Audubon NORTH CAROLINA

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U.S. Army Corps of Engineers
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Dear Mr. Sugg,

Please accept these comments on behalf of the North Carolina state office of the National Audubon Society regarding the Final Environmental Impact Statement (FEIS) for the project known as "Figure 8 Island Terminal Groin Project."

After reviewing the document and appendices, available scientific literature and data, and current conditions at Rich Inlet, we find that the FEIS fails to meet its legal obligation under NEPA to "rigorously explore and objectively evaluate all reasonable alternatives" (Section 1502.14), and "serve as the means of assessing the environmental impact of proposed agency actions, rather than justifying decisions already made" (Section 1502.2(g)). Additionally, the FEIS fails to meet its legal obligation under Section 7 of the Endangered Species Act to "use the best scientific and commercial data available" (Section 7 (a)(2)) to evaluate the impacts of the proposed alternatives on listed species.

Most importantly, we find that the applicant's preferred alternative, the construction of a terminal groin and renourishment of adjacent beach with sand mined from Rich Inlet, would result in significant habitat loss and degradation in the NC-11 Critical Habitat Unit for wintering Piping Plovers, jeopardize the recovery of the Endangered Great Lakes population of Piping Plovers, and negatively affect the Threatened Atlantic Coast population. The FEIS avoids this conclusion by:

1. Significantly understating the amount of habitat that would be lost or degraded under the applicant's preferred alternative. Contrary to the FEIS's unsupported conclusions, the proposed terminal groin would adversely impact Critical Habitat Unit NC-11 by removing 60% of the primary constituent elements of habitat for Piping Plovers found at Rich Inlet. Significantly fewer Piping Plovers occur at inlets with modifications similar to those in the applicant's preferred alternative, and annual survivorship was lower at modified sites than at natural inlets. Because they have high site fidelity and do not have the option to go elsewhere if their non-breeding habitat is modified, loss of individuals can be reasonably expected at Rich Inlet if the preferred alternative is permitted.

2. Omitting to report the significant indirect and cumulative impacts the preferred alternative would have on populations of Piping Plovers. The FEIS fails to include the fact that at least 18% of endangered Great Lakes Piping Plovers and at least 2% of threatened Atlantic Coast Piping Plovers use Rich Inlet during migration and winter. Decreasing survivorship of adults and first-year birds that

depend on Rich Inlet would therefore impact a significant proportion of those populations, especially the Great Lakes population. Population modeling shows that small changes in adult survival affect the possibility of achieving the both populations' recovery goals, especially the smaller Great Lakes population. Further, over half of the inlets in the Piping Plover's non-breeding range have already been modified in some way. As a result, the proposed alterations to habitat at Rich Inlet would jeopardize the Endangered Great Lakes population's prospect of meeting its recovery goals. The Threatened Atlantic Coast population would also be negatively impacted.

Because of these impacts, and other problems with the FEIS document, the applicant's preferred alternative cannot be permitted.

We also note that temporary actions taken by the applicant to reduce the threat of erosion have succeeded, and Rich Inlet has naturally shifted on its own, making installation of a permanent structure like a terminal groin unnecessary, costly, and inappropriate, particularly given the loss of habitat for federally listed species that would occur under the preferred alternative. Less costly, less destructive alternatives are available if the oceanfront beach narrows in the future. These include, but are not limited to, temporary use of sandbags or renourishing the beach with sand obtained from an offshore borrow site at intervals of no less than every five years.

(1) The FEIS grossly underestimates amount of habitat for federally listed species that will be negatively affected by the preferred alternative.

The preferred alternative would negatively affect habitat at Rich Inlet through three primary mechanisms which we have described in detail in our earlier comments on the SEIS. We briefly summarize those mechanisms below.

Removal of Sand from the Rich Inlet System

Hard structures at inlets result in the permanent loss of sand from the inlet system by disrupting natural sand transport, inlet migration, and overwash, thereby reducing or eliminating ebb and flood shoal systems from affected inlets (Pilkey *et al.* 1998). Hard structures at inlets also accelerate the loss of saltmarsh in the vicinity of the inlet (Hackney and Cleary 1987).

If a terminal groin is installed on the north end of Figure 8 Island, intertidal sand flats and saltmarsh will be permanently lost, along with the extensive emergent spit on the north end Figure 8 Island. Similar impacts can be seen all along the Atlantic coast wherever a terminal groin is installed: Over time, extensive spits and shoals are lost and do not reform. Scouring behind the western side of the terminal groin may also occur as can be seen on the north end of Masonboro Island, NC, East Bay, MA, and Murrells Inlet, SC and could require frequent renourishment or hardened structures such as the rock wall seen at Midway Inlet, SC.

In addition to losses of sand through disruption of natural inlet transport systems, the FEIS does not address the loss of sediment from Rich Inlet through sand mining and channelization of the inlet. This loss of marsh, intertidal habitat, and dry sand beach will be exacerbated by the removal of sand from Rich Inlet for the proposed renourishment of the beach on Figure 8 Island. Furthermore, given the likelihood that renourishment will be needed at more frequent intervals to maintain the Figure 8 Island shoreline, it is likely that additional sand will be removed more frequently from the inlet, beyond what is forecast in the FEIS, thereby further reducing the amount of sediment available to maintain the primary constituent elements of Piping Plover Critical Habitat throughout Rich Inlet.

Downdrift Erosion

A terminal groin would create erosion of the Figure 8 Island beach downdrift of the structure, narrowing the beach and leading to additional beach renourishment projects. These effects are well known and documented extensively in scientific literature, yet not addressed in the FEIS. Longshore currents run predominantly north to south in the area of Figure 8 Island, placing nearly all of the oceanfront homes on Figure 8 Island in danger from accelerated erosion, should a terminal groin be built. Downdrift erosion could affect other sites, including Mason Inlet, which is already a mitigation site for a different inlet stabilization project, and Wrightsville Beach, which already receives regular beach renourishment.

The FEIS's proposed five-year interval for beach renourishment is questionable given the effects of downdrift erosion and the fact that Wrightsville Beach, Carolina Beach, and southern Figure 8 Island, are replenished more frequently, and beaches in the vicinity of the terminal groins at Fort Macon and Oregon Inlet also require more frequent renourishment projects. Additional beach renourishments would add to the cost of the preferred alternative, result in additional negative impacts to federally-listed species, and impact other protected species as well.

Artificial Stabilization

A terminal groin would stabilize the area immediately to its south. This would result in vegetative succession that will overtake and eliminate the open, sandy beach habitat that is required by beach-nesting species including the Piping Plover, roosting shorebirds such as Piping Plover and Red Knot, and habitat for federally-listed Seabeach Amaranth. This effect can be seen locally at the north end of Masonboro Island. The FEIS fails to mention this negative impact.

Foreseeable Habitat Impact

Through these three mechanisms and the reasonable expectation that the need for additional beach renourishment will require even more sand mining in the future, Critical Habitat at Rich Inlet will be lost. Based on responses of other inlets to terminal groins and well-known coastal processes, we find that the amount of habitat that would be lost at Rich Inlet under the preferred alternative is approximately 241 acres of high-quality habitat that supports Piping Plovers, Red Knots, and other shorebirds, plus additional saltmarsh and dry beach habitat. The 241 acres of habitat lost would be primarily low-energy intertidal shoals and sandbars which provide habitat for a variety of benthic invertebrates that are essential food for shorebirds and fishes, and the emergent sandy spit which is prime nesting habitat for Piping Plovers and other beach-nesting birds. By eliminating the spit on the north end of Figure 8 Island and interfering with natural sediment transport throughout the inlet system, the preferred alternative would adversely impact Critical Habitat Unit NC-11, eliminating approximately 60% (241 of 401 acres) of the total primary constituent elements of habitat for Piping Plovers in Rich Inlet and at least 25% of all the primary constituent elements of habitat for Piping Plovers in the unit (Fig. 1). These affected habitats are where the majority of Piping Plovers have been observed in the past seven years at Rich Inlet (Addison and McIver 2014, Audubon North Carolina unpublished data). Other habitat affected would be salt marsh supporting larval fish and crustaceans and dry beach habitat that in a naturally dynamic state would support seabeach amaranth.

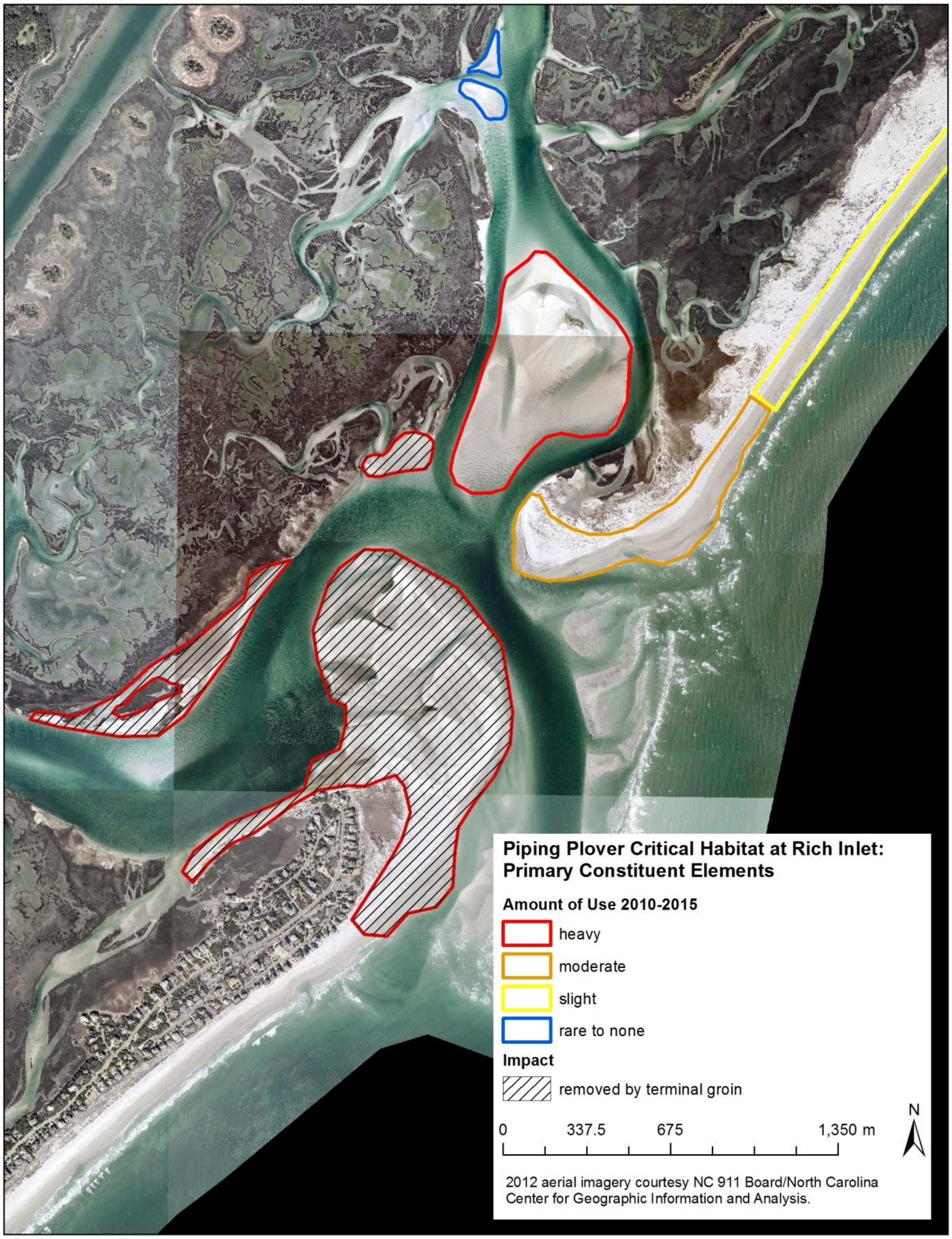

Figure 1. Habitat used by Piping Plovers at Rich Inlet, 2011-2016. Heavy: seen on appropriate tide approximately >75% of visits; moderate: seen on appropriate tide approximately 25%-50% of visits; slight: seen on appropriate tide approximately <25% of visits; rare to none: not seen or seen fewer than 5 visits in a year.

Unsupported FEIS Predictions

The FEIS ignores the large, well-documented body of knowledge regarding the harmful physical impacts of terminal groins, beach renourishment, and sand mining. It instead makes erroneous assumptions by first relying on models that were never intended for the use they are put to and that have already failed to predict 2012 conditions when run using 2006 conditions (see FEIS, Fig. 5.2a-5.7a; for actual 2012 conditions, see FEIS, Fig. 5.2b). The FEIS itself casts doubt on its own

modeling, repeatedly stating the models cannot predict future conditions and that future conditions are unknown or difficult to forecast, even as it uses models to predict future conditions. For example:

"The model results are by no means intended to represent predictions of what changes to expect in the future with certainty, as this would require an ability to predict future weather and oceanic conditions" (p. 209).

"The EIS acknowledges the reduction of piping plover habitat along the northern end of Figure 8 Island for the terminal groin options, but it also discloses that the magnitude and extent of any long-term or cumulative impacts to the bird's habitat is unknown and is difficult to determine over the 30-year study period" (Appendix I, #92).

Second, the FEIS fails to model ongoing sand loss beyond the initial five years of the project (FEIS, Appendix B pp. 176-181). This is a critical omission because impacts of the project, and associated loss of habitat, will continue over the 30-year lifespan of the project. Instead, the FEIS makes vague and unsupported generalizations that ignore the sediment deficit that the terminal groin and sand mining will create:

"After the initial post-construction effects on the north side of the terminal groin equilibrate, it is anticipated that the presence of intertidal flat and shoal habitats will be largely dictated by the migration and position of the inlet bar channel over the 30-year study period" (p. 452).

Third, the FEIS does not consistently rely on the most recent data for its modeling and instead cherry picks periods of severe erosion to predict impacts of a terminal groin although the long-term trend on Figure 8 Island has been "net progradation" (Appendix B, p. 56). For example, its Summary of Impacts Table (Table 5.1) is now attributed to "2006 shoreline conditions" (p. 212) when net loss of habitat would appear less because in 2006 there were fewer intertidal shoals and the spit was smaller.

Fourth, the FEIS simply ignores listed species' habitat requirements—and in some cases its own predictions—and draws the unsupported conclusion that Piping Plovers and other listed species will not be significantly affected. For example, loss of the spit is discussed by the FEIS in Appendix B (pp.176-181), and a loss of 25% of its area is forecast in the first five years. Despite this, the FEIS finds no significant habitat loss for Piping Plovers and other listed species, even though that is where the majority of Piping Plovers observations are made and seabeach amaranth plants are found.

Fifth, in order to justify the applicant's preferred alternative, the FEIS consistently presents natural erosion and accretion of barrier islands, barrier island spits, and ebb and flood shoals as having a positive or negative impact on listed species. Although it can result in temporary habitat loss, natural change at the coast is the primary mechanism that ensures the persistence of nesting, resting, and foraging habitat for Piping Plovers (USFWS 1996a), shorebirds, and other species. Stabilization of barrier islands such as occurs through the construction of a terminal groin or other coastal engineering projects causes negative direct, indirect, and cumulative impacts which permanently degrade or remove habitat, and which cannot be avoided if the applicant's preferred alternative is permitted.

(2) The FEIS fails to use the best available scientific data to objectively evaluate the impact of the preferred alternative on federally listed species that regularly occur in Rich Inlet.

Four species listed as Threatened or Endangered under the Endangered Species Act (ESA) regularly occur at Rich Inlet: Piping Plovers (*Charadrius melodus*), Red Knots (*Calidris canutus rufa*), loggerhead sea turtles (*Caretta caretta*), and seabeach amaranth (*Amaranthus pumilus*).

<u>Impacts to Piping Plovers and Red Knots</u>

Piping Plovers have three breeding populations: the Northern Great Plains, Great Lakes, and Atlantic Coast from North Carolina to maritime Canada. Piping Plovers winter in the Southeastern U.S. from North Carolina to Florida, the Gulf side of Florida to Texas, Mexico, and parts of the Caribbean. The Great Lakes breeding population is Endangered, and the Atlantic Coast and Northern Great Plains breeding populations are Threatened. Among the reasons for their status is the prevalence of inlet stabilization and relocation, sand mining and dredging, groins, and beach renourishment (USFWS 1996a, USFWS 2009). Critical Habitat has been designated for wintering Piping Plovers, and Piping Plover Critical Habitat Unit NC-11 includes Lea-Hutaff Island and the emergent shoals and sandbars within Rich Inlet (USFWS 2001).

Banded Piping Plovers seen at Rich Inlet represent all three breeding populations. A total of 45 uniquely banded individual Piping Plovers were observed at Rich Inlet during January 2007-May 2016 (Audubon North Carolina unpublished data). These individuals were banded as chicks or nesting adults in Michigan, New York, Canada, North Dakota, North Carolina, Wisconsin, and Virginia, or as non-breeding birds in South Carolina and the Bahamas. The greatest number of banded Piping Plovers (29 individuals) documented at Rich Inlet were from the Endangered Great Lakes breeding population; 11 were from the Atlantic coast population, four were from the Great Plains population, and one, which was banded in the Bahamas, was not seen on its breeding grounds (Audubon North Carolina unpublished data).

Piping Plovers occur at Rich Inlet year-round. They nest at Rich Inlet in small numbers; for the past three years (2014-2016) 1-2 pairs have nested on the north end of Figure 8 Island (NCWRC unpublished data). They have also nested on the south end of Hutaff Island within the project area, though not within the past six years (Audubon North Carolina unpublished data). Flocks also occur at Rich Inlet during spring and fall migration. Migration and winter counts at Rich Inlet are among the highest in the state, equaled or exceeded only at Cape Hatteras and Cape Lookout (eBird 2016, John Fussell personal communication).

Threatened Red Knots occur at Rich Inlet from fall through spring, where they forage in low-energy intertidal areas, on the oceanfront beach, and along the marsh edge and roost on spits and flood tide shoals (Audubon North Carolina unpublished data). The largest flocks are found during spring migration in April and May. In 2016, the peak single survey count was 270, and spring counts regularly exceeded 150 in all of the past five years (Audubon North Carolina unpublished data). Cape Lookout and Cape Hatteras are the only sites in the state that currently support larger flocks (John Fussell personal communication, eBird 2016, NCWRC unpublished data). Banded individuals at Rich Inlet were captured in Florida, Delaware, New Jersey, Massachusetts, and Argentina and resighted in Ontario, Massachusetts, New Jersey, Delaware, North Carolina, South Carolina, Georgia, and Florida (Audubon North Carolina unpublished data). When Red Knots were listed as Threatened in 2014, one of the primary causes was "U.S. shoreline stabilization and coastal development" (USFWS 2013).

The loss of sediment leading to loss of 60% of primary constituent elements of habitat in Critical Habitat Unit NC-11 would have significant adverse impacts on the habitats at Rich Inlet that both Piping Plovers and Red Knots depend on. However, the FEIS ignores the robust body of peer-reviewed scientific literature that shows preferential use of inlets and associated low-energy intertidal flats by Piping Plovers during migration and winter Piping Plovers (Haig and Oring 1985, Johnson and Baldassarre 1988, Nicholls and Baldassarre 1990, Harrington 2008, Lott *et al.* 2009, Maddock *et al.* 2009). It also ignores literature demonstrating that during nesting, Piping Plovers are also often associated with natural coastlines, including unmodified inlets and overwash fans (Kisiel 2009a, 2009b; NPS 2014a, 2014b).

Though it cites some of these articles, the FEIS pointedly declines to connect the Piping Plover's habitat preferences with negative impacts to them should that habitat be degraded or destroyed. Instead, it explicably references data that (despite appearing to sum counts from all surveys which is not standard scientific practice) shows a decline in Piping Plover observations at Oregon Inlet to support its claim that Piping Plovers will not be negatively impacted by a terminal groin (p. 375-376). It also uses data that shows fewer Piping Plovers using stabilized Masonboro Inlet than natural Rich Inlet to, again, support its claim that Piping Plovers will not be impacted by a terminal groin (p. 376). The source that the FEIS cites for the Oregon Inlet data is the North Carolina Costal Resources Commission's final report on terminal groins. That report concluded that

[T]he presence of the terminal groin [at Oregon Inlet]*, as well as other actions such as dredging and nourishment, has adversely modified habitat important to piping plovers by eliminating intertidal flats and allowing encroachment of vegetation in stabilized areas, and generally impeding inlet dynamics that create and maintain habitats piping plovers require* (NCCRC 2010).

The report also found that, in general,

Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (NCCRC 2010).

Beach renourishment, which is proposed for all alternatives except Alternative 2, will also negatively impact Piping Plovers, Red Knots, and other shorebirds because it depresses populations of the infaunal organisms (species that live within the sediment) that are their primary prey. Every recovery or management plan that pertains to Piping Plovers (USFWS 1996a, 2001, 2003, 2009) or Red Knots (USFWS 2013) recognizes the importance of infaunal organisms and their habitats. The diversity and abundance of shorebirds on beaches was positively correlated with the diversity and abundance of macroinvertebrate prey, and when a decline in prey was observed, a decrease in foraging shorebirds, gulls, and other seabirds was also observed (Dugan and Hubbard 2006, Dugan *et al.* 2008). In Bogue Banks, NC, the abundance of foraging shorebirds was depressed for two years following one renourishment and four years following another (Peterson *et al.* 2014).

The FEIS largely overlooks impacts of the alternatives on the infaunal community at Rich Inlet and Figure 8 Island and consistently understates impacts to these organisms. The SEIS repeatedly uses the terms "short-term" and "resilient" (for examples, see pages 291, 295, 297, 330, 331, 332, 333, 334, 350, 352, 354, 382, 385, 409, 410) when addressing the impacts to the infaunal community, which is misleading because some organisms take up to four years to recover (Jaramillo *et al.* 1987, Peterson *et al.* 2014). For example, one study found a 48% average reduction in invertebrates and a decline in taxon richness following beach renourishment, which was primarily driven by decreases in polychetes and *E. talpoida*, which are primary prey species for Piping Plovers and Red Knots, respectively (Woolridge *et al.* 2016). These declines existed through the end of the 15-month study period. In North Carolina, *Emerita talpoida* (mole crab) abundance recovered within months on nourished beaches compared to control beaches, but *Donax* spp. (coquina clam) and amphipods did not recover within the time frame of the study (Peterson *et al.* 2006). Peterson *et al.* (2014) monitored the recovery of a sandy beach community for 3-4 years following nourishment and documented that haustoriid amphipods (small crustaceans) and *Donax* spp. had reduced densities for 3-4 years following nourishment, *E. talpoida* had lower densities for 1-2 years following nourishment. Given these recovery times, even the optimistic five-year cycle that the FEIS suggests would result in 40% reduction in foraging availability if recovery takes two years.

Despite the loss of both habitat and prey base that would result from the preferred alternative, the FEIS suggests repeatedly that the project will increase habitat for listed species:

"The increased area of dry beach on the south side of the groin as a result of nourishment as well as the retention of sediment within the accretion fillet will result in positive indirect impacts including the increased habitat for nesting sea turtles, resting and nesting shorebirds, and seabeach amaranth" (p. 407, 454).

To the contrary, the 17-69 foot increase in beach width that the FEIS forecasts south of the terminal groin (p. 454) will not benefit these species, and would not compensate for the loss of hundreds of acres of excellent habitat already at Rich Inlet. Rather, stabilization of the beach in the immediate area of the terminal groin will result in vegetative succession which over time will remove the open, sandy habitat that Piping Plovers, as well as other beach-nesting species, require. An example of this effect is the north end of Masonboro Island, which hosted large numbers of nesting birds prior to the installation of the terminal groin there in 1981 (NCWRC Colonial Waterbird Database).

The results of loss of habitat and loss of prey base due to coastal engineering projects that disrupt natural coastal processes in order to stabilize inlets can be seen in southeast North Carolina at two formerly natural inlets. Masonboro Inlet is significantly modified with two hard structures and regular dredging and Mason Inlet is artificially stabilized with dredging. We conducted weekly (during migration) and bi-weekly (during winter) boat-based bird surveys at Rich Inlet, Mason Inlet, and Masonboro Inlet from January 2014-May 2016 to determine how birds used each site.

For Piping Plovers, significant differences occurred between the three inlets (Kruskal-Wallis test, $p<0.001$). <u>Pairwise multiple comparison tests found that significantly more Piping Plovers were observed at Rich Inlet compared to highly modified Mason and Masonboro Inlets</u> (Dunn's test, $p<0.05$). The numbers of Piping Plovers observed at Masonboro Inlet and Mason Inlet were not statistically different. For Red Knots, significant differences also occurred between the three inlets (Kruskal-Wallis test, $p<0.001$). Pairwise multiple comparison tests found that <u>significantly more Red Knots were observed at Rich Inlet than Mason and Masonboro Inlets</u> (Dunn's test, $p<0.05$). It is apparent that Piping Plovers and Red Knots rely on Rich Inlet to a significantly greater extent than they rely on the two nearby modified inlets, likely because of the greater amount of low-energy, intertidal foraging habitat there.

The impacts of modifications to non-breeding habitats are beginning to be quantified in other ways as well. Annual survival of Piping Plovers is influenced by conditions at non-breeding sites (Roche *et al.* 2010); therefore, what happens at migration stopover and wintering sites can have an effect on Piping Plover populations. Preliminary results of research that is currently underway indicate that Piping Plover body condition and annual survival is lower at sites with human recreation or modifications than at more natural sites. Further, fewer Piping Plovers enter the populations at these sites. Finally, survival of Piping Plovers from the Great Lakes population is lower at disturbed sites than among Piping Plovers from other populations (Daniel Catlin and Daniel Gibson personal communication). The beach modifications at the study sites were multiple beach renourishments, a groin installation, and two inlet relocations. These are among the alternatives proposed in the FEIS, and the preferred alternative would involve both a terminal groin and beach renourishments. Based on these results, it is logical to expect a significant decline in Piping Plovers at Rich Inlet should the preferred alternative be permitted.

Because Piping Plovers exhibit site fidelity (Drake et al. 2001, Noel and Chandler 2008, Stucker and Cuthbert 2006, Addison and McIver 2014; Gratto-Trevor *et al.* 2012, Gratto-Trevor *et al.* 2016) and use small core home ranges during the winter months (Drake *et al.* 2001), the importance of specific inlets such as Rich Inlet to individuals is magnified. Based on the comparison of Piping Plover abundance at modified versus unmodified inlets, the differential rate of survival at modified versus unmodified sites, and their high site fidelity, it is clear that loss of 60% of Piping Plover habitat at Rich Inlet will negatively impact its carrying capacity for migrating and wintering Piping Plovers, and the individual plovers that use Rich Inlet will not be able to "go somewhere else."

Range-wide band resight studies find that Piping Plovers using the southeast coast during non-breeding months are predominantly from the Atlantic and Great Lakes breeding populations (Stucker and Cuthbert 2006, Gratto-Trevor *et al.* 2009, Gratto-Trevor *et al.* 2012). In particular, an estimated 57% of the Great Lakes population winters from North Carolina to the Atlantic coast of Florida; most of the rest are on Florida's Gulf Coast (Gratto-Trevor *et al.* 2012). Therefore, the applicant's preferred alternative would have the greatest effect on the Great Lakes and Atlantic Coast Piping Plover populations which migrate through and winter in North Carolina. Though the Critical Habitat Units for wintering Piping Plovers span a geography from North Carolina to Texas, a smaller subset (about 36% of total area of CHUs) support the Great Lakes population, magnifying the impact of modifications to Rich Inlet for Great Lakes Piping Plovers and for Atlantic Coast Piping Plovers.

The Endangered Great Lakes breeding population consisted of between 55-75 breeding pairs from 2010-2015 (Vincent Cavalieri personal communication), with an average of 64 pairs or 128 breeding adults. In 2016, preliminary results found 72-74 breeding pairs (Vincent Cavalieri personal communication). Between January 2007 and May 2016, Audubon North Carolina documented at least 29 banded individuals from the Endangered Great Lakes breeding population (Addison and McIver 2014, Audubon North Carolina unpublished data). It is highly likely that more individuals from the Great Lakes breeding population depend on Rich Inlet during migration and winter because it is highly unlikely weekly surveys document every individual that utilizes Rich Inlet during migration.

The importance of Rich Inlet to the Endangered Great Lakes breeding population of Piping Plovers cannot be overstated. Based on 74 breeding pairs and an estimated additional 30 adult birds that haven't bred yet, and about 120 fledglings produced in a typical year with an estimated first-year survival rate of 35-37% (Vincent Cavalieri personal communication), and an adult survival rate of 74% (Wemmer *et al.* 2001), next March the Great Lakes population will consist of about 132 individuals two years of age or older, plus about 44 first-year birds after accounting for typical first-year mortality for a total of about 176 Great Lakes Plovers. Given at least 29 individuals known to be from the Great Lakes population, detectability rates, brood-marked individuals, and not all Great Lakes piping plovers being banded, we estimate that <u>Rich Inlet supports at least 18% and likely over 20% of the Great Lakes breeding population.</u>

The Atlantic Coast breeding population of Piping Plovers averaged 1,800 pairs or 3,600 breeding adults from 2010-2015 (the most recent years for which final data is available) (USFWS 2015). The peak, single-survey counts of Piping Plovers at Rich Inlet in fall 2014 and 2015 (38 and 44, respectively) comprise more than 2% of the Atlantic breeding population of Piping Plovers (Addison and McIver 2014, Audubon North Carolina unpublished data). This qualifies the Rich Inlet complex as a Wetland of International Importance under the Ramsar Convention and a site of hemispheric significance by the Western Hemisphere Shorebird Network.

However, peak migration counts do not reflect the total number of individual Piping Plovers that depend on habitats at Rich Inlet. Most individuals use Rich Inlet during migration to refuel, rest, and gain sufficient energetic reserves to continue on to wintering or breeding sites. Stopover duration can vary from just a few days to as much as one month (Noel and Chandler 2005; Stucker and Cuthbert 2006). Weekly surveys during migration at Rich Inlet indicated that stopover duration for the majority of banded Piping Plovers was one week or less during spring (99.1%) and fall (63.2%) (Audubon North Carolina unpublished data). <u>The mean number of non-breeding Piping Plovers that depend on Rich Inlet based on a stopover duration of one week for January 2011-September 2015 is estimated at 256 individuals (range 96-443).</u>

These proportions indicate that Rich Inlet is essential to the survival and recovery of the Great Lakes population of Piping Plovers and nearly as important to the recovery of the Atlantic coast population. Modeling shows that Piping Plover populations in general (Calvert *et al.* 2006, Brault 2007, Melvin and Gibbs 1994) and the Great Lakes population in particular (Wemmer *et al.* 2001) are most sensitive to small declines (1-20%) in adult and first-year survivorship. The five-year status review of the Piping Plover states:

The most consistent finding in the various population viability analyses (PVAs) conducted for piping plovers (Ryan et al. 1993, Melvin and Gibbs 1996, Plissner and Haig 2000, Wemmer et al. 2001, Larson et al. 2002, Calvert et al. 2006, Brault 2007) is the sensitivity of extinction risk to even small declines in adult and/or juvenile survival rates. […] *Progress toward recovery would be quickly slowed or reversed by even small sustained decreases in survival, and it would be difficult to increase current fecundity levels sufficiently to compensate for widespread long-term declines in survival* (USFWS 2009).

In addition to permanently causing degradation and loss of high-quality habitat in the inlet's immediate area, the negative cumulative impacts of a terminal groin, beach renourishment, sand mining, or other inlet stabilization projects at Rich Inlet would extend beyond its boundaries. Piping Plovers, Red Knots, and other birds that use the coast are not sedentary species. They undertake annual migrations that encompass thousands of miles. Winter and migration stopover sites are critical to their survival during the non-breeding season. Because of the nature of their life history, protecting a single site or even several sites, is not sufficient to protect healthy populations or recover threatened or endangered ones. Therefore, loss of sites that shorebirds depend on during one part of the year or on one step of their journeys cannot be considered insignificant. The quality of nesting habitat, for example, is unimportant if birds cannot survive the winter to migrate back in the spring; thus, adversely impacting one Critical Habitat Unit adversely impacts the ability of other Critical Habitat Units to support the recovery of listed species.

This is important because Rich Inlet exists in a landscape of coastal development, inlet modification, and beach renourishment that extends throughout the Piping Plover's U.S. breeding and winter ranges (Tables 1 and 2). In North Carolina, 85% of inlets have been modified with hard structures, dredging, relocation, sand mining, or artificial opening or closing. Throughout the U.S. winter range, 54% of inlets have seen some form of modification (Rice 2012b). In the U.S. breeding range, 69% of inlets have been modified (Rice 2015). And additional projects continue to be proposed, including two in South Carolina (Hunting Island and Captain Sam's Inlet) and one in Georgia (Gould's Inlet), increasing the extent of cumulative impacts to Piping Plover habitat.

Table 1. Number of inlets and number of modified inlets in the Piping Plover's U.S. winter range (after Rice 2012b).

	# of inlets	**# modified**	**% modified**
NC	20	17	85%
SC	47	21	45%
GA	23	6	26%
FL – Atlantic	21	19	90%
FL – Gulf	48	24	50%
AL	4	4	100%
MS	6	4	67%
LA	34	10	29%
TX	18	14	78%
Total – Atlantic coast	111	63	57%
Total – Atlantic and Gulf coasts	221	119	54%

Table 2. Number of inlets and number of modified inlets in the Piping Plover's U.S. breeding range (after Rice 2015).

	# of inlets	**# modified**	**% modified**
ME	21	9	43%
NH	3	3	100%
MA	122	81	66%
RI	17	9	53%
CT	56	48	86%
NY	133	93	70%
NJ	11	10	91%
DE	1	1	100%
MD	1	1	100%
VA	14	2	14%
NC	20	17	85%
Total	399	274	69%

In the Piping Plover's U.S. winter range, approximately 32% of sandy beaches have received sand placements, including 91.3 miles of North Carolina's coastline out of 326 total miles (28%) (Rice

2012a). In its U.S. breeding range, approximately 33% had previously received sediment prior to Hurricane Sandy (Rice 2015). Of Critical Habitat Units for wintering Piping Plovers, 29% have received beach renourishment; from Florida to North Carolina, the heart of the Great Lakes breeding population's range, 41% have received renourishment; and within North Carolina, 39% have received renourishment (USFWS 2009 Table WM2).

The cumulative impact of these modifications to Piping Plover habitat—as well as to Red Knots which use similar habitat during migration—is to diminish carrying capacity and survivorship at large proportions of sites throughout the Piping Plover's range. Habitat loss at Rich Inlet takes place in this context and must be analyzed as such. It would negatively impact survivorship of migrating and over-wintering Piping Plovers from the Great Lakes and Atlantic Coast populations. Impacts at Rich Inlet would therefore jeopardize the survival and recovery of the Great Lakes population because significant proportions of those groups use Rich Inlet at some point in their annual cycle and because significant proportions of their Critical Habitat has already been lost or degraded altered throughout their range. This information and analysis of cumulative impacts is wholly absent from the FEIS.

Other Impacts to Birds

Rich Inlet is one of the most important sites in North Carolina for many other species of nesting, migrating, and wintering birds. A total of 100 species of birds were observed at Rich Inlet from January 2010-May 2016, including 26 species of shorebirds (sandpipers, plovers, and their relatives) (Addison and McIver 2014, Audubon North Carolina unpublished data). Of these 100 species, 29 (29%) are of conservation concern, either as federally listed species, state-listed species, or identified as declining or otherwise vulnerable by various watch lists.

Permanent loss of the spit from the north end of Figure 8 Island would reduce nesting habitat available for Wilson's Plovers, American Oystercatchers, Least Terns, Common Terns, and Black Skimmers. Loss of similar habitat at Mason Inlet resulted in decreases in numbers of nesting birds at Mason Inlet (Gilstrap *et al.* 2013). Non-breeding shorebirds occurring in Rich Inlet rely on the same roosting and foraging habitats that Piping Plovers do. For all bird species and for all shorebird species, during January 2014-May 2016, significant differences occurred between Rich, Mason and Masonboro Inlets (Kruskal-Wallis test, $p<0.001$). Pairwise multiple comparison tests found that significantly more birds and shorebirds were observed at Rich Inlet than Mason and Masonboro Inlets (Dunn's test, $p<0.05$) (Audubon North Carolina unpublished data). The FEIS does not take this data into account, even though it demonstrates that habitat alterations such as those in the applicant's preferred alternative decrease the carrying capacity of inlets for multiple species of birds.

The FEIS repeatedly misrepresents the direct impacts of construction during the winter months to wintering populations of shorebirds. It states that construction work in "a November 16th-March 31st window would take place when the [bird] species populations utilizing the intertidal flats and shoal are at their lowest" (p. 324). To the contrary, peak annual counts of birds at Rich Inlet came within that window in 2015 and 2012, and large flocks occur there regularly from November through March in all survey years (Addison and McIver 2014, Audubon North Carolina unpublished data). The area is also used constantly throughout the winter by a flock of Piping Plovers, including in 2016 four wintering members of the Great Lakes population (Audubon North Carolina unpublished data). Further, Piping Plover migration begins in late February (Haig and Oring 1985), and in the past three years at Rich, peak March counts of Piping Plovers were 17, 32, and 17 (Audubon North Carolina unpublished data). As with all peak counts, these numbers under-represent the total number of individuals using the inlet, as they do not account for turnover rates as migrants arrive, rest and refuel, and depart.

Instead of using the data cited above, which was supplied multiple times to the Corps, the FEIS uses two monitoring regimes, one at New River Inlet which is a consultant's report, and one at Bogue Inlet which is uncited to support its finding of no direct impacts to Piping Plovers or other bird species during wintertime work (p. 324). However, no pre-construction monitoring was conducted to determine if or how abundance and habitat use was affected by the projects. All monitoring is instead described as "during construction," providing no before-after comparison. Therefore, the FEIS cannot draw conclusions about whether Piping Plovers or other species were directly impacted by the projects.

<u>Impacts to Seabeach Amaranth</u>

Seabeach amaranth (*Amaranthus pumilus*) is a federally Threatened plant historically found on Atlantic beaches from Massachusetts to South Carolina; it currently occurs in New York, New Jersey, Delaware, Virginia, North Carolina, and South Carolina (USFWS 2007). It is found on barrier island beaches where it occurs in sparsely vegetated areas on overwash fans, the accreting ends of barrier islands, and the toe of foredunes.

Seabeach amaranth was listed due to its extirpation from two-thirds of its historic range and its vulnerability to threats including the construction of beach stabilization structures, beach erosion, beach grooming, pedestrian and vehicular traffic, and consumption by insects and feral animals. Of these threats, habitat loss and degradation resulting from coastal engineering were considered the most serious (USFWS 1996b, USFWS 2007) because it "appears to need extensive areas of barrier island beaches and inlets, functioning in a relatively natural and dynamic manner, allowing it to move around in the landscape, occupying suitable habitat as it becomes available" (USFWS 1996b).

Attempts to stabilize shorelines that lead to vegetative succession are also detrimental to seabeach amaranth:

Attempts to halt beach erosion in the Carolinas and New York through beach hardening (sea walls, jetties, groins, bulkheads, etc.) appear invariably to destroy habitat for seabeach amaranth. Simply put, any stabilization of the shoreline is detrimental to a pioneer, upper beach annual, whose niche of "life strategy" is the colonization of unstable, unvegetated, or new land and which is unable to compete with perennial grasses. […] Groins have mixed effects on seabeach amaranth. Immediately upstream from a groin, accretion sometimes provides or maintains, at least temporarily, habitat for seabeach amaranth; immediately downstream, erosion usually destroys seabeach amaranth habitat. [...] In the long run, groins (if they are successful) stabilize upstream beach, allowing succession to perennials, rendering even the upstream side only marginally suitable for seabeach amaranth (USFWS 1996b).

The analysis of impacts to seabeach amaranth presented in the FEIS is not in accordance with the best available information on the species habitat requirements. A terminal groin would eventually result in the loss of the spit at the north end of Figure 8 Island, habitat that seabeach amaranth prefers and where the majority of plants were found in 2015 (Table 4.36). It would also cause downdrift erosion to the south, where according to the FEIS (Tables 4.27-4.35) the majority of plants were recorded in years for which Figure 8 Island data were reported. The FEIS repeatedly suggests that the fillet that would accrete behind the terminal groin would compensate for any other habitat loss by providing habitat for seabeach amaranth (e.g. pp. 407, 430, 455), but such stabilization negatively impacts seabeach amaranth according to its recovery plan (USFWS 1996b), which is not cited by the FEIS. Further, contrary to assertions in the FEIS that seabeach amaranth needs "protection" from "storm influenced damage" (p. 290), an 18-year review of rangewide data did not find a correlation between population size and tropical storm or hurricane activity (Rosenfeld *et al.* 2006).

<u>Impacts to Loggerhead Sea Turtles</u>

Federally Threatened loggerhead sea turtles (*Caretta caretta*) nest along the length of North Carolina's coast, including on Figure 8 Island, which is adjacent to the LOGG-N-04 critical habitat unit. They nest from May-August in North Carolina and hatchlings emerge from the nest 50-60 days after laying.

Contrary to the FEIS, the loggerhead sea turtle recovery plan emphasizes that the only beneficial impacts of nourishment are in cases where beaches are so highly eroded, there is "a complete absence of dry beach" (NMFS and USFWS 1991). Sea turtles will not benefit from the relatively short area of widened beach that may result from the construction of a terminal groin because they tend to avoid hard structures when emerging to nest. Lamont and Houser (2014) documented that loggerhead turtle nest site selection is dependent on nearshore characteristics, therefore any activity that alters the nearshore environment, such as the construction of groins or jetties, may impact loggerhead nest distribution. Loggerhead sea turtle nests on North Carolina beaches increased in number as distance from hard structures including piers and terminal groins increased (Randall and Halls 2014). Studies in Florida have also found avoidance behavior and decreased hatching success associated with a managed inlet (Herren 1999).

The FEIS does not address the impacts to sea turtles should beach renourishment intervals turn out to be similar to those at other North Carolina inlets with hardened structures, rather than at the five-year intervals it forecasts. Nesting activity on nourished beaches decreased for one to three years following nourishment events due to changes in the sand compaction, escarpment, and beach profile (NMFS and USFWS 1991, Steinitz *et al.* 1998, Trindell *et al.* 1998, Rumbold 2001, Brock *et al.* 2009), and renourishment can decrease survivorship of eggs and hatchlings by altering characteristics such as sand compaction, moisture content, and temperature of the sand (Leonard Ozan 2011).

(3) The FEIS fails to present a biological monitoring plan.

The FEIS proposes major, long-term alterations to a naturally functioning inlet without providing a monitoring plan for birds, infauna, and seabeach amaranth. Instead, it states that Dr. David Webster

"conducts shorebird and colonial waterbird monitoring throughout the year along the beachfront of Figure 8 Island and the areas surrounding Mason and Rich Inlet since 2008. These monitoring efforts are expected to continue for the foreseeable future (Webster, pers. comm.). It is anticipated that bird monitoring efforts will occur prior to construction of the groin and continue for at least two years thereafter. Annual monitoring reports will be submitted to the USACE and NC DCM for determining project impacts to endangered and threatened bird species" (p. 471).

Based on the information provided, it appears the FEIS proposes a continuation of Dr. Webster's surveys, which are restricted to Figure 8 Island and are insufficient to detect or measure impacts to Piping Plovers and other bird species throughout Rich Inlet. In fact, according to Table 4.8, the referenced monitoring efforts have failed even to produce any non-breeding data for Piping Plovers.

A similar vague statement regarding the continuation of existing work is made for seabeach amaranth (p. 471-472). There is no mention of monitoring for infaunal organisms. The FEIS also does not provide triggers for mitigation should there be adverse impacts, either to biological resources or oceanfront beach as the result of a terminal groin. This leaves the public and even property owners on Figure 8 Island with no obvious recourse if and when negative impacts arise.

(4) The FEIS fails to adequately respond to earlier comments that were provided by Audubon North Carolina and other agencies, organizations, and individuals.

Though the FEIS corrected some errors in consistency and addressed some omissions of data, we found that the revisions made to the FEIS were not sufficient to address the comments we provided in September 2015. A review of Appendix I shows that many of our concerns were not addressed at all. These include, most importantly, the population-level impacts to Piping Plovers, including to the Endangered Great Lakes population and the loss of over 60% of primary constituent elements in Rich Inlet, which is part of the NC-11 Critical Habitat Unit for Piping Plovers. We further note that even basic comments, such as requests to include all Piping Plover and seabeach amaranth data in relevant tables (4.7 and 4.8), from our organization as well as from the U.S. Fish and Wildlife Service were not acted upon. More generally, other concerns that were not adequately addressed include: 1) Failure to demonstrate possession of the basic property rights needed to construct the applicant's preferred alternative; 2) Failure to meet NEPA standards for objectivity, clarity, and brevity and Section 7 requirements for use of best data available; 3) Failure to present a realistic economic case for the preferred alternative; and 4) Failure to address loss of public trust resources. Our specific responses to comments in Appendix I of the FEIS are included in the attached "Response to Appendix I of the FEIS" below.

Conclusion

Throughout our comments we have presented the best available peer-reviewed research and scientific data to describe impacts of the preferred alternative on listed species at Rich Inlet. All of this information was equally available to the Corps, but it is essentially absent from the FEIS. Therefore, it is not possible that the FEIS has objectively, clearly, and accurately assessed impacts to listed species. The ESA requires that actions funded, authorized, or carried out by federal agencies are "not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species" (Section 7 (a) (2)). According to the USFWS,

> *Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features.* (USFWS 2016).

Given the failure of the FEIS to "use the best scientific and commercial data available" as required by the ESA (Section 7 (a) (2)); the known negative impacts of terminal groins, beach renourishment, and other inlet stabilization practices on the physical habitat elements that support Piping Plovers, other listed species, and their prey benthic base; the known presence of large proportions of Piping Plovers at Rich Inlet; and the demographic data that demonstrates the significance of these individuals to the survival and recovery of the Endangered Great Lakes population of Piping Plovers, the preferred alternative cannot be permitted.

Sincerely,

Heather Hahn
Executive Director/Vice President
Audubon North Carolina

cc: Pete Benjamin, USFWS Raleigh Field Office
Kathy Matthews, USFWS Raleigh Field Office
Todd Miller, North Carolina Coastal Federation
Derb Carter, Southern Environmental Law Center

Response to Appendix I of the FEIS

We found that most of Audubon North Carolina's prior comments that were enumerated in Appendix I of the FEIS were not adequately resolved for the reasons explained below.

#85 – The basic question of what happened to the report and data that we were informed was "destroyed" has not been answered. Instead, the Corps changed the citation to personal communication with Dr. Cleary.

#86 – The easements have still not been obtained, and public funds continue to be expended. We disagree that it is appropriate to continue incurring public costs in order to pursue a project that cannot legally proceed.

#87 – Chapter 5 remains inadequate to accurately and objectively assess the impacts of the alternatives presented. The FEIS is almost wholly unchanged from the SEIS, on which we previously commented extensively to support the assertion that the SEIS, and now the FEIS, either misrepresent or do not cite appropriate scientific literature and do not accurately describe the impacts of a terminal groin, beach nourishment, and inlet channelization. For a specific example of the persistence of this problem in the FEIS revisions, see the response to #95 below.

#88 – Even the Corps' response to this concern cedes that "it is difficult to make predictions using models." Given the inability of the 2006 models to predict the 2012 conditions at Rich Inlet, the FEIS has no basis for anticipating nourishment intervals of five years. The rationales we used for anticipating more frequent nourishment intervals are the fact that typical nourishment intervals in the area are fewer than five years, including on south Figure Eight Island, which is renourished about every three years (see FEIS Table 2.1) and the well-known downdrift impacts of terminal groins. Therefore, the FEIS does not address our concern that the terminal groin will create a demand for more frequent nourishments and therefore more frequent sand mining from Rich Inlet, both with negative impacts to Piping Plovers and other wildlife.

#89 – The Corps' response to this concern is in part this opaque statement: "As the 2010 Moffat Nichol terminal groin study demonstrated, the amount of resources concerning long-term effects from terminal groins, as allowed by the SB 110, is limited." It is unclear what is intended by this sentence. The second part of the response ("The EIS acknowledges the difference between Figure Eight's proposal and other terminal groins in NC, but disagrees that all the information is irrelevant and not useful in making general assessments.") does not address our concern. We agree that, to a degree, information concerning Oregon Inlet is relevant. To the contrary, we are concerned with the over-reliance of the SEIS and the FEIS on Overton's reports, which the FEIS continues to put forward a rationale for a Rich Inlet terminal groin but which are refuted in other coastal geologists' work at Oregon Inlet.

#90 – The response to this concern is to refer to assertions in Chapter 5 that salt marsh habitat will not be affected. For an example of these assertions see Chapter 5's discussion of Alternative 5A, which reports a consulting firm's unverified finding of no impact to salt marsh based on review of aerial imagery at Amelia Island, FL ("these inferences have not been verified," p. 362). We do not find this a compelling response to our concern that because terminal groins deplete sand from inlet systems (Pilkey *et al.* 1998), they accelerate erosion of nearby marsh (Hackney and Cleary 1987). We further note that the North Carolina Coastal Resources Commission's 2010 terminal groin report assessed the Amelia Island project as follows:

Prior to terminal groin construction, the Amelia Island shoreline was eroding over most of the first three miles, except for the first quarter mile. After construction, the shoreline has accreted substantially over the first half mile, but erosion is evident over the next 2.5 miles. This trend is even more evident once the beach nourishment is subtracted out (NCCRC 2010).

#91 – The second half of the concern expressed, that a terminal groin will remove far more sandy spit and intertidal habitat than is projected in Alternative 5D, remains unaddressed. These assertions rely on the output of models that have already failed to accurately predict current conditions and which the FEIS states "are by no means intended to represent predictions of what changes to expect in the future with certainty" (p. 209).

#92 – The response to this concern is a statement that there will be habitat loss at Rich Inlet and that the magnitude and extent is "unknown" and "difficult to determine over the 30-year study period." Given this statement, one questions how the applicants can have any confidence in the expected outcomes of the project, with severe potential impacts on habitat that Piping Plovers and Red Knots depend upon—particularly Piping Plovers from the Endangered Great Lakes population, .
#93 – "Noted" does not address our concern. The Corps' comment in #77 is in reference to construction activities not impacting migrating or wintering Piping Plovers. However, the paragraphs added to the FEIS about direct impacts during the construction phase cite consulting firms' monitoring reports that are not readily available and did not incorporate pre-construction monitoring to accurately measure impacts.

#94 – The treatment the benthos is given in the specific discussion of each of the alternatives appears to be identical to that in the SEIS, which was and is still inadequate. See the response to #95 below for why the additional material added to the FEIS's general discussion of impacts to the benthos is inadequate.

#95 – Our comments regarding the review of available peer-reviewed literature pertaining to impacts to benthic organisms and the presentation of literature available have not been adequately addressed. The FEIS cites six peer-reviewed articles, which is more than the two cited in the SEIS, and one presentation at a seminar. However, at least one of the new paper's results are misrepresented, and the given the amount of information available, the FEIS's summary of impacts to infaunal organisms remains inadequate.

The FEIS includes an additional four peer-reviewed publications (Gorzelany and Nelson 1987; Hayden and Dolan 1974; Colosio *et al.* 2007; Bilodeau and Bourgeois 2004) and one seminar presentation on pages 280-282 and in Table 5.16. This is not adequate to address the paucity of scientific literature cited in the FEIS. We conducted a non-exhaustive literature review which found over 50 peer-reviewed articles, over 75% of which found an impact to one or more species of benthic organism. Further, as occurred repeatedly in the SEIS, the FEIS misrepresents the content of peer-reviewed articles.

For example, the FEIS cites Colosio *et al.* (2007) on page 280, saying "The beach that received sediment similar to the native beach, [sic] the macrofaunal assemblage did not differ significantly from the non-nourished nearby beach following construction." However, Colosio *et al.* (2007) summarize their study in the abstract as follows:

We tested whether sediment descriptors (grain size structure and organic content) and macrobenthic assemblages (species composition and abundance) differed among replicated shores previously exposed to nourishment alone (N), nourishment in combination with pre-existing hard structures (N+H) or no nourishment (NoN) along about 50 km of shores of the Emilia Romagna region (North Adriatic Sea, Italy). There was large variation among shores. Two out of three N shores were nearly defaunated, while one N shore had species composition and abundances comparable to NoN shores. There were also large differences between N and N+H shores, the latter possessing higher abundances of organisms and the presence of species that do not usually occur in the nearshore surf habitats in this region. More than 50% of the variability in the benthic assemblages was related to variations in the grain size structure of the sediments among shores. The results suggest that beach nourishments may lead to modifications of sedimentary environments and inhabiting fauna, but the resulting effects may be strongly related to local conditions, which dictate the rate at which added sand is redistributed.

Further, in their Discussion, Colosio *et al.* (2007) state,

The results of the present study suggest that beach nourishments could have more serious effects on native beach habitats and assemblages than have been generally appreciated, leading to protracted modifications of sedimentary environments and inhabiting fauna over large spatial scale. Yet, predicting the effects of beach nourishment may be difficult, because they appear to be related to local conditions. [...] [T]he magnitude and duration of the effects may vary depending on several local factors, including the movements and redistribution of sediments in relation to bottom morphology and hydrodynamics.

Colosio *et al.* (2007) describe all nourished beaches receiving "sediment that consisted of relict sands, with unimodal granulometric distribution and the modal class between 250 and 125 lm, corresponding to the fine sand interval, and a low content (0.3–0.7%) of organic matter," so it is unclear why the FEIS assumed some nourished beaches received sediment that was similar to the native material and others did not.

Another of the articles added to the FEIS, Gorzelany and Nelson (1987), was cited in Peterson and Bishop (2000) as a study that was likely compromised by the proximity of the sites, leading to the experimental site's sediment contaminated the control site's. That paper was used in the FEIS to show a finding of mole crab recovery within two weeks of impact, but other more recent peer-reviewed studies found much longer recovery times for mole crabs (Peterson *et al.* 2014, Woolridge *et al.* 2016).

Due to the continued problems with reporting results and the lack of a thorough review of the literature available, we believe an objective review of the available literature is still not completed in the FEIS.

#97 – The response "See Comment #94" is not adequate to address the concerns expressed in this comment. The FEIS still fails to report the most relevant peer-reviewed research regarding impacts to the benthos, and it distorts the results of at least one of the papers that was added To the FEIS. Our concerns remain.

#98 – Adding the results of Rakocinski *et al.* (1996) to Table 5.16 and in two sentences does not adequately address our concerns, as explained above.

#99 – As described above, the additions were inadequate and fail to properly represent the findings of scientific research.

#100 – We note that a sentence has been added on page 169, but that Table 4.7 has not been updated with the 2015 data we provided. Instead of the count of 262 plants, 30 are reported for 2015. The question of why Dr. Webster did not provide 2011-2015 data for the SEIS has not been addressed, which is concerning, given the assertion (p. 471) that his work will provide the monitoring data should the project go forward.

#101 – The FEIS continues to assert erroneously that stabilizing dry beach habitat will benefit seabeach amaranth: "Any accretion in this area is expected to continue providing a stable oceanfront dry beach habitat for nesting turtles, shorebirds, and seabeach amaranth" (p. 408). "Noted" does not address our concern that the biology and habitat requirements of this threatened plant is poorly understood in the FEIS, particularly that seabeach amaranth—as well as beach-nesting birds—rely on dynamic barrier island shorelines for habitat, not stabilized dune systems where it competes poorly with other plant species.

#102 – The FEIS still does not cite the conclusions or recommendations of any of the relevant Threatened and Endangered species recovery plans, including those not only for sea turtles, but Piping Plovers and Red Knots as well. Our concern has not been addressed because without accurate and complete consideration of the known needs of these species, the biological impacts of the alternatives is incomplete.

#103 – The FEIS does not address impacts to surf zone fishes propagating upwards from impacts to benthic infauna. It asserts that the groin will not affect larval transport.

#104 – The response to this concern does not address or explain the lack of a second scoping meeting to reflect the change in the project to include a terminal groin.

#105 – "Noted" does not address our concern that at 2,696 pages, the FEIS does not conform to NEPA standards of 150 pages, or 300 pages for unusually complex projects.

#106 – We still find outdated imagery in Figure 3.1, and Figure 2.9 now calls all marked houses "current and/or previously threatened" without identifying which are currently threatened in the Corps' opinion. A recent site visit did not find any homes that appeared to be threatened at this time. "Currently" is even more alarmist than "imminently," as the former refers to something that is happening right now, whereas "imminently" just refers to something that will happen very soon. Our concerns have not been addressed.

#107 – The FEIS still uses an atypical worst-case scenario erosion rate to forecast the loss of up to 40 houses over the next 30 years, even though Rich Inlet has never remained in the Hutaff-side orientation for that many consecutive years. Therefore, we still find the FEIS overstates the risks of Alternatives 1 and 2 and overlooks less costly, less environmentally damaging solutions.

#108 – If roads and other infrastructure will not be rebuilt if they are lost to natural erosion, the cost to replace them cannot be counted as a "future economic impact." The FEIS continues to conflate assessed value with cost. If no funds will be expended, such as in the case of a road being lost and not replaced, then it cannot be equitably compared with cases in which funds will be expended, such as for the construction of a terminal groin.

#109 – If funds will not be expended to replace roads or infrastructure, a cost will not be incurred. The FEIS continues to conflate value with cost in order to inflate the cost of Alternatives 1 and 2 and make the preferred alternative more appealing.

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