacrificial anode (like zinc) that corrodes at faster rate to reduce corrosion.

Table 4.12.2-2 Outside Forces Incidents by Cause^a 1996-2015		
Cause	Number of Incidents^b	Percent of All Incidents^c
Third-party excavation damage	172	13.1
Heavy rains, floods, mudslides, landslides	74	5.6
Vehicle (not engaged with excavation)	49	3.7
Earth movement, earthquakes, subsidence	32	2.4
Lightning, temperature, high winds	27	2.1
Operator / contractor excavation damage	25	1.9
Unspecified excavation damage / previous damage	13	1.0
Natural force (unspecified and other)	13	1.0
Fire / explosion	9	0.7
Fishing or maritime activity	9	0.7
Other outside force	9	0.7
Previous mechanical damage	6	0.5
Intentional damage	1	0.1
Electrical arcing from other equipment / facility	1	0.1
Total	440	-
^a	Excavation, outside force, and natural force from table 4.12.2-1.	
^b	The numbers in this table have been rounded for presentation purposes. As a result, the totals may not reflect the sum of the addends.	
^c	Percentage of all incidents was calculated as a percentage of the total number of incidents natural gas transmission pipeline significant incidents (i.e., all causes) presented in table 4.12.2-1.	

Older pipelines have a higher frequency of outside forces incidents partly because their location may be less well known and less well marked than newer lines. In addition, older pipelines contain a disproportionate number of smaller-diameter pipelines; which have a greater rate of outside forces incidents. Small-diameter pipelines are more easily crushed or broken by mechanical equipment or earth movement.

Since 1982, operators have been required to participate in “One-Call” public utility programs in populated areas to minimize unauthorized excavation activities in the vicinity of pipelines. The “One-Call” program is a service used by public utilities and some private sector companies (e.g., oil pipelines and cable television) to provide pre-construction information to contractors or other maintenance workers on the underground location of pipes, cables, and culverts.

4.12.2.3 Impacts on Public Safety

Public scoping comments expressed concern regarding the safety of the RB Pipeline, including potential damage due to weather events such as flooding, leak detection, and pipeline

accidents (including releases of natural gas and explosions). As described above, RB Pipeline must operate and maintain its facilities in compliance with the DOT regulations at 49 CFR 192 to minimize the potential for pipeline damage and accidents. These requirements include specifications for the depth of soil cover over the pipeline, which would protect the pipe from damage or exposure during flood events.

Operation of the facilities would be monitored electronically on a continuous basis, and an emergency shutdown system would be installed. In addition, annual overflight inspections or routine pipeline right-of-way walkover patrols and leak surveys would be conducted by trained operations personnel to detect pipeline damage or integrity concerns. While fire and/or explosion after a gas pipeline leak or rupture are rare, implementation of DOT safety regulations and RB Pipeline's IMP would further reduce the risk of an incident.

On December 15, 2017, the Union Pacific Railroad Company noted its objection to the proposed Project and cited safety concerns from a possible hazardous material release by the pipeline and adverse consequences from an accident. The Union Pacific Railroad Company indicates that the pipeline appears to cross the railroad tracks at approximate MP 46.5 and parallel the track from approximate MPs 46.5 to 97.

According to the information in the project docket, RB Pipeline proposed to cross the railroad tracks by the bore method at MP 69.9 and then construct its pipeline parallel to the railroad in multiple areas between MPs 19.9 and 67.7. As previously indicated in this EIS, RB Pipeline must operate and maintain its facilities in compliance with the DOT regulations at 49 CFR 192 to minimize the potential for pipeline damage and accidents. Further, the DOT's FRA includes guidelines and requirements for infrastructure crossing railroad facilities. In its letter, the Union Pacific Railroad Company also indicated a request for coordination between RB Pipeline on compensation for the right to cross the railroad property.

The FERC is not an arbitrator between parties with regards to compensation. We believe that reimbursement is more appropriately determined during the permanent right-of-entry agreement process. However, there should be coordination between RB Pipeline and Union Pacific Railroad Company regarding construction, operation, and safety concerns. RB Pipeline has not responded on the FERC docket to the comment letter. Therefore, **we recommend that:**

- **Prior to pipeline construction across, in, or adjacent to the Union Pacific Railroad Company right-of-way, RB Pipeline should file with the Secretary, for review and written approval by the Director of OEP, details concerning the pipeline construction under the railroad, including the depth of cover for the pipeline under the railroad, correspondence with the Union Pacific Railroad Company regarding construction and operation of the pipeline under and parallel to the railroad, and the specific federal and state regulations that RB Pipeline would follow to ensure safety and reliability of the pipeline operations in or under the railroad right-of-way.**

Table 4.12.2-3 presents the annual injuries and fatalities that occurred on natural gas transmission lines from incidents for the 5-year period between 2011 and 2015. The majority of fatalities from pipelines are due to local distribution pipelines not regulated by FERC. These are

natural gas pipelines that distribute natural gas to homes and businesses after transportation through interstate natural gas transmission pipelines. In general, these distribution lines are smaller-diameter pipes and/or plastic pipes which are more susceptible to damage. Local distribution systems do not have large rights-of-way and pipeline markers common to the FERC-regulated natural gas transmission pipelines. Therefore, incident statistics inclusive of distribution pipelines are inappropriate to use when considering natural gas transmission projects.

Table 4.12.2-3 Injuries and Fatalities - Natural Gas Transmission Pipelines		
Year	Injuries	Fatalities
2011	1	0
2012	7	0
2013	2	0
2014	1	1
2015	14	6
Source: PHMSA 2016b		

The nationwide totals of accidental fatalities from various anthropogenic and natural hazards are listed in table 4.12.2-4 in order to provide a relative measure of the industry-wide safety of natural gas transmission pipelines. Direct comparisons between accident categories should be made cautiously, however, because individual exposures to hazards are not uniform among all categories. The data nonetheless indicate a low risk of death due to incidents involving natural gas transmission pipelines compared to the other categories. Furthermore, the fatality rate is much lower than the fatalities from natural hazards such as lightning, tornadoes, or floods.

The available data show that natural gas transmission pipelines continue to be a safe, reliable means of energy transportation. From 1996 to 2015, there were an average of 65.4 significant incidents, 9.1 injuries, and 2.3 fatalities per year. The number of significant incidents over the more than 303,000 miles of natural gas transmission lines indicates the risk is low for an incident at any given location. While the data indicate that the operation of the RB Pipeline would represent a slight increase in risk to the safety of the nearby public, that the risk would be considered low.

**Table 4.12.2-4
Nationwide Accidental Deaths^a**

Type of Accident	Annual No. of Deaths
Motor vehicle ^a	35,369
Poisoning ^a	38,851
Falls ^a	30,208
Drowning ^a	3,391
Fire, smoke inhalation, burns ^a	2,760
Floods ^b	81
Tornado ^b	72
Lightning ^b	49
Hurricane ^b	47
Natural gas distribution lines ^c	13
Natural gas transmission pipelines ^c	2
<p>^a Accident data presented for motor vehicle, poisoning, falls, drowning, fire, smoke inhalation, and burns represent the annual accidental deaths recorded in 2013 (Centers for Disease Control 2013).</p> <p>^b NOAA National Weather Service, Office of Climate, Water and Weather Services, 30-year average (1985-2014) (NOAA 2015).</p> <p>^c Accident data presented for natural gas distribution lines and transmission pipelines represent the 20-year average between 1996 and 2015 (PHMSA 2016b).</p>	

4.13 CUMULATIVE IMPACTS

NEPA requires the lead federal agency to consider the potential cumulative impacts of proposals under its review. Cumulative impacts may result when the environmental effects associated with the proposed action are superimposed on or added to impacts associated with past, present, and reasonably foreseeable future projects, regardless of what agency or person undertakes such other actions. Although the individual impact of each separate project may be minor, the additive or synergistic effects of multiple projects could be significant.

This cumulative impacts analysis uses an approach consistent with the methodology set forth in relevant guidance (CEQ 1997b, 2005; EPA 1999). Under these guidelines, inclusion of actions within the analysis is based on identifying commonalities between the impacts that would result from the Rio Grande LNG Project and the impacts likely to be associated with other potential projects.

The Project-specific impacts of the Rio Grande LNG Project are discussed in detail in other sections of this EIS. The purpose of this section is to identify and describe cumulative impacts that would potentially result from implementation of the proposed Project along with other projects in the vicinity that could affect the same resources in the same approximate timeframe. To ensure that this analysis focuses on relevant projects and potentially significant impacts, the actions included in the cumulative impact analysis include projects that:

- impact a resource potentially affected by the proposed Project;

- impact that resource within all or part of the time span encompassed by the proposed or reasonably expected construction and operation schedule of the proposed Project; and
- impact that resource within all or part of the same geographic area affected by the proposed Project. The geographic area considered varies depending on the resource being discussed, which is the general area in which the projects could contribute to cumulative impacts on that particular resource (geographic scope of analysis).

A geographic scope was identified for each specific environmental resource that would be affected by the Project, as described in table 4.13.1-1.

4.13.1 Projects and Activities Considered

With respect to past actions, CEQ guidance (2005) allows agencies to adopt a broad, aggregated approach without “delving into the historical details of individual past actions,” an approach we have taken here. The current regional landscape in south Texas, which is a mix of large tracts of open land that support ranch and cattle operations, NWRs, and an assortment of industrial facilities already sited along the BSC forms the environmental baseline described in other sections of this EIS and against which the impacts of reasonably foreseeable future actions are considered. Recently completed projects that may still be undergoing restoration or that were identified during the agency review process as projects of concern are also included in the cumulative impacts assessment.

Reasonably foreseeable projects that might cause cumulative impacts in combination with the proposed Project includes projects that are under construction, approved, proposed, or planned. For FERC-regulated projects, proposed projects are those for which the proponent has submitted a formal application to the FERC, and planned projects are projects that are either in pre-filing or have been announced, but have not been officially proposed. Planned projects also include projects not under the FERC’s jurisdiction that have been identified through publicly available information such as press releases, internet searches, and the applicants’ communications with local agencies.

**Table 4.13.1-1
Geographic Scope for Cumulative Impact Analysis**

Environmental Resource	Geographic Scope
Geologic Resources and Soils	Area affected by and adjacent to the Project - direct effects of geologic hazards would be highly localized and limited primarily to the period of construction; cumulative impacts from geologic hazard impacts would only occur if other projects are constructed at the same time and place as the proposed facilities.
Water Resources (Groundwater, Surface Water, and Wetlands)	HUC-12 subwatershed - impacts on groundwater, surface waters and wetlands can result in downstream contamination or turbidity; therefore, the Project could result in additional incremental impacts on waters further downstream.
Vegetation and Wildlife	HUC-12 subwatershed – impacts on vegetation within the HUC-12 subwatershed could contribute to impacts on vegetation communities and wildlife habitat within the watershed.
Aquatic Resources	HUC-12 subwatershed – impacts on surface water within the HUC-12 subwatershed could contribute to downstream impacts on aquatic organisms and their habitats.
Threatened and Endangered Species	HUC-12 subwatershed – impacts within the HUC-12 subwatershed could contribute to impacts on vegetation communities and threatened and endangered species habitat within the watershed. For marine species, impacts on marine/estuarine waterbodies in the HUC-12 subwatershed and established shipping channels used by LNG carriers are also within the geographic scope. Due to the diversity in life history and range of threatened and endangered species potentially affected by the Rio Grande LNG Project, cumulative impacts were independently reviewed for each species or group of species.
Land Use and Recreation	Cameron County; and land within 1 mile of the Pipeline System - to encompass any large areas with specialized or recreational uses.
Visual Resources	For aboveground facilities, distance that the tallest feature at the planned facility would be visible from neighboring communities (about 12 miles). For the Pipeline System, a 0.25-mile buffer and existing visual access points (e.g., road crossings).
Socioeconomics	Affected counties and municipalities.
Environmental Justice	Census tracts within affected counties.
Cultural Resources	Overlapping resource impacts. Direct impacts on cultural resources are highly localized; thus, cumulative impacts would only occur if other projects are constructed in the same place or impact the same historic properties impacted by the proposed Project.
Air Quality – Construction	Within 0.5 mile of the proposed pipeline facilities and within 1.0 mile of the LNG Terminal, because construction emissions are highly localized.
Air Quality – Operations	Within 31 miles of the proposed LNG Terminal, interconnect booster stations, and compressor stations.
Noise - Construction	Within 0.25 mile from pipeline or aboveground facilities, 0.5 mile from HDD entry and exit locations, and overlapping NSAs that would be affected by construction of the LNG Terminal.
Noise - Operations	Other facilities that would impact any NSA within 1 mile of a noise emitting permanent aboveground facility, or projects within a 2-mile radius of the LNG Terminal site or potential overlapping impacts on nearby NSAs.

Table 4.13.1-2 lists the projects and activities that we considered in this cumulative impact analysis, including the location, distance from the project, project timeframe, and resource(s) potentially cumulatively affected in conjunction with the Rio Grande LNG Project. Project locations are depicted in figures 4.13.1-1 and 4.13.1-2. Descriptions of potential cumulative impacts by resource category are discussed in section 4.13.2. For some projects we were unable to obtain quantitative information (e.g., project planning stage, size, etc.), in these cases our analysis relies on qualitative information for the project.

We received comments on the draft EIS that identified additional projects for consideration in our cumulative analysis. These include the Palmas Altas Wind Farm and an associated transmission line, a steel mill, an oil pipeline and export terminal, and an airport terminal expansion project. These projects have been added to table 4.13.1-2 and are described further below.

4.13.1.1 Future LNG Liquefaction Projects

Annova LNG Brownsville Project

Annova LNG has proposed a liquefaction and LNG export terminal along the BSC in Cameron County. The Annova LNG Brownsville Project Annova LNG Project would affect about 491 acres of land about 0.3 mile south of the Rio Grande LNG Terminal (see figure 3.3.2-1) and would include six LNG trains with an overall LNG capacity of about 6 MTPA, two 160,000 m³ LNG storage tanks, and a marine berth to accommodate one LNG carrier. A new, intrastate natural gas header pipeline would deliver domestic feed gas from the Isla Grande pipeline system to the proposed Annova LNG Terminal.

The FERC approved Annova LNG's request to enter the FERC pre-filing process on March 27, 2015, under Docket No. PF15-15; its formal application was filed with the FERC on July 13, 2016, under Docket No. CP16-480. Annova LNG initially anticipated that construction of the project would begin in 2018, and would have an in-service date of 2021. However, this timeline no longer appears feasible. Other non-jurisdictional facilities for the Annova LNG Project would include a natural gas interconnect facility within the terminal site, electricity to be provided by South Texas Electric Cooperative, and potable water to be provided by BND through planned expansions to serve various customers of the Port of Brownsville (including RG Developers). These non-jurisdictional facilities are discussed below (section 4.13.1.2).

Barca and Eos LNG Project

Barca and Eos were planning to develop a liquefaction and LNG export facility at the Port of Brownsville, about 2 miles west of the proposed Rio Grande LNG Terminal site. While the DOE authorized Eos and Barca to export to FTA nations, the applicants have not requested to participate in the FERC pre-filing process. Further, the lease option with BND has expired. As such, we conclude that the project is highly speculative, at best, and have excluded it from our cumulative impact analysis, as indicated in table 4.13.1-2.

Table 4.13.1-2
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project

Project / Activity (Mapped #, figures 4.13.1-1 and 4.13.1-2)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
Future Liquefaction and LNG Export Projects							
Annova LNG Brownsville Project (#1)	Annova LNG Common Infrastructure, LLC, Annova LNG Brownsville A, LLC, Annova LNG Brownsville B, LLC, and Annova LNG Brownsville C, LLC	2020 / 2021	491 acres	T - 0.3 mile	700-1,200 / 165	Yes	T - All resources less geology, soils, and cultural
				P - 0.6 mile			P - All resources less geology, soils, visual, cultural, and noise
Barca and Eos LNG Project (#3&4)	Barca LNG, LLC and Eos LNG, LLC	Unknown	Unknown	T - 2 miles	Unknown	No; the lease option with BND has expired	--
				P - Adjacent			--
Gulf Coast Liquefaction Project (#5)	Gulf Coast LNG Export, LLC	Unknown	500 acres	T - 4 miles	3,000 / 250	No; in May 2016 Gulf Coast LNG Export, LLC filed a request to withdraw its application and vacate its authorization	--
				P - Adjacent			--
Texas LNG Terminal Project (#2)	Texas LNG Brownsville, LLC	2020 / 2024	311.5 acres	T - Adjacent	1,312 / 80	Yes	T - All resources less cultural
				P - 2.5 miles			P - Water resources, vegetation and wildlife, aquatic resources, T&E, land use, socioeconomics, air quality

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

Project / Activity (Mapped #, figures 4.13.1-1 and 4.13.1-2)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
LNG Trucking (#10)	Unknown	Unknown	12 to 15 tanker trucks / day	T - Within	Unknown	Yes	T - Socioeconomics
				P - Varies			P - Socioeconomics
				T - Adjacent			T - All resources
Potable Water, Sewer Services, and Fiber Optic Telecommunication Line (#10)	BND	2019 / 2020	estimated 5-6 miles within a 35-foot right-of-way (3.3 acres) ^b	P - Adjacent	Unknown	Yes	P - All resources
				T - Adjacent			T - All resources
				T - Adjacent			T - All resources
Electric Transmission Line (#10)	AEP	2019 / 2020	12.7 miles of 100-foot construction right-of-way (142 acres); an additional 11 miles (121 acres) is associated with the Texas LNG Project	P - Adjacent	Unknown	Yes	P - All resources
				T - Adjacent			T - All resources
				T - Adjacent			T - All resources
Road Widening (SH-48) (#28)	TxDOT	anticipated 2019 / 2019	estimated 3 miles (estimated 36.9 acres, including 0.5 acre associated with the Texas LNG Project)	P - Adjacent	Unknown	Yes	P - All resources
				T - Adjacent			T - All resources
				T - Adjacent			T - All resources
Pipeline Facilities							
Potable Water Supply Pipeline associated with Amovva LNG (not mapped)	BND	2019 / 2021	6 miles	T - 0.3 mile	Unknown	Yes	T - All resources, less geology, soils, and cultural
				P - 0.6 mile			P - All resources less geology, soils, visual, cultural, and noise

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a		Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
				T - 3.3 miles	P - 2.5 miles			
Kingsville to Brownsville Pipeline ^e (Not mapped)	Unknown	2021 / 2021	130 miles (estimated 1,576 acres)	T - 3.3 miles	P - 2.5 miles	Unknown	Yes	T - All resources less geology, soils, cultural, and noise
				P - 2.5 miles				P - All resources less geology, soils, visual, cultural, and noise
New Intrastate Pipeline for Texas LNG ^d (#11)	Unknown	2019 / 2020	10.2 miles (108.3 acres)	T - Adjacent	P - Adjacent	Unknown	Yes	T - All resources
				P - Adjacent				P - All resources
VCP ^e (also known as Nueces-Brownville Pipeline) (Not mapped)	VCP / Comision Federal de Electricidad	In service October 2018	estimated 2,545.8 acres	T - Adjacent	P - Appears to be crossed	Unknown	Yes	T - All resources
				P - Adjacent				P - All resources
Tuxpan Project (Not mapped)	Comision Federal de Electricidad	Underway / 2019 ^f	estimated 7,576.8 acres	T - Unknown	P - Unknown	Unknown	No, since this project would be located entirely within Mexico	--
				P - Unknown				
Electric Transmission and Generation Projects								
New Electric Transmission Line associated with Amnava LNG (Not mapped)	South Texas Electric Cooperative	2019 / 2021	15 miles	T - 0.3 miles	P - 0.6 miles	Unknown	Yes	T - All resources less geology, soils, air, and noise
				P - 0.6 miles				P - Water resources, vegetation, wildlife, aquatic resources, T&E, and socioeconomics

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
Tenaska Brownsville Generating Station (#19)	Tenaska	2019 / Unknown	270 acres	T - 13.8 miles	700 / 23	Yes	T - All resources less geology, soils, and visual
				P - 7 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, and socioeconomic
San Roman Wind Farm (#20)	Acciona Energia	Operational	156 acres	T - 8 miles	80 / 7	Yes	T - Water resources, vegetation, wildlife, T&E, land use, visual, and socioeconomic
				P - 0.9 mile			P - Water resources, vegetation, wildlife, T&E, land use, and socioeconomic
Cameron Wind Farm (#21)	Apex Clean Energy	Operational	15,000 acres ^b	T - 14.0 miles	140 / 18	Yes	T - Water resources, vegetation, wildlife, T&E, land use, and socioeconomic
				P - Crossed			P - Water resources, vegetation, wildlife, T&E, land use, visual, socioeconomic, and noise

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a		Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
				T - 35 miles	P - 0.25 mile			
Bruening Breeze Wind Farm ^b (Not mapped)	E.ON	Operational	15,000	P - 0.25 mile	200 / 20	Yes	T - Socioeconomics P - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, visual, socioeconomics, and noise	
								T - 65 miles
Stella Wind Farm ^b (Not mapped)	E.ON	Underway/ Unknown	Unknown	P - 12 miles	Unknown	Yes	T - None P - Water resources, vegetation, wildlife, aquatic resources, T&E, and socioeconomics	
								T - 6.2 miles
Cross Valley Project (#22)	Electric Transmission Texas and Sharyland Utilities	Operational	96 miles (estimated 1,745.7 acres)	P - Parallel / Crossed	Unknown	Yes	T - All resources less geology, soils, cultural, and noise P - All resources	
								T - 20.6 miles
Palmas Altas Wind Farm (31) ^j	Acciona Energy	Underway/ November 2019	estimated 6,600 acres	P - Crossed	170 / 10	Yes	T - land use and socioeconomics P - All resources	
								T - 20 miles
Palmas to East Rio Hondo Transmission Line (Not mapped) ^j	South Texas Electric Cooperative, Inc.	Unknown	between 6.2 and 6.6 miles (estimated 75-80 acres)	P - 8 mile	Unknown	Yes	P - Water resources, vegetation, wildlife, aquatic resources, T&E, and socioeconomic	
								T - 20 miles

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
Transportation Projects							
East Loop (State Highway 32) (#14) ^k	TXDOT and CCRMA	2019 / Unknown	6.7 miles (126.9 acres)	T - 15 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, socioeconomic, air quality
				P - 10 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomic, air quality
South Padre Island Second Access (#17) ^l	TXDOT and FHWA ^a	Unknown	17.6 miles (240.6 acres)	T - 7 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, socioeconomic, air quality
				P - 8.7 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomic, air quality

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
SH-4 Upgrade Project ^m (#15)	TXDOT	2022 / Unknown	Unknown	T - 15 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, socioeconomics, air quality
				P - 5 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomics, air quality
SH-100 Wildlife Crossing Project (#16)	TXDOT	2016 / Unknown	0.1 mile	T - 7.4 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, socioeconomics, air quality
				P - 0.3 mile			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomics, air quality
SH-77 Wildlife Crossing Project (Not Mapped)	TXDOT	Unknown	Unknown	T - 54 miles	Unknown	Yes	T - None
				P - 430 feet			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomics, air quality

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
SH-550 Connector and Toll Project (#13) ^m	TxDOT and CCRMA ^a	Operational	Unknown	T - 11.2 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, visual, socioeconomic, air quality
				P - 5 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomic, air quality
Airport Terminal Expansion (#32) ⁿ	Brownsville South Padre Island International Airport	Unknown	Unknown	T - 12.6 miles	150/Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, visual, socioeconomic, air quality
				P - 8.7 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomic, air quality
Port of Brownsville Projects							
Brownsville Liquids Terminal (#29A)	Port of Brownsville and Howard Midstream Energy Partners	Operational	Unknown	T - 7.5 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, visual, socioeconomic, air quality
				P - 3.6 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomic, air quality

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
Bulk Liquids Terminal Facility (#29B)	Port of Brownsville and Mavericks Terminal, LLC	Operational	Unknown	T - 7.1 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, visual, socioeconomic, air quality
				P - 3.2 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomic, air quality
GEOTRAC Industrial Hub (#12)	OmniTRAX	Operational	1,400 acres	T - 13 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, visual, socioeconomic, air quality
				P - 7.2 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomic, air quality
Port of Brownsville Marine Cargo Dock 16 and Storage Yard (#24)	Port of Brownsville	Operational	600-foot marine cargo dock	T - 6 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, visual, socioeconomic, air quality
				P - 4.2 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomic, air quality

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
Centurion Brownsville Terminal Processing and Storage Facility (Not mapped)	Centurion Terminals	Operational	280 acres ^o	T – 6 miles	500/35	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, visual, socioeconomic, air quality
				P – 2.2 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomic, air quality
Steel Mill (Not mapped) ^p	Big River Steel	Unknown	800 acres	T – 4 miles	1,500/500	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, visual, socioeconomic, air quality
				P – 1 mile			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomic, air quality
Jupiter Crude Oil Pipeline and Export Terminal Project (#34) ^q	Jupiter Energy Group and Jupiter MLP	Underway / 2020	650- miles of 30-inch-diameter pipeline (estimated 7,880) and 270 acres at the Terminal	T – 5.1 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, visual, socioeconomic, air quality
				P – 1.4 mile			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomic, air quality

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
Waterway Improvement Projects							
Brazos Island Harbor Channel Improvement (#6)	COE	Underway	Deepen the BSC from 42 to 52 feet	T - Adjacent	Unknown	Yes	T - All resources less vegetation
				P - Adjacent			P - All resources less vegetation and visual
				T - Adjacent			T - All resources
Bahia Grande Channel Restoration (#7)	FWS, NMFS, TxDOT, Laguna Atascosa NWR, Cameron County, and BND	Unknown	250-foot wide channel	P - Crossed	Unknown	Yes	P - All resources
				T - Adjacent			T - All resources less vegetation
BSC and Turning Basin Maintenance Dredging (#9)	COE	Underway/ Ongoing	Unknown	T - Adjacent	Unknown	Yes	P - All resources less vegetation and visual
				P - Crossed			P - All resources less vegetation and visual
Bend Easing BSC Improvement Project (#27)	BND	Unknown	Unknown	T - 5.5 miles	Unknown	Yes	T - All resources less vegetation, cultural resources, and noise
				P - 7.7 miles			P - Water resources, wildlife, aquatic resources, T&E, socioeconomic

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
Port Isabel Maintenance Dredging (Not mapped)	COE	Underway / Ongoing	Unknown	T - 2 miles	Unknown	Yes	T - Water resources, wildlife, aquatic resources, T&E, land use, socioeconomics, visual, air quality
				P - 5.5 miles			P - Water resources, wildlife, aquatic resources, T&E, socioeconomics
Gulf Intercoastal Waterway Maintenance Dredging (Not mapped)	COE	Underway / 2019	423 miles	T - 4 miles	Unknown	Yes	T - Surface water, aquatics, vegetation, wildlife, T&E, socioeconomics, and land use
				P - 7.5 miles			P - Water resources, wildlife, aquatic resources, T&E, socioeconomics

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

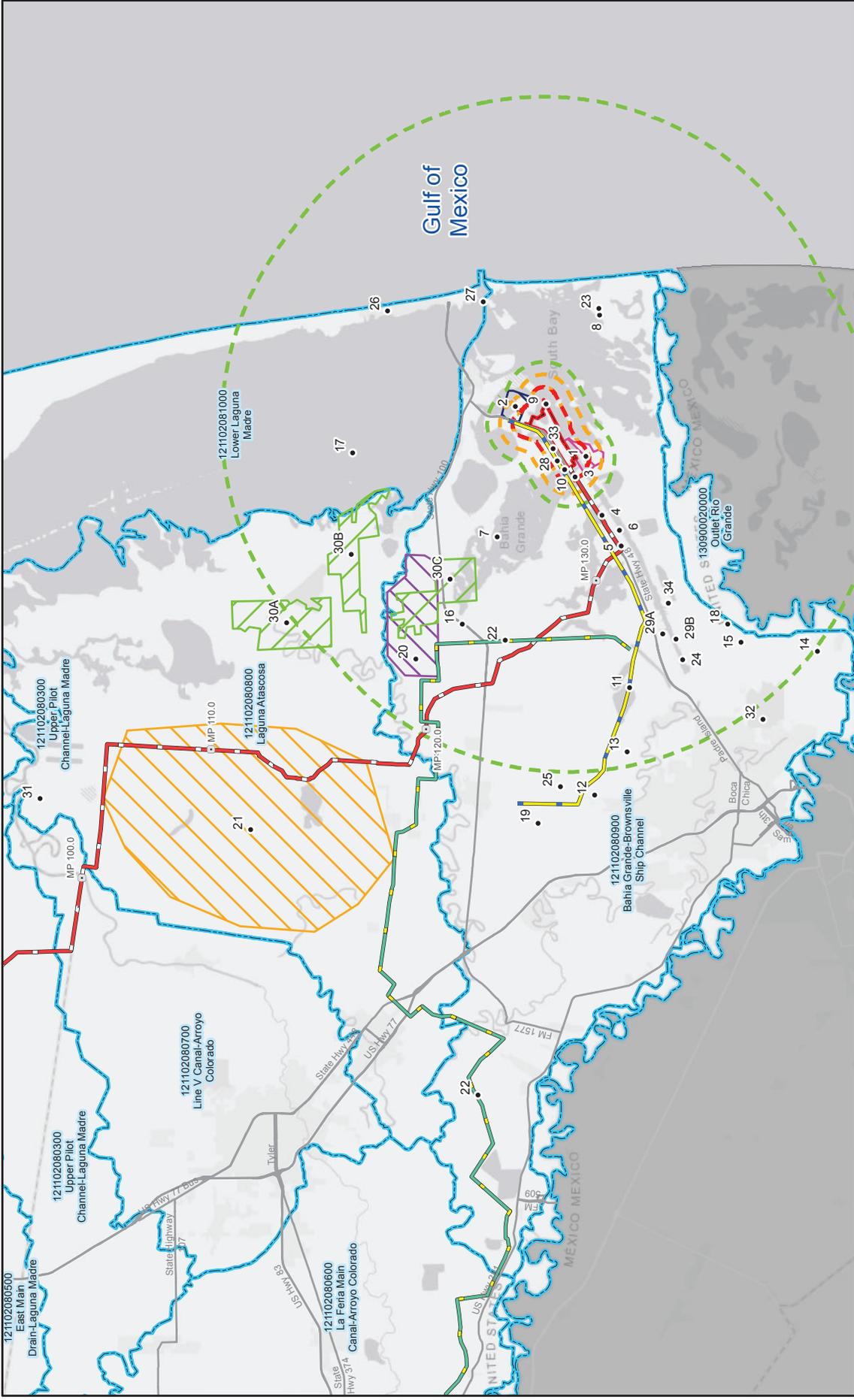
Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
Other Projects and Activities Considered							
SpaceX Commercial Spaceport Project (#8)	Space Exploration Technologies Corporation	Underway / 2019	70 acres	T - 5.5 miles	150 / 47	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, socioeconomic, and noise
				P - 6.5 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, and socioeconomics
Stargate Facility (#23)	Center for Advanced Radio Astronomy, University of Texas-Rio Grande Valley and SpaceX	Operational	2.3 acres	T - 5.5 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, and socioeconomics
				P - 6.7 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, and socioeconomics
Mobile Border Check Point (#18)	U.S. Customs and Border Patrol State Highway	Operational	N/A	T - 8 miles	Unknown	No, since the facility is mobile, no permanent facilities are proposed; also, the facility is operational	--
				P - 5.1 miles			

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

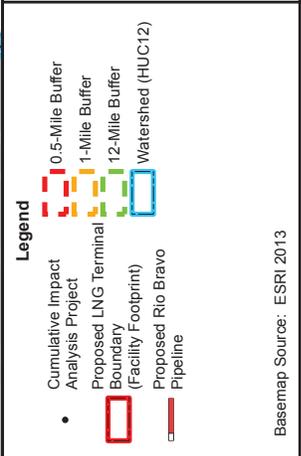
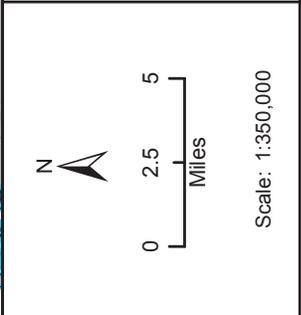
Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
South Padre Island Beach Re-nourishment (#26)	COE, TGLIO, and City of South Padre Island	Complete	0.8 miles	T - 6 miles	Unknown	Yes	T - Land use and socioeconomics
				P - 9.9 miles			P - Socioeconomics
Palo Alto Battlefield Cultural Landscape Restoration (#25)	NPS and Palo Alto Battlefield National Historical Park / National Historic Landmark	Ongoing	Unknown	T - 13 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, and socioeconomics
				P - 4.9 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, and socioeconomics
Bahia Grande Coastal Corridor Project (Current Proposal) (#30A, B, C)	FWS and TPWD	Ongoing	2,129 acres ^r	T - 5 miles	Unknown	Yes	T - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, and socioeconomics
				P - 2.5 miles			P - Water resources, vegetation, wildlife, aquatic resources, T&E, land use, and socioeconomics
Opening of Bahia Grande (#33)	FWS	Unknown	1.0 acre	T - 0.1 mile	Unknown	Yes	T - All resources less vegetation
				P - 1 mile			P - Water resources, vegetation, wildlife, aquatic resources, T&E, socioeconomics, air quality

**Table 4.13.1-2 (continued)
Projects and Resources Considered in the Cumulative Impacts Analysis for the Rio Grande LNG Project**

Project / Activity (Mapped #)	Developer	Estimated Timeframe (Con / Op)	Project Size	Closest Distance from Facilities ^a	Workforce (Con / Op)	Included in Cumulative Impact Analysis	Resources Potentially Affected within the proposed Project's Geographic Scope ^a
Note: Unless otherwise noted, data were provided by the Project Applicant in its FERC Application and associated supplemental filings available for viewing on the FERC website, eLibrary, under Docket Nos: CP16-454-000 and CP16-455-000.							
a	T = Rio Grande LNG Terminal site; P = Pipeline System; T&E = threatened and endangered species; and CCRMA = Cameron County Regional Mobility Authority.						
b	The potable water supply line would also extend to serve the Texas LNG Terminal site; impacts are included with the new interstate pipeline for Texas LNG since the projects would be installed in the same corridor.						
c	Details on this project were provided by Annova LNG, which is under review by FERC at Docket Number CP16-480.						
d	Details on this project were provided by Texas LNG, which is under review by FERC at Docket Number CP16-116.						
e	The permanent rights-of-way for the VCP pipeline and proposed pipelines would be collocated with the BND utility corridor (25 feet).						
g	Natural Gas Intel 2019.						
g	Apex Clean Energy 2016.						
h	Kimley-Horn 2017, Windpower Engineering 2018.						
i	Accoia 2018.						
j	Kelley 2018, Linarares 2018; the South Texas Electric Cooperative has submitted nine potential routes for the transmission line so the reported project size is based on the upper bound of a range and the distances area approximated based on the general location where the transmission line would be built, e.g., just east of Rio Hondo.						
k	CCRMA 2019.						
l	CCRMA 2017.						
m	TxDOT 2016 and 2019.						
n	Clark 2018a.						
o	Smith 2017.						
p	Clark 2018b, Williams 2018; The exact location of the lands to be leased by Big River Steel are unknown, the reported distances are based on an assumed location, generally west of Goose Island, where it appears that 800 acres may be available.						
q	JupiterMLP 2018 and Jupiter 2018.						
r	The total acquisition goal is 7,000 acres.						
s	FWS 2018c.						

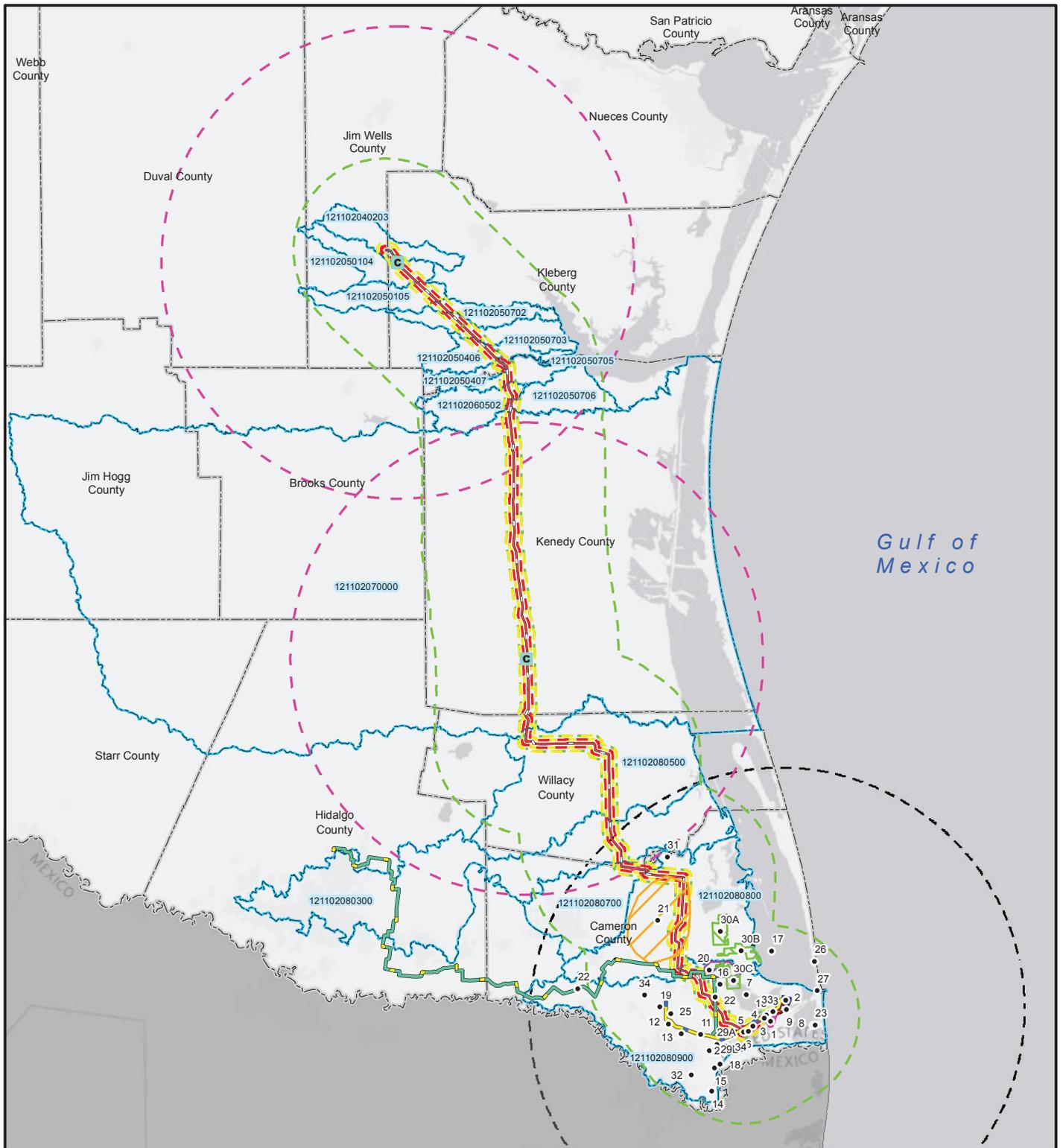


Rio Grande LNG Project
 Cumulative Projects Overview
 of the Rio Grande LNG Terminal

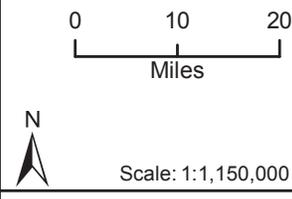


Basemap Source: ESRI 2013

Figure 4.13.1-1



- Legend**
- Cumulative Impact Analysis Project
 - Proposed Alignment
 - c** Compressor Station
 - Header System
 - Proposed LNG Terminal Boundary (Facility Footprint)
 - 0.5-Mile Buffer
 - 1-Mile Buffer
 - 12-Mile Buffer
 - 31-Mile Buffer
 - 31-Mile Buffer (Terminal)
 - Watershed (HUC12)



Rio Grande LNG Project

Cumulative Projects Overview of the Rio Bravo Pipeline

Figure 4.13.1-2

Basemap Source: Esri, DeLorme, NAVTEQ, USGS, Intermap, IPC, NRCAN, Esri Japan, METI, Esri China, Esri Thailand, Tom Tom, 2013

Gulf Coast Liquefaction Project

Gulf Coast LNG Export, LLC (Gulf Coast) was planning to develop a liquefaction and LNG export facility on a 500-acre site at the Port of Brownsville, about 4 miles west of the Rio Grande LNG Terminal site (see figure 3.3.2-1). In May 2016, Gulf Coast filed a request to withdraw its application and vacate its authorization previously received from DOE to export to FTA nations and non-FTA nations. Therefore, this project is no longer active, and it has not been included in our cumulative impact analysis, as indicated in table 4.13.1-2.

Texas LNG Terminal Project

Texas LNG has proposed a liquefaction and LNG export terminal on the BSC in Cameron County, bordering the northeast boundary of the Rio Grande LNG Terminal site (see figure 3.3.2-1). The Texas LNG Terminal Project (Texas LNG Project) would impact 311.5 acres of land and would include two LNG trains with an overall LNG capacity of approximately 4.0 MTPA, two 210,000 m³ LNG storage tanks, and a marine berth to accommodate one LNG carrier. The Agua Dulce Hub would supply feed gas to the terminal via a new, 150-mile-long intrastate natural gas header pipeline.

Texas LNG's request to enter the FERC pre-filing process was approved on April 14, 2015, under Docket No. PF15-14; its formal application was filed with the FERC on March 30, 2016, under Docket No. CP16-116. Texas LNG anticipated that construction would begin in 2018 with an in-service date of 2022. However, this timeline is no longer feasible. Other non-jurisdictional facilities, including electricity and water, would be provided by AEP and BND, respectively. These are discussed in section 4.13.1.2.

4.13.1.2 Non-jurisdictional Facilities Associated with the Rio Grande LNG Project

As described in section 1.4, the proposed Rio Grande LNG Terminal, which is a FERC-jurisdictional facility, would require power, potable water, and sewer services. However, these services do not fall under the jurisdiction of the FERC. RG LNG has also proposed LNG truck loading facilities and modifications to SH-48. Each of these projects has been included in our cumulative impacts analysis.

LNG Trucking

The proposed LNG trucking infrastructure within the Rio Grande LNG Terminal would be jurisdictional to FERC; however, LNG trucking activities that take place after the LNG truck has departed from the LNG Terminal do not fall under FERC jurisdiction. During operation of the Rio Grande LNG Terminal, a portion of the LNG would be loaded onto trucks for road distribution to refueling stations in Texas and the surrounding states. While no agreements have been executed for the transportation of LNG in trucks, RG LNG is proposing to construct four loading bays designed with a maximum load rate per bay of 300 gpm. Each bay would be able to accommodate up to 15 tanker trucks per day, for trucks with a maximum carrying capacity of 13,000 gallons. LNG trucks calling on the Rio Grande LNG Terminal are expected to deliver the LNG to any of the 30 LNG fueling stations currently in operation in south Texas, or to additional LNG refueling stations currently under development.

Tie-in to Potable Water, Sewer, and Telecommunication Services

BND is planning to construct a freshwater supply system to serve various customers of the Port of Brownsville. RG LNG would connect the LNG Terminal site to the anticipated 16-inch-diameter water supply header that would be installed along the northern boundary of the Rio Grande LNG Terminal site south of SH-48. As part of the same expansion effort for the Port of Brownsville customers, BND is planning to construct a new sewage header that would connect to an existing treatment plant. RG LNG would connect the LNG Terminal site to the anticipated 12-inch-diameter sewage header that would be located in the same corridor as the BND's planned freshwater supply system. The potable water line would also extend to serve the Texas LNG Terminal site. Telecommunication service for the LNG Terminal would be accommodated by a new 4-inch-diameter fiber optic cable buried within BND utility corridor to accommodate the water and sewer service.

RB Pipeline is currently evaluating the utility needs for Compressor Stations 1 and 2, as well as for the booster stations. Compressor Station 3 would be constructed within the Rio Grande LNG Terminal site; therefore, it would be served through the power sources discussed above.

Power Supply

RG LNG anticipates that power for operation of the Rio Grande LNG Terminal would be supplied through planned upgrades to AEP's existing system. AEP would build a double-circuit 138 kV overhead power line that would connect the AEP Union Carbide and Loma Alta substations. The power line would run south of SH-48 along the northern boundary of the Rio Grande LNG Terminal site. The power lines would continue beyond the Rio Grande LNG Terminal to provide power to the Texas LNG Terminal site.

RB Pipeline is currently evaluating the utility needs for Compressor Stations 1 and 2, as well as for the booster stations. Compressor Station 3 would be constructed within the Rio Grande LNG Terminal site; therefore, it would be served through the power sources discussed above.

Road Widening (SH-48)

TxDOT is currently planning to update portions of SH-48 along the Rio Grande LNG Terminal site to accommodate access. Modifications were identified during RG LNG's coordination with TxDOT and include the addition of land for acceleration, deceleration, and turning lanes, as well as traffic lights. Similar modifications to SH-48 would also be completed adjacent to the proposed Texas LNG Project site. During a November 2018 meeting, RG Developers also identified a reduction in speed limit near the LNG Terminal site along SH-48. TxDOT requested that RG Developers provide an updated Traffic Impact Analysis for review, including a speed study, to assess the current road conditions and traffic mitigation. RG Developers anticipates providing the updated Traffic Impact Analysis to TxDOT for review and approval in the third quarter of 2019.

4.13.1.3 Intrastate Pipeline Facilities

Kingsville to Brownsville Pipeline

Annova LNG plans to receive natural gas supply from a third-party-owned and operated intrastate pipeline running from Kingsville to Brownsville (Kingsville to Brownsville Pipeline), which Annova LNG anticipates would be in constructed in 2021. The pipeline would be an approximately 130-mile-long, 36-inch-diameter pipeline and would transport natural gas from the Agua Dulce Hub near Kingsville to various delivery points between Kingsville and Brownsville, ending at the Annova LNG facility. Because the developer of the pipeline has not yet been identified, the exact location of the pipeline is unknown.

Intrastate Pipeline to the Texas LNG Project

A new non-jurisdictional 30-inch-diameter intrastate pipeline would be constructed to supply natural gas to the Texas LNG Project. Texas LNG anticipates that the pipeline would be approximately 10.2 miles long and would interconnect with the proposed Cross Valley Pipeline Project. Texas LNG also anticipates that an additional 15,000 hp of compression would be needed to move the incremental gas destined for Texas LNG in Agua Dulce at the same compressor station constructed for the Cross Valley Pipeline Project, with an additional 50,000 hp compression also needed about halfway between Agua Dulce and Brownsville. Construction of the 10.2-mile-long intrastate natural gas pipeline would likely require a 100-foot-wide construction right-of-way and would be primarily collocated with other non-jurisdictional facilities associated with the Texas LNG Project, south of SH-48. The intrastate pipeline would originate about 5 miles west of RG LNG's Rio Grande LNG Terminal site within the BND utility corridor (described above for the non-jurisdictional facilities) following a northeastern route to the Texas LNG Terminal site. Texas LNG anticipates that construction on the intrastate natural gas pipeline would begin in 2019 and take less than 1 year to complete.

Valley Crossing Pipeline (also known as the Nueces-Brownsville Pipeline)

VCP, a subsidiary of Enbridge, Inc., installed a 165-mile-long intrastate pipeline to supply gas to Comisión Federal de Electricidad, Mexico's stated-owned utility (Enbridge 2018). The VCP, which originates near the Agua Dulce Hub in Nueces County, was placed into service in October 2018. The terminus of the pipeline is about 9 miles offshore of the BSC. The VCP is adjacent to the Rio Bravo Pipeline Project between MPs 35.6 and 70.0, crosses the Project at MPs 69.3 and 131.5, and is collocated with the Project's permanent right-of-way between MPs 132.3 and 135.4. In addition, the pipeline crosses the Rio Grande LNG Terminal site outside the boundary of the facility.

4.13.1.4 Oil and Gas Facilities

In section 4.1.2 we identified 57 active and producing oil or gas wells within 0.25 mile of the Pipeline System, as well as 15 permitted wells that have not yet been drilled. No active or producing wells were found near the Rio Grande LNG Terminal site. Given the presence of known mineral resources in the area and expected development in the oil and gas industry, it is likely that new wells will become active in the future and potentially concurrent with the construction and operation of the Rio Grande LNG Project.

4.13.1.5 Electric Transmission and Generation Projects

There are two proposed electric generation projects, as well as one currently under construction and four already in operation in the vicinity of the proposed Rio Grande LNG Project. The South Texas Electric Cooperative is expected to begin constructing a new, 15-mile-long, 138 kV electric transmission line in 2019. This transmission line would provide electricity to the Annova LNG Project described above. According to Annova LNG, the 15-mile-long transmission line would be constructed in a 100-foot-wide right-of-way that originates at the existing Farm-to-Market Road 511 Substation and would terminate at a switchyard to be constructed within the proposed Annova LNG site. The connection and transmission system would be permitted, constructed, owned, and operated by the South Texas Electric Cooperative, and would include:

- modifications of the existing Farm-to-Market Road 511 and Waterport Electric Substations to provide interconnection to the new 138-kV line;
- a new 138-kV switchyard on the Annova LNG Terminal site; and
- a new 138-kV line between the existing and new switchyard.

The transmission line would run from the Annova LNG site southwest towards Brownsville and would be about 0.3 mile from the Rio Grande LNG Terminal site.

The Tenaska Brownsville Generating Station is proposed for construction on 270 acres in Cameron County, about 7 miles west of the Pipeline System near MP 128. Tenaska anticipates the facility will be placed in service in 2019.

The Stella and Palmas Altas Wind Farms are currently under construction. Construction of E.ON's 201-megawatt Stella Wind Farm began in January 2017; the timing of operation for its 67-turbine facility is currently unknown. Acciona Energy's Palmas Altas Wind Farm will include 46 wind turbines with a capacity of 144.9 megawatts and is expected to be operational by November 2019 (Acciona 2018). The Stella Wind Farm is about 12 miles east of the Pipeline System, while the Palmas Altas Wind Farm would be crossed by the pipelines between MPs 104.0 and 106.5.

South Texas Electric Cooperative, Inc. is proposing to construct the Palmas to East Rio Transmission Line, in part to support the transport of energy generated by the Palmas Altas Wind Farm (Kelley 2018). The transmission line would be between 6.2 and 6.6 miles long, pending selection of a final route (Linares 2018), which suggests an overall footprint between 75 and 80 acres. Based on the project's general location, reported as just east of Rio Hondo, we estimate the project would be about 8 miles west of the Pipeline System.

There remaining projects that are currently in operation include the San Roman, Cameron, and Bruenning Breeze Wind Farms, and the Cross Valley Project. Acciona Energia acquired the San Roman Wind Project from the former developer, Pioneer Green Energy (2016). The project became operational in 2016 and includes 31 wind turbines along the proposed Pipeline System route between MPs 122.0 and 124.0.

The Cameron Wind Farm was built by Apex Clean Energy in 2015. The 165-megawatt facility includes 55 turbines on 15,000 acres of leased agricultural land that would be traversed by the Pipeline System between MPs 107.1 and 116.1. In December 2017, E.ON commissioned the Bruening Breeze Wind Farm in Willacy County; this 228-megawatt facility has 76 turbines. The Cross Valley Project has been operational since 2016 and includes a 345-kV electric transmission line routed from Edinburg to Palmito. This transmission line would be crossed by the proposed Pipeline System route at MPs 122.0 and 128.0.

4.13.1.6 Transportation Projects

In addition to the modifications of SH-48 associated with access to the Rio Grande LNG Terminal site, TxDOT has plans to construct four projects and recently completed one project, as presented in table 4.13.1-2. These projects could contribute to cumulative impacts within the geographic scope for many resources, as noted in section 4.13.2. None of the TxDOT projects would be crossed by the Rio Grande LNG Project. The closest TxDOT project would be one of the planned wildlife crossings under SH-100, which would be about 0.3 mile from MP 123 of RB Pipeline's proposed pipeline facilities. As discussed in section 4.6.1.4, two planned wildlife crossings were identified along U.S. Highway 77 during consultation with the FWS; the crossings are planned for installation by TxDOT, in consideration of recommendations from the FWS. These two crossings would be about 550 feet east of MP 49.9 and 430 feet east of MP 62.1; however, as the crossings have not yet been constructed, the location of the openings in relation to the proposed Pipeline System are not known.

A second access roadway and bridge to Padre Island is currently in the FHWA environmental review process and construction will commence pending final approval if funding is available (Cameron County Regional Mobility Authority [CCRMA] 2017). TxDOT and the FHWA, in cooperation with the CCRMA, are planning the 17.6-mile-long project that would be about 7 miles northeast of the Rio Grande LNG Terminal site.

TxDOT is planning an East Loop of SH-32, which includes a four- to six-lane highway that would also begin at the intersection Farm-to-Market Road 3068 to Farm-to-Market Road 1419, but would extend west to the Veterans International Bridge and Interstate 69 as would be 4.5 miles long (CCRMA 2019). The goal of the loop is to improve traffic flow in the area around and near the Port of Brownsville. This project would be 15 miles southwest of the Rio Grande LNG Terminal site and construction could begin in 2019. TxDOT is also planning a 1.4-mile-long upgrade to SH-4, which includes a 2-lane, undivided highway to a planned entrance to the Port of Brownsville (TxDOT 2019). This project, which would be 15 miles southwest of the Rio Grande LNG Terminal site, is currently under development.

The SH-550 Connector and Toll project became operational in June of 2015, based on a collaborative effort between TxDOT and the CCRMA (TxDOT 2016). Although the project is operational, it was identified during the agency review process as potentially contributing to impacts with the proposed Project; therefore, it is identified here. This limited access toll road provides access to the BSC and is about 5 miles west of the Rio Grande LNG Terminal site.

A new, larger airport terminal is proposed to be built at the Brownsville South Padre Island International Airport (Clark 2018a). Expansion of the existing airport, which is about

12.6 miles southwest of the Rio Grande LNG Terminal site, would allow additional airlines to provide service from this location, as well as increase the airport's overall passenger capacity. The timing of the expansion is currently unknown.

4.13.1.7 Port of Brownsville Projects

Six projects associated with strategic development efforts associated with the Port of Brownsville's proximity to Mexico and the international movement of goods, were identified as having the potential to contribute to cumulative impacts. The Brownsville Liquids Terminal was completed in 2014 and is composed of 21 tanks that can accommodate up to 221,000 barrels of liquid storage (Howard Midstream 2015). The Bulk Liquids Terminal Facility, which was completed in 2015, includes four tanks and the potential for capacity up to 700,000 barrels of liquid storage with future expansions (Howard Midstream 2015). These facilities are on either side of the BSC from one another, 7.5 and 7.1 miles southwest of the Rio Grande LNG Terminal site, respectively.

Dock 16 became operational in 2015, increasing the Port of Brownsville marine cargo holding capacities and versatility to maintain the pace of growing demand (Global Trade 2015). The 600-foot dock can accommodate cargo vessels with drafts up to 39.5 feet and is the second heavy-load capacity dock in Brownsville. Dock 16 is about 6 miles west of the Rio Grande LNG Terminal site.

One of America's largest private railroad and transportation management companies, OmniTRAX, developed a large-scale industrial park on 1,400 acres of BND-owned land (GEOTRAC Industrial Hub). The park provides opportunities for light and heavy manufacturing, logistics, energy services, technology development, and export/import warehousing. Centurion Terminals recently constructed the Brownsville Terminal Processing and Storage Facility with over 1.5 million barrels of crude storage capacity, including a liquid cargo dock, three-track rail spur, 10-truck lease automatic custody transfer skids, and an initial two processing towers to process condensate to 50,000 barrels per day to produce products for local markets or export.

In April of 2018, the BND voted to lease 800 acres of land between the BCS and SH-48 to Big River Steel for construction and operation of a Steel Mill and distribution facility (Clark 2018b). The facility would be modeled after Big River Steel's Arkansas plant, which is a LEED-Certified facility a green-building rating system), and would use scrap steel from local recyclers (Clark 2018b). Construction and operation of this facility would create about 1,500 and 500 jobs, respectively (Williams 2018). Based on timing associated with permitting requirements and engineering designs, construction could start in the 2nd quarter of 2020 and would last about 2 years; however, Big River has not formally announced its schedule (Williams 2018). The exact location of the lands to be leased to Big River Steel are unknown; however, based on our review of aerial data, we identified the closest location in proximity to the Project to allow for conservative estimates of proximity, land west of Goose Island, which suggest the mill could be as close as 4 miles to the Rio Grande LNG Terminal site.

Jupiter Energy Group and JupiterMLP, LLC (collectively, Jupiter) has secured funding to construct a pipeline to transport crude oil from the Permian Basin to the Port of Brownsville

(Jupiter Pipeline). Jupiter has also obtained permits to receive vessels up to 65,000 deadweight tons and to construct 2.8 million barrels of storage at its existing terminal in Brownsville (Jupiter Export Terminal; JupiterMLP 2018, Jupiter 2018). Additional permits for increased storage at the terminal to achieve an overall 10 million barrels of storage capacity are pending. The 350-mile-long Jupiter Pipeline would originate near Crane, Texas and generally run southeast to the Three River/Gardendale Terminal before turning south, taking a similar route as the Rio Bravo Pipeline to its terminus in Brownsville. The modifications and improvements at the Jupiter Export Terminal would occur on 270 acres land about 5.1 miles west of the Rio Grande LNG Terminal site. Collectively, the pipeline and terminal expansion are referred to as the Jupiter Project.

4.13.1.8 Waterway Improvement Projects

Seven dredging and waterway maintenance projects were identified as having the potential to contribute to cumulative impacts. Four of these projects are associated with the COE's ongoing maintenance efforts and include maintenance dredging of the BSC, Port Isabel, the Brazos Island Harbor Channel, and the Gulf Intercostal Waterway to facilitate movement of vessels through these waterways (COE 2015a). All of these efforts, less the Bahia Grande Channel Restoration, are currently underway, and similar efforts are expected in the future as needed to safeguard these waterways. The Gulf Intercostal Waterway dredging project is scheduled to be completed in 2019 (DredgingToday.com 2019).

As discussed throughout section 4.0, the Bahia Grande Channel was constructed in 2005 to connect the BSC to the Bahia Grande to restore tidal exchange to the Bahia Grande (FWS 2016). As part of a comprehensive restoration plan, the Bahia Grande Channel would be expanded from about 34 feet wide to 250 feet wide to increase tidal exchange (Ocean Trust 2009, FWS 2010a). The project was issued an individual permit by the COE under permit number SWG-2003-01954 in 2016; however, the timing of restoration efforts is currently unknown. The existing channel is adjacent to the Rio Grande LNG Terminal site, and widening efforts would result in the dredging of an area along the western extent of the property. The channel would be crossed by the Pipeline System via HDD.

The BND is investigating the need to modify the entrance to the BSC to provide greater flexibility, accommodate the deeper draft of the largest vessels that transit the expanded Panama Canal, and allow for safe navigation of deep-draft vessels, especially in inclement weather. The timing of these improvement activities is currently unknown. The area of improvement is about 5.5 miles east of the Rio Grande LNG Terminal site.

4.13.1.9 Other Projects and Activities Considered

Five other projects and activities were identified as having the potential to contribute to cumulative impacts. In early 2016 the Galveston District of the COE completed a beach re-nourishment project in collaboration with the City of South Padre Island (COE 2015b). About 651,000 yd³ of dredged material from the BSC was placed across 0.8 mile of shoreline along South Padre Island about 6 miles northeast of the LNG Terminal sites.

The Bahia Grande Coastal Corridor Project is a multi-stage project currently underway, with the goal of acquiring land for conservation purposes. The Nature Conservancy, Conservancy Fund, FWS, and TPWD are working to identify parcels for acquisition, through purchase or easement, to connect the Lower Rio Grande Valley NWR, Laguna Atascosa NWR, Boca Chica State Park, and other privately held land to provide protection for various threatened and endangered species, as discussed in section 4.7. These lands to be acquired are 2.5 or more miles from the proposed LNG Terminal (see figure 4.13.1-2). An existing easement on BND land, which is associated with this project, is held by the FWS and acts as a wildlife corridor for ocelots and other wildlife to cross SH-48 to habitat on either side. This corridor would be crossed by the Pipeline System between MPs 134.5 and 134.7; however, as the crossing would be constructed by HDD, direct impacts would be avoided. To date, the conservation sponsors noted above have acquired 2,129 acres out of a total acquisition goal of 7,000 acres (The Nature Conservancy 2017). The lands recently acquired and identified for future acquisition are included in this analysis.

The FWS is planning to construct a public parking lot, information kiosk, and contact station at its Red Gate Entrance off SH-48 in Cameron County. The new access site is part of a multi-phase effort by the Laguna Atascosa NWR to increase visitation to the Bahia Grande Unit per the goals and objectives of its Comprehensive Conservation Plan (FWS 2018c). The timing of construction of the new access site is currently unknown. Further, it is unknown whether these plans would be modified, or abandoned, if the proposed LNG Terminal is approved and constructed.

The NPS and Palo Alto Battlefield National Historical Park/National Historic Landmark developed an Integrated Vegetation Management Plan with the goal of restoring and maintaining the landscape and vegetation within the battlefield for cultural and historic preservation (NPS 2014). The project aims to remove the invasive woody and cacti vegetation from the battlefield and reintroduce gulf cordgrass. In addition to mechanical, cultural, chemical, and biological treatments to maintain the cultural landscape of the battlefield, prescribed fires will be utilized to promote the development of the cordgrass as well as prevent the reestablishment of the invasive woody and cacti vegetation. Maintenance of the landscape in accordance with the Integrated Vegetation Management Plan is ongoing; the Palo Alto Battlefield National Historical Park/National Historic Landmark is about 13 miles northwest of the Rio Grande LNG Terminal site.

Development of a commercial space launch facility, SpaceX, about 5.5 miles southeast of the Rio Grande LNG Terminal site, began in September 2014, and the first launch is anticipated as soon as 2019 (SpaceX 2014, Brownsville Herald 2019). A related “Stargate Facility”, which was completed in March 2019, is on a 2.3-acre parcel adjacent to the SpaceX facilities. The Stargate Facility is a 15,000-square-foot research center, was designed to provide students and professors of the University of Texas, Rio Grande Valley capabilities to track spacecraft (University of Texas Brownsville 2015). Construction of the facility began in 2016 and would be fully operational in late 2018/early 2019 (University of Texas-Rio Grande Valley 2018, Montoya 2019).

4.13.1.10 Residential Developments

As of this writing, no planned residential developments have been identified within 0.25 mile of the Rio Grande LNG Project.

4.13.2 Potential Cumulative Impacts by Resource

The following sections address the potential cumulative impacts of the activities identified within the geographic scope on specific environmental resources, as identified in table 4.13.1-2. The projects considered in each section that are most likely to contribute to cumulative impacts with the Project are those that would occur within the same timeframe as the proposed Project.

4.13.2.1 Geologic Resources and Soils

The geographic scope for geologic resources and soils was defined as the area that would be affected by, or immediately adjacent to, the Rio Grande LNG Project. Large projects with ground disturbance and excavation associated with construction and permanent aboveground facilities would have the greatest impacts on geologic resources and soils. The Texas LNG Project and associated intrastate pipeline, non-jurisdictional facilities, the Cameron and Palmas Altas Wind Farms, VCP, Cross Valley Project where it is parallel to the proposed Rio Bravo Pipeline, three of the waterway improvement projects, and the active and producing oil or gas wells have the greatest potential to contribute to cumulative impacts on geologic resources and soils.

Projects that would be constructed in close proximity to one another, and require evacuation or considerable grading, would generally have greater impacts on geological resources and soils than projects with limited ground disturbance or those projects that are separated by time and space. Therefore, the potential increase for erosion and impact on geological hazards would be highly localized and limited primarily to the period of construction.

LNG Terminal

Geologic Resources

Construction of the LNG Terminal would permanently modify topographic contours present at the site. Similarly, the Texas LNG Project, which would be adjacent to RG LNG's site, would permanently alter topographic contours through cut and fill activities, import of fill, and dredging of a marine berth. The Brazos Island Harbor Channel Improvement Project would deepen the BSC from -42 feet to -52 feet, which would also alter topographic contours near the proposed Project. The BSC and Turning Basin Maintenance Dredging waterway improvement project involves ongoing dredging to maintain sufficient depths for deep-draft vessels (see table 4.13.1-2). The non-jurisdictional facilities associated with the proposed Project consist of modifications to SH-48 as well as the installation of water and electric transmission lines, which would cross between SH-48 and the LNG Terminal. Natural topography was likely altered in this area during the initial construction of SH-48; however, it is anticipated that existing contours would be restored following construction of the water line and electric transmission lines.

Fuel and non-fuel mineral resources are not anticipated to be impacted by the LNG Terminal, as no active mining operations or oil and gas wells are located within 0.25 mile of the LNG Terminal site. Therefore, cumulative impacts on mineral resources due to the construction and operation of the proposed LNG Terminal are not anticipated.

As described in section 4.12.1, the potential for impacts on or by the proposed LNG Terminal related to geologic hazards is low. Hurricanes and/or storm surge are the geologic hazards with the greatest potential to affect the Project. Both RG LNG and Texas LNG have designed their respective facilities to withstand predicted maximum hurricane force winds and storm surge. The non-jurisdictional facilities are not anticipated to exacerbate potential impacts associated with a hurricane or storm surge; however, aboveground components, such as the electric transmission lines could be damaged. The deepening of the BSC associated with the Brazos Island Harbor Channel Improvement Project is not anticipated to affect storm surge during hurricanes or other large storms; therefore, no cumulative impacts on geologic hazards would occur from this project (COE 2014).

Overall, cumulative impacts on geologic resources resulting from the construction and operation of LNG Terminal and other projects identified in the geographic scope would primarily consist of permanent modification to existing contours. No mineral resources would be affected by the LNG Terminal and potential effects associated with geologic hazards have been acceptably mitigated for through facility design. Therefore, we have determined that RG LNG's Terminal, along with other projects, would contribute to minor cumulative impacts on geologic resources.

Soils

Cumulative impacts on soils may occur when adjacent projects increase the area of soil disturbance, resulting in greater potential for the adverse impacts identified above, or when projects disturb the same area in succession. In the latter circumstance, soil disturbance may be prolonged and revegetation delayed, so that soils are not sufficiently stabilized, resulting in increased potential for runoff and erosion. None of the other projects identified in table 4.13.1-2 would overlap the same footprint as the proposed LNG Terminal site; however, the non-jurisdictional facilities associated with the proposed Project and the Texas LNG Project are adjacent to the LNG Terminal. Collectively, the Texas LNG and Rio Grande LNG terminal sites would encumber a contiguous disturbed area totaling about 1,365.4 acres. The Brazos Island Harbor Channel Improvement Project and the Bahia Grande Channel Restoration projects would also be adjacent to the site; however, because all activities would take place within the BSC or the Bahia Grande Channel, no impacts on soils would occur.

Soil impacts resulting from the Texas LNG Project would be similar to those described above for the proposed Project. Construction of the proposed LNG Terminal, the Texas LNG Project, and the non-jurisdictional facilities are anticipated to occur concurrently; therefore, soils would be disturbed and exposed at the same time. The majority of soil impacts associated with the 311.5-acre Texas LNG Project would be permanent. The SH-48 modifications would result in permanent impacts on soils associated with the addition of the paved auxiliary lane. Impacts on soils would also occur during construction of the water line and electric transmission line; however, these impacts are anticipated to be temporary. The Texas LNG Project is also

regulated by the FERC and would implement the measures in the FERC Plan and Procedures to minimize erosion and offsite transit of soils and ensure successful stabilization of soils through revegetation. While not FERC-regulated, it is anticipated that the construction of the non-jurisdictional facilities associated with the proposed Project would also implement erosion controls in accordance with applicable permit requirements. The Rio Grande LNG Terminal, and other projects within the geographic scope for cumulative impacts on soils, would contribute to moderate, permanent impacts on soils.

Pipeline Facilities

Cumulative effects on geology and soils would be limited to the impacts of the Pipeline System combined with other projects that have been recently completed, or would be concurrently constructed, within the same footprint as the Pipeline System. The facilities associated with the Pipeline System are expected to have a temporary, but direct impact on near-surface geology and soils. The soil stabilization and revegetation requirements included in RG Developers' Plan would prevent or minimize impacts on soils, including erosion and offsite sedimentation. Projects that require considerable excavation or grading would also have temporary, direct impacts on soils, although like the proposed pipeline facilities, the duration and effect of these projects would be minimized by the implementation of erosion control and restoration measures. No active oil and gas wells are within the construction workspace for the Pipeline System, and therefore the Project will not impact the development of mineral resources in the geographic scope. Therefore, the proposed pipeline facilities, with other projects in the geographic scope, would not contribute to significant cumulative impacts on geology and soils.

Conclusion

The Rio Grande LNG Project would result in permanent modification to existing topographic contours at the LNG Terminal site; impacts from the Pipeline System would be temporary and limited to the period of construction. No mineral resources would be affected by the LNG Terminal and potential effects associated with geologic hazards have been acceptably mitigated for through facility design. Therefore, we have determined that the Rio Grande LNG Project, along with other projects, would contribute to minor cumulative impacts on geologic resources. The cumulative impacts of the Project on soils, when considered with other projects, would be temporary (during construction of buried or temporary project components) to permanent (within aboveground facility footprints), and moderate.

4.13.2.2 Water Resources

The geographic scope established for water resources was considered to be the HUC-12 subwatersheds crossed by the Rio Grande LNG Project. Any projects listed in table 4.13.1-2 involving ground disturbance within HUC-12 subwatersheds crossed by the Rio Grande LNG Project could result in cumulative impacts on water resources. This includes the Brownsville LNG terminals and associated non-jurisdictional facilities, restoration of the VCP, the Jupiter Project, waterway improvement projects, and the majority of the current, proposed, and reasonably foreseeable projects identified in table 4.13.1-2.

Projects that involve dredging, modification of surface water resources, or operational vessel traffic would result in permanent, operational impacts on surface water resources and have the greatest potential to contribute to cumulative impacts with the LNG Terminal. Generally, impacts resulting from pipeline construction across waterbodies are localized and short-term. Cumulative impacts would therefore only occur if more than one project crossed the same waterbody within a similar period of time.

LNG Terminal

Groundwater

Cumulative impacts on groundwater may occur through construction activities, including clearing and grading, dewatering, contamination through fuel and other hazardous material spills, and groundwater withdrawal. As discussed in section 4.3.1.4, the majority of potential impacts on groundwater resources associated with the proposed Project would be short-term and localized, primarily associated with clearing, grading, excavating, filling, and placement of piles and foundations, with groundwater effects limited to water table elevations in the immediate vicinity of the LNG Terminal site. The majority of the other projects considered for cumulative impacts on groundwater would involve similar ground-disturbing activities that could temporarily affect groundwater levels.

RG LNG would not directly withdraw groundwater during construction or operation of the Project and would instead obtain water from the Brownsville Public Utilities Board; however, water sourced from the Brownsville Public Utilities Board would include both surface water from reservoirs along the Rio Grande River and groundwater from wells located west of Brownsville. Because the Brownsville Public Utilities Board has stated that it has sufficient capacity to meet the construction and operational needs of the LNG Terminal without affecting water availability for other uses, and no new groundwater wells would be required for construction and operation of the LNG Terminal, the LNG Terminal is not expected to affect the quantity of available groundwater. Proposed groundwater use is not known for the majority of the other projects considered; therefore, a quantitative analysis of anticipated groundwater withdrawals is not feasible. However, because groundwater is not the primary source of potable water in the region, and the proposed Project would not directly withdraw groundwater, cumulative impacts on groundwater are anticipated to be minor.

Shallow groundwater areas could be vulnerable to contamination caused by inadvertent surface spills of hazardous materials (e.g. fuels, lubricants, and coolants) used during construction and operation of the LNG Terminal and other projects within the HUC-12 subwatershed. However, RG LNG would implement its Plan and Procedures, as well as its SPCC Plans, to minimize the risk of occurrence and potential impacts. As described in section 4.3.1.2, groundwater impacts resulting from construction or operation of the Project are not anticipated and, should they occur, would be localized and would not affect other groundwater users. Therefore, the Project would not contribute to significant cumulative impacts on groundwater with other projects in the geographic scope.

Surface Water and Wetlands

Surface Water

Several of the projects listed in table 4.13.1-2 could be under construction at the same time as the Rio Grande LNG Terminal, including the non-jurisdictional facilities, the Annova LNG and Texas LNG Projects, the Jupiter Project, multiple pipelines, electric transmission and generation projects, and transportation projects. Thus, there is the potential that cumulative impacts on water quality of the BSC could result if the Rio Grande LNG Terminal was constructed during the same time period as these other projects.

In-water activities, such as dredging and open-cut pipeline crossing techniques have the greatest potential to contribute to cumulative impacts on surface water resources. In addition, pile-driving, hydrostatic test water withdrawal and discharge, stormwater runoff, potential spills of hazardous materials, and increased vessel traffic within the BSC could also contribute to cumulative impacts on surface water. If dredging associated with the proposed Project were to occur concurrently with other in-water activities, especially those requiring dredging (Annova LNG Project, Texas LNG Project, and waterway improvement projects), adverse impacts on water quality associated with increased turbidity and sedimentation could be exacerbated. Pipeline projects may also impact surface water resources through increases of turbidity and sedimentation if upstream waterbodies are crossed via an open-cut crossing technique; however, these impacts are typically minor due to the short duration of in-water activities and would be unlikely to reach the BSC. Further, it is anticipated that larger waterbodies, such as the BSC would be crossed via HDD for pipeline projects including the Kingsville to Brownsville Pipeline, thereby avoiding direct impacts on the waterbody.

Concurrent dredging of the proposed Project, Annova LNG, Texas LNG, the Jupiter Export Terminal, and the Brazos Island Harbor Channel Improvement Projects would result in the greatest cumulative impacts on surface water resources. All of these projects currently have similar proposed construction schedules that could overlap if all regulatory approvals and authorizations are obtained as currently foreseen by the Project proponents. Dredging associated with the proposed Project would occur over an approximately 3-year period. It is anticipated that timelines for dredging of the other LNG projects would occur over approximately 1 year. All three LNG projects are proposing to utilize hydraulic cutterhead dredges that would minimize turbidity to the extent practicable; however, if conducted concurrently, dredging of the Brazos Island Harbor Channel Improvement Project, the Jupiter Export Terminal, and the Brownsville LNG projects would further contribute to cumulative increases in turbidity and sedimentation within the BSC. Further, the concurrent dredging and thus concurrent placement of dredged material in confined dredged material placement areas would also result in increased effluent discharge into the BSC. Increased effluent discharge would likely result in increased turbidity and suspended solids in the vicinity of the discharge structures.

Annova LNG evaluated the potential cumulative impact on sedimentation from dredging during construction; this assessment considered the potential for contributions from the Rio

Grande LNG and Texas LNG Projects, as well as other projects occurring within the BSC.⁸³ The majority of expected sedimentation due to construction is attributed to the LNG projects, which results in an estimated maximum sedimentation of 0.3, 0.4, and 0.2 inches for the Annova, Rio Grande, and Texas LNG Projects, respectively. The Bahia Grande Channel Restoration Project could also contribute an estimated 0.5 inch of additional sedimentation. The Brazos Island Harbor Channel Improvement Project is not expected to result in long-term net sediment accumulation as the purpose of the project is to deepen the main channel. Details on the need for or extent of dredging associated with the Jupiter Export Terminal are currently unknown. During operation, although sedimentation patterns may be impacted by the LNG projects, overall accumulation is expected to be minor. Increased accumulation during operation will be driven by any changes in hydrodynamic characteristics associated with the Brazos Island Harbor Channel Improvement Project and would be limited to 0.4 inch within the main channel of the BSC based on Annova LNG's assessment.

Similar to the Rio Grande LNG Project, each of the projects would be required to comply with water quality standards and cumulative impacts on water quality would be temporary, with turbidity and sedimentation levels returning to pre-dredging conditions following the cessation of dredging activities. Therefore, the Project, with other projects in the vicinity, would contribute to minor to moderate, but temporary, impacts on water quality within the BSC.

The Brazos Island Harbor Channel Improvement Project and the three proposed Brownsville LNG projects may use Port of Brownsville PA 5A for placement of dredged material during construction and maintenance dredging. Preliminary analysis indicates that Port of Brownsville PA 5A would not have the capacity, even if the perimeter containment levees were raised to the maximum effective/acceptable height, for all construction- and maintenance-dredged material from the three proposed LNG projects. However, alternative dredged material placement areas could accommodate some or all of the material, and the final management of dredged material will be determined by the BND and COE, in consultation with other federal, state, and local resource agencies.

Concurrent construction of other projects involving clearing, grading, or other earthwork within the HUC-12 subwatershed may also increase the potential for cumulative impacts on water quality from increased stormwater runoff. Several of the projects identified in table 4.13.1-2 would require hydrostatic testing of storage tanks and/or pipelines. All project proponents would be required to adhere to state and federal regulations regarding hydrostatic, construction, and industrial stormwater and wastewater discharges. Compliance with these regulations by RG Developers and the other project proponents, and implementation of BMPs in the Project-specific Plan and Procedures, would minimize potential cumulative impacts on surface water resources from stormwater runoff and wastewater discharges.

Surface water could be subject to contamination caused by inadvertent surface spills of hazardous materials (e.g., fuels, lubricants, and coolants) used during construction and operation of the LNG Terminal and other projects within the HUC-12 subwatershed. However, RG LNG would implement its Plan and Procedures, as well as its SPCC Plan, to minimize the risk of

⁸³ Annova LNG's assessment is available on FERC's eLibrary website, located at <http://www.ferc.gov/docs-filing/elibrary.asp>, by searching Docket Number CP16-480 and accession number 20170731-5180.

occurrence and potential impacts. Similarly, all projects considered in the cumulative impacts analysis for surface water resources would likely use equipment and or materials that could be hazardous to the environment in the event of a spill. However, it is anticipated that these projects would prepare and implement spill prevention and response procedures to prevent spills of hazardous materials from reaching surface water resources, as well as the measures to be implemented if such a spill occurs. Therefore, overall cumulative impacts on surface water resources as a result of stormwater runoff, hydrostatic test water withdrawals and discharges, as well as spills of hazardous materials are anticipated to be minor and incidental.

Current vessel traffic in the BSC is estimated to be 1,059 vessels annually. The operation of all three proposed Brownsville LNG projects would result in an increase in the number of large, ocean-going vessels transiting the BSC (estimated to be up to 511 LNG carriers per year combined; see section 4.13.2.7), which equates to a 48 percent increase in vessel traffic within the BSC. Other industrial projects located along the BSC (i.e., the Port of Brownsville projects identified in table 4.13.1-2) are also anticipated to result in increased ship traffic within the BSC, although the exact number of additional vessels is unknown.

Increased vessel traffic would result in a significant cumulative impact on surface water resources during operations from increases in turbidity and shoreline erosion. Impacts on turbidity would be limited to the duration of each vessel's transit time in the BSC, and would be greater for larger ships, such as the LNG carriers. It is anticipated that the water quality could return to baseline conditions once each LNG carrier docks or leaves the BSC. Shoreline erosion would primarily occur while the LNG carriers, or other large vessels requiring the assistance of tug boats, are maneuvering at each of the LNG terminals or other project docks. Each of the three LNG projects has designed its respective facilities to minimize shoreline erosion through placement of rock rip-rap along the shoreline, or similar measures. It is anticipated that other projects along the BSC would implement similar measures to protect the shoreline. Each project would also be responsible for maintaining shoreline protection to prevent future erosion. While the areas within each project's marine berth are anticipated to be protected, the majority of the BSC is unarmored. Further, the use of waterways by LNG carriers, barges, and support vessels during construction and operation of the LNG Terminal would be consistent with the planned purpose and use of the BSC, an active shipping channel. However, given the substantial increase in large vessel traffic within the BSC related to the three Brownsville LNG projects, and other projects, it is expected that cumulative impacts on surface water resources associated with shoreline erosion and turbidity from increased vessel traffic would be significant and relatively persistent throughout the life of the projects, particularly along unarmored portions of the BSC.

Increased vessel traffic would also result in increased cooling and ballast water exchanges. Cooling water exchanges would result in minor changes in water temperature at the point of discharge, but these impacts are not anticipated to extend beyond the immediate vicinity of the vessel, with temperatures quickly returning to ambient temperatures. Therefore, cumulative impacts as a result of cooling water are anticipated to be minor. The Coast Guard requires that all vessels carry out an open-ocean ballast water exchange prior to calling at U.S. ports. Ballast water can affect water quality by discharging water that differs in the physiochemical properties of the ambient water, including pH, salinity, and temperature. Based on the anticipated volumes and frequency of ballast water discharge that would occur as a result of the proposed Project, any changes in the physiochemical properties of water within the BSC

would be localized and negligible. Similarly, it is anticipated that ballast water and cooling water impacts associated with LNG carriers calling on the Annova LNG and Texas LNG terminals would also be localized and minor. As the discharges of these vessels for each project are generally not anticipated to comingle, cumulative impacts on water quality as a result of the ballast and cooling water exchanges associated with the Project and other projects in the vicinity are anticipated to be minor.

Wetlands

Wetlands that would be affected by the Rio Grande LNG Terminal include 182.4 acres of EEM, estuarine scrub-shrub (mangrove) marsh, and estuarine unconsolidated shore wetlands. In addition, about 233.8 acres of land, including 103.5 acres of wetlands and mudflats, are present outside the boundary of the Rio Grande LNG Terminal site. Of that area, about 10.5 acres would be dredged for a planned expansion of the Bahia Grande Channel for wetland restoration that is not related to the Rio Grande LNG Project, as discussed in section 4.3.2.2. The remaining areas would not be directly affected by Project construction, but would be retained as natural buffer.

Construction of the potable water, sewer, and power linear non-jurisdictional facilities associated with the Rio Grande LNG Project would impact about 54 additional acres of wetlands. The widening of SH-48 would also likely impact wetlands.

Any of the other projects within the HUC-12 subwatershed that impact wetlands, including the other two LNG projects and associated non-jurisdictional facilities, would contribute incrementally and cumulatively when added to the impacts from the Rio Grande LNG Terminal. In its filing with FERC, the Annova LNG Project indicated that about 52.8 acres of wetlands would be permanently converted to uplands for its terminal. Similarly, the Texas LNG Project would affect about 45.2 acres of wetlands. Other applicable projects with available wetland data include the SpaceX Commercial Spaceport (16 acres affected), Cross Valley Pipeline Project (24 acres affected), and the GEOTRAC Industrial Hub Phases I and II (62 acres and 19 acres affected, respectively.) In addition, the Kingsville to Brownsville gas pipeline and Jupiter Project would impact wetlands, although the acreage within the geographic scope is not known. The VCP has been constructed, thus restoration and revegetation could be ongoing during construction of the proposed Project. Although we present an estimate of total cumulative wetland impacts above, the Sierra Club issued comments on the draft EIS that the analysis of cumulative impacts should include an assessment by wetland type. While the cover type for wetlands in the geographic scope is not known, table 4.13.2-1 includes an assessment of the wetland impacts for each proposed Brownsville LNG terminal by wetland cover type.

**Table 4.13.2-1
Wetlands Affected by the Proposed Brownsville LNG Terminals^a**

Facilities	PEM Wetland		EEM Wetland		ESS Wetland		EUS		Total	
	Con ^b	Op ^b	Con	Op	Con	Op	Con	Op	Con	Op
Rio Grande LNG ^c	0.0	0.0	114.9	114.9	19.8	19.8	47.7	47.7	182.4	182.4
Annova LNG Terminal	0.0	0.0	53.0	50.8	0.0	0.0	2.7	2.0	57.7	52.8
Texas LNG Terminal	1.6	1.1	0.0	0.0	0.0	0.0	43.6	41.8	45.2	42.9
Total	1.6	1.1	167.9	165.7	19.8	19.8	94.0	91.5	285.3	278.1

^a The numbers in this table have been rounded for presentation purposes. As a result, the totals may not reflect the sum of the addends.
^b Con = Construction; Op = Operation.
^c Acreages for the LNG Terminal site include those acreages associated with RG LNG's Compressor Station 3 and the marine facilities; acreages for offsite facilities are not included.

The COE issues permits under Section 404 of the CWA for construction in jurisdictional Waters of the United States, including wetlands, and requires mitigation or compensation to ensure there is no net loss of wetlands or wetland functions. Mitigation requirements would include considerations for wetland cover type. All projects and activities would be required to comply with the CWA by avoiding, minimizing, or mitigating wetland impacts.

Development of the Bahia Grande Channel Restoration Project would expand the Bahia Grande Channel, increasing tidal exchange and improving estuary function, resulting in positive cumulative impacts on estuarine wetlands within the HUC-12 subwatershed. In addition, projects such as the Bahia Grande Coastal Corridor Project are focused on maintenance or enhancement of the natural environment; as such, these projects may result in positive effects on wetland resources in the Project area.

The total known wetland impacts associated with the other projects, as identified above, is 560.0 acres. The Rio Bravo Pipeline, discussed in detail below, would affect about 90 acres of wetlands in the HUC-12 subwatershed. The HUC-12 subwatershed has a total area of 234,353 acres of land. Based on NWI data developed by the FWS, approximately 65,495 acres of wetlands are present within the Bahia Grande-BSC HUC-12 subwatershed; therefore, it is anticipated that less than 1 percent of the wetlands within the subwatershed would be affected by construction of the projects considered in our cumulative impacts analysis. In addition, while RG LNG would avoid impacts on wetlands within onsite buffer areas as described above, the buffer area on the eastern side of the LNG Terminal site would be between the Rio Grande LNG Terminal and the proposed Texas LNG Project, thereby reducing the contiguous wetland area. Additionally, while direct impacts on the wetlands between the Texas LNG and Rio Grande LNG Projects would not occur, the proximity of the two projects would result in fragmentation of the wetland habitat along the northern bank of the BSC. In addition, some of these wetlands could have been disturbed during construction of the VCP and could be undergoing restoration and/or revegetation during construction of the proposed Project. Similarly, construction of the Jupiter Pipeline could impact wetlands in proximity to the VCP and Rio Bravo Pipeline routes. Wetland hydrology and the quality of wildlife habitat provided by these areas could become degraded.

Wetlands provide important ecosystem functions due to their ability to retain water, minimizing flooding and improving water quality by filtering contaminants before reaching surface waterbodies. Therefore, conversion of wetlands to uplands or developed land can affect water quality, as well as flooding, within a subwatershed. Wetlands also provide valuable wildlife habitat. Several of the projects identified in table 4.13.1-2 are not anticipated to result in significant permanent impacts on wetlands. For example, the majority of pipeline and electric transmission projects would only temporarily impact wetlands during construction. These types of projects may result in a permanent conversion of cover type within wetlands such as forested or scrub-shrub to herbaceous; however, following completion of construction, areas affected by these types of projects typically maintain their functionality as a wetland. In addition, all projects and activities would be required to comply with the CWA by avoiding, minimizing, or mitigating wetland impacts. Therefore, while the proposed LNG Terminal would contribute to cumulative impacts on wetlands, along with other projects in the area, this impact would not be significant.

Pipeline Facilities

Groundwater

Of the projects identified above, the proposed pipeline facilities, the intrastate pipeline for the Texas LNG Project, the Kingsville to Brownsville Pipeline, the wildlife crossing projects, and the Jupiter Pipeline have yet to be constructed. The VCP is complete and may be undergoing restoration during construction of the proposed Project. These projects would be expected to implement similar mitigation measures on land where construction of aboveground facilities occur; however, areas that are permanently converted from vegetated land to industrial uses with impervious cover would result in a localized reduction in groundwater infiltration. This relatively small amount of new impervious surface is not expected to affect overall groundwater recharge rates in the area. Further, all major projects (such as the other FERC projects and wells and gathering lines) would be required to obtain water use and discharge permits and would implement their various SPCC Plans as mandated by federal and state agencies. Projects that require large amounts of excavation or grading could also have temporary impacts on groundwater quality and infiltration rates, although like the proposed pipeline facilities, the duration and effect of these projects would be minimized by the implementation of erosion control and restoration measures. For these reasons, we anticipate that the proposed pipeline facilities in conjunction with other projects within the geographic scope would only contribute to minor and temporary cumulative impacts on groundwater.

Surface Water and Wetlands

The proposed pipeline facilities would contribute little to the long-term cumulative impacts on wetlands and waterbodies because the majority of the potential impacts would be temporary and short-term. The Palmas Altas and Stella Wind Farm Projects, Palmas to East Rio Hondo Transmission Line, Jupiter Pipeline, and non-jurisdictional facilities would likely follow BMPs similar to those proposed by RB Pipeline so as to minimize impacts on waterbodies and avoid or minimize impacts on wetlands in accordance with Section 404 of the CWA. Other FERC-regulated projects would be required to adhere to our Procedures, with approved deviations, which minimize impacts on waterbodies and wetlands. In addition, all projects

affecting wetlands and waterbodies would be subject to the permitting and mitigation requirements of the COE. Therefore, most of the impacts on wetlands would be of short duration. Consequently, the cumulative effect on wetland and waterbody resources from the proposed Rio Bravo Pipeline in combination with other projects would be temporary and minor.

Conclusion

Groundwater

In summary, the Rio Grande LNG Project would result in temporary, minor impacts on groundwater during construction. Impacts would be localized and would not affect other groundwater users. Other projects in the geographic scope built at the same time as the proposed Project could contribute to minor cumulative impacts on groundwater recharge and quality with the Project. However, because groundwater is not the primary source of potable water in the region and the proposed Project would not directly withdraw groundwater, the cumulative impacts of the Project and other projects in the geographic scope on groundwater use would be minor. Where aboveground facilities are proposed, the relatively small amount of new impervious surface is not expected to affect overall groundwater recharge rates in the geographic scope. Overall, the cumulative impacts on groundwater of the Project when considered with other projects would be minor given the area of the HUC-12 subwatersheds within the geographic scope.

Surface Water and Wetlands

The Rio Grande LNG Project would result in temporary, short-term, and permanent impacts on existing surface water quality and temporary and permanent impacts on wetlands. For other projects in the geographic scope built at the same time as the proposed Project, cumulative impacts on surface water and wetlands would be additive. Temporary, moderate, to significant impacts on surface water quality specifically within the BSC could occur during concurrent dredging for the Brownsville LNG terminals due to increases in turbidity and sedimentation, and from the potential erosion of shorelines along unarmored portions of the BSC due to the increase in large LNG carriers persistently transiting the BSC. However, the Rio Grande LNG Project and other projects would be required to comply with the CWA to minimize impacts on surface water quality and to avoid, minimize, or mitigate wetland impacts. Further, certain projects such as the Bahia Grande Channel Restoration and Bahia Grande Coastal Corridor Project are focused on maintenance or enhancement of the natural environment; as such these projects may result in positive effects on surface water and wetland resources in the geographic scope. Overall, the cumulative impacts on surface waters and wetlands of the Project when considered with other projects would be temporary (during construction of the buried or temporary project components) to permanent (within aboveground facility footprints and within vessel transit paths in the BSC), but minor given the area of the HUC-12.

4.13.2.3 Vegetation and Wildlife

The geographic scope for vegetation and wildlife was determined to be the HUC-12 subwatershed affected by the Rio Grande LNG Project. The projects listed in table 4.13.1-2 would disturb thousands of acres of habitat. As identified in table 4.13.1-2, projects with the

potential to contribute to cumulative impacts on vegetation and wildlife with the proposed Rio Grande LNG Project include the Brownsville LNG facilities and associated non-jurisdictional facilities, VCP, Kingsville to Brownsville Pipeline, intrastate pipeline for the Texas LNG Project, Cross Valley Project, six transportation projects, six Port of Brownsville projects, SpaceX Commercial Spaceport Project, Stargate Facility, Palo Alto Battlefield Cultural Landscape Restoration, electric transmission and generation projects (including the San Roman, Cameron, Bruenning Breeze, Stella, Palmas Altas Wind Farms), SH-100 Wildlife Crossing Project, Bahia Grande Channel Restoration Project, the Bahia Grande Coastal Corridor Project, and Opening of Bahia Grande Project.

Projects with permanent aboveground facilities (such as the Brownsville LNG terminals), wind energy projects, and roads would have greater impacts on vegetation and wildlife habitat than buried utilities, which allow for restoration of vegetation following construction. Therefore, with the exception of aboveground facilities and the permanent right-of-way, pipeline projects typically only have temporary impacts on vegetation and wildlife. The majority of long-term or permanent impacts are associated with vegetation clearing and maintenance of the pipeline right-of-way.

LNG Terminal

Vegetation

As described in section 4.5.2, a total of 562.9 acres of vegetation would be cleared during construction of the Rio Grande LNG Terminal, most of which would be converted to developed land. Offsite facilities associated with the Rio Grande LNG Terminal would result in impacts on 18.9 acres of vegetation, which would be restored after construction is complete. Construction and operation of several of the projects listed above would also result in the permanent conversion of vegetated habitats to industrial land. Other projects, such as pipeline or transmission line projects would result in temporary impacts on vegetation during construction and could result in the conversion of wetlands or shrubland to upland or herbaceous vegetation; however, permanent conversion of vegetation to developed land associated with these types of projects is typically limited to associated aboveground facilities. Based on publicly available information, we know or can estimate the amount of vegetation that would be disturbed by all of the projects listed above, with the exception of the transportation projects, and three of the seven Port of Brownsville Projects, as indicated in table 4.13.1-2.

Several linear projects included in the cumulative impacts analysis extend outside of the HUC-12 subwatershed, including the VCP, Kingsville to Brownsville Pipeline, Rio Bravo Pipeline, Cross Valley Project, South Padre Island Second Access Project, and the Jupiter Pipeline. While information is generally available for the total impacts associated with each project, data are not presented for impacts within individual HUC-12 subwatersheds (with the exception of the Rio Bravo Pipeline). Therefore, we calculated the percent of the project impacts in the HUC-12 subwatershed based on the length of each project within the subwatershed. We then applied this percentage to the total project impacts to estimate the acres of vegetation that would be impacted by each project in the HUC-12 subwatershed.

Overall, an estimated total of approximately 7,202 acres of vegetation would be impacted by the projects identified above within the HUC-12 subwatershed (Bahia Grande-BSC), including the Rio Grande LNG Project components. This accounts for approximately 3 percent of the total subwatershed area (234,353 acres). Certain projects such as the South Padre Island Beach Re-nourishment, the Palo Alto Battlefield Cultural Landscape Restoration, the wildlife crossings, and the Bahia Grande Coastal Corridor Project are focused on maintenance or enhancement of the natural environment; as such, these projects may result in positive effects on vegetation in the geographic scope.

Vegetation plays an important role in an ecosystem, providing wildlife habitat, stabilizing soils, assisting in drainage, and providing filtration of stormwater within the subwatershed. Removal of vegetation can lead to loss or degradation of wildlife habitat, increased stormwater runoff, decreased water quality, increased erosion, and increased flooding. In addition, the proposed Project, Annova LNG Project, and Texas LNG Project would all impact rare or unique plant communities, including those associated with the loma landforms.

While sufficient information is unavailable to accurately quantify the extent that all projects considered for cumulative impacts on vegetation would impact rare plant communities, it can be reasonably assumed that at least some of the projects, in addition to the FERC-regulated projects for which information is available, would impact these resources. Impacts would be permanent within the operational workspaces of the LNG terminals and other aboveground facilities

All projects potentially contributing to cumulative impacts on vegetation would be required to adhere to applicable federal, state, and local regulations regarding water quality, erosion control, and construction within floodplains. In addition, the majority of the projects considered for cumulative impacts on vegetation are within the eastern portion of the HUC-12 subwatershed (see figure 4.13.1-1), where coastal processes have a greater impact on the vegetation communities, as well as the soil characteristics and revegetation potential. Due to dry conditions and saline soils characteristic of the region (see section 4.2.1) revegetation is anticipated to be difficult for the proposed Project, as well as the majority of other projects considered. However, linear utilities may be required to meet restoration requirements per agency consultations. As discussed above, several of the projects considered for cumulative impacts on vegetation consist of large industrial developments that would result in the permanent loss of vegetation.

Due to the relatively large proportion of the HUC-12 subwatershed that would be affected by the projects considered, as well as the low revegetation potential and presence of rare plant communities in the HUC-12 subwatershed, we have determined that the proposed LNG Terminal would contribute to moderate cumulative impacts on vegetation with other projects in the geographic scope.

Wildlife

Impacts on wildlife associated with the Rio Grande LNG Terminal include the disturbance, loss, and/or conversion of approximately 562.9 acres of terrestrial wildlife habitat within the LNG Terminal site, and an additional 18.9 acres within offsite facilities associated

with the Rio Grande LNG Terminal. It is anticipated that the majority of the projects identified above that were considered for cumulative impacts on wildlife would result in similar impacts to those described for the proposed LNG Terminal. The waterway improvement projects are anticipated to directly impact aquatic wildlife, as further discussed in section 4.13.2.4; however, the impact on other wildlife is anticipated to be more indirect, likely associated with temporary increases in noise and light. As detailed in table 4.13.1-2, construction and/or operation of most of the projects identified above are anticipated to be concurrent with the proposed LNG Terminal.

Habitat (vegetation) loss and conversion associated with the projects identified above account for much of the direct impact on wildlife species. Increased development and loss of habitat within the HUC-12 subwatershed would cause wildlife to either adapt to new conditions (in the case of some generalist species) or relocate to undisturbed suitable habitat. Displacement of wildlife could result in additional stress and increased competition in available habitats. Further, the projects considered are within the Central Flyway bird migration route, as described in section 4.6.1. Development, construction activities, and removal of habitat could require migrating birds to travel greater distances to locate suitable stopover habitat or stop in less suitable habitat. Depending on the additional distances traveled and/or quality of habitat found, this could result in increased energy expenditure, competition, and/or predation. A comment from the FWS was issued on the Texas LNG draft EIS (CP16-116-000) that cumulative impacts on pollinator habitat would be significant. Past development of the region for industrial and agricultural practices have reduced the available habitat for pollinator species resulting in an environmental baseline consisting of fragmented and diminished pollinator habitat. All three Brownsville LNG projects would result in the permanent loss of pollinator habitat. However, the impact on pollinator habitat as a result of the other projects considered for cumulative impacts on wildlife are unknown. Generally, electric transmission line and pipeline rights-of-way that are cleared for construction are revegetated and could be revegetated with species important for pollinator species.

Alternatively, conservation and restoration projects, such as the Bahia Grande Coastal Corridor Project, Palo Alto Battlefield Cultural Landscape Restoration, and ongoing management and acquisition of NWRs and state preserve land, would have a positive cumulative impact on wildlife habitat. Conservation of these areas in perpetuity ensures that no future development would occur. Thus, these areas will continue to serve as suitable wildlife habitat in the area. Nevertheless, as discussed above, given the number of large-scale developments in the area, cumulative impacts on wildlife habitat (i.e., vegetation) from the Project and other projects in the geographic scope are anticipated to be moderate.

Cumulative impacts on wildlife as a result of increased noise, lighting, road traffic, and human activity, would be greatest during the concurrent construction of the proposed LNG Terminal and other projects considered; however, due to operation noise and permanent facility lighting associated with the LNG Terminal and several of the other projects that have permanent aboveground facilities, permanent cumulative impacts would also occur. While portions of the HUC-12 subwatershed are already developed and characterized by industrial activities, such as those projects closer to Brownsville, other areas, such as the northern and eastern portions of the HUC-12 subwatershed, including the proposed LNG Terminal site, are less developed (see figure 4.13.1-1). In general, projects located in areas characterized by more extensive existing

development are anticipated to have less of an impact on wildlife than projects in areas where there is less development. Wildlife inhabiting developed areas typically includes human commensal species or individuals that have otherwise become acclimated to human activity.

Cumulative impacts on wildlife resulting from noise would be greatest during the concurrent construction of the projects considered, but would also occur during operation. Quantitative cumulative noise impacts are further discussed in section 4.13.2.9. While noise contributions from the proposed Project would not directly impact wildlife beyond the geographic scope for cumulative noise impacts, an overall increase in noise associated with projects located throughout the HUC-12 subwatershed could limit the available habitat not affected by noise to which disturbed wildlife can relocate. Wildlife that cannot relocate away from noise emitting sources could be adversely affected by increasing stress levels and masking auditory cues necessary to avoid predation, hunt prey, and find mates.

Construction lighting requirements likely vary among the projects considered; however, it can reasonably be assumed that several of the larger industrial projects, waterway improvement projects, and transportation projects could require nighttime construction lighting. The majority of the projects considered are not anticipated to require operational facility lighting, with the exception of the industrial developments (e.g., the proposed Project, Texas LNG Project, Annova LNG Project, the Brownsville South Padre Island International Airport, and Port of Brownsville projects). The infrastructure associated with the Opening of the Bahia Grande Project may also require lighting for the safety of those accessing the NWR unit for recreation, although specific details such as these are not known at this time and lighting is expected to be minimal. Increased lighting can cause more mobile wildlife to become disoriented, such as migrating birds, and can increase predation on prey species by making them more visible to predators. Artificial lighting can also adversely affect wildlife behavior by causing individuals to avoid the area or alter sleep/activity patterns. RG LNG and the other FERC-regulated projects would minimize impacts on wildlife as a result of lighting by implementing Project-specific facility lighting plans that incorporate the use of shielded, down-facing lights, to the extent practicable (see section 4.6.1.2). It is anticipated that other facilities would utilize similar methods to minimize the impacts of lighting on wildlife.

Elevated structures such as storage tanks, communication towers, flares, wind turbines, and transmission lines would also contribute to cumulative impacts on migratory birds. RG LNG has indicated that it would minimize the likelihood of bird strikes by minimizing the amount of lighting at the terminal and by designing the Project to include ground flares. It is anticipated that other projects with elevated structures would implement similar measures to minimize impacts on migratory birds; however, bird strikes with elevated structures could still occur.

Increased road traffic associated with the projects considered would result in cumulative impacts on wildlife as a result of increased noise and wildlife-vehicle collisions. The effects of increased noise and light on wildlife are discussed above. However, wildlife in the area are currently exposed to traffic along SH-48. Further, because the traffic associated with construction and operation of the Project and other projects within the geographic scope and would be within the capacity of existing roadways, including SH-48, cumulative impacts on wildlife due to increased road traffic would not be significant.

Overall, cumulative impacts on wildlife would be greatest during the concurrent construction of the projects considered, and would continue, to a lesser extent during operation. Cumulative impacts on wildlife would occur as a result of habitat disturbance and loss and increased noise, light, and road traffic. While most projects considered are anticipated to implement BMPs to ensure restoration of temporarily impacted wildlife habitat and minimize noise and lighting, we have determined that cumulative impacts on wildlife would be moderate.

Pipeline Facilities

Vegetation and wildlife habitat in the vicinity of the proposed pipeline facilities have been affected by ongoing ranch, cattle, and agricultural practices, and construction and maintenance of existing roads, railroads, natural gas and oil pipelines and wells, utility lines, and electrical transmission line rights-of-way. In addition, several future projects could be constructed and/or operational at the same time as the Rio Bravo Pipeline, as described above and in table 4.13.1-2. Cumulative impacts on vegetation and wildlife would result if these projects were constructed concurrently.

Construction and operation of the pipeline facilities would affect a total of 2,455.5 acres of vegetation. Of this total, 1,162.7 acres would be in temporary work areas that would be allowed to revert to pre-construction condition after construction is completed. About 1,195.8 acres would be within the permanent easements for the Pipeline System, and 6.2 acres would be associated with permanent access roads. About 92.9 acres would be within the permanent aboveground facilities. Construction activities such as right-of-way and other workspace clearing and grading would result in loss of vegetation cover and soil disturbance, alteration of wildlife habitat, displacement of wildlife species from the construction zone and adjacent areas, mortality of less mobile species, and other potential indirect effects as a result of construction noise and increased human activity in the area. Overall impacts would be greatest where projects are constructed in the same timeframe and area as the proposed Project.

While the vegetation impacts of the projects discussed above and the proposed pipeline facilities would not be inconsequential, the overall impact of these projects would be considered minor in comparison to the abundance of comparable habitat in the HUC-12 subwatersheds crossed by the pipelines. FERC-jurisdictional projects, including the Annova LNG and Texas LNG Terminals, would be required to adhere to the measures in our Plan and Procedures for restoration of habitat as discussed above, where these projects fall within the geographic scope for the pipeline facilities. RB Pipeline would be required to restore vegetation in temporarily disturbed areas, and non-jurisdictional Project-related facilities would likely be held to similar standards by state permitting agencies. Wind energy projects, intrastate pipeline facilities, and non-jurisdictional Project-related facilities would also likely be required to implement mitigation measures designed to minimize the potential for long-term erosion and resource loss, increase the stability of site conditions, and revegetate disturbed areas, thereby minimizing the degree and duration of the impacts of these projects.

The aboveground facilities associated with the projects would result in some permanent impacts on wildlife habitat. The wind farms and VCP, as well as some of the transportation projects, would also have associated aboveground facilities or other permanent infrastructure associated with their projects; however, due to the limited size of these facilities relative to the

geographic scope and the prevalence of similar habitats in adjacent areas, the permanent loss of this land would not be a significant impact on wildlife resources within the area of the proposed pipeline facilities. The operation of large turbines associated with the San Roman, Cameron, Bruenning Breeze, and Stella Wind Farm projects could potentially affect bird and bat species through collision-related fatalities.

Because impacts on wildlife species from construction and operation of any of the projects would be local, temporary, and minor considering the abundance of comparable habitat in the geographic scope, in conjunction with the wildlife crossing projects, which would aid in the safe movement of wildlife through the area, we have determined that impacts on wildlife species within the geographic scope for the Rio Bravo Pipeline would be short-term and would not be significant.

Conclusion

In summary, the Rio Grande LNG Project would result in temporary, short-term, and permanent impacts on vegetation and wildlife habitat. For other projects in the geographic scope built at the same time as the proposed Project, cumulative impacts on vegetation would be additive. Along the pipeline route, impacts on vegetation and wildlife habitat would be minor in comparison to the abundance of comparable habitat in the HUC-12 subwatersheds. However, due to the relatively large proportion of the Bahia Grande-BSC HUC-12 subwatershed that would be affected by the LNG Terminal and the projects considered, as well as the low revegetation potential and presence of rare plant communities in the HUC-12 subwatershed, the proposed Project would contribute to moderate cumulative impacts on vegetation with other projects in the geographic scope. However, certain projects such as the South Padre Island Beach Re-nourishment, the wildlife crossing projects, the Palo Alto Battlefield Cultural Landscape Restoration, and the Bahia Grande Coastal Corridor Project are focused on maintenance or enhancement of the natural environment; as such these projects may result in positive effects on vegetation and wildlife in the geographic scope.

Overall, the cumulative impacts of the Project when considered with other projects would be temporary (during construction of the buried or temporary project components) to permanent (within aboveground facility footprints), and moderate given the relatively large proportion of the Bahia Grande-BSC HUC-12 subwatershed that would be affected by the projects considered, the low revegetation potential and presence of rare plant communities in the HUC-12 subwatershed, and increased noise, light, and road traffic.

4.13.2.4 Aquatic Resources and EFH

The geographic scope established for aquatic resources was considered to be the HUC-12 subwatersheds crossed by the Rio Grande LNG Project. Any of the projects listed in table 4.13.1-2 that would involve ground disturbance or excavation could result in cumulative impacts on water resources, which in turn could impact aquatic resources through sedimentation and turbidity, habitat alteration, stream bank erosion, fuel and chemical spills, water depletions, or impingement/entrainment due to water withdrawals or construction crossing operations. This includes the Brownsville LNG projects and associated non-jurisdictional facilities, the Kingsville to Brownsville Pipeline, the intrastate pipeline for the Texas LNG Project, the VCP, the Palmas

Altas and Stella Wind Farms, the Cross Valley Project, the Palmas to East Rio Hondo Transmission Line, transportation projects, waterway improvement projects, Port of Brownsville Projects, the SpaceX Commercial Spaceport Project, the Stargate Facility, the Palo Alto Battlefield Cultural Landscape Restoration, the Bahia Grande Coastal Corridor Project, the wildlife crossing projects, and the Opening of the Bahia Grande Project.

LNG Terminal

While all upstream projects in the HUC-12 subwatershed have the potential to contribute to incremental impacts on water quality in the BSC (as discussed in section 4.13.2.2), the potential for cumulative impacts on aquatic resources would be greatest for those projects that would be directly impacting the BSC and adjacent waterways through dredging, increased vessel traffic, pile-driving, or other in-water activities. The projects identified in table 4.13.1-2 that are anticipated to contribute the most to potential cumulative impacts on aquatic resources include the Annova LNG Project, Texas LNG Project, Port of Brownsville projects, and the waterway improvement projects, especially the Brazos Island Harbor Channel Improvement Project.

As discussed in section 4.13.2.2, the other Brownsville LNG projects, the Jupiter Project, as well as the Brazos Island Harbor Channel Improvement Project, could be constructed concurrently with the proposed Project. This would result in active dredging of a large portion of the BSC for an extended duration. In addition to the increases in turbidity affecting water quality (see section 4.13.2.2), dredging would decrease dissolved oxygen levels and result in a cumulative impact on the amount of benthic habitats and species that are directly affected. This would reduce the overall prey availability for predators in the area that feed on these species. In addition, more mobile species would also have to travel further to relocate to suitable habitat where dredging is not occurring, or be forced to occupy less suitable habitat, both of which could reduce the overall fitness of the individual and affect behaviors, such as foraging and mating. Therefore, cumulative impacts on aquatic resources as result of dredging activities would be moderate, but temporary.

Similarly, concurrent dredging of the projects identified above would result in cumulative impacts on EFH. However, as described in section 4.6.3, consultation under the MSFCMA is complete, and given the temporary, minor impacts on EFH, NMFS does not have EFH conservation recommendations for the Project. The Brazos Island Harbor Channel Improvement Project would require the deepening of the BSC through dredging of the existing channel; therefore, impacts on EFH are anticipated to be temporary, as there would be no change in the type of EFH available following completion of the project and the macroinvertebrates and worms inhabiting these areas would be expected to recolonize quickly. The Annova LNG Project would also permanently impact EFH. However, all of the LNG projects would be required to mitigate for the permanent impacts on aquatic habitats, including EFH, as part of the Section 404 permit process; therefore, cumulative impacts on EFH would be minor.

Cumulative impacts on aquatic resources could also result from concurrent pile-driving activities. As discussed in section 4.6.3, in-water pile-driving can increase underwater sound pressures that can result in injury or mortality to fish and other wildlife (see section 4.13.2.5 for a discussion of cumulative impacts resulting from pile-driving on marine mammals and sea turtles). RG LNG would minimize impacts on aquatic resources from pile-driving by driving

most piles into land rather than open water and utilizing vibratory hammers to drive the sheet pilings at the MOF. The only other projects considered for which pile-driving is anticipated to overlap with the proposed Project are the other two Brownsville LNG projects, and possibly the Jupiter Export Terminal. These projects are anticipated to implement measures similar to RG LNG to minimize impacts on fish associated with pile-driving. However, concurrent in-water pile-driving could limit the available habitat for fish avoiding the increased underwater sound pressure levels and increase density within those habitats. In-water pile-driving would be limited to an estimated 29 days, minimizing the duration during which cumulative impacts would occur. Therefore, cumulative impacts on aquatic resources as a result of pile-driving are anticipated to be minor.

In addition to cumulative impacts that would occur during construction of the proposed Project, operation of the Project would also affect aquatic resources. RG LNG anticipates that 312 LNG carriers would call on the LNG Terminal annually. Increased vessel traffic would result in increased impacts on aquatic resources associated with ballast and cooling water exchanges and potential fuel spills. The Annova LNG and Texas LNG Projects are anticipated to have the greatest contribution to cumulative impacts on aquatic resources from increased vessel traffic. As discussed further in section 4.13.2.7, the three Brownsville LNG projects would result in a cumulative increase in ship traffic in the BSC during operation. Combined, the three LNG projects would result in an approximate 48 percent increase in ship traffic within the BSC during operation.

Cooling water discharges that occur while LNG carriers are maneuvering to the LNG Terminal and while they are docked at the LNG Terminal would result in increases in water temperature. As discussed in section 4.13.2.2, increases in water temperature as result of cooling water discharges are anticipated to be localized, with water temperatures quickly returning to ambient levels. Mobile species may relocate to nearby suitable habitat during cooling water discharges; if LNG carriers are calling at the other LNG terminals in the area (Annova LNG and Texas LNG), suitable habitat available for fish to relocate to would be more limited; however, given that the discharges from concurrently loading vessels are not anticipated to comeingle, these impacts would be temporary and negligible.

In addition, ballast water can be a source for introduction of non-native species, as discussed in section 4.6.2.2. The cumulative increase in vessel traffic within the BSC would create greater opportunity for the introduction of non-native species in ballast water. However, all LNG carriers and other ocean-going vessels utilizing the BSC would be required to adhere to the Coast Guard regulations and IMO requirements regarding ballast water to minimize the potential introduction of non-native species; therefore, cumulative impacts on aquatic resources from ballast water would be negligible. In slight contrast, with regards to the physiochemical composition of the water within the maneuvering basin, ballast water discharges can result in localized changes. As discussed in section 4.13.2.2, these impacts would be localized and would quickly return to ambient levels. Impacts from changes in water quality on aquatic resources would be similar to those described above for cooling water.

Pipeline Facilities

Cumulative impacts on fisheries and aquatic resources could occur if other projects are disturbing the same segment of a waterbody at the same (or similar) time as the proposed pipeline facilities, or if there are permanent or long-term impacts on the same or similar habitat types. The non-jurisdictional facilities for the Rio Grande LNG Project and the intrastate pipeline facilities for the Texas LNG Project would likely cross two perennial waterbodies, the channels to San Martin Lake and the Bahia Grande. Also, construction of the observation deck proposed as part of the Opening of the Bahia Grande Project could impact the Bahia Grande. Potential cumulative effects on aquatic resources in these waters from clearing of bank vegetation and in-water disturbance have been reduced through the collocation of these facilities with the Pipeline System. We expect that the federal and state permitting agencies for the other projects would require applicable water quality protections for construction within waterbodies.

In addition, any impacts on waterbodies, and therefore fisheries and aquatic resources, would be temporary and limited to the construction periods of the projects. As such, the Rio Bravo Pipeline would not contribute to significant cumulative impacts on aquatic resources with other projects in the geographic scope since impacts would be temporary and due to the impact avoidance and mitigation measures that would be implemented. The ensuing operation of RB Pipeline's proposed facilities would not result in any impacts on waterbodies.

Conclusion

In summary, the Rio Grande LNG Project would result in temporary and permanent impacts on aquatic resources and EFH. For other projects in the geographic scope built at the same time as the proposed Project, cumulative impacts on aquatic resources would be additive. Overall, the cumulative impacts of the Project when considered with other projects would be temporary (during construction of the buried or temporary project components) to permanent (within the LNG Terminal site), and minor given the large area of the HUC-12 subwatersheds that comprise the geographic scope and available habitat for aquatic resources. The Rio Grande LNG Project and other projects would be required to comply with the CWA to minimize impacts on surface water and to avoid, minimize, or mitigate wetland impacts. Therefore, while the proposed Project would contribute to cumulative impacts on aquatic resources along with other projects in the area, this impact would not be significant.

4.13.2.5 Threatened and Endangered Species

The geographic scope for threatened and endangered species was generally determined to be the HUC-12 watershed; however, due to the diversity in life history and range of threatened and endangered species potentially affected by the Rio Grande LNG Project, cumulative impacts were independently reviewed for each species or group of species. For example, threatened or endangered bird species are more mobile with larger ranges when compared to terrestrial reptiles that may not extend beyond a relatively small area. Discussions of cumulative impacts on threatened and endangered species are grouped by taxa and are limited to only those threatened and endangered species identified in section 4.7 as potentially affected by the Rio Grande LNG Project. Species that are not anticipated to be present at the Project site, or otherwise affected by the Project, due to a lack of suitable habitat or species range, are not discussed further with

regard to cumulative impacts. Of the projects listed in table 4.13.1-2, those with the greatest potential for impacts include the non-jurisdictional facilities, the Brownsville LNG projects and associated non-jurisdictional facilities, the VCP, the San Roman, Cameron, Bruening Breeze, Stella, and Palmas Altas Wind Farms, the Palmas to East Rio Hondo Transmission Line, the wildlife crossing projects, the Opening of Bahia Grande Project, the waterway improvement projects, and the SpaceX and related Stargate Facility.

LNG Terminal

Marine Mammals

Whales and Dolphins

Other projects considered for cumulative impacts on marine mammals are those that would conduct activities within or otherwise affect the BSC. Projects considered for impacts on marine mammals include the Texas LNG Project, Annova LNG Project, Kingsville to Brownsville Pipeline, waterway improvement projects, and Port of Brownsville projects.

While there are several marine mammal species with potential to occur within the BSC, only bottlenose dolphins, which are protected under the MMPA (but not under the ESA), are considered common. The greatest potential for impacts on marine mammals associated with the Project would be acoustic disturbance and possibly auditory injury from pile-driving and increased mortality and injury potential from vessel strikes during construction and operation. With the exception of the Steel Mill and the expansion of the Jupiter Export Terminal, construction of the Port of Brownsville Projects are complete and would not contribute to threats from pile-driving, and would likely have less potential, if any, for vessel strikes during their operational phases.

The Annova LNG and Texas LNG Projects are the only other projects anticipated to require pile-driving, which could be concurrent with the pile-driving activities associated with the proposed Project. It is anticipated that these projects would implement similar measures to minimize impacts on marine mammals during pile-driving. If concurrent pile-driving were to occur, marine mammals in the area may have to travel greater distances to avoid underwater sound pressure levels that exceed the NMFS' thresholds (see section 4.7.1.1). However, because in-water pile-driving associated with the proposed Project would be limited to an estimated four days, cumulative impacts on marine mammals as a result of pile-driving is anticipated to be minor.

Increased vessel traffic during construction and operation of the proposed Project and other projects considered, would result in an increased potential for vessel strikes on marine mammals. RG LNG has indicated that it would provide the NMFS' *Vessel Strike Avoidance Measures and Reporting for Mariners* (2008) to all ship captains calling on the LNG terminal and would advocate compliance with the measures identified in the guidance document to minimize the likelihood of vessel strikes. The three LNG projects would result in an approximate 48 percent increase in ship traffic within the BSC during operation (see section 4.13.2.7), which would increase the potential of vessel strikes. However, it is anticipated that vessels calling on other Port of Brownsville facilities, including the Annova LNG and Texas

LNG Projects, would similarly advocate for compliance with NMFS' measures to minimize vessel strikes. In addition, the BSC is an active industrial channel that is regularly transited by vessels; therefore, it is assumed that marine mammals in the area are accustomed to their presence. Therefore, the overall cumulative impact on marine mammals (and specifically to the highly mobile dolphins present in the BSC) would be minor.

West Indian Manatee

Other projects considered for cumulative impacts on West Indian manatees are those that would conduct activities within, or otherwise affect, the BSC. Projects considered for cumulative impacts on West Indian manatee include the Texas LNG Project, Annova LNG Project, Kingsville to Brownsville Pipeline, waterway improvement projects, and Port of Brownsville Projects.

Impacts on West Indian manatee resulting from the proposed Project are most likely to occur during dredging and pile-driving activities, as well as increased vessel traffic during construction and operation. However, due to the rarity of manatee occurrence in the Brownsville area, as well as the lack of suitable foraging habitat, impacts, while possible, are not anticipated.

Impacts on West Indian manatees resulting from the other two LNG projects considered (Texas LNG and Annova LNG) would be similar to those discussed for the proposed Project. The Steel Mill has not yet been constructed, and details on construction and operational activities are not known. Similarly, information on vessel transits associated with the Jupiter Export Terminal is unknown; therefore, we assume these projects would be similar to the LNG projects. While the Kingsville to Brownsville Pipeline would cross the BSC, it is anticipated that this crossing would be conducted via HDD and would not result in any direct impacts on the BSC. Therefore, these pipeline projects are not anticipated to affect the West Indian manatee. In addition, five of the Port of Brownsville projects that were recently completed would not overlap with construction of the proposed Project.

Publicly available information regarding the current anticipated schedules for the projects discussed above indicate that it is possible that construction activities associated with several of the waterway improvement projects, both of the other LNG projects, and expansion of the Jupiter Export Terminal would be concurrent with the proposed Project; the construction period for the Steel Mill is unknown. All projects operating within the BSC are anticipated to implement mitigation measures identified by the respective applicant, the FWS (during project-specific consultations), and/or the lead agency to minimize potential impacts on manatees. Due to the rarity of the West Indian manatee in the Project area, and recommended measures that would be implemented if a manatee were to occur within the BSC, the cumulative impacts of the Project when considered with other projects would be temporary (during construction) to permanent (due to increases in local traffic) but negligible.

Marine Reptiles

Other projects considered for cumulative impacts on sea turtles are those that would conduct activities within or otherwise affect the BSC. Projects considered for impacts on sea

turtles include the Texas LNG Project, Annova LNG Project, Kingsville to Brownsville Pipeline, waterway improvement projects, and Port of Brownsville Projects.

Impacts on sea turtles associated with the proposed Project are most likely to occur as a result of dredging and pile-driving activities, as well as increased vessel traffic during construction and operation. Impacts on sea turtles resulting from the other two LNG projects considered (Texas LNG and Annova LNG) would be similar to those discussed for the proposed Project, as would the measures that would be implemented to minimize impacts. As stated above, project details for construction of the Steel Mill and Jupiter Export Terminal are unknown, however we assume that impacts from construction and associated mitigation measures would be similar to the LNG Projects. While the Kingsville to Brownsville Pipeline would cross the BSC, it is anticipated that this crossing would be conducted via HDD and would not result in any direct impacts on the BSC. Therefore, these pipeline projects are not anticipated to affect sea turtles. In addition, the five Port of Brownsville projects that were recently completed would not overlap with construction of the proposed Project. Therefore, these Port of Brownsville projects are not anticipated to contribute to cumulative impacts on sea turtles.

Based on the Biological Opinion issued for the Brazos Island Channel Improvement Project, dredging activities in the BSC utilizing hopper dredges routinely result in the direct mortality of sea turtles (COE 2014). While the COE would implement numerous measures to reduce sea turtle mortality, such as pre-dredging trawls to safely remove sea turtles from the area, NMFS has conducted a jeopardy analysis and issued a take permit to the COE with limits on the number of sea turtles that can be taken during dredging activities. It is anticipated that the other four waterway improvement projects, all of which require dredging activities, would have the potential to similarly impact sea turtles.

Publicly available information regarding the current anticipated schedules for the projects discussed above indicate that it is possible that construction activities associated with several of the waterway improvement projects, both of the other LNG projects, and expansion of the Jupiter Export Terminal would be concurrent with the proposed Project, construction period for the Steel Mill is unknown. In general, sea turtles present in the area at the start of construction activities are anticipated to relocate to nearby suitable habitat or avoid the area. However, the concurrent construction activities within the BSC could limit the habitat available to which sea turtles could relocate. For instance, a sea turtle startled into moving from one project area may relocate to another project area, and so on until suitable habitat is found. During dredging activities in which hopper dredges are used, such as the Brazos Island Harbor Channel Improvement Project, this could cause sea turtles to move into the dredging area that might otherwise have been avoided.

Similar to the impacts discussed in section 4.13.2.3 for other wildlife species, increased disturbance and searching for available habitat could result in increased stress and energy expenditure for sea turtles in the area. Further, increases in sedimentation and turbidity (see section 4.13.2.3) as well as disturbance of benthic environments that serve as habitat for certain sea turtle prey species could also result in cumulative impacts on sea turtles by reducing water quality and prey/foraging habitat availability.

Concurrent pile-driving and dredging activities could result in cumulative increases in underwater sound pressure levels, as discussed in section 4.13.2.4. The only other projects considered for which pile-driving is anticipated to potentially overlap with the proposed Project are the other two LNG projects, and expansion of the Jupiter Export Terminal. These projects are anticipated to implement measures similar to those recommended or proposed for use at the Rio Grande LNG Terminal, including limiting in water pile-driving to the minimum extent practicable, and use of biological monitors within the area of potential injury. Further, given the long construction schedules for the LNG Projects, and the limited durations of in-water pile-driving, substantial overlap in the in-water pile-driving schedules would be unlikely.

In addition to impacts on sea turtles resulting from increased vessel traffic associated with the LNG projects and the Port of Brownsville Projects could also affect sea turtles in the area. Vessel strikes are a common cause of sea turtle mortality; however, it is anticipated that most vessels would adhere to the NMFS Southeast Region's Vessel Strike Avoidance Measures and Reporting for Mariners (2008). Further, the BSC is an active vessel transit route to the Port of Brownsville and receives over 1,000 ships per year (BND 2017). Therefore, the increase in ship traffic could increase the likelihood of vessel strikes; however, this increase is not anticipated to be significant due to implementation of NMFS' guidance.

Based on the size and proximity of the projects considered, as well as the overlapping construction schedules of the LNG terminals, the waterway improvement projects, and the Jupiter Export Terminal expansion, a cumulative impact on sea turtles is anticipated. All projects are subject to the requirements of the ESA and are thus required to consult with NMFS regarding potential impacts on sea turtles in marine habitats. Through this consultation process, the projects considered would be required to implement BMPs and/or other measures recommended or required by NMFS to minimize potential impacts on sea turtles.

In some instances, such as the Brazos Island Harbor Channel Improvement Project, take of sea turtles may still be likely and NMFS would issue a take permit. In other cases, such as the proposed Project, implementation of mitigation measures may result in a determination that the project is not likely to adversely affect sea turtles. Individually, the projects considered are not anticipated to have significant impacts on sea turtles; however, the density and nature of activities potentially occurring within the area would result in moderate cumulative impacts on resident sea turtles. However, these impacts are not anticipated to have population-level or significant effects.

Birds

Five bird species of concern have the potential to occur in the vicinity of the LNG Terminal. As discussed in section 4.7.1, we have determined that the Project would be unlikely to cause a trend towards federal listing for the red-crowned parrot (candidate for listing) due to the lack of nesting habitat at the LNG Terminal site. Four federally listed or proposed birds with higher potential to use the LNG Terminal site are discussed further below.

Northern Aplomado Falcon

The geographic scope for cumulative impacts on the northern aplomado falcon was considered to be terrestrial projects located within the HUC-12 subwatershed affected by the proposed Project. Projects considered for impacts on the northern aplomado falcon include the Brownsville LNG projects and associated non-jurisdictional facilities; VCP (for which construction is complete, but restoration could be ongoing during construction of the proposed Project); Kingsville to Brownsville Pipeline; the Wind Farms; Cross Valley Project; six transportation projects; seven Port of Brownsville projects; SpaceX Commercial Spaceport Project; Stargate Facility; Palo Alto Battlefield Cultural Landscape Restoration; Bahia Grande Coastal Corridor Project; and the Opening of Bahia Grande Project.

The proposed Project site provides suitable foraging habitat for the northern aplomado falcon, and adjacent areas may be used for nesting. As discussed in section 4.7.1.3, RG LNG would implement Project-specific BMPs for the northern aplomado falcon, developed through consultation with the FWS and TPWD, to avoid impacts on active nesting adjacent to the LNG Terminal site. In consideration of the FWS' comments on the draft EIS, and because potential take would be covered under an existing Safe Harbor Agreement, we have determined that the proposed Project is not likely to adversely affect the northern aplomado falcon. Consultations under Section 7 of the ESA have not been completed (see our recommendation in section 4.7.1.6).

For the majority of the other projects considered, impacts on northern aplomado falcons are not known; however, suitable habitat is also present on the Annova LNG and Texas LNG sites and would likely be crossed by the linear transmission and pipeline projects in the area. The FWS has estimated that about 546 total acres of suitable northern aplomado falcon habitat would be affected at the three proposed LNG terminal sites. The other Port of Brownsville projects (not including the three proposed LNG projects) are primarily located in an already industrialized area that likely does not provide suitable habitat for northern aplomado falcons. The wind farms, LNG projects, and overhead transmission line projects include elevated structures and wires that could result in bird strikes, as well as injuries or mortality from flaring at the LNG terminals. These impacts would be similar to those discussed in section 4.13.2.3 for migratory birds.

Impacts on habitat associated with the pipeline and transmission lines are anticipated to be temporary with construction areas restored following the completion of activities. Permanent aboveground facilities such as the LNG terminals would result in the removal of suitable foraging and nesting habitat for northern aplomado falcons. Because of the past cumulative habitat loss and construction of aboveground structures within and adjacent to remaining habitat, we conclude that the cumulative impacts on northern aplomado falcons could be significant. These cumulative impacts on habitat could prevent establishment of nesting pairs and would limit available habitat within the area; however, there are still large areas of suitable habitat in the region, and the combined loss from the three LNG facilities represents a minor percentage of the remaining habitat. Further, the Rio Grande LNG Project' contribution to this significant impact would be minimized through implementation of Project-specific northern aplomado falcon BMPs, as discussed in section 4.7.1.3.

Shorebirds, Marsh Birds, and Wading Birds

Other projects considered for cumulative impacts on federally listed or proposed for listing shorebirds (piping plover and red knot), marsh birds (eastern black rail), and wading birds (whooping crane) are those that would conduct activities adjacent to the BSC and those projects that include elevated structures and wires that could result in bird strikes. Projects considered for impacts on these species include the Texas LNG Project, Annova LNG Project, VCP (for which construction is complete, but restoration could be ongoing during construction of the proposed Project), Kingsville to Brownsville Pipeline, waterway improvement projects, Port of Brownsville Projects, SpaceX Commercial Spaceport Project, the Stargate Facility, and the new facilities at the Red Gate Entrance of the Bahia Grande Project.

Suitable wintering habitat is present within the Project site for each species, and designated critical habitat for the piping plover is present directly across from the proposed LNG Terminal site. We have determined that the proposed Project is not likely to adversely affect the piping plover, red knot, whooping crane, and eastern black rail, as discussed in section 4.7.1.3. We also conclude that the proposed Project is not likely to adversely affect piping plover critical habitat. Consultations under Section 7 of the ESA have not been completed (see our recommendation in section 4.7.1.6).

The other industrial development projects considered, including the LNG projects and Port of Brownsville projects, are anticipated to result in similar impacts on the piping plover, red knot, and whooping crane. The proposed Project, other LNG projects, the observation deck associated with the Opening of Bahia Grande Project, and some of the Port of Brownsville projects would result in the permanent conversion of the existing shoreline habitat to industrial land (about 5 linear miles); however, the dredging of the Texas LNG marine berth would likely restore tidal flats north of the Project site, potentially creating habitat for shorebirds and wading birds. Texas LNG has also indicated that it would implement measures recommended by the FWS to minimize potential impacts on the piping plover and red knot by conducting pre-construction surveys. Further, based on consultations with the FWS, PA 5A may serve as habitat for the piping plover and red knot; however, PA 5A no longer contains the primary constituent elements for wintering piping plover critical habitat because the dredged material has raised the ground-level and effectively cut off water flow that is required for a tidal flat.

Although the projects considered would result in a cumulative impact on the piping plover, red knot, and whooping crane there is abundant wintering habitat present throughout the southern Texas coast, including within the Laguna Atascosa NWR, Lower Rio Grande Valley NWR, and the Loma Ecological Preserve that would not be directly affected by the any of the projects considered. Further, critical habitat for wintering plovers is available throughout the southern Texas coast, including 5 units totaling 71,474 acres (TX-1, 2, 3A, 3B, and 4) that include coastal areas of Cameron County (74 Federal Register 23476, 66 Federal Register 36038). Therefore, cumulative impacts on piping plovers and red knots are not anticipated to be significant.

As discussed in section 4.7.1.3, we have determined that the proposed Project is not likely to adversely affect the eastern black rail. Similar to shorebird species, the projects considered would result in cumulative impacts on potentially suitable habitat for the eastern

black rail. However, all projects and activities would be required to comply with the CWA by avoiding, minimizing, or mitigating wetland impacts. Further, the LNG Terminal is within the potential range for the species, but outside of the known year-round range. Given the availability of emergent wetlands in the vicinity of the LNG Terminal site and requirements for wetland mitigation, cumulative impacts on eastern black rails are not anticipated to be significant.

In addition, similar to the northern aplomado falcon, the projects considered that include elevated structures and wires that could result in bird strikes would result in cumulative impacts on all four of the migratory bird species discussed in this section. However, RG LNG has indicated that it would minimize the likelihood of bird strikes by minimizing the amount of lighting at the terminal and by designing the Project to include ground flares. Other project proponents are anticipated to implement similar mitigation measures to minimize the likelihood of bird strikes. Therefore, cumulative impacts on both shorebird species, the eastern black rail, and the whooping crane resulting from bird strikes with elevated structures are not anticipated to be significant. Overall, given the presence of suitable habitat in the area and the status of each of these species as wintering, non-nesting migrants in the Project area, cumulative impacts are also not anticipated to be significant.

Ocelot and Jaguarundi

The geographic scope for cumulative impacts on the ocelot and jaguarundi was considered to be terrestrial projects located within the HUC-12 subwatershed affected by the proposed LNG Terminal. As described above for the northern aplomado falcon, these include a majority of those projects identified in table 4.13.1-2.

Thorn scrub habitat associated with the lomas on the Project site provide suitable habitat for ocelot and jaguarundi, as discussed in section 4.7.1.4, and occupied habitat is known to be present in the adjacent Laguna Atascosa NWR. While suitable habitat is present on the Project site and is within the known range of ocelots and jaguarundi, the Project site likely serves only as stopover or temporary habitat for transient individuals rather than a breeding pair due to its size and lack of connectivity with larger more contiguous tracts, such as those present within the Laguna Atascosa NWR. If an ocelot or jaguarundi is present on the site at the start of construction activities it would be flushed from the property during pre-construction surveys and hazing, and would likely relocate to suitable adjacent habitat.

We have determined that the loss of any suitable ocelot habitat, which are regularly sighted in the Project area, and potential indirect impacts on habitat within the lower Laguna Atascosa NWR (see section 4.7.1.4), could have adverse impacts on ocelots; and, in accordance with our Section 7 evaluation, we have determined that the proposed Project is likely to adversely affect the ocelot. Although there is a lack of confirmed jaguarundi sightings in recent decades, the Laguna Atascosa NWR overlaps the range of the jaguarundi and would also experience habitat impacts from construction and operation of the Project; therefore, we have determined that the proposed Project is also likely to adversely affect the jaguarundi. Consultation under Section 7 of the ESA has not been completed (see our recommendation in section 4.7.1.6).

As discussed in greater detail in section 4.7.1.4, the primary threat to ocelot and jaguarundi populations in the United States is habitat loss, degradation, and fragmentation (FWS 2010b). Due to the large home ranges of ocelots and importance of corridor habitat to connect to Mexican populations, even incremental habitat loss could be significant. Also, the population size in Texas and growing isolation from loss of habitat connectivity with ocelot and jaguarundi populations in Mexico are contributing to a growing threat of genetic inbreeding in the Texas ocelot and jaguarundi populations. Moreover, the construction of roads through ocelot and jaguarundi habitat has resulted in high rates of road mortality, further inhibiting population growth and connectivity with adjacent populations (FWS 2010a). These are important factors to consider when addressing potential cumulative impacts on these species.

Not all of the projects listed above are anticipated to impact ocelot and jaguarundi habitat. This includes the wind farms, which are located in primarily agricultural and open land, and the five Port of Brownsville projects in operation, which are located within densely developed, previously disturbed areas. In addition, several projects would result in beneficial impacts on ocelots and jaguarundis including the Bahia Grande Coastal Corridor Project, the purpose of which is to further conserve land, and the wildlife crossing projects, which are intended to minimize impacts from road traffic. The other two LNG projects, as well as the pipeline projects proposed that cross eastern Cameron County (Cross Valley, VCP, Kingsville to Brownsville, and Jupiter Pipeline), are anticipated to have the greatest impacts on ocelot habitat through removal and conversion to industrial uses and fragmentation. The construction of the San Roman Wind Farm also resulted in the loss of ocelot and jaguarundi habitat and fragmentation of the Bahia Grande Ocelot Coastal Corridor between the Bahia Grande Unit of the Laguna Atascosa NWR and other units of the Laguna Atascosa NWR to the north.

As discussed above, the exact location of the sixth Port of Brownsville Project (the Steel Mill) is unknown; however, it is possible that it would be placed on an undeveloped parcel along the BSC and thus contain potential habitat for the ocelot. Similarly, construction of new infrastructure associated with the Opening of the Bahia Grande Unit of the Laguna Atascosa NWR to tourism (at the “Red Gate” Entrance) and the Jupiter Pipeline would occur on undeveloped lands that provide ocelot and jaguarundi habitat. Construction of the VCP is complete, but restoration could be ongoing during construction of the proposed Project. In addition, these projects along with several of the transportation projects and the Opening of Bahia Grande Project could result in increased road traffic and/or additional roads for transiting ocelots and jaguarundis to cross. Direct mortality as a result of construction activities for the projects considered in this cumulative impacts analysis for ocelots and jaguarundi are unlikely due to the mobility of the species; however, long-term impacts resulting from habitat loss and the potential for subsequent reduced genetic diversity from inbreeding could occur.

As discussed above, the past and continued development in and around Brownsville and across the border in Mexico has decreased the available corridor habitat necessary to connect ocelot and jaguarundi populations in Mexico and the United States. While relatively small barriers such as the BSC and SH-48 do not create a major impediment to individual movements, ocelots and jaguarundi require contiguous dense thorn scrub for cover over longer distances (TPWD 2017a, 2017b). In addition, ocelots and jaguarundis are elusive species with relatively large home ranges and low population densities that tend to avoid human development and activity (FWS 2010a). The current remaining habitat corridor in the region to connect U.S. and

Mexico populations is located close to and within the proposed Texas LNG Terminal and proposed Rio Grande LNG Terminal sites north of the BSC and within the proposed Annova LNG Terminal site south of the BSC, as well as the lands associated with the Opening of the Bahia Grande Project and Jupiter Export Terminal. A designated wildlife corridor easement, granted by the BND to the FWS for a 19-year term in 2004, is about 0.7 mile to the west of the proposed Rio Grande LNG Terminal site boundary (see figure 4.6.1-1). Annova LNG has been working closely with the FWS to configure its project to reduce potential impacts on ocelots and jaguarundis to the maximum extent practicable. This includes maintaining an approximately 1,500-foot-wide corridor to the west of the Annova LNG Terminal site, directly across from the existing wildlife corridor on the north side of the BSC. Although we know that the Steel Mill would be between the BSC and SH-48, we conservatively assume that the 800-acre site has similar scrub habitat (include possibly thorn scrub habitat) that could be used by ocelots and jaguarundis.

While a travel corridor would be maintained to allow ocelots and jaguarundis to move between Mexico and the United States, the addition of three large industrial facilities in proximity to that corridor (i.e., Annova LNG, Rio Grande LNG, and Texas LNG), would create additional noise, light, and traffic, all of which could deter ocelots or jaguarundis from utilizing the corridor. However, in an effort to minimize impacts as a result of increased light pollution on all wildlife, including ocelots and jaguarundis, all three LNG projects have indicated that they would utilize down-facing lights. Other impacts, such as those associated with noise, would be minimized by the projects to the extent practicable; however, due to the proximity of the Annova LNG and Rio Grande LNG Projects to the wildlife corridors, facility-generated noise during construction and operation would result in minor increases in sound levels at the wildlife corridor. As depicted in figure 4.13.2-2, cumulative sound levels from operation of all three projects are estimated to be about 55 dBA L_{dn} at the wildlife corridor, which would result in less than a 1 dB increase over the ambient level of 68.9 dBA L_{dn} measured by RG Developers. The Steel Mill and Jupiter Export Terminal would be expected to have similar impacts as the LNG Terminals, while impacts from construction and operation of the Red Gate Entrance would be similar, but to a lesser extent.

In addition, increased road traffic along SH-4 associated with the Annova LNG Project, Kingsville to Brownsville Pipeline, SpaceX Commercial Spaceport Project, and the Stargate Facility, as well as increased traffic along SH-48 associated with the proposed Project, Texas LNG Project, Kingsville to Brownsville Pipeline, and the Port of Brownsville projects could result in increased potential for vehicle strikes on ocelots and jaguarundis.

As described above, there is potential for the continued reduction of suitable ocelot and jaguarundi habitat to a single, narrow corridor among industrial facilities. This loss, degradation, and fragmentation of habitat have been cited by the FWS in its 2010 Recovery Plan, as the primary threat to U.S. ocelot and jaguarundi populations. The further narrowing of this corridor could result in decreased dispersal of individuals between U.S. and Mexico populations, resulting in decreased genetic diversity (inbreeding). Further, the projects assessed for cumulative impacts on ocelots and jaguarundis would increase road traffic, particularly during periods of concurrent construction (see table 4.13.1-2), which is the primary cause of direct mortality on U.S. ocelot and jaguarundi populations (TPWD 2017a, 2017b). Due to the past, present, and proposed future development throughout the geographic scope for assessing

cumulative impacts on ocelots and jaguarundis, as well as the associated increases in road traffic, light, and noise, we have determined that cumulative impacts on ocelots and jaguarundis would be significant.

Pipeline Facilities

With the exception of the marine species (sea turtles and marine mammals), the species discussed in section 4.7 of this EIS could potentially be affected by construction and operation of other projects occurring within the same area as the proposed pipeline facilities. Impacts from the proposed pipelines in the Bahia Grande-BSC HUC-12 subwatershed are discussed above, where they fall within the geographic scope for the proposed LNG Terminal. Five projects, the Stella and Palmas Altas Wind Farms, the Kingsville to Brownsville Pipeline, the Jupiter Pipeline, and the VCP (for which construction is complete, but restoration could be ongoing during construction of the proposed Project), have been identified within the geographic scope for the pipelines north of the Bahia Grande-BSC HUC-12 subwatershed boundary. The Rio Bravo Pipeline and all other projects within the geographic scope are required to consult with the appropriate federal, state, and local agencies to evaluate the types of species that may be found in the area of the projects; identify potential impacts from construction and operation of the projects to any species identified; and implement measures to avoid, minimize, or mitigate impacts on special status species and their habitat. Based on projected impacts and proposed mitigation measures, construction and operation of the proposed pipelines would not be likely to adversely affect federally listed species and would be unlikely to result in a trend towards federal listing for state listed species.

All federal projects are required by law to coordinate with the FWS, which will take into account regional activity and changing baseline conditions in determining the extent of impacts on a federally listed or proposed species. The VCP follows the same general path of the proposed pipelines and is immediately adjacent to the proposed route for about 34.4 miles. The FWS completed consultation for the VCP on June 19, 2017 (FWS 2017). The concurrence letter indicates that, with the additional mitigation recommended by the FWS, the VCP would have an insignificant and discountable impact on the jaguarundi, ocelot, northern aplomado falcon, piping plover, red knot, black lace cactus, slender rush pea, south Texas ambrosia, and Texas ayenia. Construction of the VCP is complete. Similar project-specific information is not yet available for the Kingsville to Brownsville Pipeline or the Jupiter Pipeline.

Non-federal projects, such as the Stella and Palmas Altas Wind Farms, are also required to adhere to the ESA, although the FWS has a different mechanism for evaluation and minimizing impacts. Consequently, we conclude that past and present projects in combination with the proposed pipeline facilities would have minor cumulative effects to special status species.

Conclusion

As discussed above, many species would experience a cumulatively minor or negligible effect from the projects. However, given the extent of habitat modification associated with the proposed Project, and other projects in the geographic scope that would be built at the same time

as the proposed Rio Grande LNG Project, moderate to significant cumulative impacts would likely occur for certain species, including:

- significant cumulative impacts would likely occur for the ocelot and jaguarundi, given the loss and/or decrease in suitability of habitat within and adjacent to the projects, as well as for the potential increase in vehicular strikes during construction;
- significant cumulative impacts on the northern aplomado falcon due to loss of suitable foraging and nesting habitat and potential disruption of nesting in the vicinity of the projects; and
- moderate cumulative impacts on sea turtles due to dredging, vessel traffic, and pile-driving.

Cumulative impacts associated with the Rio Bravo Pipeline on threatened and endangered species would be minor.

4.13.2.6 Land Use, Visual Resources, and Recreation

Land Use

The geographic scope established for land use was determined to be Cameron County for the Rio Grande LNG Terminal, and land within 1 mile of the Pipeline System (see table 4.13.1-1). The total available land in Cameron County, almost 630,000 acres of land which 37 percent (over 230,000 acres) is agricultural land. The projects listed in table 4.13.1-2 would or have disturbed thousands of additional acres of land affecting a variety of land uses, including the land uses impacted by the Rio Grande LNG Terminal and Pipeline System. The non-jurisdictional facilities for the proposed Project, the Annova LNG and Texas LNG Projects and associated non-jurisdictional facilities, the VCP (for which construction is complete, but restoration could be ongoing during construction of the proposed Project), the five Wind Farms, the Cross Valley Project, the Palmas to East Rio Hondo Transmission Line, the six Port of Brownsville Projects, the wildlife crossing projects, the Opening Bahia Grande Project, all of the waterway improvement projects, as well as the oil and gas facilities would all have the potential to contribute to cumulative impacts on land use.

Projects with permanent aboveground components (e.g., buildings), wind energy projects, roads, and aboveground electrical transmission lines would generally have greater impacts on land use than the operational impacts of a pipeline, which would be buried and thus allow most land use activities to resume land following construction. Therefore, with the exception of aboveground facilities and the permanent right-of-way, pipeline projects typically only have temporary impacts on land use. The majority of long-term or permanent impacts on land use are associated with vegetation clearing and maintenance of the pipeline right-of-way.

LNG Terminal

Ongoing and recently completed projects, such as the San Roman (156 acres within a 3,289-acre area), the Cameron (15,000 acres), the Palmas Altas Wind Farms (6,600 acres), and the Jupiter Project (8,150 acres) have contributed to the ongoing conversion of the land in

Cameron County from predominately open farmland to industrial use. Similarly, the planned Tenaska Brownsville Generating Station and Steel Mill would impact about 270 and 800 acres, respectively, of land in Cameron County. The existing and future transportation projects, such as the South Padre Island Second Access, State Highway 550 connector and Toll Project, the Airport Terminal Expansion, and the Opening of the Bahia Grande Project also contribute to present and future cumulative impacts on land use within Cameron County. Other past, present and future Port of Brownsville projects within Cameron County noted in table 4.13.1-2 have resulted in land use impacts that would be considered in combination with the Rio Grande LNG Terminal. The non-jurisdictional facilities associated with the Rio Grande LNG Terminal would also result in about 182 acres of land impacted in Cameron County.

Although we do not have project-specific land use information for projects not under the jurisdiction of the FERC, we can estimate the total impact of each project based on the length of each project and industry standards on the right-of-way width for a given diameter pipeline. Assuming a construction right-of-way width of 125, 150, and 100 feet, respectively, VCP affected about 2,545.8 acres of land, the Cross Valley Project would impact about 1,745.7 acres of land, and the Jupiter Project would impact about 7,880 acres, of which about 750.6, 866.5, and 650 acres, respectively, would be in Cameron County; land crossed is assumed to be similar in cover type to that crossed by the Rio Bravo Pipeline System. Similarly, the Kingsville to Brownsville Pipeline is anticipated to affect about 1,576 acres of land, of which an estimated 480 acres would be located within Cameron County. Given the land use information that we have for all these other projects in Cameron County, we estimate the land use acreage impacts to total almost 9,500 acres, in addition to the acreage associated with the Rio Grande LNG Project.

While the LNG Terminal would be consistent with BND's long-term plan, construction and operation of this project would result in permanent changes in land use. When considered with the land use impacts of other past, present, and reasonably foreseeable future projects within Cameron County, the Rio Grande LNG Terminal, which would be a new, 750.4-acre industrial facility along the BSC, would result in a minor contribution to cumulative impacts on land use in Cameron County.

If the Annova LNG and Texas LNG Projects are permitted and constructed, these projects would convert land in Cameron County from the current land use to industrial land. While impacts on land use would be permanent, these types of projects are also consistent with BND's long-term plan for the Port of Brownsville and the BSC, which identifies the area as intended for heavy industrial use. Further, the Annova LNG and Texas LNG Projects, as FERC-jurisdictional projects, would be required to adhere to the revegetation requirements of the construction and permanent workspaces in accordance with our Plan as applicable for each project, to minimize impacts on land use.

In total, the three Brownsville LNG terminals would affect 1,939.8 acres of generally undeveloped land, including a mixture of vegetated (herbaceous or scrub-shrub) and unvegetated land, 1,444.4 acres of which would be permanently converted to developed land. Construction and operation of all three FERC-jurisdictional LNG Projects would affect about 1,940 acres of land use, and when considered with the past, present, and reasonably foreseeable future projects, we do not anticipate that the three LNG Projects would contribute significantly to the cumulative impacts on land use within Cameron County.

Pipeline Facilities

In south Texas, several future projects could be constructed and/or operated concurrent with the Pipeline System, including the Annova LNG and Texas LNG Projects, associated non-jurisdictional facilities, the Jupiter Pipeline, as well as previously constructed oil or gas wells and associated pipelines that are in service. Impacts on land use could occur if these projects are constructed around the same time as the Rio Bravo pipelines.

As described above, the Annova LNG and Texas LNG Projects, as FERC-jurisdictional projects, would be required to adhere to our Plan to minimize impacts on land use. Associated intrastate pipeline facilities for the Texas LNG Project would involve activities similar to the construction of an interstate pipelines, although land requirements for construction and operation would be considerably less given they are typically smaller-diameter pipeline (30 inches in diameter) and based on its shorter length (10 miles).

Of the total impact acreage for the Rio Grande LNG Terminal and other projects in the combined geographic scope for the LNG Terminal and Pipeline System (28,892 acres⁸⁴), the Pipeline System would impact 2,495.9 acres of land during construction. This estimate includes impacts from the proposed pipelines and other projects in Cameron County as discussed above, where they fall within the geographic scope for the proposed LNG Terminal (a total of 11,058 acres). The proposed Pipeline System would affect predominantly open and agricultural land, including ranch lands, and would be temporary as these land uses would be allowed to revert to prior uses following construction. Any impacts would be minimized or mitigated to the greatest extent practicable through the use of Project-specific construction plans (for example, RG Developers' Plan) and consultation with federal agencies, state agencies, and landowners. We anticipate that other projects in the geographic scope would be required to implement similar construction and restoration practices to minimize impacts on land use.

Conclusion

The Rio Grande LNG Project would result in temporary, short-term, and permanent impacts on existing land use. For other projects in the geographic scope built at the same time as the proposed Project, cumulative impacts on land use would be additive. However, certain projects such as the South Padre Island Beach Re-nourishment, the wildlife crossing projects, the Palo Alto Battlefield Cultural Landscape Restoration, and Bahia Grande Coastal Corridor Project are focused on maintenance or enhancement of the natural environment; as such these projects may result in positive effects on land use. Overall, the cumulative impacts of the Project when considered with other projects would be temporary (during construction of the buried or temporary project components) to permanent (within aboveground facility footprints), and minor given the large geographic scope (Cameron County alone comprises almost 630,000 acres of land). Further, the Rio Grande LNG Project would be consistent with BND's long-term plan,

⁸⁴ Total based on known project sizes reported in acres in table 4.13.1-2, less the Cameron Wind Farm, for which the actual acreage of conversion within these facilities is unknown but is expected to be minimal, and the area that would be restored for the Bahia Grande Coastal Corridor Project.

which identifies the area for the proposed LNG Terminal site as intended for heavy industrial use.

Recreation and Special Interest Areas

The geographic scope established for recreation and special interest areas was determined to be Cameron County for the Rio Grande LNG Terminal, and land within 1 mile of the Pipeline System (see table 4.13.1-1). The projects listed in table 4.13.1-2 would disturb lands and waterways which could be a disruption for recreationalists resulting in diminished or lost use of recreation and special interest areas. Alternatively, projects like the Opening of the Bahia Grande are geared toward enhancing recreational opportunities. Projects with permanent aboveground components (including the proposed Project, Annova LNG and Texas LNG Projects, VCP, wind farm projects, and the Cross Valley Project) would generally have greater impacts on recreation and special use areas than the operational impacts of a pipeline, which would be buried and thus allow most land use activities to resume land following construction. Therefore, with the exception of aboveground facilities and the permanent right-of-way, pipeline projects (including the proposed Project, the VCP, Kingsville to Brownville Pipeline, and New Intrastate Pipeline for Texas LNG) typically only have temporary impacts on these areas. Construction of the VCP is complete, but restoration could be ongoing during construction of the proposed Project. The majority of long-term or permanent impacts on recreation and special interest areas are associated with vegetation clearing and maintenance of the pipeline right-of-way, and the changes in the viewshed for recreationalists from the presence of aboveground components.

LNG Terminal

Based on the information currently available, the Annova LNG and Texas LNG Projects, and their associated new intrastate pipelines and non-jurisdictional facilities, the Steel Mill, and the Jupiter Project could impact the recreation and special use areas that would be in proximity to the Rio Grande LNG Terminal (including the Lower Rio Grande Valley NWR; Laguna Atascosa NWR; and the Zapata boat launch; see table 4.8.1-3). Construction of these projects at the same time and at nearby locations as the proposed Rio Grande LNG Terminal would result in short-term impacts on the recreation and special use areas, including alteration of visual aesthetics by the presence of construction personnel and vehicles, removing existing vegetation and disturbing soils; generating dust and noise, and generally interfering with or diminishing the quality of the recreational experience by affecting wildlife movements or disturbing recreationalists.

Many of these recreation and special use areas are located on large parcels with multiple access points so as the distance to construction work areas increases, impacts would generally decrease. Where recreational use would be allowed to proceed near construction activities, RG Developers would implement mitigation measures similar to those described in section 4.8.1.3, and in consultation with land managers. Finally, Cameron County offers a variety of parks and recreation areas providing ample sites that are sufficiently removed from the proposed LNG Terminal site (Cameron County Parks and Recreation 2018, TPWD 2018). For the reasons state above, we anticipate that the Rio Grande LNG Terminal, if built at the same time and affect the same areas or features as other current and foreseeable future projects, would result in a minor contribution to cumulative impacts on recreation and special interest areas.

Operational impacts on the recreation and special use areas associated with the three LNG terminals, the Steel Mill, and Jupiter Export Terminal would generally be similar to those experienced during construction. The most notable difference would be the presence of the facilities, which would be a permanent change in the existing viewshed. As described above, most of the recreation and special use areas are located on large parcels with multiple access points, as such users of the areas in proximity to these facilities that are more sensitive to their presence could opt to recreate elsewhere within the chosen recreation site or at one of the other recreation and special use areas further removed from the facilities. The timing of construction of the new facilities associated with the Opening of the Bahia Grande is currently unknown. Similarly, it is unknown whether these plans would be modified, or abandoned, if the proposed LNG Terminal is approved and constructed.

Pipeline Facilities

Several recreation and special interest areas are in proximity to the proposed Pipeline System, including King Ranch, the Laguna Atascosa and Lower Rio Grande Valley NWRs, four Great Texas Coastal Birding Trails, and the Zapata boat launch. Recreation and special use areas are discussed in section 4.8.1.5.

Based on the information currently available, the non-jurisdictional facilities, the new intrastate pipeline for the Texas LNG Project, the VCP, and the Jupiter Pipeline could impact the recreation and special use areas that would be crossed by the proposed pipeline facilities. Construction or ongoing restoration of these projects at the same time as, and at locations proximal to, the proposed pipeline facilities would result in temporary cumulative impacts on the recreation and special use areas due to increased noise and dust, and limited access. While the Bruenning Breeze Wind Farm and the SH-100 Wildlife Crossing Project could affect some of the same recreation and special use areas as the proposed pipeline facilities, any impacts would be separated by time, and would not occur concurrently.

Following construction of the pipelines, the majority of long-term or permanent impacts on recreation and special use areas crossed or adjacent to the pipelines would be associated with vegetation clearing and maintenance of the pipeline rights-of-way. Operation of the other projects identified above would generally be similar to those described for the proposed pipeline facilities. We conclude that overall impacts on these recreation and special use areas from operation of the proposed pipelines and other projects would be considered minor in comparison to the current inventory of recreation and special use areas.

Conclusion

The Rio Grande LNG Project would result in short-term impacts on recreation areas. For other projects in the geographic scope built at the same time as the proposed Project, cumulative impacts on recreation would be additive. However, certain projects such as the South Padre Island Beach Re-nourishment, the SH-100 Wildlife Crossing, the Palo Alto Battlefield Cultural Landscape Restoration, and Bahia Grande Coastal Corridor projects are focused on maintenance or enhancement of the natural environment; as such, these projects may result in positive effects on recreation use and experiences. Overall, the cumulative impacts of the Project when considered with other projects would be temporary (during construction of the buried or

temporary project components) to short-term (as disturbed lands revegetate following construction), and minor given the large inventory of recreation areas with multiple access points.

Visual Resources

The geographic scope of analysis for cumulative impacts on visual resources was considered to be areas within the viewshed of the Rio Grande LNG Terminal site and proposed pipeline facilities (see table 4.13.1-1). For the Rio Grande LNG Terminal this was determined to be the distance at which the storage tanks, which would be the tallest features at the terminal, would be visible from neighboring communities (about 12.0 miles). For the Pipeline System, the tallest feature would vary as one moved along the proposed right-of-way, but the geographic scope for visual resources would generally be within 0.25 mile.

As described above for land use, projects with permanent aboveground components, such as the LNG terminals, wind energy projects, Port of Brownsville projects, roads, and aboveground electrical transmission lines would generally have greater impacts on visual resources than subsurface projects (e.g., pipelines). The operational impacts of a pipeline, with the exception of aboveground facilities and (in some cases) the permanent right-of-way, would only have temporary to short-term impacts on the viewshed as a vegetation cover is re-established.

LNG Terminal

The area around the LNG Terminal is flat and relatively open with scrub-shrub vegetation. As described in section 4.9.8.2, the Port of Brownsville and the BSC support the shipping of domestic and foreign products, therefore the movement of these vessels contribute to the characterization of the existing viewshed. Visual receptors in the vicinity of the LNG Terminal site include recreational and commercial users of the BSC; land-based visual receptors would include motorists on SH-48, visitors to the Laguna Atascosa and Lower Rio Grande Valley NWRs, and other nearby, existing or planned, recreation areas as discussed above.

The most prominent visual feature at the LNG Terminal site would be the four LNG storage tanks, which would be 275 feet wide and 175 feet in height. Based on our assessment of RG LNG's visual simulations and our evaluation of other sources and maps, we determined that the Rio Grande LNG Terminal would be most visible from the Bahia Grande Channel, SH-48, and the Zapata boat launch (see section 4.8.2.1). Further, as discussed in section 4.9.3.1, if plans proceed with the Opening of the Bahia Grande Red Gate Entrance, visual receptors at the observation deck would be able to see the LNG Terminal as they look to the south. The proposed LNG Terminal would not be clearly visible or would difficult to see from the other eight KOPs, obscured in part or whole by existing vegetation, or appear as an undiscernible feature on the horizon. Existing vegetation, however, should not be a determining factor for visibility. A wildfire, road widening, or other actions may remove the vegetation screen making the Project clearly visible. Therefore, the projects that have the greatest potential to contribute to cumulative visual impacts would be within about 4.0 miles of the LNG Terminal, these would include the proposed Projects non-jurisdictional facilities, the Annova LNG and Texas LNG

Projects and associated non-jurisdictional facilities, the Steel Mill, Jupiter Export Terminal, the Opening of the Bahia Grande, and the waterway improvement projects.

The visual impacts associated with waterway improvement projects would be limited to short-term impacts during active dredging and construction; similarly, contributions from the proposed new interstate pipelines would be limited to the period of active construction. Therefore, these projects would not weigh into the consideration of the cumulative visual impact of the LNG Terminal and other projects. Given the LNG Terminal site's proximity to residential areas, it may be possible to see the LNG Terminal from certain vantage points in Port Isabel and Laguna Heights, in particular elevated sites such as the Port Isabel Lighthouse; however, as discussed in section 4.8.2.1, the distance to the LNG Terminal site limits its visibility and as such it would not be a prominent feature in the viewshed for these residences.

The potential for cumulative visual impacts would be greatest if, in addition to the proposed LNG Terminal, the Annova LNG and Texas LNG Projects, the Steel Mill, and Jupiter Export Terminal are permitted and built concurrently. In particular, motorists on SH-48 and visitors to the nearby recreation areas where two of the LNG terminals would be visible (including the NWRs, Zapata boat launch, on San Martin Lake) would experience a permanent change in the existing viewshed during construction and operation of the projects. While the exact location of the Steel Mill is unknown, its general location of between the BSC and SH-48 on an 800-acre sites suggests that it could be visual from these nearby recreation areas. Similarly, the modifications and improvements proposed at the Jupiter Export Terminal would be visible to water-based receptors on the BSC as well as to visitors to recreation areas south of the BSC. As the timing of the Opening of the Bahia Grande is currently unknown, changes in the viewshed for visitors to this future recreation site may be minimized if the LNG terminals are built first, as these features would become part of the existing viewshed. Alternatively, if the Red Gate Entrance is completed before or concurrent with the LNG terminals then cumulative impacts on these visual receptors would be similar to those at other nearby recreation areas.

Short-term impacts during construction would include the presence of equipment and workers, the increase in construction-related traffic (on land and in the BSC), and the installation of large structures at the terminal sites. For land and water-based mobile receptors this impact would be short, lasting only the duration of time for the vehicle or vessel to pass the site. To help mitigate these impacts RG LNG would construct a levee around the LNG Terminal site that, once complete, would obstruct most construction activities.

Following construction, permanent changes to the visual character of the area would result from the operation of the terminals due to the presence of aboveground structures. RG LNG would mitigate these impacts by the use of ground flares, strategic selection of color schemes for the storage tanks, horticultural plantings, and a levee that would obstruct low-to-ground operational facilities from view. The Annova LNG Project would also implement measures to screen visual receptors, including using materials colored and treated to blend in with the surrounding landscape and reduce glare; and designing lighting to minimize contrast with the night sky. Texas LNG has not proposed any measures for visual screening of the LNG terminal during operation and therefore may result in a significant cumulative impact on visual resources. Although the Rio Grande LNG Terminal would change the existing landscape, its

operation, as well as the other proposed LNG terminal projects, would be consistent with BND's long-term plan, which identifies the area as intended for heavy industrial use.

Pipeline Facilities

As previously discussed, the geographic scope for visual resources along the Pipeline System is generally a 0.5-mile radius. The proposed Project's non-jurisdictional facilities, the Texas LNG Projects and associated intrastate pipeline, ongoing restoration of the VCP, the five wind farms, the Cross Valley Project, the wildlife crossing projects, as well as oil and gas facilities have the potential to contribute to cumulative impacts on visual resources. As discussed above, while specific route details for the Jupiter Pipeline are currently not available, the pipeline route appears to generally follow a similar path as VCP and the Rio Bravo Pipeline.

The visual character of the existing landscape is defined by historic and current land uses such as recreation, conservation, and development. The visual qualities of the landscape are further influenced by existing linear installations such as highways, railroads, pipelines, and electrical transmission and distribution lines, as well as wind energy facilities. Within this context, the non-jurisdictional facilities, intrastate pipelines, wind farms, and electric transmission and power projects listed in table 4.13.1-2 would all have the potential to contribute to the cumulative impact on visual resources in the geographic scope.

As described in section 4.8.2.2, the existing viewshed is characterized by large parcels of land composed predominately of open land with existing easements for oil and gas pipelines. The proposed pipeline facilities would add incrementally to this impact, but the overall contribution would be relatively minor given that the majority of the pipeline facilities would be buried. To minimize visual impacts, portions of the right-of-way would be adjacent to existing permanent rights-of-way, including the VCP, which minimizes development of new corridor. This would also help to limit the extent of changes in the viewshed.

Additionally, disturbed areas would be revegetated as appropriate. Given the rural setting composed of large tracts of land where aboveground facilities would be located, visual receptors are predominately passing motorists with limited opportunity to view these facilities. The impact of wind farm and electric transmission development activities on visual resources would vary widely depending on the location of specific facilities and access roads, but would be minimized to the extent possible through the state's review and permitting process.

The assessment of visual importance of an object or area varies greatly between individuals. In particular, some may find alternate forms of energy infrastructure (i.e., windmills) appealing for their perceived economic value while others may take a tangible approach in their evaluations, making meaningful conclusions on visual resources subjective. Visual impacts associated with operation of the pipeline facilities and other natural gas development result from maintained rights-of-way for gathering lines and other pipeline facilities, oil and gas wells, compressor stations, and meter stations. The turbines associated with the San Roman, Cameron, and Bruenning Breeze Wind Farms are visible from residences nearby the Pipeline System in Cameron and Willacy Counties. In Kenedy and Cameron Counties, ongoing construction of the Stella and Palmas Altas wind turbines would require the presence of

large equipment to transport and install the turbines and blades, and large cranes would be brought on site to complete installation of the turbines, blades, and shaft.

Although the visual impact of the wind farms and the LNG terminals may be long-term, only a minor visual impact would result due to the operation of the pipeline facilities, primarily resulting from the clearing of scrub-shrub vegetation types. Project proponents for these developments and associated non-jurisdictional project-related facilities would restore disturbed areas in accordance with state permitting agency requirements, thereby limiting permanent visual impacts on those areas where previously existing vegetation would not be allowed to reestablish within the new permanent right-of-way. The locations of any aboveground facilities for the wind farms are not known and therefore visual impacts from these projects cannot be reliably estimated at this time.

As currently proposed, the Annova LNG and Texas LNG Projects would involve construction of gas pipeline laterals. Permanent visual impacts would also occur in developed areas where permanent aboveground structures (e.g., transmission line posts) would remain. Other recently completed or proposed project aboveground facilities would, for the most part, likely be located adjacent to an existing right-of-way (e.g., transmission line), at existing paved industrial/commercial sites, in remote locations, and/or within a permanent right-of-way. Whereas these permanent visual impacts may be locally noticed, generally they would not be inconsistent with the existing visual character of the area. Therefore, the Rio Bravo Pipeline's contribution to cumulative impacts on visual resources, along with impacts from the other projects identified above, would mostly be limited to the construction phase, and would be temporary and minor. Alternatively, the presence of the wind turbines and LNG terminals would result in a permanent change in the existing viewshed for nearby visual receptors.

Conclusion

The Rio Grande LNG Project would result in temporary to permanent impacts on the viewshed. Other Projects constructed within the geographic scope Rio Grande LNG Project could contribute to cumulative impacts on the viewshed with the Project. Although construction of the pipelines would contribute to cumulative impacts on the viewshed, they would generally be temporary to short-term in nature. Given the lack of visual receptors in the vicinity of aboveground facilities associated with the Pipeline System, their contribution to cumulative visual impacts would be permanent, but minor. Following construction, the areas associated with the Pipeline System would be restored in accordance with the Project-specific Plan and Procedures. The physical facilities of the LNG Terminal and the aboveground facilities associated with the Pipeline System would result in a permanent and moderate changes in the existing viewshed for nearby visual receptors. However, as the Texas LNG terminal has the potential to result in significant visual impacts, we conclude that cumulative impacts on visual resources from the Rio Grande LNG Project, when considered with other projects, would be potentially significant.

4.13.2.7 Socioeconomics

The geographic scope for the assessment of cumulative impacts for the LNG Terminal on socioeconomic resources includes Willacy, Cameron, and Hidalgo Counties (see table 4.13.1-1).

As discussed in section 4.9, while none of the Rio Grande LNG Project facilities would be in Hidalgo County, it is included in the socioeconomic analysis because it would likely experience an influx in population from non-local workers relocating to the area during Project construction.

The geographic scope for the Pipeline System includes Jim Wells, Kleberg, Kenedy, Willacy, and Cameron Counties (see table 4.13.1-1). While many of the projects listed in table 4.13.1-2 have the potential to contribute to cumulative impacts on socioeconomic resources within the geographic scope of assessment, these impacts would be greatest during concurrent construction of projects with large construction workforces, such as the Annova LNG and Texas LNG Terminals and the Steel Mill, in close proximity to the Rio Grande LNG Project.

Population and Employment

LNG Terminal

RG LNG initially expected construction of the LNG Terminal to begin in 2018; however, the start of construction is dependent on receipt of necessary permits. Construction would occur over a 7-year period and construction workers would be on site throughout the duration. Several of the projects listed in table 4.13.1-2 would also require construction workers during the same period as the Rio Grande LNG Terminal, most notably the Annova LNG and Texas LNG Projects and the Steel Mill. If these projects were constructed concurrently, the construction labor requirements would be highest for the first 4 years, when all three projects are under construction. Based on the average construction workforce, these projects would be expected to employ about 5,850 construction workers in total, and at peak construction the combined workforces would be about 8,237 workers.

Following construction, these projects would result in the addition of 1,045 or more permanent jobs. In addition to this direct employment, the projects would likely result in increased indirect employment based on the purchases of goods and services. Collectively, the three LNG terminals would spend an estimated \$4.9 billion on direct expenditures. Similar expenditures are not known for the proposed Steel Mill; however, the facility itself is estimated to cost between 1.2 and 1.6 million dollars, and we assume some of these dollars would be associated with expenditures in the Project area. These expenditures and workforce associated with construction and operation of the LNG Terminals and Steel Mill would result in cumulative positive, short-term and permanent impacts, respectively, on the local economy.

Other projects identified in table 4.13.1-2 would likely have staggered timelines for specific labor needs, so some construction personnel working within the geographic scope may be able to support multiple projects. This would have a cumulative effect of decreasing the overall labor force required to meet the needs for all projects, however based on the size and types of these other projects, as well as the temporary nature of construction, the overall impact would likely be negligible. Finally, some of the projects identified in table 4.13.1-2 may not be permitted and/or built, which would reduce the total labor need within the geographic scope of analysis.

Pipeline Facilities

The construction periods for the pipeline facilities would likely be concurrent with several of the projects identified in table 4.13.1-2. Simultaneous construction of those projects could require a large number of workers from the local and non-local labor pools. The cumulative effect of local hires would reduce unemployment in the area; however, that reduction in unemployment could require the import of more construction workers than typically required for any single project. Other positive benefits from the new jobs and workers in the area would include increasing revenue for local business owners and generating new tax revenue in the geographic scope.

Conclusion

The Rio Grande LNG Project would substantially reduce unemployment in the Project area and potentially could result in the need to hire and train construction workers from outside the Project area to meet the needs of all projects in the geographic scope. Positive benefits from the new jobs and workers in the area would include increasing revenue for local business owners and generating new tax revenue in the geographic scope of analysis. Expenditures and the workforce required for construction of the Rio Grande LNG Project, in combination with other projects in the geographic scope, would result in temporary cumulative impacts during the construction period; operation of the LNG Terminal and other projects would result in a positive, permanent impact on the local economy.

We received comments on the draft EIS raising concerns that LNG projects would alter the character of communities, conflicting with social and cultural values, and negate the efforts by citizens and organizations who have shaped the area through conservation efforts. As described throughout the EIS, the LNG Terminal would be on undeveloped land owned by the BND, outside of city boundaries, and in an area that is characterized, in part, as industrial with the movement of domestic and foreign products within the BSC and associated with the Port of Brownsville. As described in sections 1.3 and 4.9.10 of this EIS, RG Developers have engaged in a variety of public outreach efforts, as well as coordinating additional outreach focused on job opportunities for local workers (see section 4.9.2). Further, RG LNG has committed to donations that will fund community projects (see section 4.9.5). Collectively these acts could aid in fostering community cohesion. Finally, RG Developers have been and continue to consult with federal and state agencies on mitigation measures for Project impacts on wetlands and wildlife habitat for special status species. We expect that other major projects would also engage in community outreach and would implement any mitigation measures for environmental impacts required by applicable permits, thus lessening the overall adverse cumulative impacts on the communities.

Housing and Public Services

LNG Terminal

The influx of non-local workers associated with construction of the Rio Grande LNG Terminal would affect the availability of housing in Cameron, Willacy, and Hidalgo Counties. The cumulative impact on local housing may result in increased rental rates and housing

shortages for lodging if all of the proposed and planned projects in the geographic scope of analysis are implemented according to the expected timeframes. This would benefit the local housing market, but would adversely affect those seeking housing.

The anticipated construction workforce for the Rio Grande LNG Terminal would occupy between 2.7 and 4.9 percent of the available housing in Cameron, Willacy, and Hidalgo Counties throughout the duration of construction (see section 4.9.6.1). The Annova LNG and Texas LNG Project proponents have identified Cameron County as the geographic areas from which the respective local workforces would be sourced or where individuals would likely relocate during construction. If non-local workers for all three projects found housing in Cameron County, they would occupy between 8.1 and 15.4 percent of the available units; therefore, no significant impacts on the local housing markets are expected.

The combined construction workforces for the projects identified in table 4.13.1-2 would increase the need for some public services, such as police, medical services, and schools. The need for these services would generally be spread throughout the counties that house the workforce for the Rio Grande LNG Terminal (Cameron, Willacy, and Hidalgo Counties), but there may be an increased cumulative need for medical and emergency services in Cameron County where the proposed Rio Grande LNG Terminal and associated construction workers are expected to be concentrated. RG LNG would train a portion of the construction and operation workforces as emergency responders and provide access to first-aid kits. In addition, onsite security would be provided through a third-party contractor. The other Project proponents may also mitigate the impact by providing funding for temporarily increasing the staff and equipment of the public services affected.

With construction of the three LNG terminal projects lasting several years, it is likely that some non-local construction workers would relocate to the area with their families, including school-aged children. This would increase enrollment in some schools in counties housing the workers with families; however, as increased enrollments would likely be spread throughout many school districts, the cumulative effect on schools would be long-term, but minor.

Pipeline Facilities

The influx of non-local workers would affect the availability of housing in Jim Wells, Kleberg, Kenedy, Willacy, Cameron, and Hidalgo Counties. As described in section 4.9.7, there is an adequate amount of vacant temporary housing in the geographic scope. However, with concurrent construction of larger projects identified in table 4.13.1-2, transient housing could be limited and non-local workers unable to find acceptable housing in these counties would be forced to obtain housing in neighboring counties such as Brooks and Starr Counties resulting in longer commutes.

The cumulative impact on local housing may result in increased rental rates and housing shortages for lodging if all of the proposed and planned projects are implemented according to the expected timeframes. This would benefit the local housing market, but would adversely affect those seeking housing.

As described above for the LNG Terminal, the combined construction workforces of projects would increase the need for some public services; the need for those services would generally be spread throughout the counties that house the workforce. In section 4.9.1, we estimate that the change in the local population, due to the presence of the non-local workforce for the Pipeline System, would be 0.003 percent. Given this negligible population increase, the Pipeline System's contribution to the cumulative impact on medical and emergency services in the geographic scope during construction would likely be occasional and minor.

As discussed for the LNG Terminal, some workers may bring their families, increasing enrollment at local schools. However, given construction of the Rio Bravo Pipeline would occur over a 12-month period and be separated by an 18-month gap, it is unlikely that the non-local workers would be accompanied by family members. Therefore, cumulative impacts on schools from construction of RB Pipeline's facilities would be negligible.

Conclusion

Based on the number of available rental units and motels/hotels in Project area, it is anticipated that there would be sufficient housing available for the anticipated peak Project workforce for the Rio Grande LNG Project when cumulatively considered with the other Brownsville LNG terminal projects. While the other LNG projects may be constructed concurrently with the proposed Project, and non-local workers for these projects are expected to find housing in similar areas, and specifically Cameron County, the county has sufficient temporary housing to accommodate the influx of workers. Similarly, the increased need for public services and school enrollment to support non-local workers and their families for the Rio Grande LNG Project and other projects would be spread across the geographic scope.

Further, with the expected increase in local taxes and government revenue associated with the proposed projects, we conclude that cumulative impacts on available housing and public services during construction of the LNG Terminal would be temporary and minor. Operation of the Project would require 128 new full-time workers and would, with other projects in the vicinity, contribute to minor cumulative impacts on housing resources and public services.

Land Transportation

LNG Terminal

The greatest potential for cumulative impacts on roadway traffic is associated with construction of the Rio Grande LNG Terminal. Due to staggered construction schedules and locations of many of the projects identified in table 4.13.1-2, cumulative impacts on area traffic may be substantial at times, but are expected to be intermittent, short-term, and localized. The construction and operation of the three LNG terminal projects, however, would result in a substantial increase in daily vehicle trips on area roadways, as a result of material and equipment deliveries and commuting of construction personnel to and from the LNG terminal sites. A comment from the NPS was issued on the Texas LNG Project draft EIS asserting that the cumulative impact of the three LNG projects would result in cumulative impacts on traffic on SH 511 and SH 550, which are also used to access the Palo Alto Battlefield NHP.

By the end of Year 5 following initiation of construction, the three LNG facilities could be operational if they receive the necessary regulatory approvals. Each of the three project proponents commissioned studies to assess potential impacts of vehicular traffic associated with their respective projects, and to develop measures to mitigate impacts on local traffic (Aldana Engineering and Traffic Design, LLC 2016, as updated in 2019). Construction traffic associated with the Annova LNG Project is expected to primarily use SH-4, and would therefore not contribute to cumulative impacts on SH-48 with the Rio Grande LNG Project. However, the Texas LNG Project site is located along SH-48 near the Rio Grande LNG Project and concurrent construction would result in a cumulative traffic increase. RG Developers' commissioned study found that the existing roadway network which would provide access to the LNG Terminal (SH-48 between SH-550 and SH-100) has sufficient capacity to accommodate the expected peak hour traffic volumes associated with construction of the Rio Grande LNG Project. However, some improvements were necessary to safely accommodate peak hour traffic flows. As such, RG LNG has agreed to several improvements associated with access to its site, as fully discussed in section 4.9.9.1. Similar improvements to SH-48 would be made for access to the Texas LNG site. RG LNG has also committed to hiring off-duty police officers to direct traffic during peak commuting hours and would provide offsite parking for construction personnel.

The Texas LNG Project site would be accessed via two driveways off SH-48. Texas LNG anticipates that its proposed southern driveway would generate approximately 300 right turn (northbound) movements during peak times, exceeding the threshold for an auxiliary lane, and is proposing roadway improvements to accommodate the additional traffic. The traffic impact assessment conducted by Texas LNG recommends that an auxiliary lane with deceleration, storage, and taper be constructed at the state highway northbound approach to the southern driveway at the project site. Further, the study states that the auxiliary lane should be continued approximately 1,100 feet north of the northern proposed driveway to provide for acceleration with storage and taper.

Operation of the Rio Grande LNG Terminal would result in an average of 300 roundtrips to the site per day associated with worker commutes and truck deliveries. The Traffic Impact Analysis determined SH-48 would continue to provide ample capacity with this increase in traffic (Aldana Engineering and Traffic Design, LLC 2016, as updated in 2019). Operation of the Texas LNG Project, which is also accessed by SH-48, would also contribute to an increase in traffic on that roadway (65 roundtrips per day). As the capacity of the roadway is 40,000 vehicles per day, and about 12,000 (winter season; in January 2019 this number was about 5 percent less) to 17,000 (summer season) vehicles are estimated to travel on this roadway every day, the roadway has sufficient capacity available to accommodate the additional traffic generated for concurrent operation of the Rio Grande LNG Terminal and Texas LNG Project.

Pipeline Facilities

Construction of the Pipeline System could result in temporary impacts on road traffic in some areas and could contribute to cumulative traffic, parking, and transit impacts if other projects are scheduled to take place at the same time and in the same area. The local road and highway system in the vicinity of the Pipeline System is readily accessible by federal highways, state highways, secondary state highways, county roads, and private roads. However, portions of the proposed Pipeline System are routed through undeveloped land and would require the use of

county or private roads in these areas. RB Pipeline has stated that it would provide adequate parking for workers to ensure that parking on the shoulders of major roads is avoided and install warning signs on roadways to notify travelers of construction activities. If traffic congestion occurs during construction, RB Pipeline would consider implementing additional measures, including, but not limited to, scheduling truck deliveries between peak commuting times, re-routing truck traffic to avoid busy roadways, and implementing temporary traffic signals.

The addition of traffic associated with construction personnel commuting to and from the right-of-way could also contribute to cumulative regional traffic congestion. However, any cumulative traffic impacts would be temporary and short-term. Workers associated with the Rio Bravo Pipeline would generally commute to and from the pipeline right-of-way, contractor yards, or aboveground facility sites during off-peak traffic hours (e.g., before 7:00 a.m. and after 6:00 p.m.). It is unlikely that other projects listed in table 4.13.1-2 would have similar commuting schedules or reach peak traffic conditions simultaneously.

Operation of the Pipeline System would not contribute to any long-term cumulative impact on the transportation infrastructure, because only a small number of new permanent employees, a maximum of 20, would be required to operate the pipeline facilities.

Conclusion

Based on the results of the commissioned studies for the proposed Project and other LNG terminal projects, in conjunction with RG LNG's proposed roadway improvements, the Rio Grande LNG Project and other projects would contribute to a moderate cumulative impact on roadways during the 7-year construction period. The greatest cumulative impacts would occur during concurrent construction of the Rio Grande LNG and Texas LNG terminals. The proposed Project would contribute to a permanent, but negligible impact on roadway transportation during operations with the Texas LNG Project, since the operational traffic associated with the projects will be within the capacity of existing roadways.

Marine Transportation

LNG Terminal

Current vessel traffic in the BSC is about 1,059 vessels per year, which equates to an average of about 88 vessels per month, including 61 barges (Port of Brownsville 2015b). RG LNG estimates that 880 barge deliveries would occur during the 7-year construction period for the Rio Grande LNG Terminal to supplement truck transport of construction materials. Similarly, the Annova LNG and Texas LNG Projects would include 144 and 109 deliveries, respectively, during their construction; the number of waterborne deliveries for other projects is not known. Additional vessel traffic associated with construction and operation of the Steel Mill and Jupiter Export Terminal is likely, but details on the number of vessels are currently unknown. Concurrent construction of these projects would noticeably increase the number of barges transiting the channel; however, impacts from the increased barge traffic would be consistent with existing use of the waterway.

During operations, about 312 LNG carriers would call on the Rio Grande LNG Terminal per year; about 74 LNG carriers per year would call on the Texas LNG Terminal. Annova

estimates that 125 LNG carriers would call on the Annova LNG Terminal during operation. Combined, the three Brownsville LNG Projects would result in an increase in operation traffic in the BSC by up to 511 vessels, or 48 percent. Based on RG LNG's anticipated number of port calls and its navigation simulation study, RG LNG determined that LNG carriers calling at the LNG Terminal would be transiting in the BSC for a combined duration of 30 hours per week (about 18 percent of the week). Because large vessel traffic in the BSC is one-way, and LNG carriers may be subject to a moving security zone during transit, LNG carriers in transit to the Rio Grande LNG Terminal, Annova LNG, and Texas LNG Terminals could cumulatively preclude other vessel traffic up to about 39 hours per week. To minimize impacts on other users of the BSC, it is anticipated that vessels would follow required mandates put forth in the LNG Terminal Manual, including the requirement to notify LNG Terminal managers and relevant authorities of the expected arrival of an LNG carrier about four days in advance to ensure that the timing of LNG carrier channel transits are aligned with other shipping schedules. The LNG carriers calling at the Annova LNG and Texas LNG Terminals would be subject to similar requirements.

Pipeline Facilities

RB Pipeline's facilities would not result in impacts on marine transportation; therefore, it would not result in an incremental increase in the cumulative effects on marine transportation.

Conclusion

As previously described, construction of the Rio Grande LNG Terminal and other projects are likely to temporarily increase barge and support vessel traffic in the BSC. Concurrent construction would likely result in a cumulative impact on vessel traffic in the waterway, primarily by increasing vessel travel times due to congestion. During operations, LNG carriers calling on the Rio Grande LNG Terminal and other LNG facilities along the BSC vessels would have moving security zones that would preclude other vessels from transiting the waterway. Mandates for prior notice of expected arrivals would minimize impacts on other vessels. As a result, we conclude that there would be a moderate cumulative impact on vessel traffic in the BSC during construction and operation of the Project.

Tourism and Commercial Fisheries

LNG Terminal

As discussed in sections 4.9.3 and 4.9.4.1, respectively, the Rio Grande LNG Project is not anticipated to result in significant impacts on tourism or commercial fisheries. Cumulative impacts on tourism would likely occur as a result of cumulative impacts on recreation areas, visual resources, and traffic, all of which are discussed in this section. About 55 percent of visitors to the Brownsville-Harlingen MSA in 2014 participated in beach activities. As the beach is directed away from the three Brownsville LNG terminals, this activity is not likely to be affected by the projects. It would be speculative to predict how the addition of the LNG projects would affect individual values and decisions of whether to visit Cameron County. However, as discussed in section 4.13.2.6, the three Brownsville LNG projects are anticipated to have a significant impact on visual resources from some recreational areas including the Laguna

Atascosa NWR. As discussed above, if the Red Gate Entrance is completed before or concurrent with the LNG terminals then cumulative impacts on visitors would be similar to those at other nearby recreation areas; however, it is unknown whether NWR managers would modify, or abandon, the plan to develop this access point, if the proposed LNG Terminal is approved and constructed.

Although the land proposed to be developed for the three Brownsville LNG projects is zoned for industrial use, the concurrent construction and operation of three large industrial facilities as well as the associated non-jurisdictional facilities and the yet to be constructed Port of Brownsville Projects would result in some amount of change of the character of the landscape (see section 4.13.2.6). We can reasonably assume that this change would cause some visitors to choose to vacation elsewhere or alter their recreation activities to destinations in the region that are further from the project sites. As discussed above, the concurrent operation of the three Brownsville LNG projects would result in an up to 48 percent increase in vessel traffic transiting the BSC annually. This increase would likely result in additional delays for commercial fishing and recreational vessels that need to transit the BSC to reach the Gulf of Mexico or fishing destinations in the Laguna Madre. Overall, we anticipate that cumulative impacts on tourism and commercial fisheries would be permanent and moderate.

Pipeline Facilities

Impacts of construction of the Pipeline System on nature-oriented tourism sites would be temporary and limited to the period of active construction, which typically would last several days to several weeks in any one area. Operational impacts, including the permanent conversion of aboveground facility sites to industrial/commercial land, would result in negligible impacts on tourism based on their placement outside of main tourism areas. Construction or ongoing restoration of these projects at the same time as, and at locations proximal to, the RB Pipeline would result in temporary cumulative impacts on the recreation and special use areas due to increased noise and dust, and limited access. However, given that pipeline construction would be temporary in any one area, cumulative impacts would be short-term. The pipeline facilities would not affect commercial fishing. Therefore, the pipeline facilities would not contribute to significant cumulative impacts on tourism or commercial fisheries.

Conclusion

As previously described, the three Brownsville LNG projects are anticipated to have a significant impact on visual resources from some recreational areas including the Laguna Atascosa NWR. Although the land proposed to be developed for the three Brownsville LNG projects are zoned for industrial use, the concurrent construction and operation of three large industrial facilities as well as the associated non-jurisdictional facilities and the yet to be constructed Port of Brownsville Projects would result in some amount of change of the character of the landscape. Construction or ongoing restoration of these projects at the same time as, and at locations proximal to, the proposed pipeline facilities would result in temporary cumulative impacts on the recreation and special use areas due to increased noise and dust, and limited access. Overall, we anticipate that cumulative impacts on tourism and commercial fisheries would be temporary to permanent and minor to moderate.

Environmental Justice

The geographic scope for the assessment of cumulative impacts on socioeconomic indicators was defined as the counties in the Project areas. However, based on our analysis in section 4.9.10, we found that minority populations and low-income communities, as defined per EPA guidelines, are present within a 2-mile radius of the Project facilities. Therefore, sensitive populations are present within the geographic scope and may be subject to cumulative impacts from the Rio Grande LNG Project and other projects.

LNG Terminal

As discussed in section 4.9, the nearest residential areas are about 2.2 miles from the proposed LNG Terminal site and are within a census tract that contains sensitive populations. During the pre-filing process and application review, FERC and RG Developers have made documents and notices about the Project available to the public. In addition, FERC provided materials in both English and Spanish to accommodate the local Hispanic or Latino population during public scoping and comment meetings. During the public scoping and comment meetings in Port Isabel for the Rio Grande LNG, Annova LNG, and Texas LNG Projects, both English and Spanish-speakers were present to converse one-on-one with stakeholders in attendance. Impacts on the human environment from construction of the Rio Grande LNG Terminal would consist of traffic delays, increased enrollment at public schools, and displacement of recreational fishermen and other visitors to the public use areas near the LNG Terminal site. These impacts would be minor and short-term, as described above.

Several of the projects listed in table 4.13.1-2 could contribute to potential impacts on minority populations and low-income communities, most notably the Annova LNG and Texas LNG Projects and the yet to be constructed Port of Brownsville Projects, given their size and potential cumulative impacts on socioeconomics and air quality. Contractors working on projects within the geographic scope would be required to comply with applicable equal opportunity and non-discrimination laws and policies. The criteria for all positions would be based upon qualifications and in accordance with applicable, federal, state, and local employment laws and policies. Like the Rio Grande LNG Terminal, tax revenues generated from construction of these projects could be used to offset impacts on public schools and infrastructure. These impacts would apply to everyone and not be focused on or targeted to any particular demographic group.

Potential air pollutant emissions from operation of the Rio Grande LNG Terminal would be below the thresholds for unhealthy air quality over Project-area counties, which have been established for criteria pollutants. Other projects that are permitted and built would be held to the same air quality standards. Further, the State of Texas requires a State Health Effects air quality analysis comparing predicted emissions with effects screening levels, which are used to evaluate potential effects as a result of exposure to air emissions of non-criteria pollutants. The results of RG LNG's State Health Effects modeling evaluation indicate that the Project emissions are below applicable effects screening levels, and therefore adverse health effects are not expected. Cumulative impacts on air quality are discussed in section 4.13.2.9. Therefore, the Rio Grande LNG Terminal's contribution to cumulative impacts on the low-income or minority

populations in the Project area would be limited to minor and temporary traffic delays and potential impacts on public schools during construction.

Pipeline Facilities

As noted in section 4.9.2, all of the affected counties have higher poverty rates than the State of Texas, and therefore all of the projects listed in table 4.13.1-2 could contribute to potential impacts on these populations. Based on the generally rural setting across the affected counties, impacts from the other projects on communities would include temporary impacts on road traffic during the respective construction periods. The Pipeline System would cross predominantly undeveloped land with few residences, and no existing residences are closer than 50 feet from the proposed pipeline right-of-way and would have similar impacts on low-income residents in the counties crossed by the Project. These impacts would apply to everyone and not be focused on or targeted to any particular demographic group.

As discussed above, minority populations are also present in Cameron County. Most notably would be projects with aboveground facilities, including the three LNG terminals and RB Pipeline's proposed Compressor Station 3. Proponents of the proposed Annova and Texas LNG Projects have designed each project to minimize impacts on local populations by collocating new facilities with existing facilities or rights-of-way, siting projects on lands identified for industrial/commercial development or in remote locations, and maximizing the distance to or avoiding residences where practicable. Further, as these two projects are FERC-regulated, they would be required to implement similar mitigation measures as discussed above to minimize impacts on these populations due to traffic delays and potential impacts on schools during construction. While these projects could cause impacts on minority and low-income residents, these impacts would apply to everyone and not be focused on or targeted to any particular demographic group.

Conclusion

Minor and temporary traffic delays during construction of the LNG Terminal and pipeline facilities, and potential impacts on public schools during construction of the LNG Terminal, could affect minority and low-income residents in the geographic scope. These impacts would apply to everyone and not be focused on or targeted to any particular demographic group; therefore, the Rio Grande LNG Project is not expected to contribute to cumulative disproportionate, adverse effects on minority and low-income residents in the area.

4.13.2.8 Cultural Resources

The geographic scope for cumulative impacts on cultural resources was determined to be the area directly affected by the Rio Grande LNG Terminal site and pipeline facilities. Other projects that occur within the geographic scope for cultural resources include the non-jurisdictional facilities, the Cameron and Palmas Altas Wind Farms, and the VCP (for which construction is complete). Cultural resources within 12 miles of the LNG Terminal site were also assessed for potential cumulative effects on visual resources (see section 4.13.2.6).

LNG Terminal

Direct impacts on cultural resources are highly localized; thus, cumulative impacts would only occur if other projects are constructed in the same place or impact the same historic properties affected by the proposed Project. As described in section 4.10.1, cultural resources surveys are complete for the Rio Grande LNG Terminal site, and no new archaeological resources were identified. In addition, RG Developers have developed an Unanticipated Discovery Plan, which we reviewed and found to be acceptable. The SHPO concurred with the plan on November 10, 2016. With our recommendation in section 4.10.5, and because no intact archaeological deposits or cultural materials were identified during surveys, we find that the Rio Grande LNG Terminal would not contribute to cumulative impacts on cultural resources.

Pipeline Facilities

Cumulative impacts on cultural resources would occur if the Pipeline System and another Project were to result in overlapping effects on a cultural resource. RB Pipeline has initiated consultation with the SHPO; however, all the necessary cultural resource surveys are not complete along the Pipeline System. Therefore, consultation is not complete. About 30 miles of the pipeline route would cross the King Ranch National Historic Landmark. However, once cultural resources surveys are complete, if any historic properties would be adversely affected by the Pipeline System, a treatment plan would be prepared. In addition, RG Developers have developed an Unanticipated Discovery Plan, as described above. Because RB Pipeline would be required to implement the measures in the treatment plan(s), as applicable, impacts on cultural resources would be minimized and would not contribute to significant cumulative impacts on cultural resources.

Conclusion

Construction and operation of the LNG Terminal would not contribute to cumulative impacts on cultural resources. Further, while field surveys and consultation regarding cultural resources along the Pipeline System are not complete, RB Pipeline would be required to implement the measures in the treatment plan(s) for any historic properties that would be adversely affected by the Project. Therefore, impacts on cultural resources would be minimized and would not contribute to significant cumulative impacts on cultural resources.

4.13.2.9 Air Quality and Noise

Air Quality

Construction

The geographic scope for assessment of cumulative impacts on air quality during construction of the proposed Rio Grande LNG Project is the area within 0.5 mile of the proposed pipeline facilities and within 1.0 mile of the LNG Terminal,⁸⁵ because construction emissions

⁸⁵ Although the typical construction geographic scope for air quality is 0.25 mile, we expand this on a case-by-case basis for large projects like LNG terminals.

would be highly localized (see table 4.13.2-2). The projects within the construction geographic scope that are most likely to contribute to cumulative air impacts include the Annova LNG and Texas LNG Projects, non-jurisdictional facilities associated with the Rio Grande LNG Project, and waterway improvement projects within the BSC.

LNG Terminal

Construction of the Rio Grande LNG Terminal would affect air quality due to emissions from combustion engines used to power construction equipment, vehicle emissions traveling to and from the LNG Terminal site, marine deliveries of construction materials, and fugitive dust resulting from earth-disturbing activities and equipment movement on dirt roads.

Air emissions from projects in the vicinity of the Project would be additive. Because construction emissions would be temporary and limited to the construction period, standard EPA emission thresholds do not apply. General Conformity applicability thresholds do not apply at the LNG Terminal site because the Project area is in attainment for all the NAAQS. Table 4.13.2-2 estimates the total cumulative emissions from concurrent construction of the Rio Grande LNG, Annova LNG, and Texas LNG Projects. While construction emissions estimates from non-jurisdictional projects and waterway improvement projects within the BSC are not available, based on the intermittent and short-term nature of construction, these projects would have a minor impact on cumulative air emissions when considered with the proposed LNG terminals (including the Rio Grande LNG Terminal).

Cumulative impacts from construction would be limited to the duration of the construction period. However, with other projects in the vicinity, construction of the Rio Grande LNG Project would contribute to localized elevated emissions near construction areas during the period(s) when construction of these activities would overlap. Due to the magnitude of the combined emissions, the greatest potential for cumulative impacts would be during Years 2 and 3 (see table 4.13.2-2). When compared with the EPA's most recently available national emissions inventory data, peak year (Year 3) cumulative construction emissions of NO_x, SO₂, PM₁₀, and PM_{2.5} would represent about 8.6, 61.6, 21.8, and 14.1 percent, respectively, of the 2014 inventory emissions levels.

Table 4.13.2-2						
Estimated Construction Emissions for the Brownsville LNG Projects (tons per year)^{a,b}						
Facility and Year	NO_x	CO	SO₂	PM₁₀	PM_{2.5}	VOC
Rio Grande LNG Terminal						
Year 1	12.0	18.6	2.0	589.4	60	0.7
Year 2	69.7	111.4	11.8	1,199.5	125.8	4.2
Year 3	127.8	174.3	23.5	1,146.6	125.8	6.4
Year 4	59.3	118.5	10.6	91.4	14.2	3.6
Year 5	45.0	106.7	8.0	56.1	9.2	2.9
Year 6	39.0	70.2	7.1	26.9	5.8	2.1
Year 7	1.2	10.4	<0.1	13.9	1.4	0.1
Year 8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Annova LNG						
Year 1	23	40	0.04	293	30	2.6
Year 2	172	220	0.3	158	25	22
Year 3	152	224	0.25	126	21	17
Year 4	131	202	0.22	65	14	13
Year 5	50	86	0.08	59	8	6
Texas LNG						
Year 1	63.4	36.5	4.3	180.7	29.2	4.1
Year 2	284.9	164.4	19.2	812.9	131.0	18.4
Year 3	397.9	229.6	26.8	1,135.3	183.0	25.7
Year 4	243.3	140.4	16.4	694.4	111.9	15.7
Year 5	31.9	18.4	2.2	91.1	14.7	2.1
Total Annual Construction Emissions						
Year 1	98.4	95.1	6.34	1,063.1	119.2	7.4
Year 2	526.6	495.8	31.3	2,170.4	281.8	44.6
Year 3	677.7	627.9	50.55	2,407.9	329.8	49.1
Year 4	433.6	460.9	27.22	850.8	140.1	32.3
Year 5	126.9	211.1	10.28	206.2	31.9	11.0
Year 6	39.0	70.2	7.1	26.9	5.8	2.1
Year 7	1.2	10.4	<0.1	13.9	1.4	0.1
Year 8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
The EPA National Emissions Inventory, Cameron County^c						
2008	9,366.2	52,511.8	107.0	32,165.8	4,371.8	28,884.9
2011	9,101.9	52,167.4	217.1	21,988.4	3,167.0	30,044.6
2014	7,864.3	43,352.9	82.0	11,023.3	2,340.3	24,701.4

Table 4.13.2-2 (continued)						
Estimated Construction Emissions for the Brownsville LNG Projects (tons per year) ^{a,b}						
Facility and Year	NO _x	CO	SO ₂	PM ₁₀	PM _{2.5}	VOC
^a	Emissions estimates include construction emissions from on- and off-road vehicle activity, truck deliveries, vessel activity, worker commutes, and fugitive dust. RG LNG and Annova LNG applicants initially expected construction of the LNG Terminal to begin in 2018; however, the start of construction for all proposed projects is dependent on receipt of necessary permits.					
^b	Additional fill material may be obtained from the Port Isabel dredge pile for the Project; RG LNG is currently conducting an analysis of the barge transport alternative for feasibility of use (see section 3.4). If used, RG LNG would obtain the fill via barge. RG LNG estimated annual fugitive emissions from use of the proposed temporary haul road originally proposed for use on the Project; because the haul road is no longer part of the Project, but the transport of material by barge may not be required, we have included use of the haul road as a conservative estimate.					
^c	Assumes all three Brownsville LNG Projects would initiate emission-generating construction activities in 2020.					
^d	Due to refinements and modifications in the methods used to compile each inventory, the inventory results should not be used to describe year-to-year emissions trends.					

The EPA's national emissions inventory data include estimated emissions from on- and off-road mobile sources (vehicle travel), point sources (such as electric power generation facilities), and nonpoint sources (stationary sources that are individually small and numerous, such as residential heating and commercial marine vessels; EPA 2014). Previous national emissions inventories conducted in 2008 and 2011 documented greater total emissions for criteria pollutants than the 2014 data; however, we have presented data from 2014 as a conservative estimate and to present the most recent inventory data. Further, since the 2014 emissions inventory, economic growth in Cameron County may have resulted in increased air emissions. Given the high level of construction emissions estimated for the three LNG terminals relative to the most recently inventoried emissions in the Project area, simultaneous construction of these projects could result in a temporary, moderate to major increase in emissions of criteria pollutants during construction. Construction emissions are localized, and impacts would be greatest in the immediate vicinity of the LNG terminal sites. RG LNG, Annova LNG, and Texas LNG would implement mitigation measures to minimize construction impacts on air quality, including application of water to minimize fugitive dust, limit engine idling, and using recent models of construction of equipment manufactured to meet air quality standards.

Further, transport of construction materials associated with the Project could occur within the HGB area, which is a marginal nonattainment area for the 2015 8-hour ozone standard. Similarly, the Annova LNG and Texas LNG Projects would also receive deliveries of construction materials originating from or being transported through the HGB area. Although cumulative emissions are not subject to General Conformity, the cumulative construction emissions from the Rio Grande LNG, Annova LNG, and Texas LNG Projects occurring within the HGB area would not be expected to result in an exceedance of applicable general conformity thresholds for the HGB area.

Pipeline Facilities

Construction of the pipeline facilities and many of the other projects listed in table 4.13.1-2 would involve the use of heavy equipment that would generate air emissions (including fugitive dust). The majority of these impacts would be temporary at a discrete location, because

the construction activities would occur over a large geographical area and would be moving regularly. However, construction would occur over a longer timeframe at aboveground facilities and during HDD installation at the crossings of Resaca de los Cuates, the Channel to San Martin Lake and the Channel to the Bahia Grande, which could require 1 month or more to complete.

Air emissions resulting from diesel- and gasoline-fueled construction equipment and vehicle engines for the pipeline facilities would be minimized by federal design standards required at the time of manufacture of the equipment and vehicles, and would comply with the EPA's mobile and non-road emission regulations found in 40 CFR 85, 86, and 89. In addition, RB Pipeline would use the most fuel-efficient construction equipment available, and would use buses where feasible to minimize emissions from worker commutes. While fugitive dust impacts would also be temporary and not be expected to affect local or regional air quality, dust suppression techniques would be implemented in construction work areas, when necessary, to reduce potential impacts of fugitive dust emissions. Therefore, construction of the Rio Bravo Pipeline, with other projects in the geographic scope, would contribute to minor, temporary impacts on air quality.

Operations

Cumulative impacts of pollutants such as criteria pollutants and HAPs associated with the operation of the LNG Terminal are evaluated according to the "significant impact area" of the proposed facilities, determined through a significant impact modeling assessment. These were analyzed for chronic and acute health impacts due to inhalation, as well as secondary environmental effects. For these pollutants, FERC considers a geographic scope for cumulative impacts assessment of up to 50 kilometers (31 miles). However, FERC does not use 50 kilometers to evaluate GHG emissions. GHGs were identified by the EPA as pollutants in the context of climate change. GHG emissions do not directly cause local ambient air quality impacts. GHG emissions result in fundamentally global impacts that feed back to localized climate change impacts. Thus, the geographic scope for cumulative analysis of GHG emissions is global rather than local or regional. For example, a project 1 mile away emitting 1 ton of GHGs would contribute to climate change in a similar manner as a project 2,000 miles distant also emitting 1 ton of GHGs.

Projects that are most likely to result in and contribute to cumulative air impacts with construction of the Rio Grande LNG Terminal include the Annova LNG Project, the Texas LNG Project, non-jurisdictional facilities, Port of Brownsville projects (including the Steel Mill), and waterway improvement projects. The Airport Terminal Expansion could also contribute to operational air emissions; however, the timing of the expansion is not known. In addition, those projects within 31 miles of the aboveground facilities associated with the Rio Bravo Pipeline may contribute to cumulative impacts on air quality with the pipeline facilities.

LNG Terminal

Air pollutant emissions during operation of the Rio Grande LNG Terminal would result from operation of the various components of the LNG Terminal, marine traffic, and vehicles driven by personnel commuting to and from the site. The region in the vicinity of the LNG

Terminal is currently in attainment with the NAAQS; however, increases in industrial point sources could affect local and regional air quality.

The Annova LNG and Texas LNG terminals have the greatest potential to contribute to cumulative impacts on air quality with the proposed Rio Grande LNG Terminal, given the proximity and similar operations of the projects. Emissions from currently operational facilities, such as the Brownsville Liquids Terminal and Port of Brownsville Marine Cargo Dock 16 and Storage Yard, are captured in ambient air quality monitoring data. While estimates of construction emissions from non-jurisdictional projects, the two Port of Brownsville Projects that are yet to be constructed, and waterway improvement projects within the BSC are not available, based on the intermittent and short-term nature of construction, these Projects would have a negligible impact on cumulative air emissions if they are concurrent with operations of the proposed Rio Grande LNG Terminal. Any operational emissions from the Steel Mill and Jupiter Export Terminal would be subject to applicable federal and state permitting, and therefore would not be permitted to result in a NAAQS exceedance.

We assessed the air dispersion modeling results provided for the Rio Grande LNG, Texas LNG, and Annova LNG Terminals and used these models to estimate the cumulative air emissions during concurrent operation at all three facilities. Appendix P describes the methods used to conduct the cumulative assessment and provides the results of our analysis, including figures depicting the cumulative concentrations of each criteria air pollutant assessed (figures P-1 through P-8 in appendix P). Table 4.13.2-3, below, totals the modeled ambient pollutant concentrations for the Brownsville LNG terminals operating during full build-out, including LNG carriers and support vessels operating during LNG loading and unloading at the terminal sites. The estimated cumulative peak concentration is based on combining the predicted concentrations from each project at each receptor location regardless of the time when it occurs. Since the timing and location of the maximum predicted impacts from each terminal would differ, and because it is unlikely that all three terminals would be loading LNG carriers simultaneously, the method used to develop the peak cumulative concentrations is conservative.

Peak estimated concentration for criteria pollutants and averaging periods were compared to the NAAQS, which represent standardized air quality criteria and were therefore used as a benchmark for comparison against model results. For all pollutants, except for 1-hour NO₂, cumulative impacts are predicted to be below the NAAQS and would disperse before reaching population centers in Port Isabel and Laguna Heights (see appendix P). Although estimated emissions for each project individually would not exceed the NAAQS, for 1-hour NO₂, the predicted maximum cumulative impact is estimated to exceed the short-term NAAQS of 188 µg/m³. The predicted peak cumulative impact, however, is located between the fencelines of the Rio Grande LNG and Texas LNG Terminals. It is unlikely, but possible, that people may be exposed to the NO₂ concentrations above the 1-hour NAAQS, which would occur on property within the Port of Brownsville (see appendix P and figure 4.13.2-1). Concentrations of 1-hour NO₂ in residential areas in Port Isabel and Laguna Heights are estimated to be below 75 µg/m³, which is well below the 1-hour NAAQS. While concurrent maximal operations of the LNG facilities would result in increased concentrations of air pollutants in the immediate vicinity of the facilities, the projects emissions are not expected to result in a significant impact on regional air quality, nor would any exceedance of the NAAQS occur in a populated area.

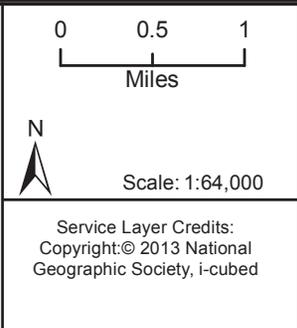
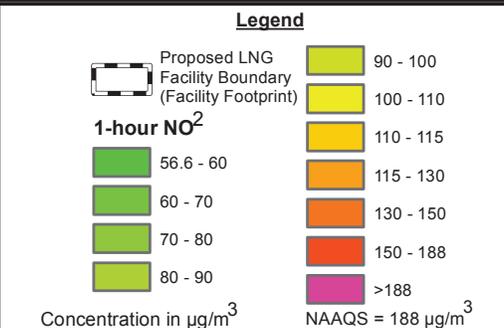
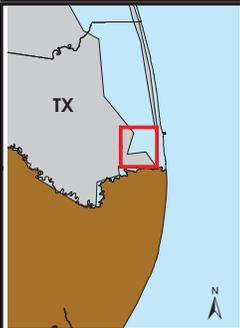
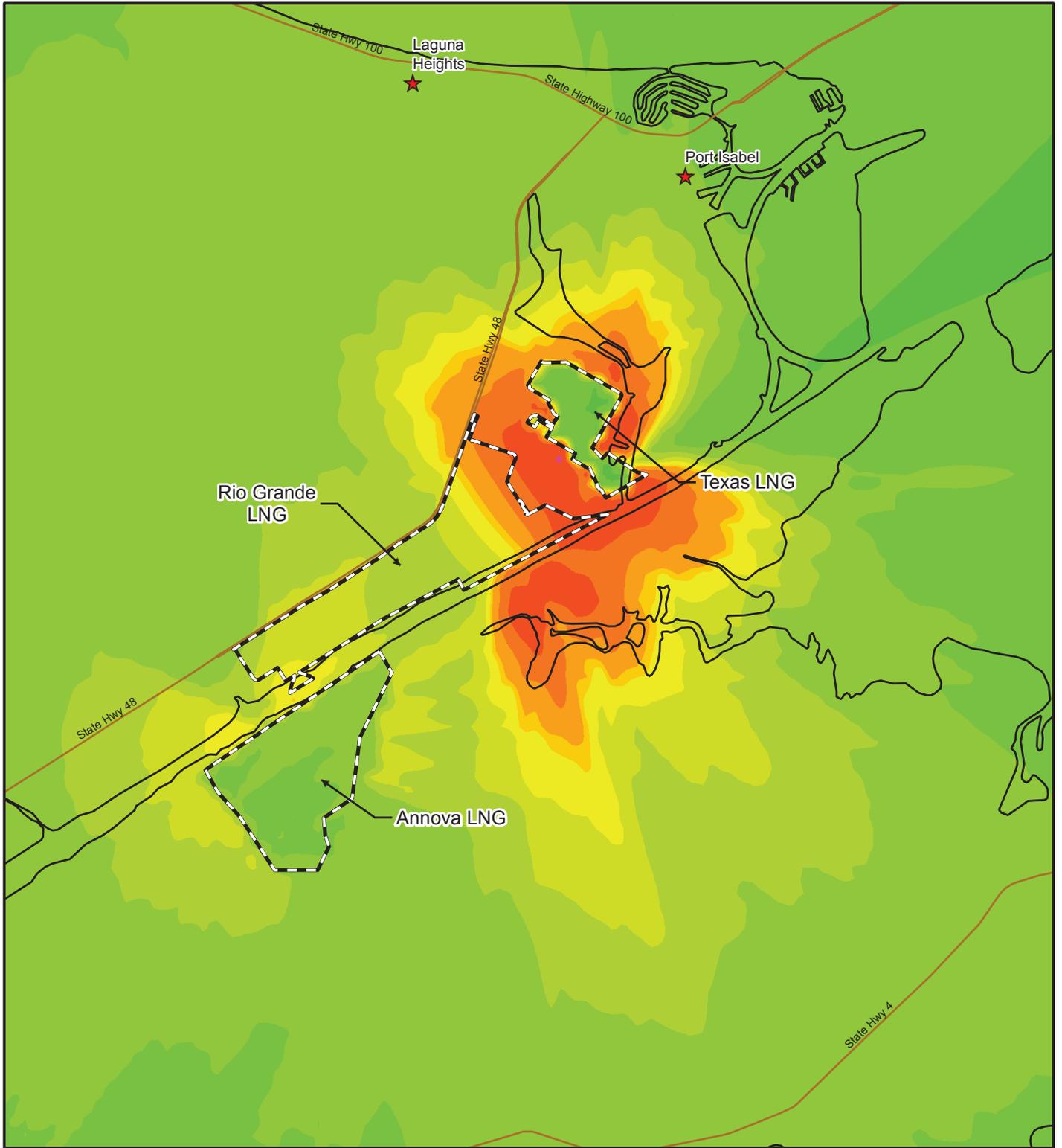
**Table 4.13.2-3
Peak Concentrations Estimated in Cumulative Air Dispersion Modeling for Stationary Source and LNG carriers for the Brownsville LNG Projects**

Criteria Air Pollutant	Averaging Period	Background Concentration ^a (µg/m ³)	Peak Concentration based on Modeled Results (µg/m ³) ^b				NAAQS (µg/m ³)
			Rio Grande LNG Terminal	Annova LNG	Texas LNG	Peak Cumulative Concentration ^c	
CO	1-hour	2,175.5	276.1	247.9	470.6	2,746	40,000
	8-hour	1,259.5	174.0	101.7	83.4	1,453	10,000
NO ₂	1-hour	49.9	78.9	39.3	134.7	196	188
	Annual	6.1	2.7	0.5	1.8	9	100
SO ₂	1-hour	10.6	2.0	3.8	10.3	23	196
PM ₁₀	24-hour	62.0	1.4	0.7	2.3	64	150
	24-hour	22.9	1.3	0.7	2.0	25	35
PM _{2.5}	Annual	9.1	0.3	0.1	0.1	9	12

^a Background concentrations retrieved from tables 4-1 and 4-2 of the dispersion modeling report provided for the Texas LNG Project (available on FERC's eLibrary website, located at <http://www.ferc.gov/docs-filing/elibrary.asp>, by searching Docket Number CP16-116 and accession number 20170928-5165).

^b Modeled impacts include stationary sources and LNG carriers at the LNG terminal sites and are based on 312 LNG carriers annually for the Rio Grande LNG Project, 74 LNG carriers annually for the Texas LNG Project, and 80 LNG carriers annually for the Annova LNG Project.

^c Peak concentrations predicted for each of the three projects for each receptor location were conservatively combined without regard to day or time of occurrence, and include background concentrations. The peak cumulative concentration for each pollutant and averaging period does not equal the sum of the peak concentrations for each terminal and background, since peak concentrations associated with each terminal occur at different locations.



Cumulative Impacts (Rio Grande LNG, Texas LNG, Annova LNG, and Background)

1-Hour NO_2 $\mu\text{g}/\text{m}^3$

Figure O-3

In response to comments issued by the Sierra Club on the draft EIS, we assessed the potential for cumulative impacts on ozone levels in the Project area. As described in section 4.11.1.3 of the EIS, based on a conservative analysis by the TCEQ, the 8-hour maximum predicted increase of ozone would be 11.6 ppb which, when considered with the background ozone concentration of 57 ppb, would not result in an exceedance of the 8-hour ozone standard. The Annova LNG Terminal and Texas LNG Terminal would not be major PSD sources with respect to ozone precursor pollutants NO_x and VOC; therefore, an ozone impact assessment is not required for air permitting for these projects. Concurrent operation of the three Brownsville LNG terminals would result in greater total emissions of NO_x, as described above and in appendix P; however, the combined total annual operating emissions of NO_x by the Annova and Texas LNG Terminals identified in their draft EISs would be less than 10 percent of the NO_x emissions estimated for the Rio Grande LNG Terminal. If the maximum predicted increase of ozone estimated for the Rio Grande LNG Terminal is increased by 10 percent, and considered with the background ozone concentration identified above, cumulative emissions would not exceed the 8-hour ozone standard.

While the cumulative ambient modeling assessment does not account for concurrent construction, commissioning, and operations emissions, the greatest emissions from each LNG Terminal are associated with operations. We are aware that each LNG Terminal could be constructed within the same time period, and the concurrent construction, commissioning, and operations emissions of the Rio Grande LNG Terminal and the other proposed LNG Terminals could potentially exceed the NAAQS in local areas, and result in cumulatively greater local air quality impacts. While these concurrent activities would result in greater ambient pollutant concentrations than those presented in table 4.13.2-3, emissions levels would not be expected to result in a long-term impact on regional air quality. Concurrent activities would be limited to the timeframe of construction and commissioning and start-up.

In addition to operation of the LNG Terminal and the vessel emissions described in section 4.11.1.3, air emissions from LNG carriers, considered mobile sources of air emissions, would occur along the entire LNG carrier route during operations. These emissions would be cumulative with the other ships using the ship channel. These mobile sources would be transitory in nature and emissions would occur over a large area, however the cumulative ship emissions would result in long-term elevated emissions for the area.

Pipeline Facilities

Operation of the proposed pipeline facilities would generate emissions from maintenance vehicles and equipment, as well as vented and fugitive emissions. While a majority of the projects in the geographic scope are included above in the assessment of cumulative impacts associated with the LNG Terminal and Compressor Station 3, the VCP, and the seven Port of Brownsville Projects, are or would be within 31 miles of the other aboveground facilities associated with the Rio Bravo Pipeline. Concurrent operation of Compressor Stations 1 and 2, the booster stations, these other projects would result in a cumulative increase in combustion and fugitive emissions. The compressor stations would emit NO_x, CO, SO₂, PM, VOC, HAPs, and GHG emissions. However, no compressor or booster stations associated with the proposed Project would trigger PSD major source permitting requirements for any pollutant. Operation of aboveground facilities would not cause a NAAQS exceedance, and concurrent operations with

the VCP and Port of Brownsville Projects are not expected to result in a NAAQS exceedance. While the Palmas Altas Wind Farm is about 31 miles from Compressor Station 2, operational emissions associated with the wind farm would likely be limited to maintenance activity and would be negligible. Therefore, emissions from operation of RB Pipeline's pipeline facilities are not expected to contribute to a significant cumulative impact on local or regional air quality.

Conclusion

In summary, the Rio Grande LNG Project would result in impacts on air quality during construction and long-term impacts during operations. Cumulative impacts from construction would be limited to the duration of the construction period. However, with other Projects in the vicinity, construction of the Rio Grande LNG Project would contribute to localized moderate elevated emissions near construction areas during the period(s) when construction of these activities would overlap.

Operational air emissions from the Rio Grande LNG Project would contribute to cumulative emissions with other projects in the geographic scope, and would be required to comply with applicable air quality regulations. Overall, impacts from the Rio Grande LNG Project along with the other facilities would cause elevated levels of air contaminants in the area and a potential exceedance of the 1-hour NO₂ NAAQS in an uninhabited area between the facilities. Therefore, cumulative impacts on regional air quality as a result of the operation of the Rio Grande LNG Project and other facilities would be long-term during the operational life of the Project, but minor. We are aware that each LNG Terminal could be constructed within the same time period, and the concurrent construction, commissioning, and operations emissions of the proposed Brownsville LNG terminals could potentially exceed the NAAQS in local areas, and result in cumulatively greater local air quality impacts. In addition, emissions from LNG carriers would occur along vessel transit routes and would be cumulative with the other ships using the ship channel. These emissions sources would be transitory in nature and emissions would occur over a large area, however the cumulative ship emissions would result in long-term elevated emissions for the area. Emissions from operation of RB Pipeline's aboveground facilities (including Compressor Stations 1 and 2 and the booster stations) would be long-term, minor, and are not expected to contribute to a significant cumulative impact on local or regional air quality.

Climate Change

Climate change is the variation in climate (including temperature, precipitation, humidity, wind, and other meteorological variables) over time, whether due to natural variability, human activities, or a combination of both, and cannot be characterized by an individual event or anomalous weather pattern. For example, a severe drought or abnormally hot summer in a particular region is not a certain indication of climate change. However, a series of severe droughts or hot summers that statistically alter the trend in average precipitation or temperature over decades may indicate climate change. Recent research has begun to attribute certain extreme weather events to climate change (U.S. Global Change Research Program [USGCRP] 2018).

The leading U.S. scientific body on climate change is the USGCRP, composed of representatives from 13 federal departments and agencies.⁸⁶ The Global Change Research Act of 1990 requires the USGCRP to submit a report to the President and Congress no less than every four years that “1) integrates, evaluates, and interprets the findings of the Program; 2) analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and 3) analyzes current trends in global change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years.” These reports describe the state of the science relating to climate change and the effects of climate change on different regions of the United States and on various societal and environmental sectors, such as water resources, agriculture, energy use, and human health.

In 2017 and 2018, the USGCRP issued its *Climate Science Special Report: Fourth National Climate Assessment*, Volumes I and II (Fourth Assessment Report) (USGCRP 2017; and USGCRP 2018, respectively). The Fourth Assessment Report states that climate change has resulted in a wide range of impacts across every region of the country. Those impacts extend beyond atmospheric climate change alone and include changes to water resources, transportation, agriculture, ecosystems, and human health. The United States and the world are warming; global sea level is rising and acidifying; and certain weather events are becoming more frequent and more severe. These changes are driven by accumulation of GHG in the atmosphere through combustion of fossil fuels (coal, petroleum, and natural gas), combined with agriculture, clearing of forests, and other natural sources. These impacts have accelerated throughout the end 20th and into the 21st century (USGCRP 2018).

Climate change is a global phenomenon; however, for this analysis, we will focus on the existing and potential cumulative climate change impacts in the Project area. The USGCRP’s Fourth Assessment Report notes the following observations of environmental impacts are attributed to climate change in the Southern Great Plains and South Texas regions (USGCRP 2017; USGCRP 2018):

- the region has experienced an increase in annual average temperature of 1°-2 °F since the early 20th century, with the greatest warming during the winter months;
- over the past 50 years, significant flooding and rainfall events followed drought in approximately one-third of the drought-affected periods in the region when compared against the early part of the 20th century;
- the number of strong (Category 4 and 5) hurricanes has increased since the early 1980s; and

⁸⁶ The USGCRP member agencies are: Department of Agriculture, Department of Commerce, Department of Defense, Department of Energy, Department of Health and Human Services, Department of the Interior, Department of State, Department of Transportation, Environmental Protection Agency, National Aeronautics and Space Administration, National Science Foundation, Smithsonian Institution, and U.S. Agency for International Development.

- global sea level rise over the past century averaged approximately eight inches; along the Texas coastline, sea levels have risen 5-17 inches over the past 100 years depending on local topography and subsidence.

The USGCRP’s Fourth Assessment Report notes the following projections of climate change impacts in the Project region with a high or very high level of confidence⁸⁷ (USGCRP 2018):

- annual average temperatures in the Southern Great Plains are projected to increase by 3.6°–5.1 °F by the mid-21st century and by 4.4°-8.4 °F by the late 21st century, compared to the average for 1976-2005;
- the region is projected to experience an additional 30 to 60 days per year above 100 °F than it does currently;
- tropical storms are projected to be fewer in number globally, but stronger in force, exacerbating the loss of barrier islands and coastal habitats;
- southern Texas is projected to see longer dry spells, although the number of days with heavy precipitation is expected to increase by mid-century; longer periods of time between rainfall events may lead to declines in recharge of groundwater, which would likely lead to saltwater intrusion into shallow aquifers and decreased water availability; and
- sea level rise along the western Gulf of Mexico during the remainder of the 21st century is likely to be greater than the projected global average of 1-4 feet or more, which would result in the loss of a large portion of remaining coastal wetlands.

It should be noted that while the impacts described above taken individually may be manageable for certain communities, the impacts of compound extreme events (such as simultaneous heat and drought, wildfires associated with hot and dry conditions, or flooding associated with high precipitation on top of saturated soils) can be greater than the sum of the parts (USGCRP 2018).

The GHG emissions associated with construction and operation of the Project are described in section 4.11. Construction and operation of the Project would increase the atmospheric concentration of GHGs in combination with past, current, and future emissions from all other sources globally and contribute incrementally to future climate change impacts.

Currently, there is no universally accepted methodology to attribute discrete, quantifiable, physical effects on the environment to Project’s incremental contribution to GHGs. We have

⁸⁷ The report authors assessed current scientific understanding of climate change based on available scientific literature. Each “Key Finding” listed in the report is accompanied by a confidence statement indicating the consistency of evidence or the consistency of model projections. A high level of confidence results from “moderate evidence (several sources, some consistency, methods vary and/or documentation limited, etc.), medium consensus.” A *very* high level of confidence results from “strong evidence (established theory, multiple sources, consistent results, well documented and accepted methods, etc.), high consensus.” <https://science2017.globalchange.gov/chapter/front-matter-guide/>

looked at atmospheric modeling used by the EPA, National Aeronautics and Space Administration, the Intergovernmental Panel on Climate Change, and others, and we found that these models are not reasonable for project-level analysis for a number of reasons. For example, these global models are not suited to determine the incremental impact of individual projects, due to both scale and overwhelming complexity. We also reviewed simpler models and mathematical techniques to determine global physical effects caused by GHG emissions, such as increases in global atmospheric CO₂ concentrations, atmospheric forcing, or ocean CO₂ absorption. We could not identify a reliable, less complex model for this task and we are not aware of a tool to meaningfully attribute specific increases in global CO₂ concentrations, heat forcing, or similar global impacts to project-specific GHG emissions. Similarly, it is not currently possible to determine localized or regional impacts from GHG emissions from the Project.

Absent such a method for relating GHG emissions to specific resource impacts, we are not able to assess potential GHG-related impacts attributable to this project. Additionally, we have not been able to find any GHG emission reduction goals established either at the federal level⁸⁸ or by the State of Texas. Without either the ability to determine discrete resource impacts or an established target to compare GHG emissions against, we are unable to determine the significance of the Project's contribution to climate change.

Noise

The geographic scope for construction noise typically includes other identified projects within 0.25 mile of the proposed Project, or within 0.5 mile from HDD entry and exit locations. However, due to the duration of construction and similar timelines, we have included the Annova LNG and Texas LNG Projects in our cumulative construction noise impact analysis, even though the Annova LNG Project would be outside of the 0.25-mile distance. Cumulative noise impacts on residences and other NSAs are related to the distance from the disparate noise sources as well as the timing of each noise source.

The geographic scope for operational noise from long-term projects includes any facilities that can cause an impact at NSAs within 1 mile of the proposed Rio Grande LNG Terminal and aboveground facilities along the Rio Bravo Pipeline. The Annova LNG and Texas LNG Projects have been included in the cumulative effect impact assessment, as well as other existing and proposed projects in the area (see table 4.13.1-1).

After construction is completed for the non-LNG projects, including the gas and water pipeline projects, electric transmission projects, channel improvements and maintenance dredging, and road projects, there would be minimal operational noise impacts. The non-jurisdictional SH-48 auxiliary lane and new driveways that would be developed for the Rio Grande LNG Project would have some long-term but minor noise associated with vehicle traffic

⁸⁸

The national emissions reduction targets expressed in the EPA's Clean Power Plan and the Paris climate accord are pending repeal and withdrawal, respectively.

entering and leaving the Project site. Therefore, these projects are not expected to have any significant long-term operational cumulative impacts.

Construction noise from the non-jurisdictional facilities associated with the Rio Grande LNG Project is expected to be localized and limited in duration. These projects are small compared to the scope of the proposed three LNG projects, and are generally linear activities with construction moving through the length of the right-of-way with limited durations near any given location. These projects are not expected to come within 0.25 mile of any of the Project NSAs; therefore, the construction activities associated with the non-jurisdictional facilities are not expected to result in cumulative impacts from noise at NSAs.

Maintenance dredging and channel improvement activities would result in periodic small increases in the sound level impacts due to operation of dredging equipment. Sound levels from the maintenance dredging are not expected to cause a significant impact at the NSAs.

The SpaceX Commercial Spaceport Project, located approximately 5.5 miles southeast of the Project, anticipates rocket launches starting as soon as late 2018. Once they commence, commercial spaceflight launches would be a significant noise source at the NSAs. However, spaceflight launches are not expected to cause a significant cumulative environmental noise impact because they are short-duration events lasting only a few minutes from start to finish, they are typically scheduled during the daytime, and each launch would be well publicized, so nearby residents would be ready for the short-term intense noise of the rocket launch. During the launches, noise from the launch would dominate the sound levels at the nearby residences and low-frequency noise would likely cause noise-induced-structural vibration. Project-related noise contributions would not be significant during this brief period, as the sound field would be dominated by launch noise.

As significant cumulative noise impacts are not expected from the non-LNG projects considered, as discussed above, the cumulative assessment for noise impacts focuses on the two other LNG projects in the planning and permitting stages in the general vicinity of the Project: the Annova LNG and Texas LNG Projects. These projects are pending review by the FERC. The potential cumulative noise impact of these three LNG projects has been evaluated for construction and facility operations, for both airborne and underwater sound. Construction noise impacts would be cumulative only if construction activities occur simultaneously. Given the current schedule for the three Brownsville LNG projects, it is likely that there would be some overlap in construction activities because of the long duration of construction for the three projects. For the purposes of this analysis we have assumed that peak construction of all three projects would overlap; however, the construction phases may not coincide, so maximum construction sound levels may not occur at all projects simultaneously.

Construction

LNG Terminal

Airborne Noise

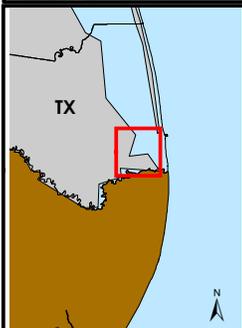
Construction activities for the three LNG projects would be similar, and would include heavy equipment operation, pile-driving, dredging, and other activities similar to those described

in section 4.11.2.3. In order to evaluate the potential cumulative impact of construction activities, basic sound propagation calculations were used to estimate the combined construction sound levels at a set of standardized NSAs and calculation point (CP) locations.

The standardized NSA and CP locations were selected using the common NSAs for each of the three proposed projects. NSAs and CPs in close proximity were combined into single representative NSA or CP positions for the cumulative analysis. Three CP locations were included for each project: the Palmito Ranch Battlefield (CP-1), a central CP location in the Laguna Atascosa NWR (CP-2), and at the location in the Laguna Atascosa NWR at the closest approach to the given LNG project. CP-1 and CP-2 were the same for all projects.

In order to quantify the highest sound level contribution from each project in the Laguna Atascosa NWR, the closest location in the Laguna Atascosa NWR for each of the projects was specified as a CP. Each was given a unique designation: CP-TX, CP-AN, and CP-RG for Texas LNG, Annova LNG, and Rio Grande LNG terminals, respectively. Each project reported its operations sound level contribution at the project-specific CP. These three CPs have not been used to calculate impacts in the cumulative tables, rather, they are presented separately for each project to indicate the highest expected project-specific sound level contributions in the Laguna Atascosa NWR for operations and construction noise. A list of the standardized NSAs and CPs is presented in table 4.13.2-4. A map showing the location of the standardized cumulative NSAs and CPs is shown in figure 4.13.2-2.

Table 4.13.2-4 Standardized NSAs and Calculation Point Locations for Cumulative Noise Analysis		
NSA / CP	Location	Coordinates
NSA		
NSA C1	Laguna Heights neighborhood, Lincoln Ave. and Pennsylvania Ave.	26.077312°; -97.249653°
NSA C2	Residences, mobile home park, on Port Rd., southeast of Woodys Ln.	26.067031°; -97.217732°
NSA C3	Residences, northwest end of West Scallop	26.063153°; -97.208717°
NSA C4	Residences, Weems Rd. and LBJ St.	25.993437°; -97.182485
NSA C5	Residences, north end of 199, north of Boca Chica Blvd.	25.965084°; -97.245563°
NSA C6	Residence located east of Palmito Hill Rd. on private drive	25.952706°; -97.289272°
CP		
CP-1	Palmito Ranch Battlefield	25.959536°; -97.303490°
CP-2	Laguna Atascosa NWR, calculation point	26.028053°; -97.265482°
CP-AN, CP-TX, CP-RG ^a	Laguna Atascosa NWR, closest location to given facility	Varies
CP = calculation point. ^a The CP-AN, CP-TX, and CP-RG points represent the locations of the highest sound level contribution from each individual facility in the nearby Laguna Atascosa NWR.		



Legend

-  NSA Location
-  Calculation Point
-  Facility Property Line

0 0.5 1
Miles

Scale: 1:78,868

Service Layer Credits:
Copyright: © 2013 National Geographic Society, i-cubed

Location of Cumulative Impact NSA's and Calculation Points

Figure 4.13.2-2

Cumulative effects of construction noise were analyzed by combining the predicted construction sound levels for each project. Each of the three LNG projects used a slightly different methodology for calculating construction noise impacts. These variations were normalized during the cumulative assessment process and all predicted values were compared on an L_{dn} basis. For those cumulative NSAs at which the construction noise had not been calculated by a project in the FERC application, a hemispherical spreading calculation was used to estimate the construction contributions based on reported construction sound levels at other NSAs. The existing ambient sound levels for each NSA, as reported in table 4.13.2-5, were determined by using the lowest measured ambient level at a corresponding project NSA for the three projects. For example, if the measured ambient sound level at NSA C2 differed among FERC applications for the three projects, the lowest ambient sound level reported was used as the ambient for the cumulative analysis. The source of the ambient sound level data is provided in table 4.13.2-5.

Location	Predicted Construction Sound Level Contributions ^a				Existing Ambient	Ambient Data ^b	Combined Ambient plus Cumulative LNG	Predicted Increase over Ambient
	Annova LNG	Rio Grande LNG	Texas LNG	Cumulative LNG				
NSA C1	49.0	49.2	50.3	54.3	56.0	AN NSA 1	58.2	2.2
NSA C2	47.1	43.1	54.9	55.8	50.2	TX NSAs 1 & 2	56.9	6.7
NSA C3	46.8	42.7	54.6	55.5	50.2	TX NSA 3	56.6	6.4
NSA C4	48.0	46.7	46.0	51.8	46.0	AN NSA 2	52.8	6.8
NSA C5	54.0	47.9	44.2	55.3	46.0	AN NSA 2	55.8	9.8
NSA C6	49.8	46.0	41.7	51.7	46.0	AN NSA 2	52.8	6.8
CP-1	52.0	39.9	41.6	52.6	43.0	AN NSA 4	53.1	10.1
CP-2	56.9	48.7	51.0	58.4	59.0	TX Laguna Atascosa NWR	62.1	2.7

AN = Annova LNG, RG = Rio Grande LNG, and TX = Texas LNG

^a The **bold** values highlight the highest individual LNG facility contributions, as used in table 4.13.2-6.

^b The existing ambient sound levels shown are the lowest reported levels at project NSAs near the standardized NSAs.

There was some variation in the assumptions included in the three projects for construction activities. For example, Annova LNG assumed 24-hour construction activities, while RG LNG, and Texas LNG used 12-hour daytime shifts for general construction and pile-driving and 24-hour operations for dredging. These assumptions were carried into the cumulative assessment. Annova LNG and Texas LNG reported construction sound levels as 24-hour L_{dn} values, while RG LNG reported construction contributions as daytime L_{eq} . In order to directly compare the construction sound level contributions, the sound level metrics were standardized to the 24-hour L_{dn} , and the reported sound levels for Rio Grande LNG were adjusted to the 24-hour L_{dn} . In addition, the pile-driving noise was estimated using L_{eq} and L_{dn} ,

not L_{max} . A more detailed discussion of the sound level metric standardization is provided in appendix Q.

Table 4.13.2-5 shows the individual project and cumulative construction noise contributions of the three LNG projects at the NSAs and CPs. The individual sound level contribution predictions from all construction activities are lower than the FERC criterion of 55 dBA L_{dn} at all NSAs. However, the cumulative construction sound level from the three projects ranges from 51.7 to 55.8 dBA L_{dn} , and exceeds 55 dBA L_{dn} at NSAs C2, C3, and C5. The cumulative sound levels are also expected to exceed 55 dBA L_{dn} at locations in the Laguna Atascosa NWR, with cumulative sound levels at CP-2 of 58.4 dBA L_{dn} . Construction sound levels would be expected to exceed 55 dBA L_{dn} at locations in the Laguna Atascosa NWR within about 0.75 mile of SH-48. The predicted increase in the ambient sound levels is also shown in the table, and these range from 2.2 to 9.8 dBA at the NSAs, and from 2.7 to 10.1 at the two CP locations. An increase of greater than 10 dBA is typically perceived as a doubling of loudness. In addition, nighttime pile-driving noise planned for the Annova LNG EIS could exceed acceptable levels.

The evaluation above is a very conservative estimate of the potential cumulative impact of construction noise, as it combines the maximum and simultaneous construction sound levels from the three projects. This would require that all three project schedules align so that pile-driving, dredging, and site preparation occur at full intensity at the same time. To obtain a more realistic and likely evaluation of the construction impact, an incremental analysis was made by comparing the increase in sound level at each NSA and CP due to only the highest predicted individual project contribution to the additional increase due to the other two projects. This analysis shows the potential cumulative impact of all three projects compared to the loudest single project. The impacts derived from this analysis represent for a more likely scenario in which the three project construction schedules do not align exactly.

Table 4.13.2-6 shows the incremental effect of cumulative construction noise at each NSA and CP, compared with the highest predicted *individual* project contribution affecting each NSA. This table shows that cumulative construction noise causes an incremental increase of between 0.6 and 2.7 dB at the NSAs and CPs, compared to the highest individual project construction noise. NSA C4, with an increase of 2.7 dBA L_{dn} , shows the largest cumulative effect. A three-decibel increase is generally considered perceptible to most people, so the cumulative impact of construction noise at NSA C4 would be perceptible. At other NSAs, the cumulative increases are 1.5 dBA L_{dn} or lower and would generally be considered imperceptible. At these NSAs, due to the distance between the projects, the *closest* construction activity sound levels would typically dominate the acoustical environment at the NSA. Thus, as indicated previously, we determined that typical cumulative construction noise would not be significant.

The sound levels at the project-specific CPs during construction were an Annova LNG contribution of 60.6 dBA L_{dn} at CP-AN, a Rio Grande LNG contribution of 48.7 dBA L_{dn} at CP-RG (based on 12-hour per day construction and 51.7 L_{max} dBA), and a Texas LNG contribution of 63.5 dBA L_{dn} at CP-TX. This demonstrates that construction sound levels in the Laguna Atascosa NWR are dominated by contributions from Texas LNG.

Table 4.13.2-6 Calculation of the Incremental Impact of Cumulative LNG Construction Noise at Standardized NSA and CP Locations, All Levels are dBA L _{dn}					
Location	Existing Ambient ^a	Highest Individual LNG Construction Contribution	Highest Individual LNG Contribution Plus Ambient	Increase over Ambient due to only the Single Highest LNG Contribution	Additional Increase Caused by Cumulative Construction Noise
NSA C1	56.0	50.3	57.0	1.0	1.2
NSA C2	50.2	54.9	56.2	6.0	0.7
NSA C3	50.2	54.6	55.9	5.7	0.7
NSA C4	46.0	48.0	50.1	4.1	2.7
NSA C5	46.0	54.0	54.6	8.6	1.2
NSA C6	46.0	49.8	51.3	5.3	1.5
CP-1	43.0	52.0	52.5	9.5	0.6
CP-2	59.0	56.9	61.1	2.1	0.6

^a The existing ambient sound levels shown are the lowest reported levels at project NSAs near the standardized NSAs. See table 4.13.2-5 for the data source.

Vessel Traffic

During construction of the three LNG projects, the area would experience an increase in noise due to marine traffic delivering construction supplies. Rio Grande LNG estimates that barges would make 880 marine deliveries to the project site during construction. Marine deliveries to the Rio Grande LNG Terminal site would take place about 15 times per month during the first 5 years of construction; no deliveries are currently anticipated during the remainder of the construction period, though sporadic deliveries could occur as needed. Annova LNG estimates that a total of 24 to 36 barge deliveries to the project site per year would be required during construction. If these construction periods overlap, the total expected construction barge traffic is approximately 20 visits a month, or 1 barge visit every 1.5 days. This is only slightly more than the one barge visit every two days estimated for the Rio Grande LNG Project and the cumulative effects would not be significant. The Texas LNG Project is not anticipated to contribute significantly to the cumulative noise impact because only a small amount of the anticipated construction supplies would arrive via barges or ships (109 deliveries over the 5-year construction period, which averages less than 2 per month).

Underwater Noise

Underwater noise would be produced by construction activities including in-water pile-driving and dredging, and increased vessel traffic associated with equipment delivery. Cumulative impacts for underwater construction noise would be limited due to the large distance between the various project marine facilities.

The marine facilities closest to each other are the proposed Rio Grande LNG and Texas LNG facilities, with a center to center distance of about 4,400 feet. As an example of the distance effects, underwater pile-driving sound levels would be expected to decrease by 32 decibels re 1 μ Pa at a distance of 4,400 feet compared to reference levels at 32 feet. The LNG

sites are so far apart that pile-driving activities at any single facility would have a limited cumulative effect on underwater noise at locations close to either of the other construction areas.

Due to the short impulsive nature of pile-driving noises, it is very unlikely that the peak sound pressure levels from multiple pile-drivers would occur at exactly the same instant, so there would be no increase in the predicted pile-driving peak sound pressure levels. Rather, the number of pile-driving events would increase due to the multiple active construction areas.

At locations midway between two active pile-driving projects, the sound exposure levels would be expected to increase during simultaneous pile-driving activities. The threshold distances for permanent and temporary injury for marine mammals, fish, and sea turtles, as outlined for the Rio Grande LNG Project in tables 4.6.2-2 and 4.7.1-1, would not be expected to increase significantly in size. However, during simultaneous pile-driving at the three projects, the behavioral disturbance area for most species would increase. In some cases, the behavioral disturbance distances for the projects would overlap and would likely encompass much of the BSC. Cumulative impacts on aquatic resources as a result of underwater noise are discussed further in section 4.13.2.4 and 4.13.2.5.

As an example of the potential overlap between adjacent behavioral disturbance areas, table 4.7.1-2 identifies the behavioral disturbance distances for pile-driving for the Rio Grande LNG project. As indicated, for cetaceans during vibratory pile-driving, the behavioral disturbance area extends about 4.6 miles from the LNG Terminal, encompassing much of the BSC and those areas adjacent to both the Texas LNG and Annova LNG sites. For impact pile-driving of the sheet pile (if required), the behavioral disturbance area for fish could extend up to 1.3 miles from pile-driving activities at the Rio Grande LNG Terminal site. Therefore, the behavioral disturbance areas would overlap with adjacent projects, and would increase the total continuous behavioral disturbance areas. The other behavioral disturbance areas: cetaceans (i.e., impact installation of traditional piles), sea turtles (i.e., impact pile and vibratory pile), and fish (i.e., vibratory pile), are much smaller, and would not likely overlap with the disturbance areas for other projects.

As a mitigating factor, the expected durations of the marine pile-driving activities for the three projects are limited. Rio Grande LNG expects that marine pile-driving would be required for sheet piling, which is anticipated to occur over 25 days and for installation of four in-water piles, which would take 4 days. Annova LNG expects to perform in-water pile-driving over the course of 5 days. Texas LNG plans to drive only 12 piles in-water. Due to the long construction schedules for the projects, and the limited duration of in-water pile-driving, it seems unlikely that there would be substantial overlap in the in-water pile-driving schedules. Even with complete overlap in pile-driving activity schedules, there could possibly be only 4 days in which all three projects would be driving (non-sheet) piles.

Dredging activities at all three projects would have the potential to produce underwater noise. The proposed dredging activities would be far enough apart that generally there would be no cumulative impacts expected for underwater dredging noise for species other than mid-frequency cetaceans. For mid-frequency cetaceans, the behavioral disturbance range would tend to overlap with dredging areas for the LNG Terminal site. If these activities occurred simultaneously, the expected area of potential auditory impact for mid-frequency cetaceans

would extend from the mouth of the BSC to inland of the LNG Terminal site. However, the BSC is an active waterway that already has ongoing and regular maintenance dredging activities. The additional construction dredging activities associated with the projects are expected to be similar to the existing maintenance dredging and is not expected to cause a significant cumulative underwater noise impact in the BSC.

Pipeline Facilities

Construction of the pipeline facilities could contribute to cumulative noise impacts; however, the impact of noise is highly localized and attenuates quickly as the distance from the noise source increases; therefore, cumulative impacts are unlikely unless one or more of the projects listed in table 4.13.1-2 are constructed at the same time and location. Based on the schedule and proximity of these activities to the pipeline route, there may be some cumulative noise impacts. However, since the majority of noise impacts associated with the projects would be limited to the period of construction and most construction activities would occur during daytime hours and would be intermittent rather than continuous, the proposed contribution from the pipeline facilities to cumulative noise impacts would primarily be for only short periods of time when the construction activities are occurring at a given location.

Further, while the results of the HDD construction acoustical impact assessment indicated that sound levels for 24-hour operations would be above the FERC guidance of 55 dBA L_{dn} at NSAs in the vicinity of seven HDDs. Given our recommendation in section 4.11.2.3 that RB Pipeline prepare and implement a noise mitigation plan at each of these locations, and because HDD construction would only occur for periods up to 10 weeks at each site, impacts would be minor.

Operations

LNG Terminal

Airborne Noise

In order to consistently analyze the potential cumulative impact of airborne operational noise from the three proposed LNG projects, the noise models for each project were used to predict the sound levels due to facility operation at the standardized NSAs and at the three CPs located close to points of interest. The methodology behind the noise model development for the Rio Grande LNG Project is presented in section 4.11.2 of this EIS. The methodology for the other two LNG projects is described in their FERC applications.⁸⁹ Generally, each project used three-dimensional environmental noise modeling software to predict the sound levels from the respective project equipment. In order to combine the sound level predictions for operations noise, each project submitted the noise model results in a standardized grid format as outlined in the August 2, 2017 Environmental Information Request issued for the Rio Grande LNG Project.⁹⁰ The standardized grid results used the same spacing and nominally the same

⁸⁹ Available online at www.ferc.gov. Annova LNG: FERC Docket No. CP16-480-000; Texas LNG: FERC Docket Nos., CP16-116-000.

⁹⁰ Available online at www.ferc.gov. FERC Docket No. CP16-454 and CP16-455, Accession No. 20171011-5199.

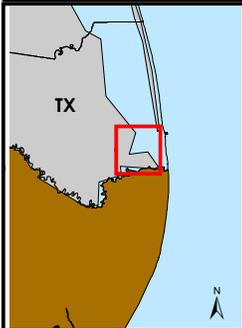
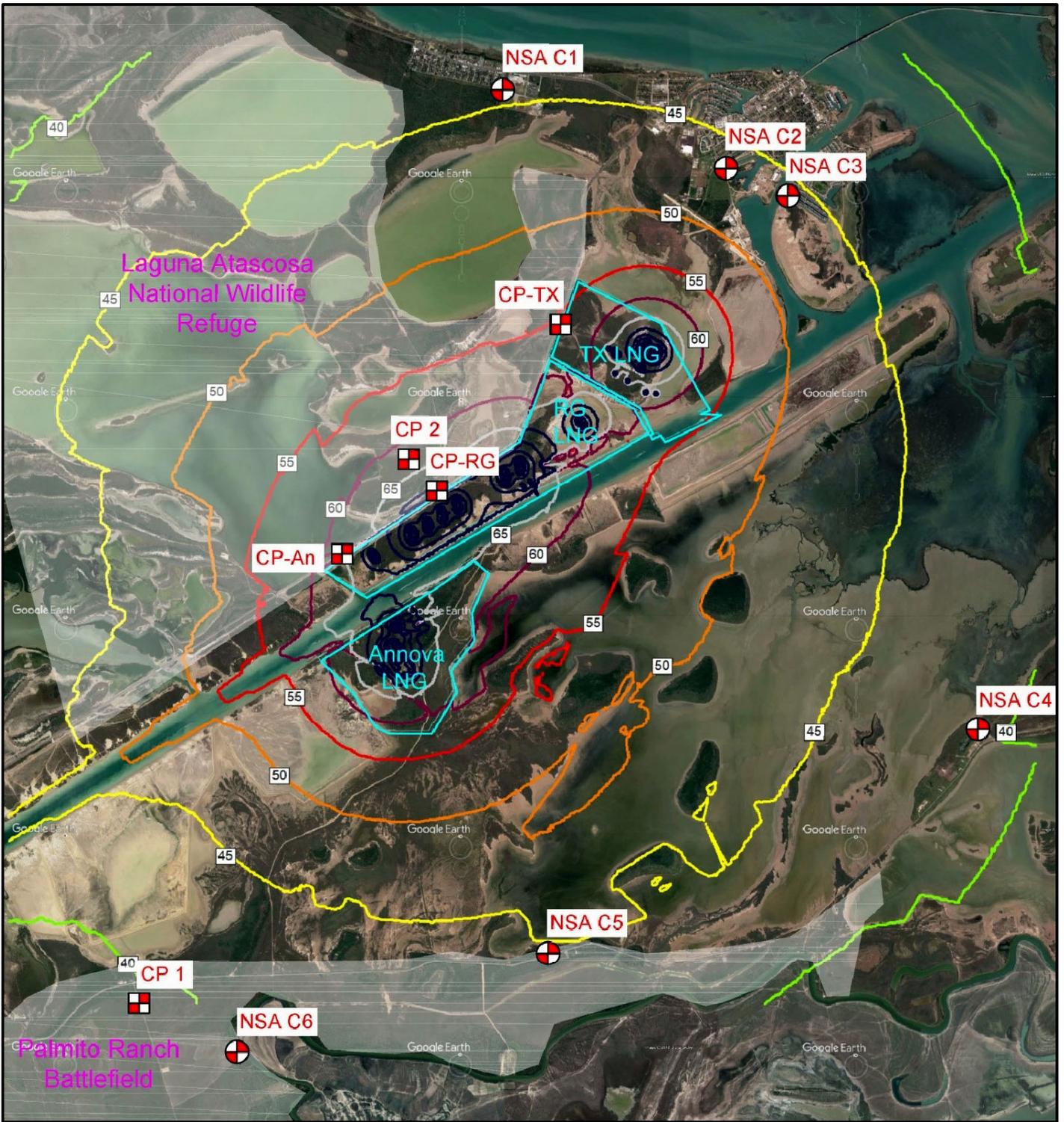
boundaries. The grid maps were overlaid and logarithmically summed and the overall cumulative impact of operations noise from the three projects was calculated. Figure 4.13.2-3 shows the predicted sound levels as 24-hour L_{dn} values for the three projects in simultaneous operation at full project completion. In addition to the grid map results, predicted operations sound levels were calculated by each project for the cumulative NSAs and CP locations described in table 4.13.2-6. The predicted sound levels were logarithmically summed for the cumulative NSAs and for CPs 1 and 2.

Each project also reported predicted sound levels at the location in the Laguna Atascosa NWR closest to the project, with these unique CPs labeled as CP-RG, CP-AN, and CP-TX, for the Rio Grande LNG, Annova LNG, and Texas LNG Projects, respectively. These project-specific CPs were used to evaluate the highest predicted individual project sound level in the Laguna Atascosa NWR. Cumulative sound levels were not calculated for these points, as the levels were predicted by each project for only that respective project CP.

Table 4.13.2-7 presents a summary of the predicted operation sound levels at the cumulative NSA and CP locations for each of the individual LNG projects. As shown in this table, the expected increases in the sound levels at the standardized NSA locations range from 0.3 to 1.5 dB. These are very small increases and would be considered imperceptible to most listeners. The small difference in the overall cumulative increases and those increases predicted for each separate project is due to the large distances between the noise-generating equipment at the project sites, and the small impact of the more distant projects to the overall sound levels at each NSA location.

Location	Predicted Sound Level Contributions, dBA L_{dn}				Existing Ambient	Ambient Data ^a	Combined Ambient plus Cumulative LNG	Predicted Increase over Ambient
	Annova LNG	Rio Grande LNG	Texas LNG	Cumulative LNG				
NSA C1	31.4	41.9	40.2	44.4	56.0	AN NSA 1	56.3	0.3
NSA C2	30.4	40.2	44.8	46.2	50.2	TX NSAs 1 & 2	51.7	1.5
NSA C3	30.4	39.7	44.4	45.8	50.2	TX NSA 3	51.5	1.3
NSA C4	31.4	38.7	34.7	40.7	46.0	AN NSA 2	47.1	1.1
NSA C5	39.4	41.0	32.2	43.6	46.0	AN NSA 2	61.4	0.1
NSA C6	34.4	37.3	28.7	39.5	46.0	AN NSA 2	46.9	0.9
CP 1	33.4	36.1	28.5	38.4	43.0	AN NSA 4	44.3	1.3
CP 2	46.4	61.8	41.0	62.0	59.0	TX	63.8	4.8

^a The existing ambient sound levels shown are the lowest reported levels at project NSAs near the standardized NSAs.



Legend

- NSA Location
- Calculation Point
- Facility Property Line

0 0.5 1
Miles

N

Scale: 1:78,868

Service Layer Credits:
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Cumulative Sound Levels, dBA Ldn, for TX LNG, RG LNG, and Annova LNG Operations

Figure 4.13.2-3

Sound levels at CP-1, representing the Palmito Ranch Battlefield National Historic Landmark, are predicted to have a cumulative increase of 1.3 dB, which would be imperceptible for most listeners. At CP-2 in the Laguna Atascosa NWR, the sound level impact is somewhat higher, with a predicted cumulative increase of 4.8 decibels and an overall cumulative sound level of 62 dBA L_{dn} . As shown on figure 4.13.2-3, there would be areas in the Laguna Atascosa NWR in which the cumulative sound levels exceed 55 dBA L_{dn} . The sound levels in the Laguna Atascosa NWR are generally dominated by contributions from the Rio Grande LNG Terminal.

The sound levels at the project-specific CPs during operation were a Rio Grande LNG contribution of 69.7 dBA L_{dn} at CP-RG, Annova LNG contribution of 55.4 dBA L_{dn} at CP-AN, and a Texas LNG contribution of 52.9 dBA L_{dn} at CP-TX. This demonstrates that operational sound levels in the Laguna Atascosa NWR are dominated by contributions from Rio Grande LNG, due to its proximity to the Laguna Atascosa NWR. As shown in figure 4.13.2-2, the area of the Laguna Atascosa NWR with sound levels exceeding 55 dBA L_{dn} extends to approximately 1 mile northwest of SH-48. Sound levels in this area are dominated by operational noise from the Rio Grande LNG Terminal, as the process area for that facility is directly across SH-48. Cumulative impacts resulting from increased noise on wildlife is further discussed in section 4.13.2.3.

Flaring

There would be flaring noise associated with all three projects. However, all three projects report that flaring would not be part of standard operations. The maximum sound levels predicted for flaring were 59 dBA, 52 dBA, and 43 dBA for Rio Grande LNG, Annova LNG, and Texas LNG Projects, respectively, at the worst-case NSAs for each project (NSA C1 for the Rio Grande LNG Project). Although possible, it is unlikely that flaring would occur simultaneously at all three projects. In the event of simultaneous flaring at all three projects, the highest predicted sound levels would be at cumulative NSA C1, with a predicted cumulative flaring sound level of 59.6 dBA, or 0.6 dBA higher than the individual impact of the Rio Grande LNG flare operating alone. This is not a noticeable difference indicating that the cumulative impact of flaring events would be minimal. However, with three facilities in operation, the frequency of occurrence of flaring events would be approximately tripled, so flaring events would occur more often, though the overall sound level from each flaring event would be similar or lower than predicted by each project.

Maintenance Dredging

Occasional maintenance dredging would be required during the operational lifespan of the three LNG projects to maintain the channel, turning basin, and other marine facilities associated with the projects. Generally, the projects anticipate that maintenance dredging would be necessary every few years. Maintenance dredging activities would be substantially quieter than the sound levels reported with construction sound level predictions, as the predicted construction levels also include pile-driving, general construction, and dredging activities. The BSC is an active waterway that already has ongoing and regular maintenance dredging. The additional maintenance dredging activities associated with the projects are not expected to cause a significant cumulative airborne noise impact at the NSAs.

Pipeline Facilities

With the exception of planned projects in the vicinity of Compressor Station 3 (addressed above with the Rio Grande LNG Terminal), we are not aware of any other projects that would contribute overlapping noise impacts to NSAs in the vicinity of the pipeline facilities. Operation of RB Pipeline's compressor and booster stations would result in noise from the compressors, pumps, and cooling fans, and blowdown events. Based on the analyses conducted, we conclude that these compressor stations would not result in significant noise impacts on residents, or the surrounding communities during operation as noise levels are expected to be below the FERC criterion of 55 dBA L_{dn} , and are not expected to result in a perceptible noise increase at the nearest NSAs. In addition, operation of the pipeline facilities is not expected to result in a perceptible increase in vibration at any NSA. Therefore, operation of the pipeline facilities would not contribute to significant cumulative impacts on noise.

Conclusions

The cumulative noise impacts of reasonably foreseeable future actions have been reviewed. Of these actions, significant cumulative noise impacts would be expected only from the three LNG-related projects due to their size, extent, construction techniques, and long operational lifespan. In order to evaluate the potential cumulative impact of construction and operations noise from these LNG projects, the predicted sound levels for construction and for operations were combined at a standardized set of cumulative NSAs.

For simultaneous construction activities at all of the three LNG projects, the predicted sound level increase over the existing ambient ranges from 2.2 to 9.8 dBA L_{dn} at the NSAs and sound levels of slightly over 55 dBA L_{dn} are predicted for NSAs C2, C3, and C5. These noise level increases range between less than noticeable increases in ambient noise to a doubling of noise at specific NSAs. For construction activities that are not simultaneous but incremental, the predicted sound level increase ranges from 1.0 to 8.6 dBA L_{dn} at the NSAs. These increases would be minor to moderate; however, all levels would be below the FERC criterion of 55 dBA L_{dn} . For CP-1, the predicted cumulative construction increase was 10.1 dBA L_{dn} over the existing ambient which could result in periods of perceived doubling of noise. At CP-2 in the Laguna Atascosa NWR there is a higher ambient sound level so the predicted increase due to cumulative construction noise would be 2.7 dBA L_{dn} , which would be a less than noticeable increase. However, for the duration of Annova's nighttime pile-driving, significantly higher levels of noise are estimated and this would result in significant cumulative noise impacts. The only 24-hour construction proposed at the Rio Grande LNG Terminal would be dredging. As described in section 4.11.2.3, the estimated sound level from dredging associated with the Rio Grande LNG Terminal at the nearest NSAs would be below existing ambient sound levels, and noise associated with dredging activities is not expected to be perceptible. Therefore, RG LNG's contribution to cumulative nighttime construction noise would be negligible.

The predicted sound level impacts for simultaneous operation of all three LNG projects are much lower than construction impacts, with potential increases over the existing ambient sound level between 0.3 and 1.5 dBA L_{dn} at NSAs, resulting in a negligible to minor impact. Construction and operation of the pipeline facilities would not contribute to significant cumulative noise impacts on nearby NSAs. Operational impacts are slightly higher at CP-1 and

CP-2, with possible increases in sound levels due to operations of between 1.3 and 4.8 dBA L_{dn} . This is generally considered barely noticeable to minor long-term impact. Construction and operation of the pipeline facilities would not contribute to significant cumulative noise impacts on nearby NSAs.

4.14 TRANSBOUNDARY EFFECTS

We received a comment requesting that the EIS address the transboundary effects of the Project on nearby areas of Mexico. CEQ guidance suggests that agencies must include an analysis of reasonably foreseeable transboundary effects of proposed actions in their analysis of proposed actions in the United States. The CEQ also advises, however, that federal agencies should use the scoping process to identify those actions that may have transboundary environmental effects and determine at that point their information needs, if any, for such analyses (CEQ, 1997b). Should potential impacts be identified, the agencies may rely on available professional sources of information and should contact agencies in the affected country with relevant expertise.

Because the LNG Terminal would be about 5 miles from the border with Mexico and the HUC subwatersheds containing the Project do not reach the Mexican border, the greatest potential for environmental impacts on Mexico would result from air emissions at the LNG Terminal site. Any transboundary effects on air quality in Mexico would be similar to those documented in section 4.11.1 of the EIS. Construction of the Project would result in a minor to moderate, temporary, and local impact on air quality, and operation would not impact the local area's air quality designation (i.e., attainment status). Therefore, we conclude that transboundary effects of the Project would not be significant.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 SUMMARY OF THE ENVIRONMENTAL ANALYSIS

The conclusions and recommendations presented in this section are those of the FERC environmental staff. Our conclusions and recommendations are based on input from the COE, FWS, NPS, NMFS, FAA, Coast Guard, EPA, DOE, and DOT as cooperating agencies in preparation of this EIS. However, the cooperating agencies will present their own conclusions and recommendations in their respective Records of Decision or determinations. The cooperating agencies can adopt this EIS consistent with 40 CFR 1501.3 if, after an independent review of the document, they conclude that their requirements have been satisfied. Otherwise, they may elect to conduct their own supplemental environmental analyses.

We conclude that construction and operation of the Rio Grande LNG Project would result in limited adverse environmental impacts. Most adverse environmental impacts would be temporary or short-term during construction and operation, but long-term and permanent environmental impacts would also occur as part of the Project. As part of our analysis, we developed specific mitigation measures that are practical, appropriate, and reasonable for the construction and operation of the Project. We are, therefore, recommending that these mitigation measures be attached as conditions to any authorization issued by the Commission. With the exception of certain cumulative impacts that the Project would contribute to (sediment/turbidity and shoreline erosion within the BSC during operations from vessel transits; federally listed ocelot and jaguarundi from habitat loss and the potential for increased vehicular strike during construction; on the federally listed northern aplomado falcon from habitat loss; and visual resources from the presence of new facilities), implementation of the mitigation proposed by RG Developers and our recommended mitigation would ensure that impacts in the Project area would be avoided or minimized and would not be significant. A summary of the Project impacts and our conclusions are presented below by resource.

5.1.1 Geologic Resources (Pipeline Facilities)

Construction and operation of the pipeline facilities would not significantly affect or be affected by geologic conditions in the area. Active mining and nonfuel mineral resources would not be affected by construction or operation of the pipeline facilities, and no active or permitted well sites are within or adjacent to the proposed Pipeline System right-of-way or compressor, booster, or meter station sites. In general, the potential for geologic hazards such as earthquakes, soil liquefaction, or landslides to significantly affect construction or operation of the pipeline facilities is low. To avoid potential damage to equipment by flooding, and to minimize the potential for contamination in the event of a flood, critical infrastructure and potential sources of contamination would be elevated. Additionally, Compressor Station 3 would be sited within a flood protection levee to mitigate potential flood hazard.

Subsidence could occur in the Project vicinity due to oil and gas extraction and groundwater withdrawal. Facilities would be within active oil and gas fields and within 200 feet of 13 water supply wells for groundwater withdrawals from the Gulf Coast Aquifer. However, water withdrawal and associated subsidence along the pipeline route would be minimal. The

overall effect of the pipeline facilities on topography and geology would be minor. The primary impacts on geologic resources would be due to the permanent alteration of geologic conditions at the aboveground facilities. At the aboveground facilities, grading and filling may be required to create a safe and stable land surface to support the facility. Blasting is not anticipated during construction of the pipeline facilities.

Results of the geotechnical investigation concluded that a shallow foundation system would adequately support lightly loaded structures at the aboveground facilities; however, at the heavily loaded and settlement-sensitive structures at Compressor Station 1, deep foundations consisting of piles are recommended. The pipeline facilities must be designed and installed in accordance with DOT standards, including those in 49 CFR 192, *Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards*. In addition, RB Pipeline would routinely monitor the geotechnical integrity of its facilities as part of its current operations and maintenance activities, and take any corrective actions necessary to repair damage during the life of the Project. Geotechnical investigations for Compressor Station 2, the booster stations, and proposed HDD locations are pending; therefore, we recommend that the results of these investigations, as well as any mitigation that RB Pipeline would adopt as part of the final engineering design, be provided prior to construction. Based on implementation of the Project-specific Plan and Procedures, and our recommended mitigation measures, we conclude that impacts on geological resources would be adequately minimized and the potential for impacts on the pipeline facilities from geologic hazards also would be minimal.

5.1.2 Soils

Project construction activities such as clearing, grading, excavation, backfilling, and the movement of construction equipment may affect soil resources. To reduce the impacts of construction on soils, RG LNG would implement measures outlined in its Plan and Procedures. Additional mitigation measures would include the installation and maintenance of temporary erosion and sedimentation controls to prevent sediment flow from construction areas into adjacent, undisturbed areas, and regular monitoring and inspection of disturbed areas until final stabilization is achieved. RG LNG would use timber mats and low ground pressure equipment to minimize potential rutting and compaction during wet soil conditions. In severely compacted areas on agricultural land, RB Pipeline would decompact soils by tilling in accordance with its Plan. RG Developers would implement their SWPPPs and SPCC Plans to reduce potential impacts on soils from spills of hazardous materials used during construction and operation; we recommend that these plans be finalized prior to construction. To account for agency input into fugitive dust control specifying that no chemicals may be used in Willacy and Cameron Counties, we recommend that prior to construction RG Developers file their final Fugitive Dust Control Plans for the LNG Terminal and pipeline facilities for review and written approval by the Director of OEP.

Preparation of the LNG Terminal site would include adding material such as cement or lime to stabilize soils, depositing fill to increase ground elevation, and installing aggregate material to provide a safe and level work surface. These activities would permanently alter the soils and increase the potential for erosion until the LNG Terminal is constructed and the remaining exposed soils are stabilized and revegetated. Dredging at the LNG Terminal site would be completed by RG LNG in accordance with permits issued by the COE; dredged

materials placement would be conducted in accordance with the Dredged Material Management Plan, as finalized in coordination with the BND and COE. RG LNG would implement its Unanticipated Contaminated Sediment and Soils Discovery Plan if contaminated materials were encountered. To minimize shoreline erosion, the LNG Terminal waterfront along the BSC would be stabilized from the MOF to the berths and turning basin. RG LNG would maintain the integrity of the shoreline protection throughout the operational life of the LNG Terminal. Given the impact minimization and mitigation measures described above, and our recommendation to provide final plans prior to construction, we conclude that impacts on soils due to construction and operation of the Project would be permanent, but minor.

5.1.3 Water Resources

The Rio Grande LNG Project is within the Gulf Coast Aquifer. Although not a sole-source aquifer, groundwater is the primary water supply source along the northern portion of the Pipeline System (Jim Wells, Kleberg, and Kenedy Counties); surface water is the primary source of drinking water in the southern Project counties. RG Developers anticipate that all water required for operations would be obtained from municipal sources and would not impact the quantity of available groundwater. In addition, for wells within 150 feet of Project workspaces RB Pipeline would offer to perform pre- and post-construction monitoring for changes in well water quality and yield, and to mitigate for any adverse effects due to Project activities. While construction of the Project could result in temporary impacts on groundwater quality and recharge, implementation of RG Developers' Plan and Procedures and SPCC Plans would reduce the potential for groundwater impacts.

The proposed LNG Terminal site is on the north shore of the BSC, a man-made, marine navigation channel that connects to the Gulf of Mexico. The BSC, along with its Entrance Channel and Jetty Channel, form the Brazos Island Harbor. Construction and operation of the LNG Terminal would result in permanent impacts on 174.8 acres of open water, including impacts on the BSC and an open water lagoon within the LNG Terminal site. RG LNG would be required to mitigate for the permanent loss of open water resources and proposes to preserve open water within an off-site wetland mitigation area about 1 mile south of the Project; this proposal is under review by the COE.

Dredging, which would be conducted by hydraulic cutter suction or mechanical dredge, would result in increased suspended solid and turbidity levels in the BSC. All dredging would be conducted using equipment designed to meet the Texas state water quality standards and in accordance with applicable COE permit requirements. Disposal of dredged material would be conducted in accordance with RG LNG's draft Dredged Material Management Plan, as finalized; however, the final management of dredged material would be determined by the BND and COE, in consultation with other federal, state, and local resource agencies and interested stakeholders, including the EPA, NMFS, FWS, and the TCEQ. Impacts on surface water quality would be adequately mitigated through adherence to applicable COE permits and requirements for dredging and dredged material management. We conclude that dredging and dredged materials placement for construction of the LNG Terminal would have temporary and minor impacts on water quality.

Based on the results of hydrodynamic modeling conducted for the proposed widening of the BSC, the COE determined that the Brazos Island Harbor Project, a separate federal action not directly related to the proposed Project, would result in only negligible differences in surface water conditions (including tidal velocity, water surface elevations, and tidal range in the Laguna Madre). RG LNG's hydrodynamic model similarly indicated negligible changes on water conditions due to Project dredging, including modeled current speeds for both the current and deeper proposed depth of the BSC. RG LNG's hydrodynamic modeling also indicated that maintenance dredging would be required every 2 to 4 four years to maintain adequate depths.

RG LNG estimates that 880 barges and support vessels would deliver construction materials and equipment to the MOF and Port of Brownsville during LNG Terminal construction. During operation, about 312 LNG carriers would call on the LNG Terminal per year (about 6 LNG carriers per week). Vessel traffic during construction and operation could increase shoreline erosion and suspended sediment concentrations due to increased wave action. To minimize these impacts, the channel embankments and slope of the LNG Terminal site along the BSC, the marine loading berths, and the turning basin would be stabilized using rip-rap. Although FERC does not have jurisdiction over the transit of LNG carriers through the BSC, final permitting for the Brazos Harbor Channel Improvement Project should account for the impacts of these larger vessels on the stability of unarmored shorelines due to vessel passage and reflective wave energy.

During the 20- to 24-hour LNG loading period, each LNG carrier serving the LNG Terminal is anticipated to discharge about 10 million gallons of ballast water and withdraw/discharge up to 12 million gallons of water for engine-cooling and hoteling. Ballast water discharges at the LNG Terminal could impact water quality by changing the salinity, temperature, pH, and dissolved oxygen level of water within the BSC. Impacts on surface waters as a result of cooling water intake and discharge would be primarily limited to an increase in water temperature in the vicinity of the LNG carrier. As the volume of discharge per vessel would be negligible compared with the total volume of the BSC (estimated to be about 25 billion gallons), and because the LNG carriers would conduct ballast water exchanges in accordance with Coast Guard regulations and International Maritime Organization requirements, we conclude that impacts on surface water quality resulting from ballast and cooling water would be minor.

Before placing each component of the LNG Terminal into service, LNG tanks, non-cryogenic piping, and freshwater storage tanks would be hydrostatically tested. LNG tanks would be tested using about 30 million gallons of seawater each (120 million gallons total), which would be withdrawn from the BSC, and treated via filtration or use of a corrosion inhibitor, if needed, before use. Following each hydrostatic test, water would be transferred to the onsite stormwater ponds and tested for contamination prior to release in accordance with applicable discharge permits. RG LNG developed a draft LNG Tank Hydrostatic Test Plan for the use of water from the BSC for hydrostatic testing, which we recommend be finalized prior to construction. Hydrostatic test water used in the Pipeline System would be withdrawn from three waterbodies crossed by the pipelines (Los Olmos Creek, Arroyo Colorado, and Resaca De Los Cuates), and water would be re-used across different pipe segments to decrease the total volume of water required; about 45 million gallons of water would also be withdrawn from these waterbodies for dust suppression.

The Pipeline System would cross 63 waterbodies, including 21 perennial streams, 19 intermittent streams, 10 ephemeral streams, and 13 ponds and reservoirs. These waterbodies would be crossed using various crossing methods, including conventional bore and HDD. Two waterbodies crossed by the Project are regulated by the IBWC, both of which would be crossed via HDD; RB Pipeline indicated that it would design these HDDs to adhere to IBWC's criteria and plans to submit its permit application for crossing these waterbodies to the IBWC in the second quarter of 2019. Crossing of the IBWC-regulated waterbodies would not commence prior to the IBWC issuing a permit for these crossings.

RB Pipeline would minimize potential impacts on surface waters by implementing its Procedures and utilizing trenchless crossing methods for 26 of the 34 waterbodies anticipated to be flowing at the time of construction. Following construction of each pipeline, waterbody contours would be restored to pre-construction conditions, and riparian areas would be revegetated using native grasses, legumes, and woody species, and allowed to return to pre-construction conditions. With implementation of RG Developers' Plan and Procedures, SWPPPs, SPCCs, additional mitigation measures included in the EIS, adherence to applicable permits, and our recommendations, we conclude that impacts on groundwater and surface water resources would be adequately minimized.

5.1.4 Wetlands

Construction of the LNG Terminal would result in the permanent loss of 182.4 acres of wetlands and special aquatic sites, including 114.9 acres of EEM, 19.8 acres of ESS (mangroves), and 47.7 acres of mudflats. RB Pipeline has proposed a 75-foot-wide construction right-of-way for the majority of wetland crossings less than 1,000 feet in length. For wetlands with crossing lengths greater than 1,000 feet, RB Pipeline has proposed a construction right-of-way width of 100 feet. Construction workspace for Pipeline 1 would impact a total of 137.0 acres of wetlands, including 9.9 acres of PFO wetlands, 3.5 acres of PSS wetlands, 117.4 acres of emergent (PEM and EEM) wetlands, and 6.2 acres of mudflats (EUS). About 18 months after the construction of Pipeline 1, Pipeline 2 would be constructed within the same right-of-way, which would impact the same wetlands in early successional stages of regrowth. Following construction, wetlands would be restored to pre-construction conditions and would be allowed to revegetate naturally, or by RB Pipeline's use of seed mixes in accordance with NRCS recommendations. Of the 107.3 acres of wetlands within the permanent footprint of the Pipeline System, 7.8 acres would be PFO and 3.5 acres would be PSS wetland.

RG Developers would implement their Procedures to control erosion and restore the grade and hydrology after construction in wetlands. In accordance with its Procedures, RB Pipeline would consult with the COE to develop a Project-specific wetland restoration plan. RG LNG is also developing a plan to mitigate for wetland impacts; its Conceptual Mitigation Plan identifies the potential to acquire and preserve a portion of the Loma Ecological Preserve in perpetuity, and to transfer the land to a land manager, such as the FWS. The COE has not approved RG LNG's Conceptual Mitigation Plan and is working with RG Developers, in conjunction with the FWS, EPA, and TPWD to revise the proposed mitigation measures as appropriate.

The FERC Procedures (section VI.A.6) specify that aboveground facilities, with few exceptions, should be located outside of wetlands. Although RG LNG proposes to site the LNG Terminal (including Compressor Station 3) in wetlands, we determined that the proposed location is the most environmentally preferable and practical alternative that meets the Project's stated purpose. However, the placement of the LNG Terminal in wetlands must be approved by the COE prior to construction. RB Pipeline has identified temporary workspace near one wetland that is inaccessible from the right-of-way; we recommend that, prior to construction, RB Pipeline reconfigure the right-of-way at this location (MP 36.5).

With adherence to measures contained in the Project-specific Procedures and applicable COE permits, impacts on wetlands would be reduced, with the majority of adverse permanent impacts occurring at the LNG Terminal site. We anticipate that the COE's CWA Section 404/Section 10 permit for the Project would be conditioned to effectively offset the Project-related adverse impacts on waters of the United States by wetland mitigation, such that impacts would be reduced to less than significant levels.

5.1.5 Vegetation

RG LNG has leased a 984.2-acre property from the BND for placement of the Rio Grande LNG Terminal. The property is generally low-lying (elevations of less than 10 feet), with higher-elevation features (up to 25 feet high) including lomas (coastal clay dunes) and dredge spoil piles. The site itself is dominated by a lagoon, tidal flats, and marshes on the east; a mud/salt flat complex and mangroves on the west; and a terraced area in the center and along the banks of the BSC that was used as historic dredge spoil placement. A total of 750.4 acres of land would be cleared during construction at the LNG Terminal site, including 562.9 acres of vegetated land that would be permanently converted to industrial use associated with operation of the facility. This permanent conversion would result in the loss of 191.5 acres of upland herbaceous land, 189.1 acres of upland shrub/forest land, 162.5 acres of emergent wetlands, and 19.8 acres of shrub/forested wetlands. About 233.8 acres of land, including 103.5 acres of wetland habitat, is present outside the boundary of the proposed facilities, but within the larger parcel leased by RG LNG, and would generally be maintained as a natural buffer.

Construction of the Header System and Pipeline 1, including ATWS, would affect 1,980.6 acres of vegetation, including 828.4 acres of upland herbaceous land, 533.9 acres of agricultural land, 481.2 acres of upland shrub/forest land, 123.7 acres of emergent wetlands, and 13.4 acres of shrub/forested wetlands. Following construction, 497.1 acres of upland herbaceous land, 321.2 acres of agricultural land, 287.5 acres of upland shrub/forest land, 95.5 acres of emergent wetlands, and 11.3 acres of shrub/forested wetlands within the permanent easement would be restored to pre-construction conditions, but would be subject to routine maintenance. Shrub/forest land within maintained portions of the permanent right-of-way would be permanently converted to herbaceous or early successional-stage scrub-shrub land. Pipeline 2 would be installed within the same 125-foot-wide construction right-of-way affected by Pipeline 1. As such, all land disturbed by the construction of Pipeline 2 would have been previously disturbed during the construction of Pipeline 1. Aboveground facilities for the Pipeline System would permanently convert vegetation to a developed state.

RG Developers conducted noxious and invasive weed surveys at the LNG Terminal site and along accessible portions of the pipeline route. No state listed weeds were identified; however, additional surveys along the pipeline route would be conducted prior to construction, and RB Pipeline would implement its Noxious and Invasive Plant Management Plan to control the potential spread of weeds.

Two vegetation communities of concern occur within proposed Project workspaces, including lomas and south Texas salty thornscrub. Although neither community is a protected habitat, they are considered habitat for the federally endangered ocelot and northern aplomado falcon. Three lomas are within the LNG Terminal site, one of which would be lost during construction. As no special vegetation communities have been noted as occurring on these lomas, the loss of this habitat would be considered a permanent, but minor impact. Construction and operation of the LNG Terminal would result in the conversion of 138.4 acres of south Texas salty thornscrub habitat to developed land. No land classified as south Texas salty thornscrub was identified within the footprint of the pipeline facilities. The TPWD, in its comments on the draft EIS, requested that topsoil segregation be conducted across the entire Pipeline System to preserve the native seed bank, which may include rare plant species; we recommend that RB Pipeline consult with the TPWD to determine specific areas of potential rare plant occurrence to determine additional areas where topsoil segregation may be warranted.

Overall, the Project would result in temporary to permanent impacts on vegetation. The impacts of the Pipeline System would generally be temporary or short-term, although vegetated habitat would be converted to industrial/commercial land within the footprint of the aboveground facilities, and would be maintained as herbaceous or early successional scrub-shrub habitat within the permanent right-of-way. Construction and operation of the LNG Terminal would result in permanent impacts on vegetation within the footprint of the facility, although impacts on wetland vegetation would be mitigated as required by the COE under Section 404 of the CWA.

5.1.6 Wildlife and Aquatic Resources

Construction of the LNG Terminal site, including Compressor Station 3, would affect the vegetated wildlife habitat identified above, as well as 174.8 acres of open water onsite and in the proposed dredging areas. This habitat would be permanently converted to an industrial state, resulting in displacement, stress, and direct mortality of some individuals. To minimize the potential for direct mortality during initial clearing, RG LNG would conduct pre-construction surveys and hazing at the LNG Terminal property to flush wildlife from the site prior to completing the fencing. Impacts from construction and operation of the LNG Terminal from increased human activity, lighting, and noise are not anticipated to result in significant impacts on wildlife populations, given that local wildlife are likely acclimated to the increased noise and human presence associated with the adjacent SH-48 and BSC. Further, in response to comments on the draft EIS regarding concern over facility lighting, we recommend that RG Developers finalize Project lighting plans in coordination with the FWS and TPWD to minimize potential effects on wildlife. However, the direct loss of habitat and the indirect effects associated with displacement indicate that the construction and operation of the proposed LNG Terminal would result in a minor to moderate, permanent impact on local wildlife.

The Header System and Pipeline 1 would affect 1,998.5 acres of wildlife habitat, including 828.4 acres of upland herbaceous land, 533.9 acres of agricultural land, 481.2 acres of upland shrub/forest land, 123.7 acres of emergent wetlands, 13.4 acres of shrub/forested wetlands, and 7.9 acres of open water. Following construction, 497.1 acres of upland herbaceous land, 321.2 acres of agricultural land, 287.5 acres of upland shrub/forest land, 95.5 acres of emergent wetlands, and 111.3 acres of shrub/forested wetlands within the permanent easement would be restored to pre-construction conditions but would be subject to routine maintenance; 6.5 acres of water within the permanent right-of-way would not be subjected to routine maintenance. Shrub/forest land within maintained portions of the permanent right-of-way would be permanently converted to herbaceous or early successional-stage scrub-shrub land. Pipeline 2 would be installed within the same right-of-way as Pipeline 1. Similar to impacts at the LNG Terminal, wildlife would experience displacement, stress, and direct mortality during construction of the pipeline facilities; however, most impacts would be restricted to periods of active construction and the habitat would re-establish over time after construction had been completed, with the exception of aboveground facilities and the permanent right-of-way, which would be periodically maintained.

The proposed Project is within the migratory bird Central Flyway, which generally covers the central portion of North America and into Central America. South Texas acts as a funnel for migratory birds as they try to avoid flying too far east (into open Gulf waters) or west (into desert habitat). RG LNG proposes measures to avoid or minimize impacts on migratory birds and has developed a MBCP outlining the measures that it would implement, as practicable, during construction of the Project; RB Pipeline would also implement measures in this plan if vegetation clearing along the Pipeline System would take place during the bird nesting period between March 1 and August 31. Because of the high use of habitat at the LNG Terminal by migratory birds (including birds of conservation concern), we agree that the measures in RG LNG's MBCP are appropriate and we recommend that the plan be finalized in consultation with the FWS and TPWD. We have also determined that the overall increase in nighttime lighting during operation of the proposed Project would result in permanent, but minor impacts on resident or migratory birds.

Sensitive or management wildlife habitat in the vicinity of the Project includes the Laguna Atascosa and Lower Rio Grande Valley NWRs. Operational noise at the LNG Terminal would increase ambient noise in adjacent areas of the Laguna Atascosa NWR, which could result in moderate impacts on wildlife through increased avoidance; however, no significant changes in general wildlife behaviors further within the NWR are anticipated, as noise attenuates over distance. Although the LNG Terminal would not be within 0.25 mile of the Lower Rio Grande Valley NWR, RB Pipeline is proposing two HDDs adjacent to its boundaries. Therefore, we recommend that RB Pipeline provide ambient sound levels at an HDD location adjacent to this NWR at MPs 115.6 and 116.4, and identify any necessary mitigation, prior to construction.

Loss or disturbance of vegetation decreases available habitat for pollinator species, including bats, bees, hummingbirds, butterflies, wasps, moths, and flies, that require plant pollen and/or nectar for food. RG Developers have consulted with the NRCS to develop preliminary seeding mixes for use during restoration that would enhance the habitat for pollinator species, which includes predominantly native grasses. Further, RG Developers will continue to coordinate with the Caesar Kleberg Wildlife Research Institute at the FWS' request, and have

committed to incorporating monarch butterfly-friendly species into their revegetation plan, which could provide an energy source for local and migrating pollinators.

Construction of the Rio Grande LNG Project would result in minor impacts on aquatic resources due to water quality and noise impacts and direct mortality of some immobile individuals during dredging for the LNG Terminal and installation of the Pipeline System across waterbodies. During operations, the Project would have minor impacts on aquatic resources due to maintenance dredging and increased marine vessel traffic. Permanent impacts on aquatic habitat would occur where open water would be converted to industrial/commercial land within the LNG Terminal site and where dredging would convert existing wetlands and mudflats to open water. Impacts on aquatic resources due to increased turbidity and suspended solid levels would vary by species; however, the aquatic resources present within the Project area are likely accustomed to regular fluctuations in noise and turbidity levels from maintenance dredging within the BSC. To minimize impacts on aquatic resources due to increased turbidity and suspended solid levels, RG LNG would use equipment designed to meet Texas state water quality standards and in accordance with applicable COE permit requirements which include turbidity minimization methods as well as avoidance of adverse effects to water quality and aquatic resources. Further, in accordance with the TPWD's recommendations on the draft EIS (and per section V.B.1 of FERC's Plan), RB Pipeline must cross all waterbodies with perceptible flow between November 1 and January 31, unless further approval from the TPWD is obtained. With the implementation of these permit requirements and mitigation measures, we have determined that the Project would have temporary and minor impacts on fisheries and aquatic resources.

Portions of the BSC, the channel to San Martin Lake, the Bahia Grande Channel, and the water column at potential dredged material disposal sites have been designated as EFH. Although the construction activities would result in the alteration of habitat and the mortality or displacement of individuals, the impacts on EFH and the species and life stages that utilize EFH would be temporary and minor. Consultation under the MSFCMA is complete, and given the temporary, minor impacts on EFH, NMFS does not have EFH conservation recommendations for the Project.

5.1.7 Threatened, Endangered, and Other Special-status Species

A total of 25 species that are federally listed as threatened or endangered, or those that are candidates, proposed, or under review for listing, may occur in counties affected by the Project. Within these counties, or offshore of them, critical habitat has been designated for two species, the piping plover and the loggerhead sea turtle. We determined that the Project would have *no effect* on one federally listed and one candidate species, is *not likely to adversely affect* 19 federally listed (or proposed) species, and would *not result in a trend towards federal listing* for two species (one candidate and one that is under review). We have also determined that the Project would not be likely to destroy or adversely modify designated critical habitat for the piping plover or loggerhead sea turtle. Our *not likely to adversely affect* determinations for the West Indian manatee and federally listed plants are based on our recommendations to conduct appropriate training and complete applicable surveys, respectively. Similarly, our *not likely to adversely affect* determination for the northern aplomado falcon is based on our recommendations related to nest identification, monitoring, and implementation of BMPs for the

species, but also accounts for its coverage under a Safe Harbor Agreement that allows development (and take) in the Project area. RG Developers have committed to multiple mitigation measures for the protection of federally and state listed species (e.g., implementing biological monitors, following agency recommended BMPs); we have also recommended that RG Developers file documentation demonstrating that such measures have been incorporated into their environmental training program.

We have determined that the Project *is likely to adversely affect* the ocelot and jaguarundi based on direct and indirect habitat impacts, and consideration of how those habitat impacts would affect the recovery of the species. RG Developers are consulting with the FWS regarding potential mitigation for the ocelot; final mitigation requirements would be determined by the FWS in its Biological Opinion and through completion of the ESA Section 7 consultation process. Because consultation with the FWS and NMFS is ongoing, we recommend that the FERC staff completes any necessary ESA consultation with these agencies prior to construction.

In consultation with the TPWD and review of county species lists, we identified 30 species that are state listed as threatened or endangered with the potential to occur in the Project area. RB Pipeline has proposed use of the Texas Tortoise BMPs during construction to minimize the potential for impacts on the species; however, as the Texas tortoise was identified during surveys on the LNG Terminal site, we note that RG Developers may need to work with the TPWD to mitigate potential impacts on this species. Further, we recommend that RG Developers work with the TPWD to identify locations of sensitive habitat that may warrant the restriction of certain erosion control materials to minimize the potential for species entanglement. With implementation of RG Developers' Plan and Procedures, SWPPPs, and SPCCs, we have determined that state listed species would not be significantly affected by the Project. In addition, dolphins, which are protected under the MMPA, may be affected by noise produced by in-water pile-driving at the LNG Terminal site. Although RG LNG has minimized this potential by restricting in-water pile-driving to just four conventional piles and one sheet pile, we recommend that RG LNG consult with the NMFS to identify mitigation measures to avoid or minimize noise-related impacts from in-water pile-driving.

5.1.8 Land Use, Recreation, and Visual Resources

Construction of the Rio Grande LNG Project would occur predominately on large tracts of land classified as open land with scrub-shrub vegetation and would affect about 3,633.2 acres of open land, shrub/forest land, agricultural land, barren land, emergent wetlands, open water, and industrial/commercial land. About 2,149.2 acres of the affected area would be maintained for operation of the Project. A portion of the Project is within the designated coastal zone, which is managed by the RRC. We recommend that RG Developers file documentation of concurrence from the RRC that the Project is consistent with the Texas CZMP.

RG Developers would construct the Project across or near several recreation areas, including a National Historic Landmark (King Ranch); the Lower Rio Grande Valley and Laguna Atascosa NWRs; the Zapata boat launch; land planned for conservation through the Bahia Grande Coastal Corridor Project; four Great Texas Coastal Birding Trails; and three conservation easement areas under the CRP. The pipelines would directly affect each of these recreation areas, except for the Laguna Atascosa and Lower Rio Grande Valley NWRs.

However, construction of the Pipeline System would last a few weeks in any one area, except at 19 discrete locations along the Pipeline System (including areas adjacent to recreation/special use areas) where up to 10 weeks would be required for crossings accomplished by HDD; therefore, impacts would be temporary.

In addition to the special use areas, recreational boating and fishing activities occur within the BSC, Bahia Grande Channel, and San Martin Lake and could be affected by construction and operation of the LNG Terminal due to increased noise, restrictions on fishing in the immediate vicinity of the LNG Terminal, and LNG and barge vessel traffic. Increased noise associated with construction of the Project could deter recreational users from fishing in the immediate vicinity of Project activities. In particular, dredging activities, which would take place 24 hours per day, 7 days per week, during a two-week period; and land- and water-based pile-driving which would occur at discrete points during construction for periods as short as a few days to as long as five months, could result in avoidance of these areas by recreational users. In addition, construction of the Pipeline System across the Zapata boat launch would be accomplished by HDD, and could take up to 10 weeks. As a result, we have determined that there would be moderate impacts on recreational use of the Zapata boat launch during construction of the Pipeline System.

The nearest residential areas to the LNG Terminal are in Port Isabel and Laguna Heights, Texas, (about 2.2 miles north and northeast, respectively). Views of the LNG Terminal would generally be associated with mobile receptors such as motorists on SH-48, and boaters on the BSC or in the Bahia Grande Channel; these receptors may experience moderate impacts on the viewshed from the presence of the LNG Terminal. RG LNG's siting of the LNG Terminal along the BSC, which supports the movement of domestic and foreign products, and in proximity to the Port of Brownsville, result in it being consistent with current industrial use. Lighting at the LNG Terminal would be minimized to the extent practicable to maintain safe working conditions.

Numerous public comments identified concerns with the visual impact of the LNG Terminal to surrounding communities, specifically including Port Isabel and South Padre Island. Based on our review of visual simulations conducted by RG LNG, most public vantage points (e.g., the Port Isabel lighthouse, historic battlegrounds/landmarks, Isla Grand Hotel) are at a distance far enough away from the LNG Terminal site that impacts on the viewshed would be permanent, but negligible or minor. Visual receptors within nearby waters north of the LNG Terminal site, such as Laguna Madre, would be at lower elevations and/or far enough away such that the nearby shoreline areas would obscure the LNG Terminal site. Visual receptors at locations closer to the LNG Terminal site (e.g., SH-48, the Bahia Grande Channel, and the Zapata boat launch), would be able to discern individual structures; however, these receptors would generally not be stationary and therefore would have a short viewing time (i.e., until the vehicle or vessel passes the site). Based on these considerations, we conclude that the visual impact of the LNG Terminal would be permanent, but negligible to moderate, dependent on the elevation and proximity of the viewers.

Given the siting of the Pipeline System on larger tracts of land, no planned residential developments would be within 0.25 mile, and no residences are within 50 feet of proposed construction work areas. Although three residences are within 50 feet of proposed access roads;

these roads are existing and would be used without modification. RB Pipeline would affect visual resources along the pipeline route by vegetation clearing along the right-of-way and construction of the pipeline facilities. Visual impacts on the greatest number of people would occur where the pipeline route parallels or crosses roads, trails, or prominent offsite observation points and other places where the right-of-way may be seen by passing motorists or recreationists. The presence of construction personnel and equipment would result in short-term impacts on the viewshed of those areas. Although clearing of shrub/forest land would result in minor long-term and permanent impacts on the viewshed, we conclude that the visual character would not change substantially from existing conditions given the presence of other oil and gas pipeline easements throughout the Project area and RB Pipeline's effort to site the pipelines within or directly adjacent to existing pipeline corridors (about 66.0 percent of the route). Similarly, although passing motorists may be able to view Compressor Station 2 from U.S. Highway 77, we conclude that there would be no significant impacts on visual resources at Compressor Stations 1 and 2 given the distance to the nearest residences (2.9 miles or greater).

5.1.9 Socioeconomics

Construction of the Rio Grande LNG Project would generally have a minor impact on local populations, employment, housing, provision of community services, and property values. There would not be any disproportionately high or adverse environmental and human health impacts on low-income and minority populations from construction or operation of the Project. No residences or businesses would be displaced as a result of construction or operation of the LNG Terminal or pipeline facilities.

Construction of the LNG Terminal would occur in phases over a 7-year period. RG LNG expects an average monthly construction workforce of 2,950 workers would be required, with a peak workforce of 5,000 workers during a 17-month period. About 30 percent of the workforce is expected to be hired locally, resulting in on average 2,065 non-local workers and a maximum of 3,658 non-local workers. Assuming non-resident workers would be accompanied by family members, and based on the average household size in Texas, up to 10,058 non-local persons and family members could relocate to the affected area during construction of the LNG Terminal, which would represent a 0.8 percent increase in the total population within Cameron, Willacy, and Hidalgo Counties. Given the number of housing units that we estimate would be available for rent to the workforce (75,406 units), no serious disruptions to housing and temporary accommodations are anticipated. Operation of the LNG Terminal would require 108 workers, all of which are expected to be non-local hires.

RB Pipeline estimates the average monthly workforce would be 1,240 workers, with a peak of 1,500 workers, during the first two stages of construction, which would last about 12 months. The workforce would be concentrated near the compressor stations with an average monthly workforce of 160 workers each (including Compressor Station 3); the remaining workers would be separated into two construction spreads along the Header System and Pipeline 1. Stages 3 through 6 would require smaller workforces, estimated to be 240 workers each month on average with 300 workers at the peak of construction efforts.

RB Pipeline estimates that about 10 percent of the workers for the pipeline facilities would be hired locally. Based on the expected peak construction workforce, the addition of

1,350 non-local workers would result in a negligible increase in the affected area's population (0.003 percent). Within the affected area for the pipeline facilities, a total of 38,212 housing units would be available for rent to the workforce, including hotel and motel rooms, vacant housing units, and RV sites. This inventory of housing units indicates that sufficient lodging units would be available to accommodate the non-resident workers. Twenty permanent workers, including three to four staff at each compressor station, would be required for operation of the pipeline facilities. This workforce and their families would represent a permanent but minor increase in the local population and housing requirements.

Impacts on roadways in the Project area would include potential delays from increased traffic levels and diminished roadway capacity. To identify, quantify, and recommend mitigation for traffic impacts on area roadways during construction of the Rio Grande LNG Project, RG Developers commissioned a *Traffic Impact Analysis*, which recommended several improvements to safely accommodate access to the LNG Terminal, as well as strategic scheduling of deliveries and arrival/departure of construction workers to limit congestion. RG LNG committed to the measures recommended in the *Traffic Impact Study*, as well as hiring off-duty police officers to direct traffic during peak commuting hours and installing roadway warning signs to notify travelers of construction activities. To further minimize impacts on traffic congestion, we recommend that, prior to the end of the draft EIS comment period, RG Developers develop traffic monitoring and mitigation procedures in consultation with applicable transportation authorities. Additionally, if onsite parking becomes limited RG LNG would be provided offsite parking at a 25-acre Port of Brownsville temporary storage area on the south side of SH-48. Construction workers would be bused from this location to the LNG Terminal site. With the implementation of the proposed measures, we have determined that impacts from construction of the LNG Terminal would have temporary and minor impacts on local users of the roadway network.

Marine barge transportation would supplement truck transport for delivery of construction materials to the LNG Terminal site. RG LNG anticipates about 880 barge deliveries over the 7-year construction period for the LNG Terminal site, which represents a 25 percent increase in the current barge traffic. In addition to increased vessel traffic during construction, dredging for the marine facilities would temporarily reduce the area of the BSC available for vessel transit. RG LNG would coordinate with local authorities so that dredging activity would not restrict large vessels from transiting the BSC during the limited period for which this activity would be required. The additional vessels in the BSC during construction would not result in an exceedance of the channel's traffic capacity. Based on these considerations we anticipate that the overall impact on recreational boating and fishing would be minor.

The BSC currently experiences about six large vessels per week (i.e., about two transits per day) calling at the Port of Brownsville, including cargo vessels, tankers, and ocean barges. During operation of the Project, about 312 LNG carriers would call on the LNG Terminal per year, or about 6 per week. In a letter dated December 26, 2017, the Coast Guard issued the LOR for the Project, which stated that the BSC is considered suitable for LNG marine traffic in accordance with the guidance in the Coast Guard's NVIC 01-2011. The WSA review focused on the navigation safety and maritime security aspects of LNG carrier transits along the BSC. The WSA itself is designated Sensitive Security Information as defined in 49 CFR 1520. Because

any unauthorized disclosure of these details could be employed to circumvent the proposed security measures, they are not releasable to the public. Based on the Coast Guard's LOR for the Project, the expected doubling in large vessel traffic, and the potential to preclude vessel traffic 30 hours per week, we have determined that operation of the LNG Terminal would result in a permanent and moderate increase in marine traffic within the BSC, based on current conditions.

Construction of the pipelines would increase traffic on roadways, most notably during the first year of construction. Use of a segment of FM 106 in Cameron County during construction of the pipeline facilities was not recommended per the findings of the *Traffic Impact Analysis*; however, RB Pipeline has stated that it would use FM 106. To further minimize impacts on traffic congestion, we recommend that, prior to the end of the draft EIS comment period, RG Developers identify traffic mitigation procedures in consultation with applicable transportation authorities.

Construction of the Rio Grande LNG Project would result in positive impacts due to increases in construction jobs, payroll taxes, purchases made by the workforce, and expenses associated with the acquisition of material goods and equipment. Operation of the Project would have a positive effect on the local governments' tax revenues due to the increase in property taxes that would be collected.

5.1.10 Cultural Resources

To date, our responsibilities under Section 106 of the NHPA have not been completed and are pending the completion of all outstanding cultural resources surveys and subsequent review of the resulting reports and/or plans by FERC staff and the SHPO. We recommend that RG Developers file documentation of consultation with the SHPO, NPS, and Advisory Council on Historic Preservation prior to construction to ensure the FERC's responsibilities under Section 106 are met. Surveys conducted through 2016 cover about 56 percent of the current pipeline facilities (including the pipeline route, access roads, aboveground facilities, and contractor/pipe yards). Some areas along pipeline re-routes have been surveyed since that time, but landowner access for surveys along the entire Project has not been granted. Surveys have been completed for the entire LNG Terminal site, including 4.5 miles of the non-jurisdictional BND Utility Corridor, 2.9 miles of SH-48 turning lanes, the two offsite storage/parking areas, and a 1.3-mile-long section of the 1.8-mile-long temporary haul road (this haul road is no longer being proposed for use).

Surveys for the remainder of the pipelines (including along the Header System) remain incomplete due to access restrictions. This includes approximately 30 miles of the Project that crosses the King Ranch National Historic Landmark. These surveys will be completed once access is obtained.

RG Developers have conducted viewshed and noise impacts assessments of two National Historic Landmarks, including the Palmito Ranch Battlefield and the Palo Alto Battlefield, and concluded that due to distance and topography, visual impacts would be moderate and minor, respectively. They also concluded that the Project would have no noise impacts on the National Historic Landmarks.

RG Developers contacted seven Native American tribes with requests for consultation; four responded with requests to review survey reports and to be notified in the event of unanticipated discoveries, including human remains. We sent our NOI and follow-up letters to the same tribes; no responses were received. RG Developers requested comments from 13 other parties, including local historic preservation groups and museums. Of these groups, three responded. No concerns were expressed by any of the responding organizations.

RG Developers submitted a plan to the FERC and SHPO for addressing unanticipated discovery of cultural resources or human remains during construction. We and the SHPO requested revisions to the plan. RG Developers submitted a revised plan which we find acceptable. The SHPO concurred with the plan on November 10, 2016.

5.1.11 Air Quality and Noise

5.1.11.1 Air Quality

The Project would be located in areas currently classified as being in attainment for all criteria pollutant standards. Air pollutant emissions during construction of the Project would result from the operation of construction vehicles, marine traffic, vehicles driven by construction workers commuting to and from work sites, and fugitive dust generated during construction activities. Air quality impacts due to construction would generally be localized, and are not expected to cause or contribute to a violation of applicable air quality standards. Combustion emissions during construction at the LNG Terminal site would occur over a longer period than construction of the pipeline facilities. RG Developers would minimize combustion emissions by using bus transportation during construction, limiting engine idling, using recent models of construction equipment, and conducting regular inspections of construction vehicles. Fugitive dust emissions would be minimized through implementation of RG Developers' Fugitive Dust Control Plans. Based on our independent review of the analyses conducted and mitigation measures proposed, we conclude that construction of the Project would result in elevated emissions near construction areas and would impact local air quality. However, construction emissions would not have a long-term, permanent effect on air quality in the area.

The LNG Terminal (including Compressor Station 3) would be a PSD major source and a Title V major source for certain criteria pollutants, HAPs, and GHGs. On March 21, 2017, RG Developers submitted a revised application to the TCEQ for a PSD permit for the LNG Terminal and Compressor Station 3, and the TCEQ issued an Order granting the PSD permit on December 17, 2018. The results of ambient pollutant concentration modeling and ozone modeling conducted by RG Developers and the TCEQ show that the LNG Terminal and Compressor Station 3 would not cause or significantly contribute to an exceedance of the NAAQS. In addition, the results of the State Health Effects modeling evaluation required by the TCEQ for the LNG Terminal indicate that the Project emissions are below applicable effects screening levels, and therefore adverse health effects are not expected. However, concurrent emissions from staged construction, commissioning and start-up, and operations of the LNG Terminal would temporarily impact local air quality and could result in exceedances of the NAAQS in the immediate vicinity of the LNG Terminal during these construction years. These exceedances would not be persistent at any one time during these years due to the dynamic and fluctuating nature of construction activities within a day, week, or month. RG Developers would minimize

air quality impacts by adhering to applicable federal and state regulations and installing BACT as described in their PSD permit application to meet the emissions limitations required by the TCEQ. RG Developers plan to submit the Title V permit application for the LNG Terminal and Compressor Station 3 prior to beginning construction.

Compressor Stations 1 and 2 and Booster Stations 1 and 2 would require state minor source permits for all criteria pollutants; RB Pipeline submitted state permits for these facilities on March 24, 2017, and the permits were approved in June 2017. In addition, Compressor Stations 1 and 2 would be Title V major sources for NO_x and CO. RB Pipeline would minimize potential impacts on air quality due to operation of the aboveground facilities by adhering to applicable federal and state regulations as described in its air permit applications.

Based on our independent review of the analyses conducted and mitigation measures proposed, we conclude that operation of the Project would have minor impacts on local and regional air quality. However, given the mitigation measures proposed by RG Developers, and air quality controls and monitoring requirements that would be included in the Title V/Prevention of Significant Deterioration permits/state minor source permits for the facilities, the Project would not result in regionally significant impacts on air quality.

5.1.11.2 Noise

Construction activities at the LNG Terminal would generate increased noise levels over a period of about 7 years. Construction activities would occur predominantly during the day, between 7:00 a.m. and 7:00 p.m., Monday through Friday, and site preparation and construction activities (including pile-driving) would be limited to daytime hours. However, dredging may be conducted up to 24 hours per day, 7 days per week. The most prevalent noise-generating equipment and activity during construction of the LNG Terminal is anticipated to be pile-driving, although internal combustion engines associated with general construction equipment would also produce noise that is perceptible at the nearest NSAs. RG LNG plans to use both impact-type and vibratory pile-drivers during each stage of construction of the LNG Terminal, and pile-driving would be conducted both on-land and in-water. During the first stage (including LNG Train 1 and related offsite utilities), land-based pile-driving would require up to 165 days; each subsequent stage of construction and water-based pile-driving would require less time.

The highest expected sound level from pile-driving would occur at nearby NSA 3 when three impact pile-driving platforms are simultaneously in use for installation of the marine berths (56.4 dBA L_{max} at a distance of about 2.8 miles). This level corresponds to a quiet to moderate sound level, and would result in an 11 dB increase over ambient sound levels at NSA 3. As a result, we recommend that RG LNG monitor pile-driving, file weekly noise data, and implement mitigation measures in the event that measured noise impacts are greater than 10 dB over ambient levels at nearby NSAs. Estimated noise levels for site preparation and facility construction (including intermittent pile-driving during which all three pile-drivers do not operate simultaneously) are not estimated to result in significant impacts on NSAs in the LNG Terminal vicinity.

Installation of the pipeline facilities would include noise from internal combustion engines associated with typical pipeline and aboveground facility construction, as well as HDD

activities. While most construction activity would take place during daytime hours, RB Pipeline indicated that some specialized construction activities could occur at night (between 10 p.m. and 7 a.m.).

RB Pipeline conducted an HDD acoustical impact assessment, which found that sound levels for 24-hour HDD operations would exceed FERC's noise criterion of a day-night noise level of 55 dB on the A-weighted scale at NSAs near seven proposed HDDs. While RB Pipeline has identified potential mitigation measures to reduce sound levels during HDD construction, the site-specific measures that it would implement at each location have not been identified. Therefore, we recommend that RB Pipeline prepare a noise mitigation plan for HDDs at MPs 82.0, 92.0, 93.0, 99.8, 101.2, 102.0, and 118.7, which would exceed FERC's noise requirement at the nearest NSAs, and that these plans be implemented during construction.

Typical pipeline installation and facility construction would be temporary at a given location; however, construction at Compressor Stations 1 and 2 would occur in stages over several years. During construction activities, the composite sound level at the NSA nearest to Compressor Station 1 is estimated to be 42.7 L_{eq} (dBA). The recently monitored daytime sound level at this NSA is 38.3 dBA L_{eq} , and the combined ambient and construction sound levels would be 44.1 dBA, a 5.8 dB increase above ambient levels. Construction of Compressor Station 2 would not result in an increase above ambient levels at the nearest NSA. Noise levels would be below the FERC criterion of 55 dBA at both locations.

Operation of the LNG Terminal, and compressor, meter, and booster stations would produce noise on a continual basis during the lifetime of the Project. The results of the noise impact analysis indicate that the noise attributable to construction and operation of the LNG Terminal would be lower than the FERC noise level requirement at the nearest NSAs and the Palmito Ranch Battlefield (between 3.7 and 5.4 miles from the LNG Terminal site), and the predicted increases in ambient noise would be below perceptible levels (between 0.1 and 0.4 dB). To ensure that NSAs are not significantly affected by noise during operation of the LNG Terminal, we recommend that RG LNG conduct post-construction noise surveys after each after each noise-producing unit (e.g. each liquefaction train and compressor) is placed into service and once the entire LNG Terminal (including Compressor Station 3) is placed into service. If the noise attributable to operation of the equipment at the LNG Terminal exceeds the FERC threshold at any stage, RG LNG should file a report on what changes are needed and should install additional noise controls to meet the level within 1 year of the in-service date. RG LNG should confirm compliance with these requirements by filing an additional noise survey no later than 60 days after it installs the additional noise controls.

The results of the noise impact analysis conducted for the compressor and booster stations indicates that operation of these facilities would not generate noise that exceeds FERC sound level requirements or results in an increase in ambient sound levels at the nearest NSAs. To further ensure that NSAs are not significantly affected by noise during operation of the pipeline facilities, we recommend that RB Pipeline conduct post-construction noise surveys after each compressor unit is placed into service, as well as after the completed stations are operational. No NSAs are within 1 mile of the stand-alone meter stations proposed for the Project; therefore, operation of these facilities is not expected to result in perceptible noise impacts at any NSAs.

While construction of the Rio Grande LNG Project would result in localized minor to moderate elevated noise levels near construction areas, impacts would be limited to the construction period for the Project. During operations, noise impacts would be minor at the aboveground facilities along the Pipeline System and at the NSAs in the vicinity of the LNG Terminal. Based on the analyses conducted, mitigation measures proposed, and with our additional recommendations, we conclude that construction and operation of the Project would not result in significant noise impacts on residents and the surrounding communities.

5.1.12 Reliability and Safety

As part of the NEPA review, Commission staff assessed the potential impact to the human environment in terms of safety and whether the proposed facilities would operate safely, reliably, and securely.

As a cooperating agency, the DOT advises the Commission on whether RG LNG's proposed design would meet the DOT's 49 CFR Part 193 Subpart B siting requirements. On March 26, 2019, the DOT provided an LOD on the Project's compliance with 49 CFR Part 193 Subpart B. This determination was provided to the Commission for consideration in its decision on the Project application. If the Project is authorized, constructed, and operated, the facility would be subject to the DOT's inspection and enforcement program; final determination of whether a facility is in compliance with the requirements of 49 CFR 193 would be made by the DOT staff.

Furthermore, DOT's 49 CFR 192 requirements would apply to the VCP that is routed through the northern part of the LNG Terminal site. FERC staff has evaluated the potential risk and impact from an incident on the VCP. Based on PHMSA's incident data, the likelihood of a pipeline incident or failure would be low, and a worst-case pipeline rupture scenario would be even less likely. If a pipeline incident were to occur, the likely consequences from these cascading effects would not reach the public. To protect the VCP during construction and operation of the Project, RG LNG has identified extra protective measures, and we have made additional recommendations regarding temporary and permanent crossings. Therefore, FERC staff does not believe the proposed Project would significantly increase the risk to offsite public.

As a cooperating agency, the Coast Guard also assisted the FERC staff by reviewing the proposed LNG Terminal and the associated LNG marine carrier traffic. The Coast Guard reviewed a WSA submitted by RG LNG that focused on the navigation safety and maritime security aspects of LNG carrier transits along the affected waterway. On December 26, 2017, the Coast Guard issued an LOR to FERC staff indicating the BSC would be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this Project, based on the WSA and in accordance with the guidance in the Coast Guard's NVIC 01-11. If the Project is authorized constructed, and operated the LNG Terminal would be subject to the Coast Guard's inspection and enforcement program to ensure compliance with the requirements of 33 CFR 105 and 33 CFR 127.

As a cooperating agency, the FAA assisted FERC staff in evaluating impacts on and from the SpaceX rocket launch facility in Cameron County. Specific recommendations are included to address potential impacts from rocket launch failures on the Project. However, the extent of

impacts on SpaceX operations, the National Space Program, and to the federal government would not fully be known until SpaceX submits an application with the FAA requesting to launch, and whether the LNG Terminal is under construction or in operation at that time.

FERC staff conducted a preliminary engineering and technical review of the RG LNG design, including potential external impacts based on the site location. Based on this review, we recommend a number of mitigation measures and continuous oversight prior to initial site preparation, prior to construction of final design, prior to commissioning, prior to introduction of hazardous fluids, prior to commencement of service, and throughout life of the LNG Terminal, in order to enhance the reliability and safety of the terminal to mitigate the risk of impact on the public. With the incorporation of these mitigation measures and oversight, we conclude that RG LNG's terminal design would include acceptable layers of protection or safeguards that would reduce the risk of a potentially hazardous scenario from developing into an event that could impact the offsite public.

The Pipeline System and associated aboveground facilities would be constructed, operated, and maintained in compliance with DOT standards published in 49 CFR 192. These regulations are intended to minimize the potential for natural gas facility accidents and protect the public and environment. The DOT specifies material selection and qualifications; minimum design requirements; and protection from internal, external, and atmospheric corrosion. We conclude that the Pipeline System would not have a significant impact on public safety.

5.1.13 Cumulative Impacts

We considered the potential contributions of the Project to cumulative impacts in specific cumulative impact areas for the affected resources. As part of that assessment, we identified existing projects, projects under construction, projects that are proposed or planned, and reasonably foreseeable projects—including future LNG liquefaction and export projects, currently operating and future oil and gas projects, electric transmission and generation projects, land transportation projects, commercial developments, waterway improvement projects, and other miscellaneous activities. Our assessment considered the cumulative impacts of the proposed Project combined with the impacts of other projects on resources within all or part of the same area and timeframe.

As discussed in detail in section 4.13 and as summarized in sections 5.1.1 through 5.1.12, due to measures to minimize effects on environmental resources, mitigation measures, laws and regulations protecting environmental resources, and permitting requirements on the Rio Grande LNG Project and other projects, the potential for the LNG Terminal and pipeline facilities to contribute moderate to significant cumulative impacts is not anticipated for the following environmental resources: geology, groundwater, wetlands, cultural, land use, recreation, socioeconomics (except land- and water-based transportation, tourism, and commercial fisheries), and safety. Cumulative impacts for the remaining resources are further summarized below.

Construction of the proposed Project, the Texas LNG Project, and the non-jurisdictional facilities for both projects are anticipated to occur concurrently and on immediately adjacent lands, which would result in soil disturbance in succession. The Annova LNG Terminal would

be on the south side of the BSC, thus it would not contribute to cumulative impacts on soils. Collectively the Rio Grande LNG and Texas LNG Projects would contribute to moderate, permanent impacts on soils due to prolonged and delayed revegetation and the potential for increased runoff and erosion from unstable soils. Similarly, if dredging were to occur in the BSC for multiple projects at the same time, moderate, but temporary, impacts on water quality and aquatic resources may occur.

The greatest potential for cumulative impacts associated with surface water resources for the Rio Grande Project is associated with dredging activities (initial and maintenance) and vessel traffic in the BSC. Moderate to significant impacts on surface water quality specifically within the BSC could occur during concurrent dredging for the Brownsville LNG terminals due to increases in turbidity and sedimentation, and from the potential erosion of shorelines along unarmored portions of the BSC due to the increase in large LNG carriers persistently transiting the BSC. The Rio Grande LNG Project and other projects would be required to comply with the CWA to minimize impacts on surface water quality and to avoid, minimize, or mitigate wetland impacts. Therefore, while the proposed Project would contribute to cumulative impacts on surface water and wetlands, along with other projects in the area, this impact would not be significant.

The Rio Grande LNG Project and most of the other projects we identified (including, but not limited to Texas LNG and Annova LNG) would be constructed partially or wholly within the HUC-12 watershed, which is the geographic scope for vegetation, wildlife, aquatic species, and threatened and endangered species. Due to the relatively large proportion of the HUC-12 subwatershed that would be affected by the projects considered, as well as the low revegetation potential of the local soils, we have determined that the LNG Terminal would contribute to moderate cumulative impacts on rare plant communities and vegetation. This impact on vegetation would also contribute to moderate impacts on wildlife species using the vegetation communities. Federally listed threatened and endangered species that may be subjected to moderate to significant cumulative impacts include sea turtles (moderate), from the combined construction impacts associated with dredging and in-water pile-driving; the northern aplomado falcon (significant), because of past cumulative habitat loss and construction of aboveground structures adjacent to areas of remaining habitat; and the ocelot and jaguarundi (significant), from the loss and/or decrease in suitability of habitat and the potential increase in vehicular strikes during construction. All federally regulated projects, including all three of the proposed LNG projects along the BSC, are required to coordinate with the FWS to minimize impacts on federally listed species.

Construction of the Rio Grande LNG Project and the other projects within the geographic scope would result in increased land- and water-based traffic within common transportation corridors and during the period(s) when construction activities overlap. Specifically, the construction of the proposed LNG Terminal and the Texas LNG Project would result in a substantial increase in daily vehicle trips on SH-48. Both RG LNG and Texas LNG have agreed to make improvements to SH-48 to ensure safe movement of traffic along the road, especially during peak hour traffic flows. Further, RG LNG has committed to hiring off-duty police officers to direct traffic during peak commuting hours and would provide off-site parking for construction personnel. Based on the results of the commissioned studies for the proposed Project and Texas LNG, in conjunction with RG LNG's proposed roadway improvements, the

Rio Grande LNG Project and other projects would contribute to a moderate cumulative impact on roadways during the 7-year construction period. The greatest cumulative impacts would result during concurrent construction of the Rio Grande LNG and Texas LNG terminals.

The potential for cumulative visual impacts would be greatest if, in addition to the proposed LNG Terminal, the Annova LNG and Texas LNG Projects are permitted and built concurrently. Motorists on SH-48 (and other local roadways) and visitors to local recreation areas would experience a permanent change in the existing viewshed operation of the projects and we conclude that cumulative impacts of the three LNG projects on visual resources would be potentially significant.

All three LNG Projects are proposing use of the BSC during construction and operation, which would likely result in a cumulative impact on marine vessel traffic flow and would likely increase vessel travel times due to congestion. During operations, LNG carriers calling on the Rio Grande LNG Terminal and other LNG facilities along the BSC may have moving security zones that could preclude other vessels from transiting the waterway for up to 39 hours per week. Mandates for prior notice of expected arrivals would minimize impacts on other vessels. As a result, we conclude that there would be a moderate cumulative impact on marine vessel traffic in the BSC during from overlapping construction and operation.

Although the land proposed to be developed for the three Brownsville LNG projects is zoned for industrial use, the concurrent construction and operation of three large industrial facilities would result in change of the character of the landscape that could cause some visitors to choose to vacation elsewhere or alter their recreation activities to destinations in the region that are further from the Brownsville LNG project sites. In addition, increased vessel traffic resulting from the concurrent operation of the three Brownsville LNG projects would likely result in delays for commercial fishing and recreational vessels that need to transit the BSC. Therefore, we anticipate that cumulative impacts on tourism and commercial fisheries would be permanent and moderate.

With other projects in the geographic scope, construction of the Rio Grande LNG Project would contribute to localized moderate elevated emissions of criteria pollutants near construction areas during the period(s) when construction of these activities would overlap. Operational air emissions from the Rio Grande LNG Project would contribute to cumulative emissions with other projects in the geographic scope, and would be required to comply with applicable air quality regulations. Overall, impacts from the Rio Grande LNG Terminal along with the other LNG facilities would cause elevated levels of air contaminants in the area and a potential exceedance of the 1-hour NO₂ NAAQS in an uninhabited area between the proposed LNG project facilities. We are aware that each LNG Terminal could be constructed within the same time period, and the concurrent construction, commissioning, and operations emissions of the proposed Brownsville LNG terminals could potentially exceed the NAAQS in local areas, and result in cumulatively greater local air quality impacts. Along the Rio Bravo Pipeline, no compressor or booster stations would trigger PSD major source permitting requirements for any pollutants and would not cause or contribute to a NAAQS exceedance. Therefore, cumulative impacts on regional air quality as a result of the operation of the Rio Grande LNG Project and other facilities would be long-term during the operational life of the Project, but minor.

The Rio Grande LNG Project would emit GHGs. Currently, there is no universally accepted methodology to attribute discrete, quantifiable, physical effects on the environment to Project's incremental contribution to GHGs. Absent such a method for relating GHG emissions to specific resource impacts, we are not able to assess potential GHG-related impacts attributable to this Project. Additionally, we have not been able to find any GHG emission reduction goals established either at the federal level⁹¹ or by the State of Texas. Without either the ability to determine discrete resource impacts or an established target to compare GHG emissions against, we are unable to determine the significance of the Project's contribution to climate change.

For simultaneous construction activities at all of the three LNG projects proposed along the BSC, the predicted sound level increase over the existing ambient ranges from 2.2 to 9.8 dBA L_{dn} at certain NSAs (residences) in the general vicinity of the projects. These noise level increases result in levels slightly over 55 dBA L_{dn}, and range between less than noticeable increases in ambient noise to a doubling of noise at specific NSAs. For construction activities that are not simultaneous but incremental, the predicted sound level increase ranges from 1.0 to 8.6 dBA L_{dn} at the NSAs. These increases would be minor to moderate; however, all levels would be below 55 dBA L_{dn}. For the Palmito Ranch Battlefield National Historic Landmark (4.1 miles from the Rio Grande LNG Project), the predicted cumulative construction increase is 10.1 dBA L_{dn} over the existing ambient level, which could result in periods of perceived doubling of noise. However, for the duration of Annova's nighttime pile-driving, significantly higher levels of noise are estimated and this would result in significant cumulative noise impacts. The only 24-hour construction proposed at the Rio Grande LNG Terminal would be dredging. As described in section 4.11.2.3, the estimated sound level from dredging associated with the Rio Grande LNG Terminal at the nearest NSAs would be below existing ambient sound levels, and noise associated with dredging activities is not expected to be perceptible. Therefore, RG LNG's contribution to cumulative nighttime construction noise would be negligible. The predicted sound level impacts for simultaneous operation of all three LNG projects are much lower than construction impacts, with potential increases over the existing ambient sound level between 0.3 and 1.5 dBA L_{dn} at NSAs, resulting in a negligible to minor impact. Construction and operation of the pipeline facilities would not contribute to significant cumulative noise impacts on nearby NSAs.

In summary, the anticipated cumulative impacts associated with the construction and operation of projects in the geographic scope are primarily construction-related dredging and pile-driving impacts in the BSC on fish and sea turtles, construction vehicle traffic on SH-48, potential direct impacts on the federally endangered ocelot and jaguarundi, and construction noise impacts on NSAs during concurrent construction. The primary operation-related cumulative impacts include marine vessel impacts on water quality and on existing marine vessel traffic in the BSC, as well as loss or degradation of vegetation that provides habitat for federally listed species. These cumulative impacts are predominantly based on concurrent construction and operation of the Rio Grande LNG, Texas LNG, and Annova LNG Projects.

⁹¹ The national emissions reduction targets expressed in the EPA's Clean Power Plan and the Paris climate accord are pending repeal and withdrawal, respectively.

5.1.14 Alternatives

In accordance with NEPA and FERC policy, we evaluated the no-action alternative, system alternatives, and other siting and design alternatives that could achieve the Project objectives. The range of alternatives that could achieve the Project objectives included system alternatives for both the terminal and pipeline, alternative LNG Terminal sites, and alternative pipeline configurations. Alternatives were evaluated and compared to the Project to determine whether these alternatives presented a significant environmental advantage to the proposed Project. While the no-action alternative would avoid the environmental impacts identified in this EIS, adoption of this alternative would preclude meeting the stated Project objectives. If the Project is not approved and built, the need could potentially be met by other LNG export projects developed elsewhere along the Texas Gulf Coast. Implementation of other LNG export projects likely would result in impacts similar to or greater than those of the proposed Project.

We evaluated seven LNG Terminal system alternatives, including four existing LNG import terminals with planned, proposed, or authorized liquefaction projects; and three proposed/planned stand-alone LNG export terminals. To meet all or part of RG LNG's contractual agreements, each of these projects would require substantial construction beyond what is currently planned and would not offer significant environmental advantages over the proposed LNG Terminal. In addition, the permitting and authorization processes for constructing additional facilities and the time required for construction would substantially delay meeting the proposed timeline for the Project. As a result, we eliminated all potential system alternatives from further consideration.

We evaluated alternative sites for the LNG Terminal along the Texas coast and along the BSC. Four alternative sites along the Texas coast were identified; however, the sites either lacked a tract size large enough to meet the needs of the Project or lacked a port system that could accommodate the deep draft LNG carriers. Along with the proposed location on the BSC, we reviewed five other sites along the BSC as alternatives. Each alternative site provided access to the deep draft LNG carriers; however, one was not an adequate size for the Project, one was not available for a long-term lease, and the other alternatives affected more resources such as wetlands and special status species. We concluded that these sites would be impractical, and they were eliminated from further consideration.

In the draft EIS we evaluated alternatives to RG LNG's proposed new haul road to bring fill material from the Port Isabel dredge pile to the terminal site. In response to our recommendation in the draft EIS, RG LNG adopted an alternative to transport the fill materials, if necessary, using barges.

We reviewed three pipeline system alternatives; however, none of the alternatives had enough available capacity to transport the Project volumes. We also reviewed the construction of one larger diameter pipeline as opposed to the two mainline pipelines, as well as concurrent construction of both pipelines, but eliminated these alternatives from further review based on construction and safety considerations. RB Pipeline reviewed potential pipeline alternatives as part of its routing process to minimize and avoid environmental impacts; however, as much of the proposed Pipeline System is collocated with existing rights-of-way and the King Ranch

National Historic Landmark cannot be fully avoided due to its size, we did not evaluate alternatives for the Pipeline System.

5.2 FERC STAFF'S RECOMMENDED MITIGATION

If the Commission authorizes the Project, we recommend that the following measures be included as specific conditions in the Commission's Order. We believe that these measures would further mitigate the environmental impacts associated with construction and operation of the proposed Project. These measures may apply to RG LNG, RB Pipeline, or to both Applicants collectively, referred to as "RG Developers."

1. RG Developers shall follow the construction procedures and mitigation measures described in their application and supplements (including responses to staff data requests) and as identified in the EIS, unless modified by the Order. RG Developers must:
 - a. request any modification to these procedures, measures, or conditions in a filing with the Secretary;
 - b. justify each modification relative to site-specific conditions;
 - c. explain how that modification provides an equal or greater level of environmental protection than the original measure; and
 - d. receive approval in writing from the Director of OEP **before using that modification.**
2. For the LNG Terminal, the Director of OEP, or the Director's designee, has delegated authority to address any requests for approvals or authorizations necessary to carry out the conditions of the Order, and take whatever steps are necessary to ensure the protection of life, health, property, and the environment during construction and operation of the project. This authority shall allow:
 - a. the modification of conditions of the Order;
 - b. stop-work authority and authority to cease operation; and
 - c. the imposition of any additional measures deemed necessary to ensure continued compliance with the intent of the conditions of the Order as well as the avoidance or mitigation of unforeseen adverse environmental impact resulting from Project construction and operation.
3. For the pipeline facilities, the Director of OEP, or the Director's designee, has delegated authority to address any requests for approvals or authorizations necessary to carry out the conditions of the Order, and take whatever steps are necessary to ensure the protection of environmental resources during construction and operation of the Project. This authority shall allow:
 - a. the modification of conditions of the Order;
 - b. stop-work authority; and

- c. the imposition of any additional measures deemed necessary to ensure continued compliance with the intent of the conditions of the Order as well as the avoidance or mitigation of unforeseen adverse environmental impact resulting from Project construction and operation.
4. **Prior to any construction**, RG Developers shall file an affirmative statement with the Secretary, certified by a senior company official, that all company personnel, EIs, and contractor personnel will be informed of the EI's authority and have been or will be trained on the implementation of the environmental mitigation measures appropriate to their jobs **before** becoming involved with construction and restoration activities.
5. The authorized facility locations shall be as shown in the EIS, as supplemented by filed alignment sheets. **As soon as they are available and before the start of construction**, RG Developers shall file with the Secretary any revised detailed survey alignment maps/sheets at a scale not smaller than 1:6,000 with station positions for all facilities approved by the Order. All requests for modifications of environmental conditions of the Order or site-specific clearances must be written and must reference locations designated on these alignment maps/sheets.

RB Pipeline's exercise of eminent domain authority granted under NGA Section 7(h) in any condemnation proceedings related to the Order must be consistent with these authorized facilities and locations. RB Pipeline's right of eminent domain granted under NGA Section 7(h) does not authorize it to increase the size of its natural gas pipeline or facilities to accommodate future needs or to acquire a right-of-way for a pipeline to transport a commodity other than natural gas.

6. RG Developers shall file with the Secretary detailed alignment maps/sheets and aerial photographs at a scale not smaller than 1:6,000 identifying all route realignments or facility relocations, and staging areas, contractor/pipe yards, new access roads, and other areas that will be used or disturbed and have not been previously identified in filings with the Secretary. Approval for each of these areas must be explicitly requested in writing. For each area, the request must include a description of the existing land use/cover type, documentation of landowner approval, whether any cultural resources or federally listed threatened or endangered species will be affected, and whether any other environmentally sensitive areas are within or abutting the area. All areas shall be clearly identified on the maps/sheets/aerial photographs. Each area must be approved in writing by the Director of OEP **before construction in or near that area**.

This requirement does not apply to extra workspace allowed by the Commission's *Upland Erosion Control, Revegetation, and Maintenance Plan* and/or minor field realignments per landowner needs and requirements which do not affect other landowners or sensitive environmental areas such as wetlands.

Examples of alterations requiring approval include all route realignments and facility location changes resulting from:

- a. implementation of cultural resources mitigation measures;

- b. implementation of endangered, threatened, or special concern species mitigation;
 - c. recommendations by state regulatory authorities; and
 - d. agreements with individual landowners that affect other landowners or could affect sensitive environmental areas.
7. **Within 60 days of the Order and before construction begins**, RG Developers shall file an Implementation Plan with the Secretary for review and written approval by the Director of OEP. RG Developers must file revisions to the plan as schedules change. The plans shall identify:
- a. how RG Developers will implement the construction procedures and mitigation measures described in their application and supplements (including responses to staff data requests), identified in the EIS, and required by the Order;
 - b. how RG Developers will incorporate these requirements into the contract bid documents, construction contracts (especially penalty clauses and specifications), and construction drawings so that the mitigation required at each site is clear to onsite construction and inspection personnel;
 - c. the number of EIs assigned per spread and/or facility, and how RG Developers will ensure that sufficient personnel are available to implement the environmental mitigation;
 - d. company personnel, including EIs and contractors, who will receive copies of the appropriate material;
 - e. the location and dates of the environmental compliance training and instructions RG Developers will give to all personnel involved with construction and restoration (initial and refresher training as the Project progresses and personnel changes), with the opportunity for OEP staff to participate in the training session(s);
 - f. the company personnel (if known) and specific portion of RG Developers' organizations having responsibility for compliance;
 - g. the procedures (including use of contract penalties) RG Developers will follow if noncompliance occurs; and
 - h. for each discrete facility, a Gantt or PERT chart (or similar project scheduling diagram), and dates for:
 - i. the completion of all required surveys and reports;
 - ii. the environmental compliance training of onsite personnel;
 - iii. the start of construction; and
 - iv. the start and completion of restoration.
8. RG Developers shall employ a team of EIs (at least one EI per stage of LNG Terminal construction and at least two EIs per pipeline spread) for the Project. The EIs shall be:

- a. responsible for monitoring and ensuring compliance with all mitigation measures required by the Order and other grants, permits, certificates, or other authorizing documents;
 - b. responsible for evaluating the construction contractor's implementation of the environmental mitigation measures required in the contract (see condition 7 above) and any other authorizing document;
 - c. empowered to order correction of acts that violate the environmental conditions of the Order, and any other authorizing document;
 - d. a full-time position, separate from all other activity inspectors;
 - e. responsible for documenting compliance with the environmental conditions of the Order, as well as any environmental conditions/permit requirements imposed by other federal, state, or local agencies; and
 - f. responsible for maintaining status reports.
9. Beginning with the filing of the Implementation Plan, RG Developers shall file updated status reports with the Secretary on a **monthly** basis for the LNG Terminal and a **weekly** basis for the Pipeline System until all construction and restoration activities are complete. Problems of a significant magnitude shall be reported to the FERC **within 24 hours**. On request, these status reports will also be provided to other federal and state agencies with permitting responsibilities. Status reports shall include:
- a. an update on RG Developers' efforts to obtain the necessary federal authorizations;
 - b. Project schedule, including current construction status of the Project and work planned for the following reporting period, and any schedule changes for stream crossings or work in other environmentally-sensitive areas;
 - c. a listing of all problems encountered, contractor nonconformance/deficiency logs, and each instance of noncompliance observed by the EIs during the reporting period (both for the conditions imposed by the Commission and any environmental conditions/permit requirements imposed by other federal, state, or local agencies);
 - d. a description of the corrective and remedial actions implemented in response to all instances of noncompliance, nonconformance, or deficiency;
 - e. the effectiveness of all corrective and remedial actions implemented;
 - f. a description of any landowner/resident complaints which may relate to compliance with the requirements of the Order, and the measures taken to satisfy their concerns; and
 - g. copies of any correspondence received by RG Developers from other federal, state, or local permitting agencies concerning instances of noncompliance, and RG Developers' response.

10. RG Developers must receive written authorization from the Director of OEP **before commencing construction of any Project facilities**. To obtain such authorization, RG Developers must file with the Secretary documentation that it has received all applicable authorizations required under federal law (or evidence of waiver thereof).
11. RG LNG must receive written authorization from the Director of OEP **prior to introducing hazardous fluids into the Project facilities**. Instrumentation and controls, hazard detection, hazard control, and security components/systems necessary for the safe introduction of such fluids shall be installed and functional.
12. RB Pipeline must receive written authorization from the Director of OEP, **before placing each phase of the Pipeline System into service** (i.e., Header System/Pipeline 1 and associated facilities, and Pipeline 2 and upgrades to associated facilities). Such authorization will only be granted following a determination that rehabilitation and restoration of the right-of-way and other areas affected by the Project are proceeding satisfactorily.
13. RG LNG must receive written authorization from the Director of OEP **before placing the LNG Terminal into service**. Such authorization will only be granted following a determination that the facilities have been constructed in accordance with FERC approval, can be expected to operate safely as designed, and the rehabilitation and restoration of the areas affected by the LNG Terminal are proceeding satisfactorily.
14. **Within 30 days of placing each of the authorized facilities in service**, RG Developers shall file an affirmative statement with the Secretary, certified by a senior company official:
 - a. that the facilities have been constructed in compliance with all applicable conditions, and that continuing activities will be consistent with all applicable conditions; or
 - b. identifying which of the conditions of the Order RG Developers have complied with or will comply with. This statement shall also identify any areas affected by the Project where compliance measures were not properly implemented, if not previously identified in filed status reports, and the reason for noncompliance.
15. **Prior to construction of Compressor Station 2, and Booster Stations 1 and 2**, RB Pipeline shall file with the Secretary results of its geotechnical investigations and recommended site preparation and foundation designs that RB Pipeline will adopt, stamped and sealed by the professional engineer-of-record licensed in the state where the Project is being constructed, for each site, that incorporates the results of geotechnical investigations. (*section 4.1.1.1*)
16. **Prior to construction of each of the HDD locations**, RB Pipeline shall file with the Secretary, results of its geotechnical investigations for each of these sites, including any recommended mitigation measures RB Pipeline will adopt as part of the final engineering design, for review and written approval by the Director of OEP. (*section 4.1.1.1*)

17. **Prior to construction of the Project**, RG Developers shall file their final Fugitive Dust Control Plans for the LNG Terminal and Pipeline System with the Secretary, for review and written approval by the Director of OEP. The final plans shall specify that no chemicals may be used for dust control in Willacy and Cameron Counties. *(section 4.2.2.1)*
18. **Prior to construction of the Project**, RG Developers shall file with the Secretary, for review and written approval by the Director of the OEP, final versions of their SWPPPs and SPCC Plans for construction and operation of the Project, as well as the final version of the *Unanticipated Contaminated Sediment and Soils Discovery Plan*. *(section 4.2.2.1)*
19. **Prior to construction of the LNG Terminal**, RG LNG shall file with the Secretary, for review and written approval by the Director of OEP, its final LNG Tank Hydrostatic Test Plan. *(section 4.3.2.2)*
20. **Prior to construction of the Rio Bravo Pipeline through wetland WW-T04-015**, RB Pipeline shall file with the Secretary, for review and written approval by the Director of OEP, revised construction right-of-way configurations that either exclude inaccessible temporary workspace at the wetland crossing, or reconfigure the workspace so that it complies with section 6.1.3 of RG Developers' Procedures. *(section 4.4.2.2)*
21. **Prior to construction of the Rio Bravo Pipeline**, RB Pipeline shall consult with the TPWD to determine specific locations along the pipeline right-of-way that may warrant topsoil segregation based on the probable presence of rare plant species. Copies of consultation with the TPWD, along with any additional areas warranting topsoil segregation, shall be filed with the Secretary, for review and written approval by the Director of OEP. *(section 4.5.4)*
22. **Prior to construction of the LNG Terminal**, RG LNG shall consult with the TPWD and FWS to finalize nighttime lighting plans to minimize impacts on wildlife to the greatest extent practical. The final plans and copies of consultation with the agencies shall be filed with the Secretary for review and written approval by the Director of OEP. *(section 4.6.1.2)*
23. **Prior to construction of the Project**, RG Developers shall consult with the FWS and TPWD to develop a final MBCP, which shall include outstanding surveys at the Port Isabel dredge pile. RG Developers shall file the revised MBCP and evidence of consultation with the FWS and TPWD with the Secretary. *(section 4.6.1.3)*
24. **Prior to construction of the Rio Bravo Pipeline HDD crossings at MPs 115.6 and 116.4**, RB Pipeline shall file with the Secretary, for review and written approval by the Director of OEP, estimates of ambient sound levels at the boundary of the Lower Rio Grande Valley NWR near the HDDs, as well as anticipated noise impacts and any necessary mitigation to minimize potential effects on wildlife. *(section 4.6.1.4)*
25. **Prior to construction of the Project**, RG Developers shall file documentation with the Secretary, for review and written approval by the Director of OEP,

demonstrating how RG Developers' commitments (as referenced in sections 4.7.1.1, 4.7.1.2, 4.7.1.4, 4.7.2.1 and 4.7.3) to implement agency recommended monitoring, avoidance, and mitigation measures for federal and state-listed species have been incorporated into RG Developers' environmental training program. *(section 4.7.1.1)*

26. **Prior to construction of the LNG Terminal**, RG LNG shall conduct training for construction and operational employees that includes the identification, treatment, and reporting protocols for the West Indian manatee. Training materials shall be developed in coordination with the FWS. *(section 4.7.1.2)*
27. **Prior to construction of each pipeline and the LNG Terminal**, RG Developers shall file with the Secretary documentation confirming that they obtained updated records of active northern aplomado falcon nests from The Peregrine Fund for the appropriate breeding season and consulted with the FWS to determine if any additional mitigation is warranted based on the new nest data. RG Developers shall also consult with the FWS on the Project-specific northern aplomado falcon BMPs, and file with the Secretary the FWS comments and any BMP modifications, for review and written approval by the Director of OEP. *(section 4.7.1.3)*
28. **Prior to construction of the Rio Bravo Pipeline**, RB Pipeline shall file with the Secretary, the results of its completed surveys for the black lace cactus, slender rush-pea, and south Texas ambrosia as well as any comments from the FWS regarding the results. If applicable, RB Pipeline shall include in its filing avoidance/minimization measures that it will implement if individual plants are found, developed in consultation with the FWS, for review and written approval by the Director of OEP. *(section 4.7.1.6)*
29. RG Developers shall not begin construction activities until:
 - a. the FERC staff receives comments from the FWS and NMFS regarding the proposed action;
 - b. FERC staff completes ESA Section 7 consultation with the FWS and NMFS; and
 - c. RG Developers have received written notification from the Director of OEP that construction or use of mitigation may begin. *(section 4.7.3)*
30. **Prior to construction of the Project**, RG Developers shall consult with the TPWD, and file with the Secretary copies of this consultation, to specifically identify locations of sensitive habitat that may warrant the restriction of synthetic mesh/netted erosion control materials. The specific areas warranting restriction of synthetic erosion control materials, shall be filed with the Secretary, for review and written approval by the Director of OEP. *(section 4.7.2.1)*
31. **Prior to construction of the LNG Terminal**, RG LNG shall file with the Secretary, for review and written approval by the Director of OEP, its proposed mitigation measures to avoid or minimize take of bottlenose dolphins during in-water pile-driving (including the potential for entrapment behind sheet pilings) at

the LNG Terminal site, developed in consultation with NMFS, and, if applicable, a copy of its MMPA Incidental Take Authorization. (section 4.7.2.2)

32. **Prior to construction of the Project**, RG Developers shall file with the Secretary a determination from the RRC that the Project is consistent with the laws and rules of the Texas Coastal Zone Management Program. (section 4.8.3)
33. **Prior to construction of the Rio Bravo Pipeline**, RB Pipeline shall file with the Secretary, for review and written approval by the Director of OEP, traffic mitigation procedures, developed in consultation with applicable transportation authorities, to monitor LOS on roadways proposed for use during construction of the Pipeline System. These procedures shall describe mitigation measures that will be implemented for a resultant LOS of C or below, including alternative routes if necessary. (section 4.9.9.1)
34. RG Developers shall **not begin construction of facilities or use of staging, storage, or temporary work areas and new or to-be-improved access roads until**:
 - a. RG Developers file with the Secretary:
 - i. outstanding SHPO comments on reports, plans, special studies, or information provided to date, as well as any NPS comments, as applicable;
 - ii. any outstanding updates, reports, plans, or special studies, and the SHPO's comments on these, as well as any NPS comments, as applicable; and
 - iii. any necessary treatment plans or site-specific avoidance/protection plans, and the SHPO's comments on the plans.
 - b. The ACHP is afforded an opportunity to comment if historic properties will be adversely affected.
 - c. The FERC staff reviews and the Director of OEP approves all cultural resources survey reports and plans, and notifies RG Developers in writing that construction may proceed.

All material filed with the Commission containing location, character, and ownership information about cultural resources must have the cover and any relevant pages therein clearly labeled in bold lettering: "**CUI/PRIV – DO NOT RELEASE.**" (section 4.10.5)

35. RG LNG shall monitor pile-driving activities, and file **weekly** noise data with the Secretary **following the start of pile-driving activities** that identify the noise impact on the nearest NSAs. If any measured noise impacts (L_{max}) at the nearest NSAs are greater than 10 dBA over the L_{eq} ambient levels, RG LNG shall:
 - a. cease pile-driving activities and implement noise mitigation measures; and

- b. file with the Secretary evidence of noise mitigation installation and request written notification from the Director of OEP that pile-driving may resume. (section 4.11.2.3)
36. RG LNG shall file a full power load noise survey with the Secretary for the LNG Terminal **no later than 60 days** after each liquefaction train is placed into service. If the noise attributable to operation of the equipment at the LNG Terminal and Compressor Station 3 exceeds an L_{dn} of 55 dBA at the nearest NSA, **within 60 days** RG LNG shall modify operation of the liquefaction facilities or install additional noise controls until a noise level below an L_{dn} of 55 dBA at the NSA is achieved. RG LNG shall confirm compliance with the above requirement by filing a second noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. (section 4.11.2.3)
37. RG LNG shall file a noise survey with the Secretary **no later than 60 days** after placing the entire LNG Terminal, including the Compressor Station 3, into service. If a full load condition noise survey is not possible, RG LNG shall provide an interim survey at the maximum possible horsepower load **within 60 days** of placing the LNG Terminal and Compressor Station 3 into service and provide the full load survey **within 6 months**. If the noise attributable to operation of the equipment at the LNG Terminal and Compressor Station 3 exceeds an L_{dn} of 55 dBA at the nearest NSA under interim or full horsepower load conditions, RG LNG shall file a report on what changes are needed and shall install the additional noise controls to meet the level **within 1 year** of the in-service date. RG LNG shall confirm compliance with the above requirement by filing an additional noise survey with the Secretary **no later than 60 days** after it installs the additional noise controls. (section 4.11.2.3)
38. **Prior to construction of HDDs at MPs 82.0, 92.0, 93.0, 99.8, 101.2, 102.0, and 118.7**, RB Pipeline shall file with the Secretary, for review and written approval by the Director of OEP, an HDD noise mitigation plan to reduce noise levels attributable to the proposed drilling operations. The noise mitigation plan shall identify all reasonable measures RB Pipeline will implement to reduce noise levels attributable to the proposed drilling operations to no more than an L_{dn} of 55 dBA at NSAs, and the resulting noise levels at each NSA with mitigation. (section 4.11.2.3)
39. RB Pipeline shall file a noise survey with the Secretary **no later than 60 days** after each set of compressor units at Compressor Stations 1 and 2, and Booster Stations 1 and 2 are placed in service. If a full load condition noise survey is not possible, RB Pipeline shall provide an interim survey at the maximum possible horsepower load **within 60 days** of placing the phased station into service and provide the full load survey **within 6 months**. If the noise attributable to the operation of all of the equipment at any of the facilities under interim or full horsepower load conditions exceeds an L_{dn} of 55 dBA at any nearby NSAs, RB Pipeline shall file a report on what additional noise controls are needed and shall install the additional noise controls to meet the level **within 1 year** of the in-service date. RB Pipeline shall confirm compliance with the above requirement by filing an additional noise survey

with the Secretary **no later than 60 days** after it installs the additional noise controls. (*section 4.11.2.3*)

40. **Prior to pipeline construction across, in, or adjacent to the Union Pacific Railroad Company right-of-way**, RB Pipeline shall file with the Secretary, for review and written approval by the Director of OEP, details concerning the pipeline construction under the railroad, including the depth of cover for the pipeline under the railroad, correspondence with the Union Pacific Railroad Company regarding construction and operation of the pipeline under and parallel to the railroad, and the specific federal and state regulations that RB Pipeline will follow to ensure safety and reliability of the pipeline operations in or under the railroad right-of-way. (*section 4.12.2*)
41. **Prior to initial site preparation**, RG LNG shall file with the Secretary documentation demonstrating LNG marine vessels will be no higher than existing ship traffic or it has received a determination of no hazard (with or without conditions) by DOT FAA for mobile objects that exceed the height requirements in 14 CFR 77.9. (*section 4.12.1.7*)
42. **Prior to initial site preparation**, RG LNG shall file with the Secretary a plan to conduct a supplemental geotechnical investigation for all four LNG Tanks and piperack along the south face of the facility, including a geotechnical investigation location plan with spacing of no more than 300 feet, a minimum of five equally distributed borings, cone penetration tests, and/or seismic cone penetration tests to a depth of at least 100 feet or refusal underneath the locations of each LNG storage tank, and field sampling methods and laboratory tests that are at least as comprehensive as the existing geotechnical investigations. In addition, the geotechnical investigations and report must demonstrate soil modifications and foundation designs will be similar to areas already investigated. (*section 4.12.1.7*)
43. **Prior to construction of final design**, RG LNG shall file with the Secretary correspondence with DOT on the use of normally closed valves to remove stormwater from local bunds and curbed areas. (*section 4.12.1.7*)
44. **Prior to construction of final design**, RG LNG shall file with the Secretary the following information, stamped and sealed by the professional engineer-of-record licensed in the state where the Project is being constructed:
 - a. site preparation drawings and specifications;
 - b. LNG storage tank and foundation design drawings and calculations;
 - c. LNG terminal structures and foundation design drawings and calculations;
 - d. seismic specifications for procured Seismic Category I equipment; and
 - e. quality control procedures to be used for civil/structural design and construction.

In addition, RG LNG shall file, in its Implementation Plan, the schedule for producing this information. (*section 4.12.1.7*)

45. **Prior to construction of final design**, RG LNG shall file with the Secretary design information adopting the recommendations presented by Fugro to minimize the impacts of the identified surface growth fault in the southwestern portion of the LNG Terminal, stamped and sealed by the professional engineer-of-record registered in Texas. (*section 4.12.1.7*)
46. **Prior to commencement of service**, RG LNG shall file with the Secretary a monitoring and maintenance plan, stamped and sealed by the professional engineer-of-record registered in Texas, for the perimeter levee which ensures the crest elevation relative to mean sea level will be maintained for the life of the facility considering berm settlement, subsidence, and sea level rise. (*section 4.12.1.7*)

Conditions 47 through 140 shall apply to the Rio Grande LNG Terminal facilities. Information pertaining to these specific conditions shall be filed with the Secretary for review and written approval by the Director of OEP, or the Director's designee, within the timeframe indicated by each condition. Specific engineering, vulnerability, or detailed design information meeting the criteria specified in Order No. 833 (Docket No. RM16-15-000), including security information, shall be submitted as critical energy infrastructure information pursuant to 18 CFR 388.113. See Critical Electric Infrastructure Security and Amending Critical Energy Infrastructure Information, Order No. 833, 81 FR. 93,732 (December 21, 2016), FERC Stats. & Regs. 31,389 (2016). Information pertaining to items such as offsite emergency response, procedures for public notification and evacuation, and construction and operating reporting requirements will be subject to public disclosure. All information shall be **filed a minimum of 30 days** before approval to proceed is requested.

47. **Prior to initial site preparation**, RG LNG shall develop and implement procedures to monitor rocket launch activity and to position onsite construction crews and plant personnel in areas that are unlikely to be impacted by rocket debris of a failed launch during initial moments of rocket launch activity from the Brownsville SpaceX facility. RG LNG's procedures for positioning of onsite construction crews and plant personnel shall include reference to any guidance from the FAA to the public regarding anticipated SpaceX launches. (*section 4.12.1.7*)
48. **Prior to initial site preparation**, RG LNG shall file calculations demonstrating the loads on buried pipelines and utilities at temporary crossings will be adequately distributed. The analysis shall be based on API RP 1102 or other approved methodology. (*section 4.12.1.7*)
49. **Prior to initial site preparation**, RG LNG shall file pipeline and utility damage prevention procedures for personnel and contractors. The procedures shall include provisions to mark buried pipelines and utilities prior to any site work and subsurface activities. (*section 4.12.1.7*)
50. **Prior to initial site preparation**, RG LNG shall file an overall Project schedule, which includes the proposed stages of the commissioning plan. (*section 4.12.1.7*)
51. **Prior to initial site preparation**, RG LNG shall file quality assurance and quality control procedures for construction activities. (*section 4.12.1.7*)

52. **Prior to initial site preparation**, RG LNG shall file procedures for controlling access during construction. (*section 4.12.1.7*)
53. **Prior to initial site preparation**, RG LNG shall file its design wind speed criteria for all other facilities not covered by DOT PHMSA's LOD to be designed to withstand wind speeds commensurate with the risk and reliability associated with the facilities in accordance with ASCE 7-16 or equivalent. (*section 4.12.1.7*)
54. **Prior to initial site preparation**, RG LNG shall develop an ERP (including evacuation) and coordinate procedures with the Coast Guard; state, county, and local emergency planning groups; fire departments; state and local law enforcement; and appropriate federal agencies. This plan shall include at a minimum:
- a. designated contacts with state and local emergency response agencies;
 - b. scalable procedures for the prompt notification of appropriate local officials and emergency response agencies based on the level and severity of potential incidents;
 - c. procedures for notifying residents and recreational users within areas of potential hazard;
 - d. evacuation routes/methods for residents and public use areas that are within any transient hazard areas along the route of the LNG marine transit;
 - e. locations of permanent sirens and other warning devices; and
 - f. an "emergency coordinator" on each LNG marine vessel to activate sirens and other warning devices.
- RG LNG shall notify the FERC staff of all planning meetings in advance and shall report progress on the development of its ERP **at 3-month intervals**. (*section 4.12.1.7*)
55. **Prior to initial site preparation**, RG LNG shall file a Cost-Sharing Plan identifying the mechanisms for funding all Project-specific security/emergency management costs that will be imposed on state and local agencies. This comprehensive plan shall include funding mechanisms for the capital costs associated with any necessary security/emergency management equipment and personnel base. RG LNG shall notify FERC staff of all planning meetings in advance and shall report progress on the development of its Cost-Sharing Plan at **3-month intervals**. (*section 4.12.1.7*)
56. **Prior to construction of final design**, RG LNG shall file calculations demonstrating the loads on buried pipelines and utilities at permanent crossings will be adequately distributed. The analysis shall be based on API RP 1102 or other approved methodology. (*section 4.12.1.7*)
57. **Prior to construction of final design**, RG LNG shall file change logs that list and explain any changes made from the front end engineering design provided in RG LNG's application and filings. A list of all changes with an explanation for the

design alteration shall be provided and all changes shall be clearly indicated on all diagrams and drawings. (section 4.12.1.7)

58. **Prior to construction of final design**, RG LNG shall file information/revisions pertaining to RG LNG' response numbers 5, 6, 7, 8, 14, 19, 22, 24, 25, 31, and 44 of its October 20, 2016 filing, which indicated features to be included or considered in the final design. (section 4.12.1.7)
59. **Prior to construction of final design**, RG LNG shall file a plot plan of the final design showing all major equipment, structures, buildings, and impoundment systems. (section 4.12.1.7)
60. **Prior to construction of final design**, RG LNG shall file three-dimensional plant drawings to confirm plant layout for maintenance, access, egress, and congestion. (section 4.12.1.7)
61. **Prior to construction of final design**, RG LNG shall file an up-to-date equipment list, process and mechanical data sheets, and specifications. The specifications shall include:
 - a. Building Specifications (e.g., control buildings, electrical buildings, compressor buildings, storage buildings, pressurized buildings, ventilated buildings, blast resistant buildings);
 - b. Mechanical Specifications (e.g., piping, valve, insulation, rotating equipment, heat exchanger, storage tank and vessel, other specialized equipment);
 - c. Electrical and Instrumentation Specifications (e.g., power system specifications, control system specifications, safety instrument system] specifications, cable specifications, other electrical and instrumentation specifications); and
 - d. Security and Fire Safety Specifications (security, passive protection, hazard detection, hazard control, firewater). (section 4.12.1.7)
62. **Prior to construction of final design**, RG LNG shall file a list of all codes and standards and the final specification document number where they are referenced. (section 4.12.1.7)
63. **Prior to construction of final design**, RG LNG shall file complete specifications and drawings of the proposed LNG tank design and installation. (section 4.12.1.7)
64. **Prior to construction of final design**, RG LNG shall file the design specifications and drawings for the feed gas inlet facilities (e.g., metering, pigging system, pressure protection system, compression, etc.). (section 4.12.1.7)
65. **Prior to construction of final design**, RG LNG shall file up-to-date process flow diagrams and P&IDs including vendor P&IDs. The process flow diagrams shall include heat and material balances. The P&IDs shall include the following information:
 - a. equipment tag number, name, size, duty, capacity, and design conditions;
 - b. equipment insulation type and thickness;

- c. storage tank pipe penetration size and nozzle schedule;
 - d. valve high pressure side and internal and external vent locations;
 - e. piping with line number, piping class specification, size, and insulation type and thickness;
 - f. piping specification breaks and insulation limits;
 - g. all control and manual valves numbered;
 - h. relief valves with size and set points; and
 - i. drawing revision number and date. (*section 4.12.1.7*)
66. **Prior to construction of final design**, RG LNG shall file P&IDs, specifications, and procedures that clearly show and specify the tie-in details required to safely connect subsequently constructed facilities with the operational facilities. (*section 4.12.1.7*)
67. **Prior to construction of final design**, RG LNG shall file a car seal philosophy and a list of all car-sealed and locked valves consistent with the P&IDs. (*section 4.12.1.7*)
68. **Prior to construction of final design**, and at the onset of detailed engineering, RG LNG shall complete a preliminary hazard and operability review of the proposed design. A copy of the review, a list of recommendations, and actions taken on the recommendations shall be filed. (*section 4.12.1.7*)
69. **Prior to construction of final design**, RG LNG shall file a hazard and operability review prior to issuing the P&IDs for construction. A copy of the review, a list of the recommendations, and actions taken on the recommendations shall be filed. (*section 4.12.1.7*)
70. **Prior to construction of final design**, RG LNG shall file an evaluation of the need for additional check valves and relief valves in the truck LNG fill line. (*section 4.12.1.7*)
71. **Prior to construction of final design**, RG LNG shall file the safe operating limits (upper and lower), alarm and shutdown set points for all instrumentation (i.e., temperature, pressures, flows, and compositions). (*section 4.12.1.7*)
72. **Prior to construction of final design**, RG LNG shall file cause-and-effect matrices for the process instrumentation, fire and gas detection system, and emergency shutdown system. The cause-and-effect matrices shall include alarms and shutdown functions, details of the voting and shutdown logic, and set points. (*section 4.12.1.7*)
73. **Prior to construction of final design**, RG LNG shall file an evaluation of the emergency shutdown valve closure times. The evaluation shall account for the time to detect an upset or hazardous condition, notify plant personnel, and close the emergency shutdown valve(s). (*section 4.12.1.7*)
74. **Prior to construction of final design**, RG LNG shall file an evaluation of dynamic pressure surge effects from valve opening and closure times and pump startup and

- shutdown operations demonstrating that the surge effects do not exceed the design pressures. *(section 4.12.1.7)*
75. **Prior to construction of final design**, RG LNG shall demonstrate that, for hazardous fluids, piping and piping nipples 2 inches or less in diameter are designed to withstand external loads, including vibrational loads in the vicinity of rotating equipment and operator live loads in areas accessible by operators. *(section 4.12.1.7)*
 76. **Prior to construction of final design**, RG LNG shall file electrical area classification drawings that reflect additional hazardous classification areas where the heat transfer fluid would be processed above its flash point (e.g., near the heat medium heaters) and at areas of fuel gas piping (e.g., fired heaters), including areas where equipment could be exposed to flammable gas during a purge cycle of a fired heater. *(section 4.12.1.7)*
 77. **Prior to construction of final design**, RG LNG shall file drawings and details of how process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system meet the requirements of NFPA 59A (2001). *(section 4.12.1.7)*
 78. **Prior to construction of final design**, RG LNG shall file details of an air gap or vent installed downstream of process seals or isolations installed at the interface between a flammable fluid system and an electrical conduit or wiring system. Each air gap shall vent to a safe location and be equipped with a leak detection device that shall continuously monitor for the presence of a flammable fluid, alarm the hazardous condition, and shut down the appropriate systems. *(section 4.12.1.7)*
 79. **Prior to construction of final design**, RG LNG shall file drawings of the storage tank piping support structure and support of horizontal piping at grade including pump columns, relief valves, pipe penetrations, instrumentation, and appurtenances. *(section 4.12.1.7)*
 80. **Prior to construction of final design**, RG LNG shall include LNG storage tank fill flow measurement with high flow alarm. *(section 4.12.1.7)*
 81. **Prior to construction of final design**, RG LNG shall include BOG flow measurement from each LNG storage tank. *(section 4.12.1.7)*
 82. **Prior to construction of final design**, RG LNG shall file the structural analysis of the LNG storage tank and outer containment demonstrating they are designed to withstand all loads and combinations. *(section 4.12.1.7)*
 83. **Prior to construction of final design**, RG LNG shall file an analysis of the structural integrity of the outer containment of the full containment LNG storage tank demonstrating it can withstand the radiant heat from a roof tank top fire or adjacent tank roof fire. *(section 4.12.1.7)*
 84. **Prior to construction of final design**, RG LNG shall file a projectile analysis to demonstrate that the outer concrete impoundment wall of the full-containment LNG tank could withstand projectiles from explosions and high winds. The analysis shall

- detail the projectile speeds and characteristics and method used to determine penetration or perforation depths. *(section 4.12.1.7)*
85. **Prior to construction of final design**, RG LNG shall file the sizing basis and capacity for the final design of the flares and/or vent stacks as well as the pressure and vacuum relief valves for major process equipment, vessels, and storage tanks. *(section 4.12.1.7)*
 86. **Prior to construction of final design**, RG LNG shall file a drawing showing the location of the emergency shutdown buttons. Emergency shutdown buttons shall be easily accessible, conspicuously labeled, and located in an area which will be accessible during an emergency. *(section 4.12.1.7)*
 87. **Prior to construction of final design**, RG LNG shall specify that all Emergency Shutdown valves will be equipped with open and closed position switches connected to the Distributed Control System/Safety Instrumented System. *(section 4.12.1.7)*
 88. **Prior to construction of final design**, and prior to injecting corrosion inhibitors into the 42-inch-diameter pipeline at any time during the life of the plant, RG LNG shall file the information used to determine that an inhibitor is required, the material data sheet for the inhibitor, the amount injected, and the schedule of injections. *(section 4.12.1.7)*
 89. **Prior to construction of final design**, the feed gas flow to the Inlet Gas/Gas Exchanger (E-1701) shall include a high temperature alarm and shutdown to protect from exposure to hot feed gas. *(section 4.12.1.7)*
 90. **Prior to construction of final design**, the De-ethanizer (C-1701) shall include an additional cryogenic manual isolation valve downstream of shutoff valve (XV-117011). *(section 4.12.1.7)*
 91. **Prior to construction of final design**, RG LNG shall equip a low-low temperature shutdown on the temperature transmitter (TT-117014) located on the De-ethanizer bottoms discharge piping to detect temperatures that may reach below the minimum design metal temperature of the discharge piping transition from stainless to carbon steel. This shutdown shall include isolation under cryogenic conditions. *(section 4.12.1.7)*
 92. **Prior to construction of final design**, RG LNG shall file an explanation and justification for the dump lines located upstream of each LNG Loading Arm. *(section 4.12.1.7)*
 93. **Prior to construction of final design**, RG LNG shall file the complete range of anti-surge recycle conditions on the LP MR Compressor to confirm that the minimum temperature conditions will not require stainless steel piping. *(section 4.12.1.7)*
 94. **Prior to construction of final design**, RG LNG shall specify the set pressure of high pressure alarm (PAH-141002) is to be below the set pressure of regulator PCV-141005 on the Hot Oil Expansion Drum. *(section 4.12.1.7)*

95. **Prior to construction of final design**, RG LNG shall file the design details of the shelters to verify safe access in all weather conditions. (*section 4.12.1.7*)
96. **Prior to construction of final design**, RG LNG shall file drawings and specifications for crash rated vehicle barriers at each facility entrance for access control. (*section 4.12.1.7*)
97. **Prior to construction of final design**, RG LNG shall file drawings of the security fence. The fencing drawings should provide details of fencing that demonstrates it will restrict and deter access around the entire facility and has a setback from exterior features (e.g., power lines, trees, etc.) and from interior features (e.g., piping, equipment, buildings, etc.) that does not allow the fence to be overcome. (*section 4.12.1.7*)
98. **Prior to construction of final design**, RG LNG shall file security camera and intrusion detection drawings. The security camera drawings shall show the locations, areas covered, and features of each camera (e.g., fixed, tilt/pan/zoom, motion detection alerts, low light, mounting height, etc.) to verify camera coverage of the entire perimeter with redundancies, and cameras interior to the facility that will enable rapid monitoring of the terminal, including a camera at the top of each LNG storage tank, and coverage within pretreatment areas, within liquefaction areas, within truck transfer areas, within marine transfer areas, and buildings. The drawings shall show or note the location of the intrusion detection to verify it covers the entire perimeter of the terminal. (*section 4.12.1.7*)
99. **Prior to construction of final design**, RG LNG shall file lighting drawings. The lighting drawings shall show the location, elevation, type of light fixture, and lux levels of the lighting system and shall be in accordance with API 540 and provide illumination along the entire perimeter of the facility, process equipment, mooring points, and along paths/roads of access and egress to facilitate security monitoring and emergency response operations. The lighting drawings should address the issues raised in condition 22. (*section 4.12.1.7*)
100. **Prior to construction of final design**, RG LNG shall evaluate the terminal alarm system and external notification system design to ensure the location of the terminal alarms and other fire and evacuation alarm notification devices (e.g. audible/visual beacons and strobes) will provide adequate warning at the terminal and external off-site areas in the event of an emergency. (*section 4.12.1.7*)
101. **Prior to construction of final design**, RG LNG shall file an updated fire protection evaluation of the proposed facilities. A copy of the evaluation, a list of recommendations and supporting justifications, and actions taken on the recommendations shall be filed. The evaluation shall justify the type, quantity, and location of hazard detection and hazard control, passive fire protection, emergency shutdown and depressurizing systems, firewater, and emergency response equipment, training, and qualifications in accordance with NFPA 59A (2001). The justification for the flammable and combustible gas detection and flame and heat detection shall be in accordance with ISA 84.00.07 or equivalent methodologies that will demonstrate 90 percent or more of releases (unignited and ignited) that could result in an off-site or cascading impact will be detected by two or more

detectors and result in isolation and de-inventory within 10 minutes. The analysis shall take into account the set points, voting logic, wind speeds, and wind directions. The justification for firewater shall provide calculations for all firewater demands (including firewater coverage on the LNG storage tanks) based on design densities, surface area, and throw distance and specifications for the corresponding hydrant and monitors needed to reach and cool equipment. (*section 4.12.1.7*)

102. **Prior to construction of final design**, RG LNG shall file spill containment system drawings with dimensions and slopes of curbing, trenches, impoundments, and capacity calculations considering any foundations and equipment within impoundments, as well as the sizing and design of the down-comer that will transfer spills from the tank top to the ground-level impoundment system. The spill containment drawings shall show containment for all hazardous fluids, including all liquids handled above their flashpoint, from the largest flow from a single line for 10 minutes, including de-inventory, or the maximum liquid from the largest vessel (or total of impounded vessels) or otherwise demonstrate that providing spill containment will not significantly reduce the flammable vapor dispersion or radiant heat consequences of a spill. In addition, RG LNG should demonstrate that the stainless steel piping spill trays at each LNG storage tank will withstand the force and shock of a sudden cryogenic release. (*section 4.12.1.7*)
103. **Prior to construction of final design**, RG LNG shall file an analysis demonstrating the side on overpressures will be less than 1 psi at the LNG storage tanks and the condensate storage tanks, or demonstrating the tanks will be able to withstand overpressures within the terminal. (*section 4.12.1.7*)
104. **Prior to construction of final design**, RG LNG shall file complete drawings and a list of the hazard detection equipment. The drawings shall clearly show the location and elevation of all detection equipment. The list shall include the instrument tag number, type and location, alarm indication locations, and shutdown functions of the hazard detection equipment. (*section 4.12.1.7*)
105. **Prior to construction of final design**, RG LNG shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of the hazard detectors when determining the lower flammable limit set points for methane, propane, ethane/ethylene, and condensate. (*section 4.12.1.7*)
106. **Prior to construction of final design**, RG LNG shall file a list of alarm and shutdown set points for all hazard detectors that account for the calibration gas of hazard detectors when determining the set points for toxic components such as natural gas liquids and hydrogen sulfide. (*section 4.12.1.7*)
107. **Prior to construction of final design**, RG LNG shall file a technical review of facility design that:
 - a. identifies all combustion/ventilation air intake equipment and the distances to any possible flammable gas or toxic release; and
 - b. demonstrates that these areas are adequately covered by hazard detection devices and indicates how these devices will isolate or shut down any

combustion or heating ventilation and air conditioning equipment whose continued operation could add to or sustain an emergency. (section 4.12.1.7)

108. **Prior to construction of final design**, RG LNG shall file an analysis of the off gassing of hydrogen in battery rooms and ventilation calculations that limit concentrations below the lower flammability limits (e.g., 25 percent LFL) and shall also provide hydrogen detectors that alarm (e.g., 20 to 25 percent LFL) and initiate mitigative actions (e.g., 40 to 50 percent LFL). (section 4.12.1.7)
109. **Prior to construction of final design**, RG LNG shall file plan drawings and a list of the fixed and wheeled dry-chemical, hand-held fire extinguishers, and other hazard control equipment. Plan drawings shall clearly show the location and elevation by tag number of all fixed dry chemical systems in accordance with NFPA 17, wheeled and hand-held extinguishers location travel distances are along normal paths of access and egress in accordance with NFPA 10. The list shall include the equipment tag number, type, capacity, equipment covered, discharge rate, and automatic and manual remote signals initiating discharge of the units. (section 4.12.1.7)
110. **Prior to construction of final design**, RG LNG shall file a design that includes clean agent systems in the instrumentation buildings and electrical substations. (section 4.12.1.7)
111. **Prior to construction of final design**, RG LNG shall file facility plan drawings showing the proposed location of the firewater and any foam systems. Plan drawings shall clearly show the location of firewater and foam piping, post indicator valves, and the location and area covered by each monitor, hydrant, hose, water curtain, deluge system, foam system, water mist system, and sprinkler. The drawings shall also include piping and instrumentation diagrams of the firewater and foam systems. In addition, firewater coverage shall include the coverage of each LNG storage tank. (section 4.12.1.7)
112. **Prior to construction of final design**, RG LNG shall demonstrate that the firewater tank would be in compliance with NFPA 22 or demonstrate how API 650 provides an equivalent or better level of safety. (section 4.12.1.7)
113. **Prior to construction of final design**, RG LNG shall specify that the firewater flow test meter is equipped with a transmitter and that a pressure transmitter is installed upstream of the flow transmitter. The flow transmitter and pressure transmitter shall be connected to the Distributed Control System and recorded. (section 4.12.1.7)
114. **Prior to construction of final design**, RG LNG shall specify the dimension ratio (DR) to be DR 7 for the high density polyethylene piping to allow consistent pressure rating requirements with the firewater system. (section 4.12.1.7)
115. **Prior to construction of final design**, RG LNG shall file drawings and specifications for the structural passive protection systems to protect equipment and supports from cryogenic releases. (section 4.12.1.7)

116. **Prior to construction of final design**, RG LNG shall file calculations or test results for the structural passive protection systems to demonstrate that equipment and supports are protected from cryogenic releases. (*section 4.12.1.7*)
117. **Prior to construction of final design**, RG LNG shall file drawings and specifications for the structural passive protection systems demonstrating that equipment and supports are protected from pool and jet fires. (*section 4.12.1.7*)
118. **Prior to construction of final design**, RG LNG shall file a detailed quantitative analysis to demonstrate that adequate mitigation will be provided for each significant component within the 4,000 Btu/ft²-hr zone from pool and jet fires that could cause failure of the component, including the Jetty Monitor Buildings and the LNG Storage and Loading Substation 2. Trucks at the truck loading/unloading areas shall be included in the analysis. A combination of passive and active protection for pool fires and passive and/or active protection for jet fires shall be provided and demonstrate the effectiveness and reliability. Effectiveness of passive mitigation shall be supported by calculations or test results for the thickness limiting temperature rise and active mitigation shall be justified with calculations or test results demonstrating flow rates and durations of any cooling water will mitigate the heat absorbed by the vessel. (*section 4.12.1.7*)
119. **Prior to construction of final design**, RG LNG shall file specifications and drawings demonstrating how cascading damage of transformers will be prevented (e.g., firewalls or spacing) in accordance with NFPA 850 or equivalent. (*section 4.12.1.7*)
120. **Prior to construction of final design**, RG LNG shall file an evaluation of the voting logic and voting degradation for hazard detectors. (*section 4.12.1.7*)
121. **Prior to commissioning**, RG LNG shall file a detailed schedule for commissioning through equipment startup. The schedule shall include milestones for all procedures and tests to be completed: prior to introduction of hazardous fluids and during commissioning and startup. RG LNG shall file documentation certifying that each of these milestones has been completed before authorization to commence the next phase of commissioning and startup will be issued. (*section 4.12.1.7*)
122. **Prior to commissioning**, RG LNG shall file detailed plans and procedures for: testing the integrity of onsite mechanical installation; functional tests; introduction of hazardous fluids; operational tests; and placing the equipment into service. (*section 4.12.1.7*)
123. **Prior to commissioning**, RG LNG shall file the procedures for pressure/leak tests which address the requirements of ASME VIII and ASME B31.3. The procedures shall include a line list of pneumatic and hydrostatic test pressures. (*section 4.12.1.7*)
124. **Prior to commissioning**, RG LNG shall file a plan for clean-out, dry-out, purging, and tightness testing. This plan shall address the requirements of the American Gas Association's Purging Principles and Practice, and shall provide justification if not using an inert or non-flammable gas for clean-out, dry-out, purging, and tightness testing. (*section 4.12.1.7*)

125. **Prior to commissioning**, RG LNG shall file the operation and maintenance procedures and manuals, as well as safety procedures, hot work procedures and permits, abnormal operating conditions reporting procedures, simultaneous operations procedures, and management of change procedures and forms. (*section 4.12.1.7*)
126. **Prior to commissioning**, RG LNG shall tag all equipment, instrumentation, and valves in the field, including drain valves, vent valves, main valves, and car-sealed or locked valves. (*section 4.12.1.7*)
127. **Prior to commissioning**, RG LNG shall file a plan to maintain a detailed training log to demonstrate that operating, maintenance, and emergency response staff have completed the required training. (*section 4.12.1.7*)
128. **Prior to commissioning**, RG LNG shall file the settlement results from hydrostatic testing the LNG storage containers as well as a routine monitoring program to ensure settlements are as expected and do not exceed applicable criteria in API 620, API 625, API 653, and ACI 376. The program shall specify what actions would be taken after seismic events. (*section 4.12.1.7*)
129. **Prior to commissioning**, RG LNG shall equip the LNG storage tank and adjacent piping and supports with permanent settlement monitors to allow personnel to observe and record the relative settlement between the LNG storage tank and adjacent piping. The settlement record shall be reported in the semi-annual operational reports. (*section 4.12.1.7*)
130. **Prior to introduction of hazardous fluids**, RG LNG shall complete and document all pertinent tests (e.g., Factory Acceptance Tests, Site Acceptance Tests, Site Integration Tests) associated with the Distributed Control System/Safety Instrumented System that demonstrates full functionality and operability of the system. (*section 4.12.1.7*)
131. **Prior to introduction of hazardous fluids**, RG LNG shall develop and implement an alarm management program to reduce alarm complacency and maximize the effectiveness of operator response to alarms. (*section 4.12.1.7*)
132. **Prior to introduction of hazardous fluids**, RG LNG shall develop and implement procedures for plant personnel to monitor the rocket launches from the Brownsville SpaceX facility and take mitigative actions before and after a rocket launch failure to minimize the potential of release reaching offsite areas or resulting in cascading effects that could extend offsite or impact safe operations. (*section 4.12.1.7*)
133. **Prior to introduction of hazardous fluids**, RG LNG shall complete and document a firewater pump acceptance test and firewater monitor and hydrant coverage test. The actual coverage area from each monitor and hydrant shall be shown on facility plot plan(s). (*section 4.12.1.7*)
134. **Prior to introduction of hazardous fluids**, RG LNG shall complete and document a prestartup safety review to ensure that installed equipment meets the design and operating intent of the facility. The prestartup safety review shall include any changes since the last hazard review, operating procedures, and operator training.

A copy of the review with a list of recommendations, and actions taken on each recommendation, shall be filed. *(section 4.12.1.7)*

135. RG LNG shall file a request for written authorization from the Director of OEP **prior to unloading or loading the first LNG commissioning cargo**. After production of first LNG, RG LNG shall file **weekly** reports on the commissioning of the proposed systems that detail the progress toward demonstrating the facilities can safely and reliably operate at or near the design production rate. The reports shall include a summary of activities, problems encountered, and remedial actions taken. The weekly reports shall also include the latest commissioning schedule, including projected and actual LNG production by each liquefaction train, LNG storage inventories in each storage tank, and the number of anticipated and actual LNG commissioning cargoes, along with the associated volumes loaded or unloaded. Further, the weekly reports shall include a status and list of all planned and completed safety and reliability tests, work authorizations, and punch list items. Problems of significant magnitude shall be reported to the FERC **within 24 hours**. *(section 4.12.1.7)*
136. **Prior to commencement of service**, RG LNG shall label piping with fluid service and direction of flow in the field, in addition to the pipe labeling requirements of NFPA 59A (2001 edition). *(section 4.12.1.7)*
137. **Prior to commencement of service**, RG LNG shall file plans for any preventative and predictive maintenance program that performs periodic or continuous equipment condition monitoring. *(section 4.12.1.7)*
138. **Prior to commencement of service**, RG LNG shall develop procedures for offsite contractors' responsibilities, restrictions, and limitations and for supervision of these contractors by RG LNG staff. *(section 4.12.1.7)*
139. **Prior to commencement of service**, RG LNG shall notify the FERC staff of any proposed revisions to the security plan and physical security of the plant. *(section 4.12.1.7)*
140. **Prior to commencement of service**, RG LNG shall file a request for written authorization from the Director of OEP. Such authorization will only be granted following a determination by the Coast Guard, under its authorities under the Ports and Waterways Safety Act, the Magnuson Act, the MTSA of 2002, and the Security and Accountability For Every Port Act, that appropriate measures to ensure the safety and security of the facility and the waterway have been put into place by RG LNG or other appropriate parties. *(section 4.12.1.7)*

In addition, conditions 141 through 144 shall apply **throughout the life of the Rio Grande LNG Terminal**.

141. The facilities shall be subject to regular FERC staff technical reviews and site inspections on at least an **annual basis** or more frequently as circumstances indicate. Prior to each FERC staff technical review and site inspection, RG LNG shall respond to a specific data request including information relating to possible design and operating conditions that may have been imposed by other agencies or

organizations. Up-to-date detailed P&IDs reflecting facility modifications and provision of other pertinent information not included in the semi-annual reports described below, including facility events that have taken place since the previously submitted annual report, shall be submitted. (*section 4.12.1.7*)

142. **Semi-annual** operational reports shall be filed with the Secretary to identify changes in facility design and operating conditions; abnormal operating experiences; activities (e.g., ship arrivals, quantity and composition of imported and exported LNG, liquefied quantities, boil off/flash gas); and plant modifications, including future plans and progress thereof. Abnormalities shall include, but not be limited to, unloading/loading/shipping problems, potential hazardous conditions from offsite vessels, storage tank stratification or rollover, geysering, storage tank pressure excursions, cold spots on the storage tanks, storage tank vibrations and/or vibrations in associated cryogenic piping, storage tank settlement, significant equipment or instrumentation malfunctions or failures, non-scheduled maintenance or repair (and reasons therefore), relative movement of storage tank inner vessels, hazardous fluids releases, fires involving hazardous fluids and/or from other sources, negative pressure (vacuum) within a storage tank, and higher than predicted boil off rates. Adverse weather conditions and the effect on the facility also shall be reported. Reports shall be submitted **within 45 days after each period ending June 30 and December 31**. In addition to the above items, a section entitled “Significant Plant Modifications Proposed for the Next 12 Months (dates)” shall be included in the semi-annual operational reports. Such information will provide the FERC staff with early notice of anticipated future construction/maintenance at the LNG facilities. (*section 4.12.1.7*)
143. In the event the temperature of any region of any secondary containment, including imbedded pipe supports, becomes less than the minimum specified operating temperature for the material, the Commission shall be notified **within 24 hours** and procedures for corrective action shall be specified. (*section 4.12.1.7*)
144. Significant non-scheduled events, including safety-related incidents (e.g., LNG, condensate, refrigerant, or natural gas releases; fires; explosions; mechanical failures; unusual over pressurization; and major injuries) and security-related incidents (e.g., attempts to enter site, suspicious activities) shall be reported to the FERC staff. In the event that an abnormality is of significant magnitude to threaten public or employee safety, cause significant property damage, or interrupt service, notification shall be made **immediately**, without unduly interfering with any necessary or appropriate emergency repair, alarm, or other emergency procedure. In all instances, notification shall be made to the FERC staff **within 24 hours**. This notification practice shall be incorporated into the LNG facility’s emergency plan. Examples of reportable hazardous fluids-related incidents include:
- a. fire;
 - b. explosion;
 - c. estimated property damage of \$50,000 or more;
 - d. death or personal injury necessitating in-patient hospitalization;

- e. release of hazardous fluids for 5 minutes or more;
- f. unintended movement or abnormal loading by environmental causes, such as an earthquake, landslide, or flood, that impairs the serviceability, structural integrity, or reliability of an LNG facility that contains, controls, or processes hazardous fluids;
- g. any crack or other material defect that impairs the structural integrity or reliability of an LNG facility that contains, controls, or processes hazardous fluids;
- h. any malfunction or operating error that causes the pressure of a pipeline or LNG facility that contains or processes hazardous fluids to rise above its maximum allowable operating pressure (or working pressure for LNG facilities) plus the build-up allowed for operation of pressure-limiting or control devices;
- i. a leak in an LNG facility that contains or processes hazardous fluids that constitutes an emergency;
- j. inner tank leakage, ineffective insulation, or frost heave that impairs the structural integrity of an LNG storage tank;
- k. any safety-related condition that could lead to an imminent hazard and cause (either directly or indirectly by remedial action of the operator), for purposes other than abandonment, a 20 percent reduction in operating pressure or shutdown of operation of a pipeline or an LNG facility that contains or processes hazardous fluids;
- l. safety-related incidents from hazardous fluids transportation occurring at or en route to and from the LNG facility; or
- m. an event that is significant in the judgment of the operator and/or management even though it did not meet the above criteria or the guidelines set forth in an LNG facility's incident management plan.

In the event of an incident, the Director of OEP has delegated authority to take whatever steps are necessary to ensure operational reliability and to protect human life, health, property, or the environment, including authority to direct the LNG facility to cease operations. Following the initial company notification, the FERC staff would determine the need for a separate follow-up report or follow-up in the upcoming semi-annual operational report. All company follow-up reports shall include investigation results and recommendations to minimize a reoccurrence of the incident. (*section 4.12.1.7*)