BIOLOGICAL OPINION ON THE EFFECTS OF GRAND MARAIS BREAKWATER PROJECT ON THE GREAT LAKES PIPING PLOVER (*Charadrius melodus*) AND PIPING PLOVER CRITICAL HABITAT

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Introduction

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) on the Effects of Grand Marais Breakwater Project on the Great Lakes Piping Plover (*Charadrius melodus*), in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C., 1531 et seq.). We received the U.S. Army Corps of Engineer's (Corps) original request for formal consultation on September 21, 2007. Formal consultation was suspended in 2008 and began again in late 2009 (see consultation history below).

We base this Opinion on information provided in several documents, including the Revised Biological Assessment for the Pile Breakwater Reconstruction at Grand Marais Harbor, Michigan (USACE 2009a) (Revised BA), the Addendum to Revised Biological Assessment for the Pile Breakwater Reconstruction at Grand Marais Harbor, Michigan (USACE 2009b) (BA Addendum), the Grand Marais Shoreline Evaluation Modeling Report (Baird and Associates 2006) (Baird Modeling Report), and the White Paper on Discussion of Physical and Biological Impacts of the Proposed Grand Marais Breakwater Alternatives versus the No Project Scenario (Baird and Associates and Applied Ecological Services 2006) (White Paper). Other sources of information include site visits, telephone conversations and meetings with the Corps and species experts. A complete administrative record of this consultation is on file at the Service's East Lansing Field Office (ELFO).

Consultation History

March 11, 2002	Paul Allerding (Corps-Detroit District) sent Jack Dingledine (Service-ELFO) a request for a preliminary review of breakwater alternatives for Grand Marais, Michigan.
March 20, 2002	The Service responded by letter to the Corps, outlining concerns about piping plover and designated critical habitat and advising the Corps of their section 7 responsibilities under ESA.
November 24, 2003	The Corps requested the Service review and provide comments on the 50% design plan for a breakwater at Grand Marais harbor.
December 9, 2003	The Service responded by letter to the Corps, expressing concerns about potential impacts piping plover and piping plover critical habitat. The letter requested a thorough analysis, including coastal process modeling to understand the potential long-term effects of the proposed project on piping plover critical habitat.
February 24, 2004	The Corps responded to the Service's comments of December 9, 2003. While the Corps agreed that the project would have an effect on shoreline processes, they indicated the net effect would be beneficial to shoreline processes by protecting the beach area

	within the breakwater and by accruing sand in the area of the breakwater. The Corps stated that they did not anticipate any significant adverse impacts on beaches and did not believe that coastal process modeling was warranted at this time.
February 1, 2006	The Service, Corps, and Michigan Department of Environmental Quality (MDEQ) held a meeting to discuss the project and section 7 consultation requirements.
April 21, 2006	Christie Deloria (Service-ELFO) met with representatives from Burt Township, the Corps, and the Corps' consultants, Applied Ecological Services (AES) and W.F. Baird & Associates (Baird), to look at plover sites and discuss the project.
May-June 2006	The Service accompanied Baird on site visits and discussed development of a Biological Assessment (BA) with the Corps, Baird, and AES.
July 5, 2006	The Corps transmitted, via email, the White Paper on Discussion of Physical and Biological Impacts of the Proposed Grand Marais Breakwater Alternatives versus the No Project Scenario, prepared by Baird and AES. The email stated that, based on this White Paper, the BA would be written for the 55 degree breakwater alternative.
July 7, 2006	AES provided a draft BA to the Corps and Service.
July 20, 2006	The Corps sent the Service copies of Baird's Grand Marais Shoreline Evaluation Modeling Report.
July 28, 2006	The Service provided comments to the Corps on the draft BA.
Aug-Feb 2007	The Service, Corps, and AES held meetings to discuss the draft BA.
April 23, 2007	The Corps transmitted the final BA and requested formal consultation.
May 21, 2007	The Service submitted a response to the Corps' request for formal consultation, advising that initiation of consultation was premature as the Corps had not initiated National Environmental Policy Act (NEPA) compliance or selected a preferred alternative. As an Opinion analyzes the impacts associated with the preferred alternative developed under NEPA, the Service suggested continuation of informal consultation until the Corps selected a preferred alternative. Further, the Service recommended

	development of an Environmental Impact Statement (EIS) for the project, due to the breadth and extent of environmental impacts and the potential for controversy. The Service also recommended a public scoping process to disseminate information regarding the predicted shoreline impacts.
Aug-Sept 2007	The Service and Corps discussed issues outlined in our May 21, 2007 letter.
September 21, 2007	The Corps responded to the Service's May 21, 2007 letter, writing that the BA included a summary of the alternatives considered and identified the Preferred Alternative. Additionally, the White Paper provided information regarding the alternative selection process. The Corps clarified that the NEPA process had started and that coordination with the Service and development of a BA were part of the NEPA process. The Corps indicated they planned to write an Environmental Assessment (EA) since they had not determined if an EIS was required. Based on these factors, the Corps requested initiation of formal consultation.
October 19, 2007	The Service sent the Corps a letter, agreeing to begin formal consultation, with an intent to provide an Opinion by February 1, 2008.
November 1, 2007	The Service, Corps, National Park Service (NPS), MDEQ, and Michigan Department of Natural Resources (MDNR) attended an interagency coordination meeting to discuss the proposed action.
November 7, 2007	The Corps proposed June 1, 2008 as the new timeline for completion of the Opinion, with a public meeting to be held in mid to late June.
November 15, 2007	Upon recommendation of the Service, the Corps agreed to receive the Opinion after the mid-June public meeting. The Service agreed to provide a draft Opinion by June 1, 2008 and a final Opinion by July 15, 2008.
Nov 2007- Feb 2008	The Service and Corps held a number of conference calls to discuss the project, timelines, and the consultation.
May 7, 2008	The Service and Corps staff met with Amy Berglund, Sheri Davie, and Tom Baldini (staff for Senator Carl Levin, Senator Debbie Stabenow, and Representative Bart Stupak, respectively) to provide an update on the analysis in the Opinion and to discuss conservation measures.

May 7, 2008	The Service and Corps staff met in Grand Marais with Jack Hubbard (Burt Township Supervisor) and Scott Weiting (Burt Township Board Member) to discuss the project. Mr. Hubbard stated that the community did not support the 55 degree alternative and had begun engineering design studies for a different breakwater alignment. After the meeting, the Service indicated to the Corps that we would not perform further work on the Opinion until uncertainty regarding the desired alternative was resolved.
August 5, 2008	The Service submitted a letter to the Corps, stating that we had suspended work on the Opinion because the type and degree of impacts to piping plover and critical habitat could change with a different breakwater alignment.
September 26, 2008	The Service received a letter from the Corps, acknowledging that the Service was not proceeding with the Opinion. The Corps' letter stated that they did not believe the chosen alternative would change, but understood the Service's reservation with continuing with the Opinion until receiving further direction.
March 11, 2009	Jack Hubbard, Amy Berglund, Sheri Davie, Tom Baldini, Christie Deloria, Angela Mundell (Corps-Detroit District), and Wayne Schloop (Corps-Detroit District) met to discuss how Burt Township would like to proceed. The Township noted they would like to see a modified 15 degree alternative (only the partial length) constructed. Both the Corps and Service mentioned that changing the design would require further engineering and modeling studies.
March 20, 2009	Burt Township passed a resolution in support of the 55 degree alternative.
April 3, 2009	Because the township passed the aforementioned resolution, the Corps submitted a letter to the Service, requesting continuation of formal consultation on the original project description and delivery of the Opinion by August 31, 2009.
April 28, 2009	The Service responded by letter to the Corps' request for formal consultation. The Service recommend that the Corps request formal consultation after a public comment period in order to avoid the need to reinitiate consultation in the event that the proposed action changed based on public input. The Service also recommended that the Corps update the 2006 BA and provide clarification on several technical issues and inconsistencies between the BA and comments from Corps staff. The Service advised the Corps that formal consultation would begin after any

	necessary changes to the BA were made and outstanding issues identified in the Service's letter were resolved.
June 18, 2009	The Corps responded by letter that they would update the 2006 BA with new information and that they understood formal consultation would begin once the Service received the Revised BA. Because the Burt Township Board had passed a resolution in support of the 55 degree alternative, the Corps indicated they were not anticipating any design changes. The Corps stated that they wanted to include the Opinion as part of their draft EA and they were striving to complete engineering design and NEPA compliance by January 2010.
July 6, 2009	Paul Allerding sent an email to the Service, indicating that a draft Revised BA would be available by August 30, 2009.
July-Aug 2009	The Service, Corps, and Congressional staff participated in conference calls to discuss the status of the project and BA.
August 25, 2009	The Service agreed to work toward a December 1 date to complete the Opinion, with the understanding that the draft Revised BA would become available on September 4, 2009.
September 18, 2009	The Service received, via e-mail from Paul Allerding, a complete draft of the Revised BA for review and comment.
October 8, 2009	The Service provided comments to the Corps on the draft Revised BA, via an e-mail from Christie Deloria. Although the information in the BA and other information in our files was sufficient to begin formal consultation, several issues remained that required discussion and response from the Corps as part of the consultation.
Oct-Dec 2009	The Service participated in conference calls with the Corps and Congressional staff to discuss the outstanding issues.
October 16, 2009	The Service received the Revised BA via e-mail from Les Weigum (Corps-Detroit District). This Revised BA concluded that the proposed project was likely to adversely affect piping plover and piping plover critical habitat.
November 5, 2009	Paul Allerding provided responses, via email, from AES to the Service's comments on the draft Revised BA.
November 9-10, 2009	The Service received emails from Angela Mundell, regarding outstanding issues, such as ownership of accreted land and the potential for migration of the Sucker River mouth.

November 16, 2009	The Service sent an e-mail to the Corps, articulating information still needed from the Corps. The e-mail also included ordinance language for the Corps to share with Burt Township, as part of a conservation measure.
November 20, 2009	The Corps responded via email to the Service's request for information.
December 7, 2009	The Service received the final Revised BA, incorporating the Service's comments and AES responses, from the Corps via email from Paul Allerding. Later that day, the Service received the BA Addendum, via email from Les Weigum.

BIOLOGICAL OPINION

Description of the Proposed Action

Action Area

Grand Marais Harbor resides along the southern shore of Lake Superior in Alger County in Michigan's Upper Peninsula (Figure 1). The shoreline at Grand Marais is a low sandy plain, bookended on the west by a substantial bluff leading into the Grand Sable Banks and Dunes and on the east by another bluff in the vicinity of Lonesome Point (Figure 2). The western third of the harbor area and the Superior Beach area are predominantly residential with commercial developments interspersed.

Several streams flow into the harbor, including Sucker River in the eastern part of the harbor and Carpenter Creek in the western part. An intermittent stream enters the harbor just east of Carpenter Creek, and another small stream, Chipmunk Creek, runs into the harbor between Carpenter Creek and Sucker River. The Sucker River mouth has migrated up and down the shoreline over time and historically has exited into the western half of the harbor. The 2006 location of the Sucker River mouth was just north of Chipmunk Creek, but the mouth has migrated farther west since that time.

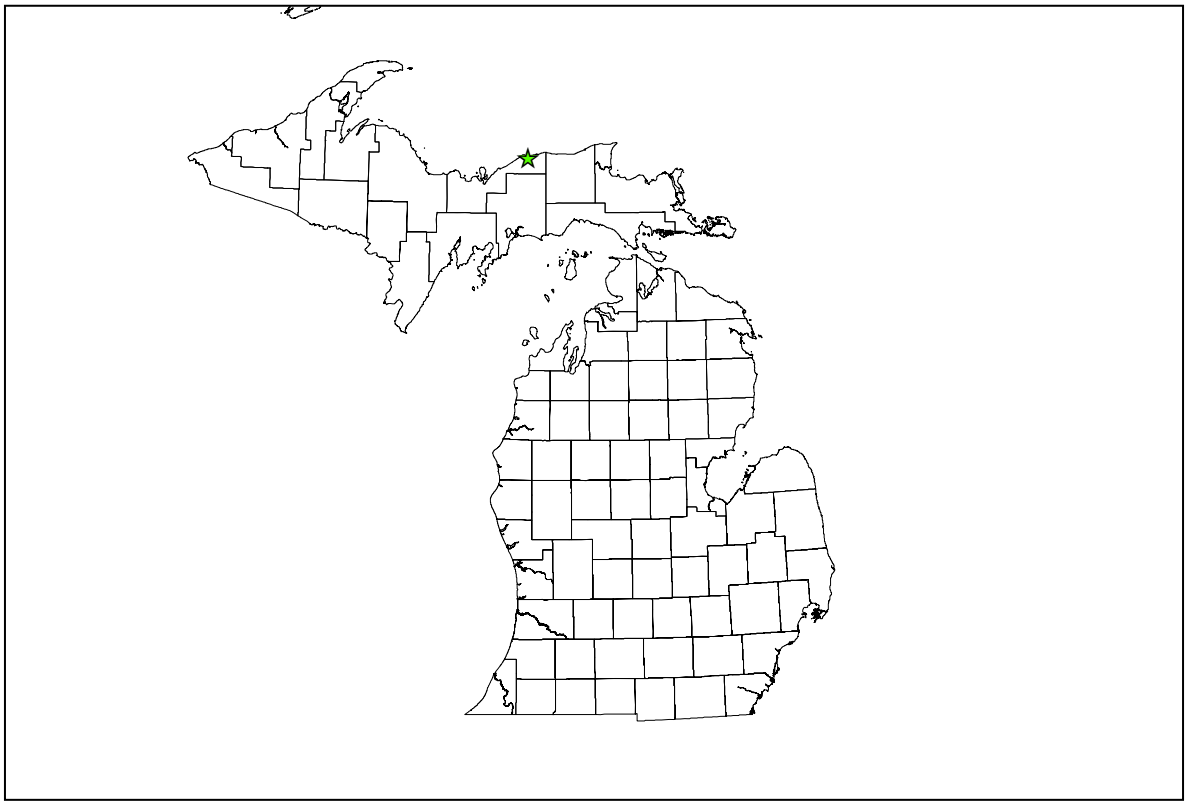

Figure 1. The location of Grand Marais, Michigan

Figure 2. Aerial photograph, from 10 May 2004, of Grand Marais Harbor highlighting and naming key features. Figure taken directly from the Baird Modeling Report.

Project Description

In the late 1800s, the Corps built a 5,770 foot timber pile breakwater at Grand Marais. The breakwater extended from a boat entryway channel, as formed by east and west jetties, eastward to Lonesome Point. After maintenance stopped in the mid-1900s, the timber pile breakwater began deteriorating. Today, very little remains of the original breakwater structure. The two entry jetties, however, remain intact and functional.

With the deterioration of the breakwater came the insurgence of sediment into the bay (Baird and Associates 2006). Baird and Associates (2006) identified three sources of this sediment: eastward transport around the entry piers, bluff erosion on the east end of the bay, and the redistribution of sediment that had accumulated behind the original breakwater.

The movement of these sediments into the bay has decreased the depth of the harbor such that only a small portion of deep water (>15m) remains (Baird and Associates 2006). To

address this need, the Corps' proposed project would reconstruct the breakwater within the harbor to provide a barrier against further sediment infilling and to improve wave sheltering in the bay (USACE 2009a).

Preferred Alternative

The Revised BA presents four alternatives, including a No Action alternative and three construction alternatives. The No Action alternative (Figure 3) serves as a baseline from which to compare the impacts of the action alternatives.

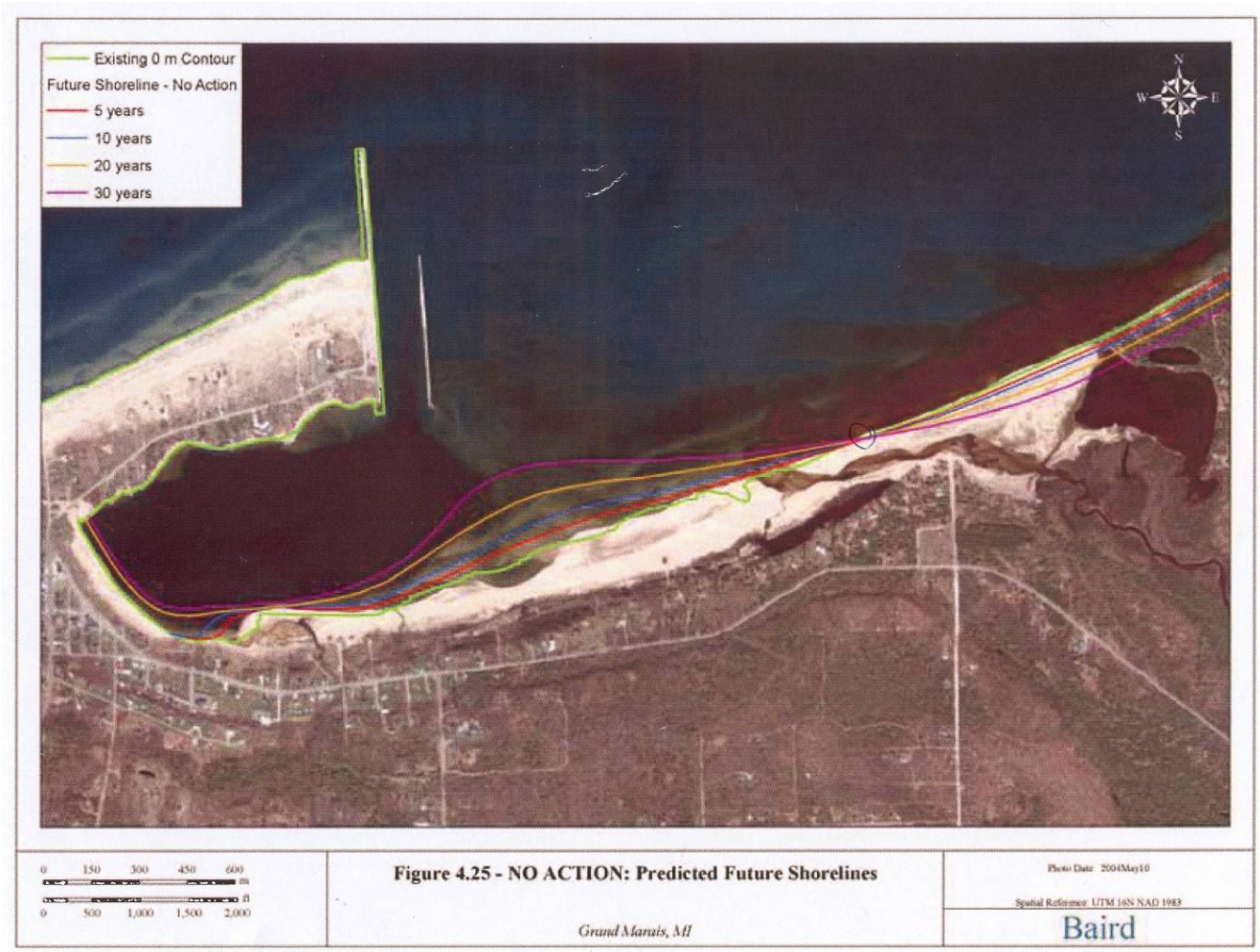

Figure 3. Predicted future Grand Marais shoreline locations without a breakwater at 5, 10, 20, and 30 years (after the year 2006). Figure taken directly from the Baird Modeling Report.

Construction of a breakwater at 55 degrees from the original alignment represents the Corps' Preferred Alternative (Figure 4). With a length of approximately 2,500 feet, the breakwater would consist of a rubble-mound structure that would connect to the southern end of the east jetty and extend landward. The design includes a straight length of breakwater with a small dogleg at the landward end, and although no direct connection to

the shore would occur, the dogleg would encourage a land connection to form (Baird and Associates 2006).

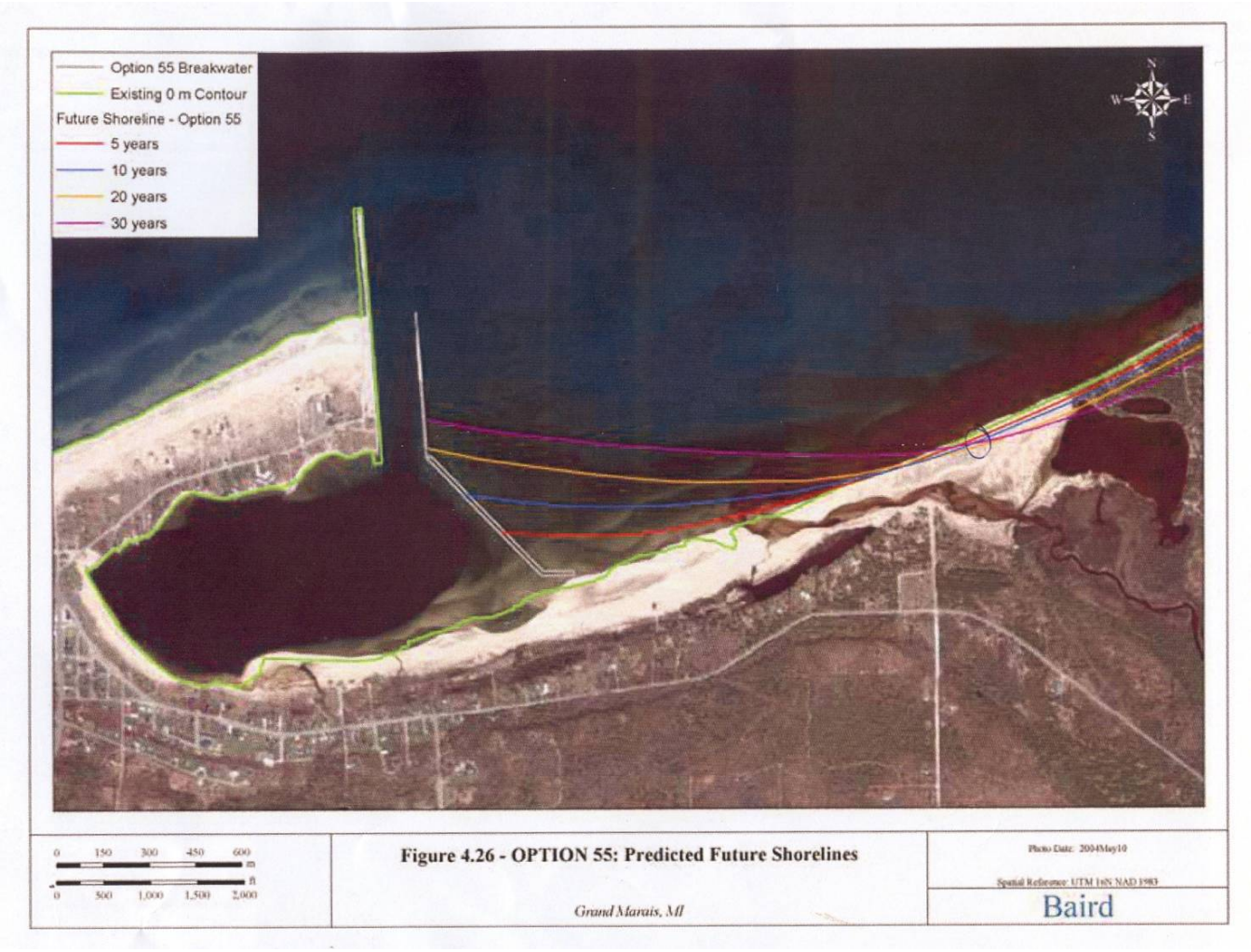

Figure 4. Predicted future Grand Marais shoreline locations at 5, 10, 20, and 30 years post construction of the 55 degree breakwater. Figure taken directly from the Baird Modeling Report.

The Revised BA states that construction of the breakwater would likely occur in a single year from May to October. Depending on the time frame of the construction contract award, availability of material, and weather conditions, however, it may be necessary to carry over construction into a second May to October construction season (L. Weigum, Corps, pers. comm. 2010). Construction activities would be water-based, utilizing cranes, supply barges, and tug boats. The Corps would not allow equipment, personnel, or materials on the beach in the vicinity of the piping plover nesting areas. In addition, the Revised BA lists the following specific construction activities:

1. mobilization of trailers to the west parking lot,
2. storage of stone material at the west parking lot area,

3. unloading of stone material from delivery trucks at the west parking lot area,
4. loading of stone onto barges that shuttle to and from the equipment that places the stone into position,
5. movement of supply vessels in and out of the harbor,
6. utilization of tugs to move vessels into position and ferry staff and minor supplies to the working vessels,
7. demolition and disposal of the existing timber crib and stone by backhoe or crane,
8. placing stone using a crane or backhoe positioned on a barge, and
9. anchoring all vessels in the harbor during non-working hours.

The BA Addendum indicates that the Corps would locate an on-site work and storage area on a portion of the government-owned land adjacent to the west pier at the southern end (in an area approximately 300-foot by 300-foot) in addition to the parking lot area.

Additionally, the project would require excavation to connect the northern end of the proposed breakwater with the existing east entrance jetty. The Corps proposes to remove approximately 165 feet of stone-filled wood cribs covered with capstone as well as remnants of the old pile dike and wood groins in the vicinity of the east jetty. The Corps proposes to dispose of the material from the demolition at an off-site location in accordance with federal, state, and local laws and regulations.

Finally, the Corps proposes to excavate approximately 4,300 cubic yards of material from the lake bottom to 6.5 feet below Low Water Datum (LWD) at the southern end of the proposed breakwater from an area approximately 700 feet in length, including the dogleg at the end of the breakwater, to set the mattress stone. Further, due to shallow water depths, the use of water-based equipment may require excavation adjacent to the proposed breakwater. The Corps proposes to place the excavated material at one of the following locations:

1. an open water disposal site, ½ mile by ½ mile square area, located one mile due north from the west pier light,
2. a nearshore site between the 4-foot and 8-foot depth contours along the State-designated high risk erosion area (HREA), located approximately 1.3 miles east of the harbor, or
3. an upland site, such as a landfill.

<u>Conservation measures</u>

The Corps has proposed conservation measures to reduce impacts to piping plover or piping plover critical habitat. Conservation measures are part of the proposed action; therefore, we consider them in the analysis of effects. The Revised BA and BA Addendum articulate the following conservation measures, which state that the Corps will:

1. require water-based construction;

2. establish a staging area at the end of Superior Beach, associated with the existing parking lot, with no modification of critical habitat;

3. prohibit construction or excavation within 250 feet of the critical habitat lakeshore from April 15 to September 1;

4. allow the Service, MDNR, or other conservation partners to place piping plover educational signs immediately adjacent to the breakwater, with the recommendation to remove the signs each winter to prevent winter ice damage;

5. incorporate an oil spill response plan (with specific measures to protect piping plover/shoreline) in the contract for services;

6. inform contractors of the presence of piping plover and the conservation measures to reduce the potential for disturbance and require contractors to attend a one hour training session by local Service personnel to familiarize the contractors with the piping plover;

7. monitor nesting piping plovers in the action area, with an emphasis on the harbor shoreline, during construction to ensure early detection of disturbance or harassment;

8. provide six signs, utilizing the Service's layout and graphics, to educate beach users about the piping plover; and

9. work with local governments to develop an ordinance to address use of the accreted land.

Status of the Species

Species and Critical Habitat Description

The Great Lakes piping plover, named for its melodic call, is a small North American shorebird, approximately 17 cm (6.7 in) in length (Palmer 1967) that weighs 40-65 g (1.4-2.3 oz) and has a wing span measuring about 38 cm (15 in) (Haig 1992). Light sand-colored upper plumage and white undersides blend in well with the piping plover's principal beach habitats. During the breeding season, the legs and bill are bright orange, and the bill has a black tip. Other distinctive markings include a single black band across the upper breast and a smaller black band across the forehead. In adult females, the breast band is often thin or incomplete, and plumage is frequently duller than in adult males (Wilcox 1959; Haig 1992). During winter, the legs pale, the bill turns black, and darker markings are lost. Chicks have speckled gray, buff, brown, and white down. The coloration of fledged young resembles that of adults in winter. Juveniles acquire adult plumage the spring after they fledge (Prater et al. 1977).

The Service listed the piping plover under the ESA on January 10, 1986 (USFWS 1985). The piping plover breeds only in North America in three geographic regions: the Atlantic Coast, the Great Lakes, and the Northern Great Plains. These three breeding populations

were recognized and treated separately in the Final Rule: the Atlantic and Northern Great Plains populations are classified as threatened and the Great Lakes population as endangered. All plovers on migration and in wintering areas are considered threatened under the ESA.

The Service designated critical habitat for the breeding population of the Great Lakes piping plover on May 7, 2001 (USFWS 2001a). The designation includes a total of 35 units, encompassing 325 kilometers (201 miles) of shoreline in 26 counties in eight states (Minnesota, Michigan, Wisconsin, Illinois, Indiana, Ohio, Pennsylvania, and New York). The greatest number of critical habitat units (23) occurs in Michigan with a total shoreline length of 224 km (139 mi). The remaining units cover approximately 101 km (62 mi) of shoreline in the other seven states. Within the geographic areas designated, only those areas that contain the primary constituent elements, as defined by 50 CFR 424.12(b), are considered as critical habitat. The primary constituent elements (PCEs) of critical habitat for the Great Lakes breeding population of the piping plover include:

1. island and mainland shoreline with sand, gravel or cobble beaches or spits,
2. shoreline length ≥ 0.2km (0.12 mi) of gently sloping sand beach,
3. sand beach area of ≥ 2ha (5 ac),
4. length of shoreline ≥ 50m (164 ft) where beach width is ≥ 7m (23 ft) or, additional sand/cobble is found between dune and treeline
5. distance from waterline to treeline ≥50 m (164 ft),
6. sparse vegetation with ≤ 50% herbaceous or woody cover,
7. protective cover for chicks – small herbaceous patches, cobble, gravel or debris (driftwood, wrack, root masses, dead shrubs),
8. low level of disturbance from human activities and domestic animals, and
9. dynamic ecological processes to create and maintain natural habitat.

The final rule designating critical habitat for the wintering grounds was published on July 10, 2001 (USFWS 2001b). The designation includes a total of 142 units, encompassing 2,891.7 km (1798.3 mi) of shoreline and approximately 66,881 ha (165,211 ac) in eight states (North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas). The greatest number of critical habitat units occurs in Florida (34 units) and Texas (37 units). Critical habitat units designated in Florida, Texas, and Louisiana encompass 2,172.5 km (1351.1 mi) of shoreline. The primary constituent elements for the wintering population of the piping plover are defined as geologically dynamic coastal areas that support intertidal beaches and flats (between annual low tide and annual high tide) and associated dune systems and flats above annual high tide. Intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important. Important components of the beach/dune ecosystem include surf-cast algae for feeding of prey, sparsely vegetated backbeach for roosting and refuge during storms, spits for feeding and roosting, salterns, and washover areas for feeding and roosting.

A final recovery plan for the Great Lakes piping plover population was published on September 8, 2003 (USFWS 2003). The recovery plan objectives are to restore and

maintain a viable population (95% or greater chance of persisting 100 years) to the Great Lakes region and remove the Great Lakes population from the list of Endangered and Threatened Species by 2020. The Service will consider reclassifying the population to threatened when the first four criteria are accomplished, and then consider delisting when all five criteria are met. The current recovery criteria are:

1. The population has increased to at least 150 pairs (300 individuals), for at least 5 consecutive years, with at least 100 breeding pairs (200 individuals) in Michigan and 50 breeding pairs (100 individuals) distributed among sites in other Great Lakes states;

2. Five-year average fecundity is within the range of 1.5-2.0 fledglings per pair, per year, across the breeding distribution, and ten-year population projections indicate the population is stable or continuing to grow above the recovery goal;

3. Ensure protection and long-term maintenance of essential breeding habitat in the Great Lakes and wintering habitat, sufficient in quantity, quality, and distribution to support the recovery goal of 150 pairs (300 individuals);

4. Genetic diversity within the population is deemed adequate for population persistence and can be maintained over the long-term; and

5. Agreements and funding mechanisms are in place for long-term protection and management activities in essential breeding and wintering habitat.

Life History

Piping plovers return to their breeding grounds in late April to early May and initiate nesting by mid- to late May (Pike 1985). Courtship behavior includes aerial displays, digging of several nest scrapes, and a ritualized stone-tossing display (Cairns 1977, 1982; Haig 1992). Piping plover nests are shallow scrapes in the sand that are lined with pebbles, shells, and driftwood. Both adults actively defend nest territories and share incubation duties that last 25-31 days (Wilcox 1959; Cairns 1977; Prindiville 1986; Wiens 1986; Haig and Oring 1988). Females lay an egg approximately every other day; clutches are complete at three or four eggs.

Eggs hatch from late May to late July at Great Lakes nesting sites (Lambert and Ratcliff 1981; Pike 1985). Precocial chicks usually hatch within one-half to one day of each other and are able to feed themselves within a few hours, following their parents and plucking invertebrates, including insects, spiders, marine worms, crustaceans, and mollusks, from the sand (Haig 1992). Most foraging is diurnal. Piping plovers utilize numerous areas within breeding and wintering habitats for foraging, including wet sand in the wash zone, intertidal ocean beach, wrack lines, washover passes, mud, sand and algal flats, and shorelines of streams, ephemeral ponds, lagoons, and salt marshes (Powell and Cuthbert 1991; Hoopes et al. 1992; Loegering 1992; Zonick et al. 1998). Several studies on the Atlantic Coast indicate that foraging habitat and food resources ultimately affect piping plover survival (Loegering and Fraser 1995; Goldin and Regosin 1998; Elias et al. 2000).

Piping plover eggs and young are so well camouflaged that they may go unnoticed. When predators or intruders are near, the young remain motionless while the parents attempt to attract the attention of the intruders to themselves, often by feigning a broken wing or false brooding. Chicks are especially vulnerable to predators after hatching until they are able to fly in 21-30 days. Piping plovers depart their Great Lakes breeding areas anywhere from mid-July to early September (Pike 1985; Wemmer 2000).

The wintering ranges of the three breeding populations of the piping plover overlap and extend from Virginia to Florida on the Atlantic Coast and from the Florida Gulf Coast west to Texas and into Mexico, the West Indies, and the Bahamas (Haig 1992). Great Lakes piping plovers winter primarily along the southeast Atlantic Coast and along the eastern Gulf Coast, although some individuals have been reported as far west as Texas and as far south as Mexico and the Bahamas. The recent ESA status review for piping plovers concluded that inter- and intra-annual fidelity of piping plovers to migration and wintering sites as described in the 1996 Atlantic Coast and 2003 Great Lakes recovery plans was accurate. Gratto-Trevor et al. (2009) reported that six of 259 banded piping plovers observed more than once per winter moved across boundaries of seven continental U.S. regions. Of 216 birds observed in different years, only eight changed regions between years, and several of these shifts were associated with late summer or early spring migration periods (Gratto-Trevor et al. 2009).

Great Lakes piping plovers on the breeding grounds exhibit nest site fidelity. In Michigan, adults returned to beaches where they nested previously approximately 65% of the time (Wemmer 2000). Adult fidelity to breeding areas in other piping plover populations ranges from 24% to 69% (Haig and Oring 1988). Because adults use numerous beaches throughout their lifetimes and many young breeders nest distant from natal areas, preservation of historic and less frequently used areas, in addition to traditional breeding sites, is important for population persistence.

Range Wide Status and Distribution

Population abundance and distribution

Piping plovers once nested on Great Lakes beaches in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and Ontario, Canada. Historically, as many as 492 to 682 breeding pairs may have nested in the Great Lakes region in the late 1800s (Russell 1983). Michigan may have had 215 pairs or more; Ontario and Illinois likely supported the next largest populations (152-162 and 125-130, respectively). Indiana, Ohio, and Wisconsin were estimated to have 100 or fewer breeding pairs each, and Minnesota, New York, and Pennsylvania fewer than 30 each.

Piping plovers were extirpated from Great Lakes beaches in Illinois, Indiana, New York, Ohio, Pennsylvania, and Ontario by the late 1970s (Russell 1983). Few piping plovers nested in Wisconsin after the 1970s, and no nests were found in the state between 1983 and 1997 (S. Matteson, Wisconsin Department of Natural Resources, pers. comm. 1998). Similarly, the small number of pairs that nested in Duluth Harbor, Minnesota had abandoned the area by 1986 (B. Eliason, Minnesota Department of Natural Resources,

pers. comm. 1999). In 1977, the Great Lakes population was estimated at 31 nesting pairs (Lambert and Ratcliff 1979) but declined to approximately 17 pairs by 1985 (USFWS 1985). When the piping plover was listed as endangered in 1986, the Great Lakes population nested exclusively at a few sites on the northeastern shore of Lake Michigan and southeastern shore of Lake Superior in Michigan, the state with the most remaining habitat.

From 1986 to 2009, the population increased from 12 to 71 breeding pairs and also expanded its breeding distribution within the Great Lakes basin. In 2009, breeding pairs were found in Michigan (59), Wisconsin (4), Illinois (1), and in the Great Lakes area of Ontario, Canada (7). The nest occurrence in Illinois in 2009 was the first nest in the state since 1979. Over the past 20 years, piping plover nests have been found in one county in Illinois, three counties in Wisconsin, 18 counties in Michigan, and in the province of Ontario, Canada (Figure 5).

Along with the general range expansion since listing, breeding location distribution has recently shifted. Between 1986 and 2002, piping plovers routinely nested on several sites in Iosco and Alpena Counties. From 2003-2009, however, few, if any, of these beaches for were used for nesting (Stucker et al. 2003; Stucker and Cuthbert 2004; Stucker and Cuthbert 2005; Westbrock et al. 2005; Cuthbert and Roche 2006, 2007b). In addition, traditional sites along the southern shore of Lake Superior such as Crisp Point, have gone unused in recent years. The reduced use of the shorelines of Lakes Huron and Superior, combined with the increasing use of the Lake Michigan shoreline, indicates a shift in distribution toward the Lake Michigan basin (USFWS 2009). In addition, the number of nest sites found in the Lower Peninsula of Michigan over the past few years has decreased, while at the same time increasing along the southern shoreline of the Upper Peninsula and at sites in Wisconsin and, more recently, Canada (Figure 6). There is also increased use of public land by nesting piping plovers. Since 2003, at least 70% of the nests have been located on publicly owned lands. In 2009 for example, nearly 35 % of all nests in the Great Lakes occurred in Michigan's Sleeping Bear Dunes National Lakeshore (Cuthbert and Roche 2009).

From 1984 to 2008, the Great Lakes piping plover population increased from 12 to 63 breeding pairs (Table 1). The most recent census conducted in 2009 found 71 breeding pairs. In addition, the number of non-nesting individuals has increased annually since 2003. Between 2003 to 2008, an annual average of approximately 26 non-nesting piping plovers were observed, based on limited data from 2003, 2006, 2007, and 2008 (Cuthbert and Roche 2009). Although there was some fluctuation in the total population over the past five years, the overall increase to 71 pairs, combined with the increased observance of non-breeding individuals, indicates an increasing population.

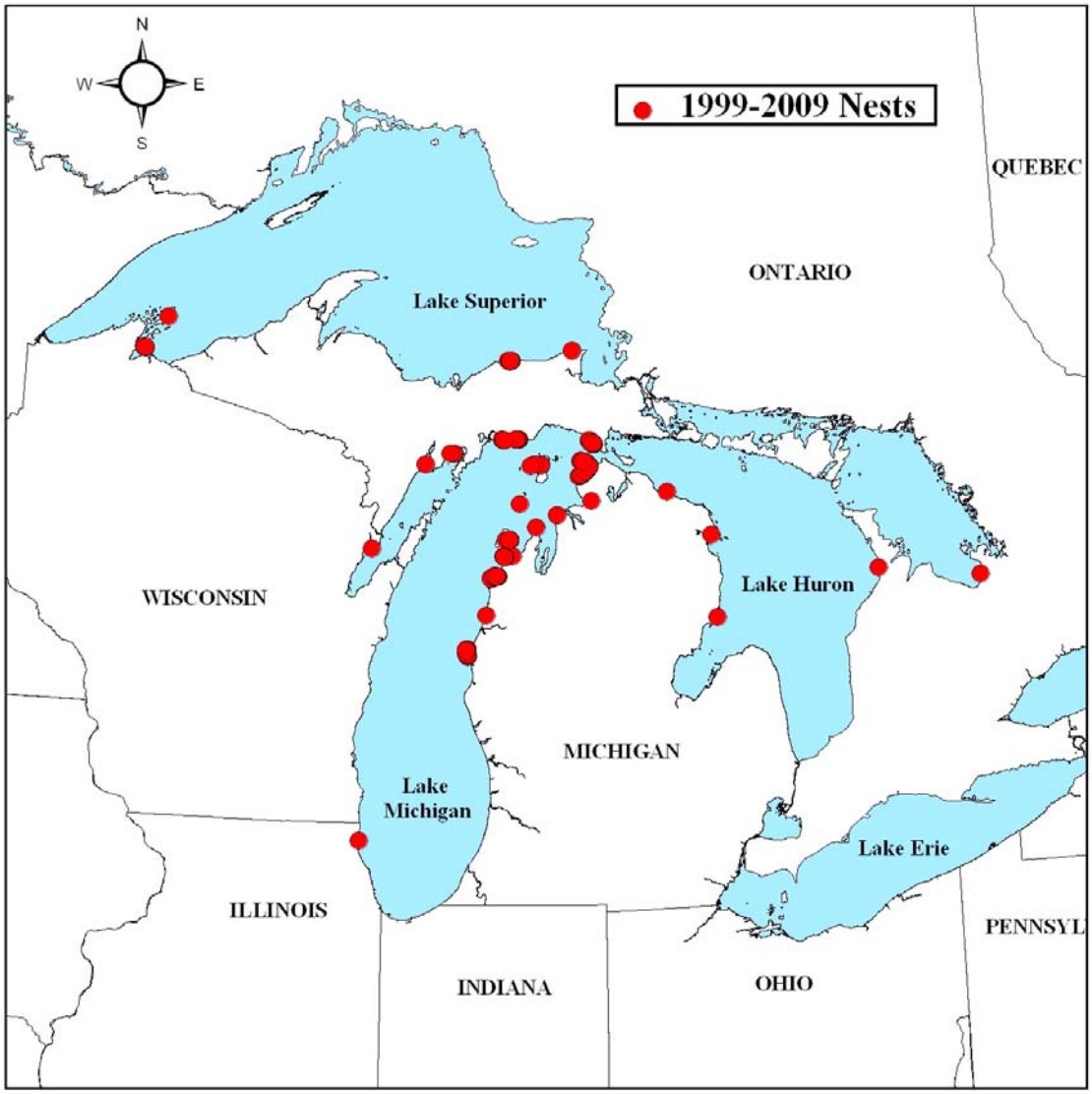

Figure 5. Distribution of piping plover nest locations in the Great Lakes basin

Although this is a substantial increase in population size since listing, the species remains at critically low numbers. Reproductive success has also fluctuated across years and may negatively correlate with increases in lake levels (Wemmer 2000). Fledging success in 2009 was 1.79 chicks fledged per pair, while overall fledging success from 1984 to 2009 has averaged 1.49 chicks fledged per pair, not including those chicks fledged from the salvage captive rearing program (Table 1).

Table 1. Summary of Great Lakes piping plover reproductive success during 1984-2009 (Cuthbert and Roche 2009).

Year	# of Pairs	# eggs laid (% hatched)	# chicks hatched (% fledged)	# fledglings	# fledged per pair
1984	13	25 (68%)	17 (77%)	13	1.00
1985	19	90 (30%)	27 (56%)	15	0.79
1986	16	72 (35%)	25 (40%)	10	0.63
1987	16	66 (30%)	20 (70%)	14	0.88
1988	14	62 (71%)	44 (66%)	29	2.07
1989	18	71 (55%)	39 (59%)	23	1.28
1990	12	49 (71%)	35 (60%)	21	1.75
1991	17	65 (77%)	50 (68%)	34	2.00
1992	16	71 (54%)	38 (47%)	18	1.13 (1.25*)
1993	18	72 (71%)	51 (26%)	13	0.72 (0.83*)
1994	19	82 (71%)	58 (48%)	28	1.47
1995	21	84 (77%)	65 (65%)	42	2.00
1996	23	90 (70%)	63 (41%)	26	1.13 (1.22*)
1997	23	92 (83%)	76 (51%)	39	1.70 (1.87*)
1998	24	94 (81%)	76 (51%)	39	1.63 (1.96*)
1999	32	148 (76%)	113 (43%)	49	1.53 (1.59*)
2000	30	131 (75%)	98 (41%)	40	1.33 (1.63*)
2001	32	139 (81%)	112 (63%)	71	2.22 (2.31*)
2002	51	207 (67%)	139 (44%)	61	1.20 (1.57*)
2003	50	198 (84%)	166 (53%)	88	1.76 (1.92%)
2004	55	223 (82%)	182 (51%)	92	1.67 (1.87)
2005	58	228 (73%)	166 (56%)	93	1.6 (1.86)
2006	53	230 (83%)	196 (48%)	94	1.77 (2.09)
2007	63	247 (79%)	194 (64%)	124	1.97 (2.16)
2008	63	266 (64%)	169 (67%)	113	1.79 (2.24)
2009	71	281 (64%)	181 (70%)	126	1.77 (2.10)

*including captive reared young

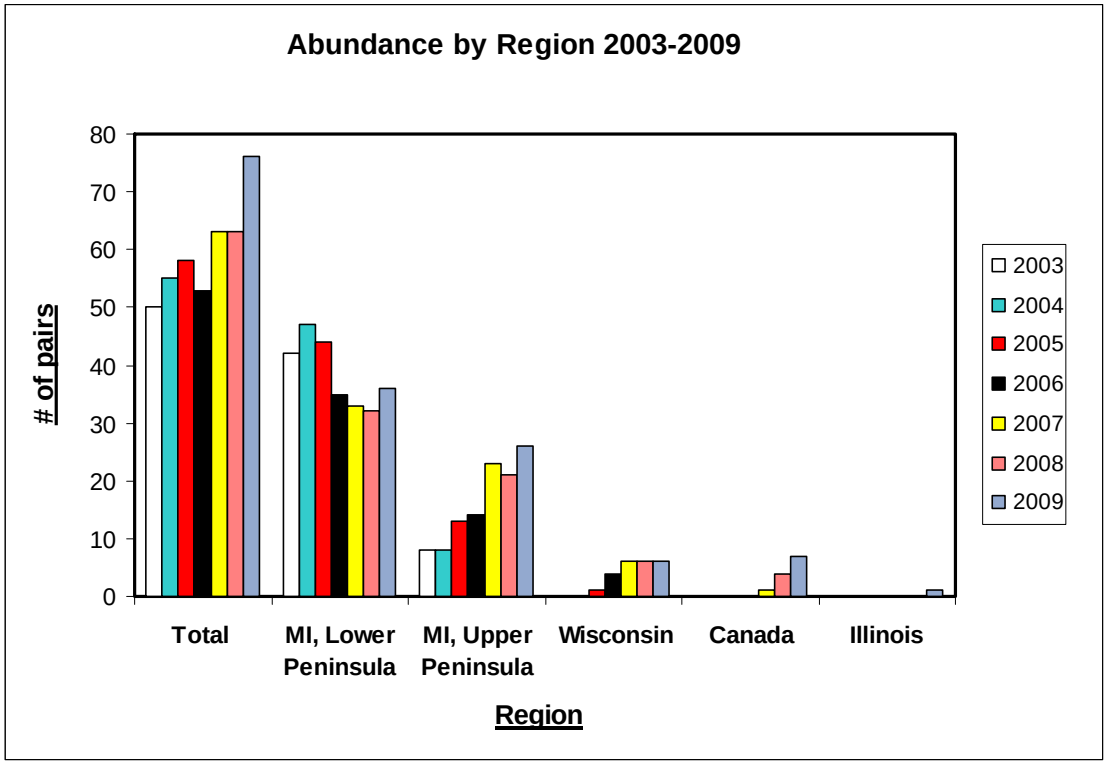

Figure 6. Annual abundance estimates per region for the Great Lakes piping plovers

Survival

Initial estimates of Great Lakes piping plover adult (after-hatch year) survival rate ranged from 73% to 83%, with a fledgling to adult (hatch year) survival rate of 28% (Wemmer 2000 *in* USFWS 2003). More recently, Cuthbert and Roche (2007a) determined an average after-hatch year survival rate of 77% and an average hatch year survival rate of approximately 24% (based on data collected from 1993-2005). In a mark-recapture analysis of resightings of uniquely banded piping plovers from seven different breeding areas across the North American range, Roche et al. (2009) found that apparent adult (after-hatch year) survival declined in four populations, including the Great Lakes. None of the populations increased over the life of these banding studies. Evidence of correlation in year-to-year fluctuations in annual survival of Great Lakes and Atlantic (eastern) Canada populations, both of which winter primarily along the southeastern U.S. Atlantic Coast, suggests that shared over-wintering and/or migration habitats may influence annual variation in survival.

Population viability

In 2006, Cuthbert and Roche (2007a) conducted a population viability analysis (PVA) for the Great Lakes piping plover population. The Great Lakes piping plover PVA used

demographic parameters determined on the basis of field data collected from 1993 to 2005 to examine the viability of the Great Lakes piping plover over the next 100 years. In addition to this custom model, VORTEX (a commercially available PVA model) was also applied to the Great Lakes population utilizing the same demographic data. Both models, using time average demographic parameters, projected negative growth rates and eventual extirpation of the Great Lakes population within 100 years. Model scenarios to test the predictive accuracy of the PVAs revealed that both models had a tendency to underestimate the observed population growth (Cuthbert and Roche 2007a). The PVA models also showed after-hatch year survival rates had the greatest impact on the overall viability of the population. In exploring possible mechanisms by which the models could mimic the observed levels of the Great Lakes population, Cuthbert and Roche (2007a) determined that a minor increase in the model input for hatch-year survival, along with the additional recruitment of approximately six individuals per year, could cause the models to project population growth that more accurately reflects the observed number of breeding pairs. This observation suggests a small number of breeding pairs go undetected each year at sites not currently surveyed or monitored as part of the annual recovery program.

Genetics

As discussed in more detail below, researchers at the U.S. Geologic Survey (USGS) recently conducted a molecular genetic investigation of piping plovers, based on mitochondrial DNA sequences and eight nuclear microsatellite loci from samples from 23 U.S. states and Canadian provinces, including analysis of samples from 17 individuals in the Great Lakes population (Miller et al. 2009). Miller et al. (2009) presented genetic diversity estimates for both mitochondrial and microsatellite data sets for Great Lakes piping plovers. Although diversity measures for Great Lakes population mitochondrial DNA were somewhat lower than those for other piping plover populations, microsatellite marker diversity measures were close to or higher than those for the Northern Great Plains and Atlantic Coast populations in the U.S. and Canada. No conclusions were made, however, regarding the adequacy of genetic diversity of the Great Lakes population or the vulnerability of the population to genetic drift over the long term.

Threats

Several factors threaten the continued existence of piping plovers on Great Lakes beaches including habitat destruction and modification from shoreline development, disturbance by humans and pets, predation, disease, small population size, and other factors. We discuss each of these in more detail below.

Shoreline Development

Shoreline development represents the leading cause of piping plover habitat loss in the Great Lakes, and remains a major threat. Over one-quarter of available breeding habitat lies on private lands that are particularly vulnerable to development. Activities, such as homebuilding, shoreline stabilization, and jetty, pier, and rip rap installation, are common examples of coastal changes that occur within the Great Lakes, and these activities continue to threaten piping plover habitat to varying degrees.

Loss of habitat due to development pressure also occurs to a limited degree on Federal lands, which currently support approximately 55% of the breeding sites. Disturbance in the form of recreational uses also continues at these sites, although nearly all Federal land management agencies currently participate in the ongoing recovery program and actively support various recovery actions. These include management of current nesting sites, limiting recreational uses, conducting regular outreach activities, and managing habitat conditions.

Disturbance by humans and pets

Human activities such as illegal off-road vehicle usage, unleashed pets, bike riding, bonfires, horseback riding, camping, and beach walking, all are known to disturb piping plover nesting habitat and behaviors (Cuthbert and Roche 2008a). Although an arrangement of educational signs, posts, and twine typically enclose a large section of beach around each nest, pedestrians and unleashed pets sometimes ignore this psychological boundary.

Predation

Predation remains one of the most significant threats to the Great Lakes population. A number of different species in the Great Lakes prey upon piping plovers. The routine use of predator exclosures (cages which keep larger predators out while allowing the attending adults free access to and from the nest) has reduced egg predation and increased hatching success from 37% to approximately 85%. To date, few observations have been made to suggest predators have "keyed" into exclosures and increased rate of adult predation. As a result, nest exclosures are used at all sites throughout the Great Lakes.

Although the use of predator exclosures has reduced egg predation, chicks and adults remain vulnerable to a variety of terrestrial and avian predators (Melvin et al. 1992). In 2003, the NPS and U.S. Department of Agriculture (USDA) Wildlife Services initiated a joint program to control predator populations on North Manitou Island in the Sleeping Bear Dunes National Lakeshore. Increases in the number of pairs nesting on the island reflect the relative success of this program (Stucker et al. 2003, Stucker and Cuthbert 2004, Westbrock et al. 2005, Cuthbert and Roche 2006, 2007b, Cuthbert and Roche 2008b).

Finally, merlins (*Falco columbarius*) are a notable concern to piping plover recovery. Since 2005, merlins are suspected of killing a total of 18 individuals (approximately six per year) (Cuthbert and Roche 2007b). Most of the instances of merlin predation occurred at sites in the northwestern portion of Michigan's Lower Peninsula, an area with high densities of nesting plovers.

Disease

Although not considered a major threat at the time of listing, two disease-related mortality events have occurred in the Great Lakes population since 2003. In 2004, two young-of-the-year piping plovers were found dead in Benzie County, Michigan. The USGS National Wildlife Health Center (NWHC) determined the cause of death was

aspergillosis, a fungal disease of the airway. No further cases of aspergillosis in the Great Lakes have been reported.

In 2007, two chicks and two adult piping plovers succumbed to Type E botulism poisoning at Sleeping Bear Dunes National Lakeshore in Benzie and Leelanau Counties in Michigan. Type E botulism is a paralytic, typically fatal disease of birds. Outbreaks have occurred at various times in the Great Lakes basin, with some of the earliest outbreaks documented in Michigan in 1963. Significant outbreaks also occurred in 1976 and 1981 (T. Cooley, Michigan Department of Natural Resources, pers. comm. 2008). The recent outbreak began in 2006, when several thousand waterbirds succumbed to the disease in the northern Lake Michigan area. Although fewer waterbird and shorebird mortalities associated with Type E botulism were reported in 2008 compared to 2007 and 2006, potential disease-related mortality remains a concern for the Great Lakes piping plover population.

Small population size/genetic diversity

An analysis of the Great Lakes population in 2003 found up to 29% of adult plovers remained unmated, suggesting a possible Allee effect[1] (Wemmer 2000 *in* USFWS 2003). On average, from 2003-2008, 18% of adult piping plovers remained unmated (based on limited figures from 2003 and 2006-2008). This decrease may reflect increased nesting densities in areas of high quality habitat or the overall increase in the population. Other factors, such as uneven sex ratios, may also contribute to this condition.

Increased susceptibility to stochastic events also occurs with a small population size. Small populations are less able to recover from losses associated with events such as severe weather, oil spills, and disease outbreaks. The population-level impacts of threats already mentioned, such as human disturbance, increase when there are fewer individuals in the population.

The potential for low and/or declining genetic diversity represents another factor often associated with small population size. In 2007, Cuthbert and Roche (2007a) performed a pedigree analysis that suggested a substantial loss of at least 14 of the 17 founder lineages and an over-representation of the remaining three. In addition, they established that the number of observed pairs known to be closely related increased from 1997-2007. Although these are somewhat alarming, Cuthbert and Roche (2007a) also acknowledged that a large percentage of the Great Lakes piping plover pedigree is unknown, and their results should be considered preliminary.

Miller et al. (2009) recently conducted a molecular genetic investigation of piping plovers, including mitochondrial DNA sequences and eight nuclear microsatellite loci, based on samples from 23 U.S. states and Canadian provinces. This included an analysis of samples from 17 individuals in the Great Lakes population. They found genetic evidence suggesting that interior birds have experienced genetic bottlenecks and that the

[1] The Allee, or under-population, effect arises when population density is reduced to the point where individual reproductive and survival rates are negatively affected.

Great Lakes region has also experienced a post-bottleneck population expansion. This finding may indicate a population growth following a previous bottleneck event (Miller et al. 2009).

Miller et al. (2009) also reported genetic diversity measures for both mitochondrial and microsatellite data for Great Lakes piping plovers. Mitochondrial control region nucleotide diversity and gene diversity were somewhat lower for the Great Lakes population compared with the Atlantic Coast and Northern Great Plains populations in the U.S. and Canada (Miller et al. 2009). The average Great Lakes mitochondrial nucleotide diversity was also below the mean (but still within the range) observed at the same locus in a study of snowy plovers (*Charadrius alexandrinus*). The lower mitochondrial nucleotide diversity associated with Great Lakes birds may be attributed to historically low (or currently small) population sizes, founder events, or bottlenecks. For microsatellite markers, however, the average number of alleles per locus and heterozygosity in the Great Lakes samples were in the middle of the range observed for all piping plover populations.

Although diversity measures observed by Miller et al. (2009) suggest that the current level of genetic diversity may not have a deleterious effect on Great Lakes piping plovers, further investigations are warranted. Furthermore, genetic drift could affect this small population over the long term.

Wind power

Wind power has emerged as an alternative energy source in and around the Great Lakes. Wind turbines potentially impact local and migrating populations of birds due to collision-associated mortality. While the exact migration routes of piping plovers are unknown, individual observations along the Great Lakes coastline strongly suggest they use the shoreline as travel corridors. Wind power facilities located along Great Lakes shorelines may pose a risk of injury to piping plovers, particularly during migration.

Climate change

The potential impacts of climate change are increasingly evident in the Great Lakes region. Summer lake water temperatures are increasing, with Lake Superior's average summer surface water temperature increasing by 4.5° F since 1980 (Austin and Colman 2007). Ice forms later and melts earlier throughout the region. According to scenarios used in a national assessment, average temperatures in the Great Lakes region could increase 4° to 8° F by 2100, while precipitation could increase by 25% (Sousounis and Glick 2000). Despite projected increases in precipitation, increased air temperatures and reduced ice cover are expected to result in lake level decreases of 1.5 to as much as 8 feet (Sousounis and Glick 2000). These changes could have significant effects on both aquatic and terrestrial ecosystems.

Expected changes due to climate change could have both positive and negative effects on piping plovers and their habitats. Reductions in lake levels could potentially increase the amount of available habitat by increasing the width and length of open beach, areas preferred by Great Lakes piping plovers. Conversely, a longer growing season, coupled

with the loss of ice scour, may allow for vegetative encroachment, thus decreasing the amount of habitat available for piping plovers. Increases in regional temperatures may also alter the frequency and intensity of seasonal storms, which can inundate and wash out nests. Such changes could have a particularly significant impact in areas where nest densities are high. Overall, the magnitude of the threats of climate change on piping plover habitat remains unknown.

Recovery and Habitat Management

Long-term protection and management of breeding areas in the Great Lakes basin occurs via a multi-partner recovery program involving a number of Federal and state land management agencies as well as non-governmental organizations. These partners work in a coordinated fashion to achieve various aspects of piping plover recovery in the Great Lakes.

Nest Protection and Monitoring

In response to the continued threat of predation and disturbance, recovery program partners routinely use nest protection and monitoring at all the piping plover nest sites in the Great Lakes. The regular use of wire predator exclosures (cages which keep larger predators out while allowing the attending adults free access to and from the nest) has reduced egg predation and increased hatching success to approximately 85%. These protection efforts are coupled with regular monitoring of nest sites to maintain protection and limit other forms of disturbance. Although the use of predator exclosures has reduced egg predation, chicks and adults remain vulnerable to a variety of predators, as well as other threats (Melvin et al. 1992).

Protection from disturbance by humans and pets

Human activities such as off-road vehicle usage, unleashed pets, bike riding, bonfires, horseback riding, camping, and beach walking, are all known to disturb piping plover nesting habitat and behaviors (Cuthbert and Roche 2008a). In response to this threat, recovery program partners typically enclose a section of beach around each nest by an arrangement of educational signs, posts, and twine. Monitoring is often accompanied by various aspects of outreach and education including interpretive signs, handouts, and direct interactions with the public.

Habitat improvement

Several management agencies have attempted to improve the suitability of breeding habitat through various methods. The U.S. Forest Service has deposited gravel onto various areas of open beach in an attempt to encourage nesting. The Nature Conservancy (TNC), the NPS, and the MDNR have conducted small scale invasive species plant removal and control, which aids in maintaining the natural coastal ecosystem that plovers require for breeding. We have not conducted formal research to evaluate these efforts; however, observations of piping plovers utilizing these sites after treatment suggest these techniques may be successful at improving habitat quality.

Habitat protection through acquisition

Habitat protection through acquisition has occurred in Michigan as a result of the Service's Recovery Land Acquisition and Habitat Conservation Plan (HCP) Land Acquisition Programs under section 6 of the ESA. This includes a shoreline site of approximately 90 acres in Benzie County, Michigan, and a 750-acre site in Cheboygan County, Michigan. These sites are currently protected and/or managed through a joint agreement between the MDNR and TNC. Activities underway at these sites include invasive species plant removal and protective measures to limit human disturbance.

Salvage Captive Rearing

In response to potential nest losses from storms and other factors, a salvage captive-rearing program was initiated in 1998. Under this program, abandoned eggs are collected and artificially incubated. Chicks are reared and released, within the same year, once they have reached the fledge stage. The captive rearing program has increased the annual number of chicks fledged by an average of 14% (Stucker et al. 2003; Stucker and Cuthbert 2004; Westbrock et al. 2005; Cuthbert and Roche 2006, 2007a). The Great Lakes captive-rearing effort has successfully produced a minimum of 10 breeding adults from 192 eggs that otherwise would have had no reproductive value. As of 2008, captive-reared individuals constitute up to 3% of the total population.

Summary and Synthesis of the Species Status

The Great Lakes piping plover population has shown significant growth, from approximately 17 pairs at the time of listing in 1986 to 71 pairs in 2009. The total of 71 breeding pairs represents approximately 47% of the current recovery goal of 150 for the Great Lakes population. Over the past five years, productivity goals as specified in the 2003 recovery plan, were met or exceeded with an average annual fledging rate of 1.76 fledglings per breeding pair. A recent analysis of banded piping plovers in the Great Lakes, however, suggests a decline in the after-hatch year survival (adult) rates.

Several years of population growth offer evidence of the effectiveness of the ongoing Great Lakes piping plover recovery program. Most major threats, however, including habitat degradation, predation, and human disturbance, remain persistent and pervasive. Threats from human disturbance and predation remain ubiquitous within the Great Lakes basin. Intensive management to minimize the effects of these continuing threats, as specified in recovery plan tasks, are implemented every year by a network of governmental and private partners.

A recent ESA status review conducted for the Great Lakes piping plover concluded that the population is properly classified as endangered under the ESA (USFWS 2009). Although more than 20 years of intensive recovery efforts have reduced near-term extinction risks, the population remains susceptible to extinction due to its small size, limited distribution, and vulnerability to stochastic events, such as disease outbreak. In addition, the factors that led to the piping plover's 1986 listing are still present, and regulatory mechanisms are needed to ensure long-term conservation of habitat and continuation of intensive annual management activities.

Environmental Baseline

Status of the Species and Designated Critical Habitat within the Action Area

Abundance and Productivity

Piping plover nesting has occurred in the action area since at least 1954 (Figure 7; Note: data from 1954-1980 is not complete). For the past 20 years, the number of nests has generally ranged from two to four. Following a slight decline to just one nest in 2005 and 2006, the number of plover pairs in the action area has increased. In 2007, 2008 and 2009, there were three, four, and six nests, respectively. The number of chicks successfully fledged from these nests has also ranged, from as few as one to as many as ten in 2008. Productivity has varied in response to several basin-wide factors. Factors affecting piping plover nesting success in the action area, as well as at other locations, include predation, weather conditions (particularly during the first 7-10 days post hatching), and disturbance levels.

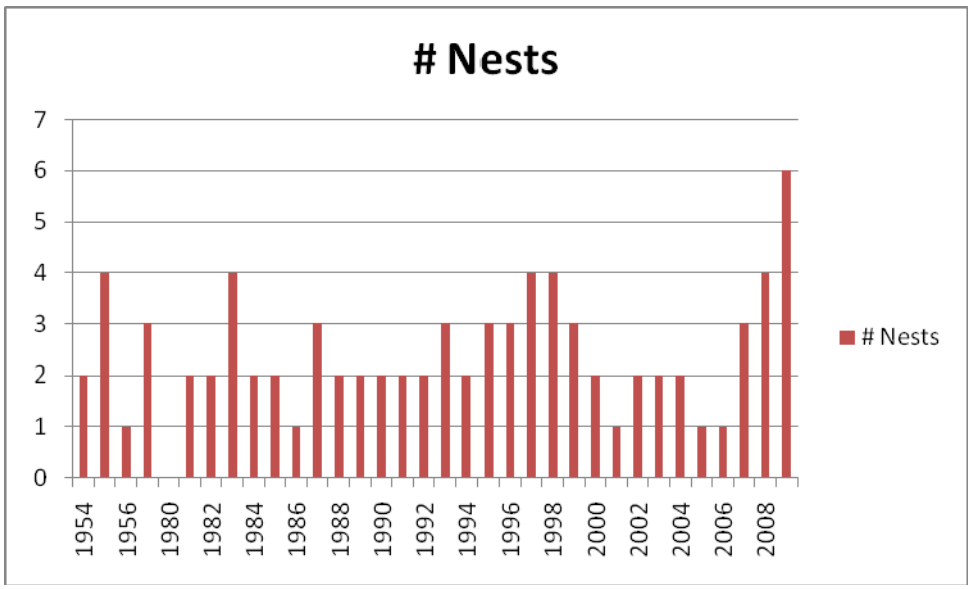

Figure 7. Number of piping plover nests within the action area (1954-2009)

The action area has served as an important source of individuals to the Great Lakes population, particularly in the 1980s-1990s, when numbers of pairs in the Great Lakes were relatively low (fewer than 20) (Cuthbert and Roche 2008). In the early to mid 1990s through 2009, however, the number of nests in the action area relative to the entire Great Lakes population declined, as total pairs increased to 71 (Figure 8). In 2009, the six nesting pairs in the action area accounted for 8.4% of the entire population. This represents a more significant percentage of the nests in the Lake Superior basin. On an annual basis, 20 to 75% of all the nests in the Lake Superior Basin have occurred in the

action area. Over the past ten years (2000-2009), approximately 40% of the all the nests on Lake Superior occurred in Grand Marais action area.

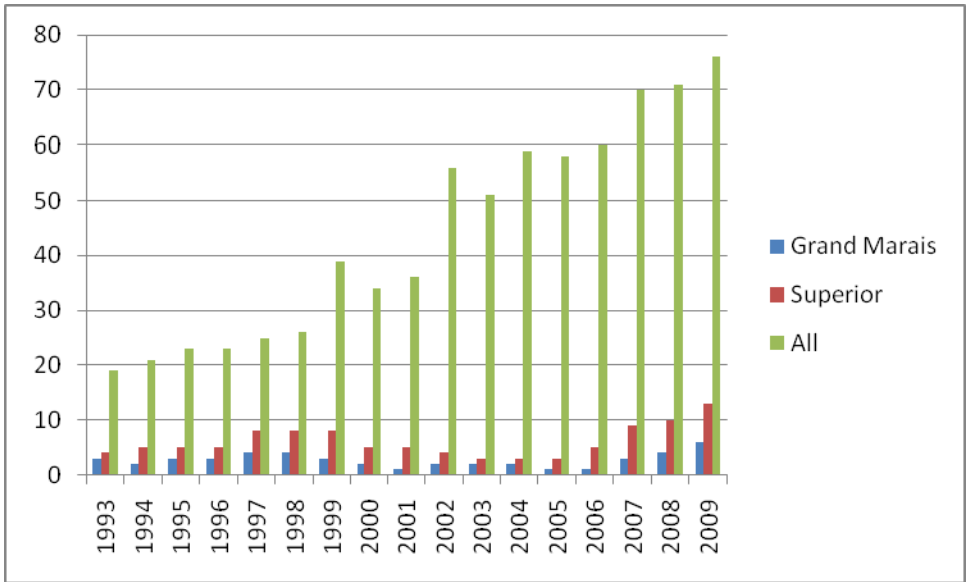

Figure 8. Number of Great Lakes piping plover nests (1993-2009)

On average, 1.5 chicks per pair (range 1-4) have fledged from the action area during the past 21 years (1989-2009). This value is slightly less than the overall Great Lakes population productivity rate of 1.6 chicks fledged per pair for the same time period. Productivity varies across breeding areas in the action area, with pairs nesting in the Lonesome Point area fledging an average of 1.7 chicks per pair (n = 24 pairs), pairs nesting in the Inner Harbor area fledging an average of 0.7 chicks per pair (n = 7), and pairs nesting in the Superior Beach area fledging an average of 1.7 chicks per pair (n = 15 pairs) (F. Cuthbert and E. Roche, University of Minnesota, pers. comm. 2009). The reasons for the reduced fledging rates in the Inner Harbor area are unclear.

A total of 71 chicks have fledged from the action area since 1989. Based on banding records, 20 of the 71 have returned to breed in the Great Lakes (11 females and 9 males). Out of these 20 individuals, nine nested in the action area, six at Vermilion, and one each at Port Inland, Cross Village South, Cathead, Ludington State Park, North Manitou Island, Sleeping Bear Point, Whitefish Point, and Alpena. This total exceeds 20 because some individuals nested at several different sites. One particularly long-lived piping plover female that nested in the action area produced 18 wild-fledged chicks. Seven of these were later observed in the Great Lakes, nesting at various sites across Michigan including Cathead Bay in Leelanau County, Cross Village in Emmet County, Port Inland in Schoolcraft County, Vermilion in Luce County, and Grand Marais (Cuthbert and Roche, pers. comm. 2009).

As demonstrated by the information from the action area, piping plover young do not exhibit a strong degree of natal site fidelity and may breed at locations some distance

from their original hatch site. Analyses of hatch-year birds (from fledging through to the following spring) further indicate that hatching location does not influence survival; however, anecdotal information suggests that hatchlings in the action area may be largely responsible for repopulating the breeding population within the Grand Marais area and along the Superior shoreline of the Upper Peninsula of Michigan (e.g., Vermilion and Whitefish Point) (Cuthbert and Roche, pers. comm. 2009).

Distribution and Habitat Use

Piping plovers nesting in the action area have historically occurred across three to five areas. These areas are called by various names, including Lonesome Beach/Lonesome Point/Cemetery Road or East Bay; Superior or Agate Beach; South Beach near Carpenter Creek or West Bay; South Beach at the Sucker River mouth or Lonesome Point; and Town Beach (Figure 9). We will refer to these sites as Lonesome Beach, Superior Beach, and West Bay. All but Town Beach are currently active nest sites. Details regarding the location and condition of each of these sites are provided in the Revised BA.

Specific nest locations within these areas have varied over the years, based on habitat condition and other factors (Table 2). Piping plovers have used the Lonesome Beach area of Grand Marais with the most frequency over the past 16 years. Up to three pairs of piping plover have nested at this site annually. Located near the mouth of Sucker River and in an area of dynamic shoreline, human and pet disturbance is limited. Predators, however, have been a continual threat, with frequent observations of merlin activity.

The Superior Beach area has also supported regular use by nesting piping plovers, although the area was not occupied during a period from 2001-2006. During this time period, the action area supported only one to two nests per year. Information provided in the Revised BA suggests increased home construction and beach conditions may have contributed to the absence at Superior Beach.

As the total number of nesting pairs in the action area increased from 2007 through 2009, this area supported two to three nests. Plovers nesting along Superior Beach are known to utilize the West Bay/Inner Harbor area for foraging, particularly during periods of adverse weather. Superior Beach now supports a relatively high density of residential homes and increased numbers of pedestrians, as compared to Lonesome Point.

Finally, piping plovers have used the West Bay nesting area with the least frequency over the past several years. Nests have occurred there in only six out of the past 17 years. In addition to these nests, over the past three years an additional pair has established and defended a territory in this area, but the female has been unable to produce eggs. This suggests habitat for at least 2 pairs is present. Most nests have occurred in the vicinity of the Carpenter Creek mouth. Residential development and human use of this portion of the action area is similar to Superior Beach, although most residences are located a greater distance from the shoreline. Vehicles on the beach have also occurred in this area over the past few years.

Table 2. The number of piping plover nests within the action area by location (1993-2009).

	# of Nests		
Year	Superior Beach	Lonesome Beach	West Bay
1993	1	1	1
1994	0	1	1
1995	1	2	0
1996	0	3	0
1997	1	3	0
1998	2	2	0
1999	2	1	0
2000	1	1	0
2001	0	1	0
2002	0	2	0
2003	0	1	1
2004	0	1	1
2005	0	1	0
2006	0	1	0
2007	2	1	0
2008	2	1	1
2009	3	2	1

Figure 9. Nest locations within the project area, 1993-2008

Factors Affecting the Species Environment within the Action Area

Factors affecting piping plovers in the action area are typical of factors common to the Great Lakes population as a whole. Predation, loss or changes to habitat from development, and human recreational uses are the major threats affecting piping plovers in the action area.

Disturbance by humans and pets

Human activities along the beaches of the action area potentially disturb nesting piping plovers and their young. Common activities include beach walking, running of off-leash pets, and occasional off-road vehicle driving. Although individual nesting areas are typically enclosed and highlighted by an arrangement of educational signs, posts, and twine, these measures are occasionally ignored. Due to the higher densities of residences in proximity to the shoreline within the action area, disturbance from human and pets is more prevalent as compared to other nest sites along the Lake Superior shoreline, such as at Vermilion.

Predation

The loss of adult and young piping plovers from predators represents a persistent threat across the Great Lakes basin, including the action area. Crows, gulls, and birds of prey are a particular concern within the action area, although fox, coyote, and other mammalian predators are also known. In the past few years, the threat of predation by merlins has increased. Merlins are suspected as the cause of adult mortality in more than one instance in the past five years. Crows and gulls have also been observed around piping plover nests and are known to prey on unprotected eggs as well as newly hatched chicks. Nest protection methods have successfully limited predator pressure on nests, but young piping plover chicks, which are precocial, are difficult to protect.

Management and Protection

Piping Plovers nesting within the action area are subject to the same nest protection and monitoring efforts implemented across the entire breeding population, although the frequency and level of monitoring has varied over the years in response to funding levels. Currently, each year's nest locations are protected with a wire nest exclosure and surrounded by signs and twine (psychological fencing). Nesting piping plovers are monitored throughout the breeding cycle, from egg laying to fledging of young. Several outreach and education efforts have occurred in the action area over the past several years.

Shoreline Development

Most of the Grand Marais shoreline has private ownership, and residential homes are prevalent. A small amount of shoreline used by piping plovers in Grand Marais has public ownership. Shoreline development has impacted piping plover habitat quality and has increased the level of human and pet usage of beaches. Some new home construction continues, although most lots are already developed.

In response to increased concerns over home construction in areas occupied by piping plovers, Burt township, in cooperation with ELFO, initiated a process in 1998 by which building permit applicants were required to contact ELFO prior to permit approval. This afforded the Service an opportunity to provide input on projects and potentially limit the impacts of construction on piping plovers. In some cases, coordination between the Service and landowner resulted in a written agreement to limit certain activities which may disturb piping plovers during the breeding season.

Other factors

Other factors known to affect piping plovers in Grand Marais include adverse weather conditions. Severe storms and cold, rainy weather conditions have adversely affected chick survival and, in rare cases, adult survival. In 2009, for example, unusually cold and rainy weather in July was considered the cause of the loss of at least one brood of piping plover chicks. In 2001, a severe hail storm caused the death of one adult female piping plover. Additionally, in May 2006 a severe northwest storm resulted in the inundation of a nest on Lonesome Beach. Although the eggs were collected and later returned to

Lonesome Beach, nest inundation during storms is another factor affecting piping plover in Grand Marais.

The existing jetties that form the entrance channel to Grand Marais Harbor have influenced habitat conditions along Superior Beach. The western jetty has acted as a barrier to sand movement along the shoreline and has led to increased beach width. At this time, it appears that Superior Beach west of the jetties has reached capacity and is now stable (USACE 2009a).

Conservation Value of Critical Habitat within the Action Area

The action area lies within piping plover critical habitat unit MI-1 (Figure 10). The unit begins just west of Superior Beach at the Pictured Rocks National Lakeshore property and extends, with a short interruption, to the Whitefish Point area in Chippewa County. The unit is approximately 53.6 miles in total length. Land ownership within MI-1 represents a mix of private, state, federal, and municipal governments, with state lands comprising the majority of ownership.

Since 1979, nesting within MI-1 occurred primarily at six locations: Grand Marais, Vermilion, Crisp Point, Little Lake Harbor, Deer Point, and Whitefish Point, although most nests were found at either Grand Marais or Vermilion (Figure 11). Over the past ten years, piping plover have nested almost exclusively within the action area and at Vermilion, with one nest occurring at Whitefish Point in 2009. Piping plovers have not occupied Crisp Point, Little Lake Harbor, and Deer Point, since the mid 1980s.

Within the action area, critical habitat extends from the boundary of Pictured Rocks National Lakeshore to the edge of the westernmost jetty that defines the Grand Marais harbor entrance. The unit begins again north of the east end of the private road originating at the junction of Highway 58, Morris Road, and Veteran Road. It continues along the inner harbor shoreline, past Carpenter Creek to Lonesome Point and beyond (USFWS 2001a) (Figure 12). The unit does not include the northern shoreline of the harbor and most of the area identified as Town Beach.

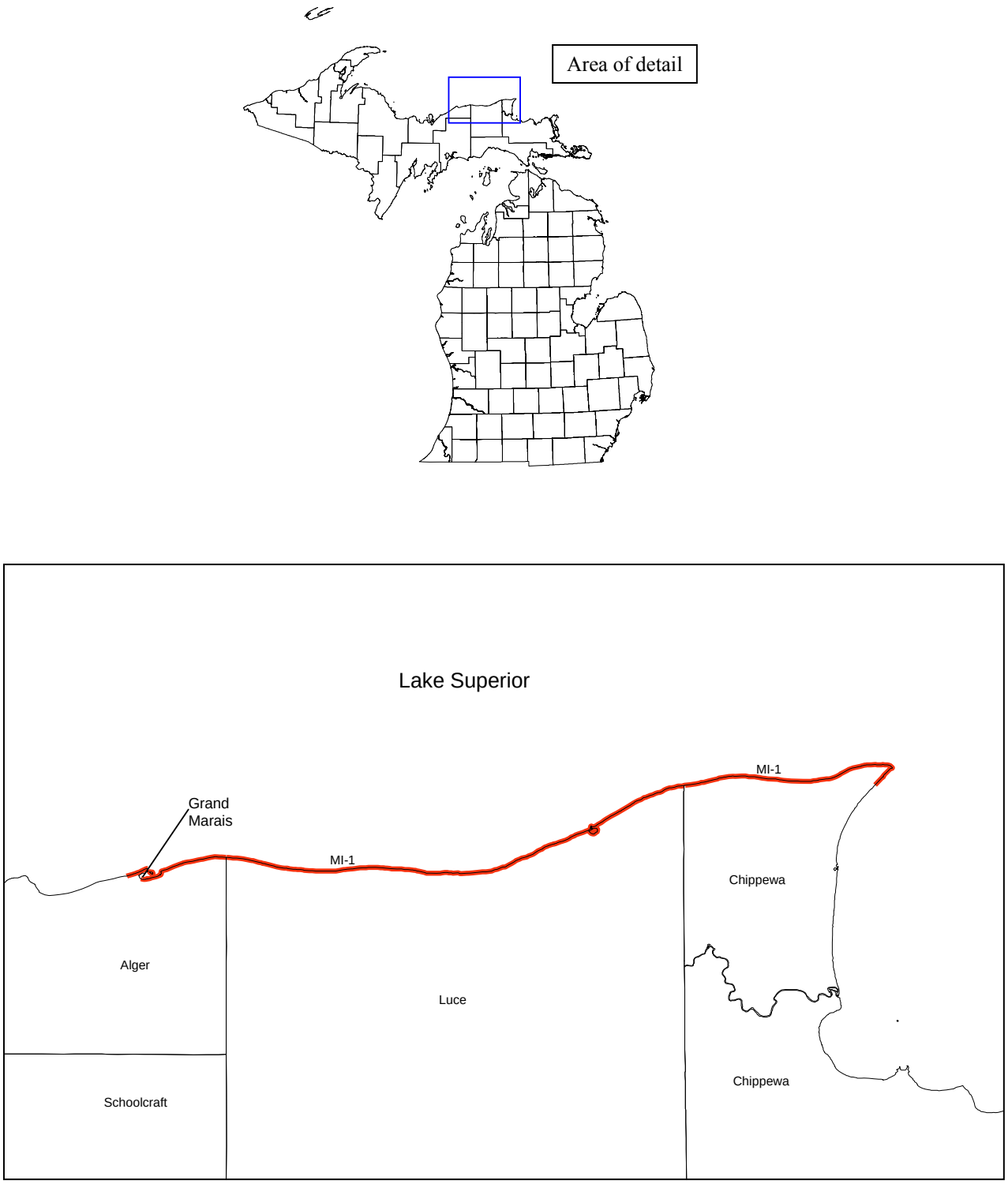

Figure 10. MI-1 unit of piping plover critical habitat in Alger, Luce and Chippewa Counties, Michigan

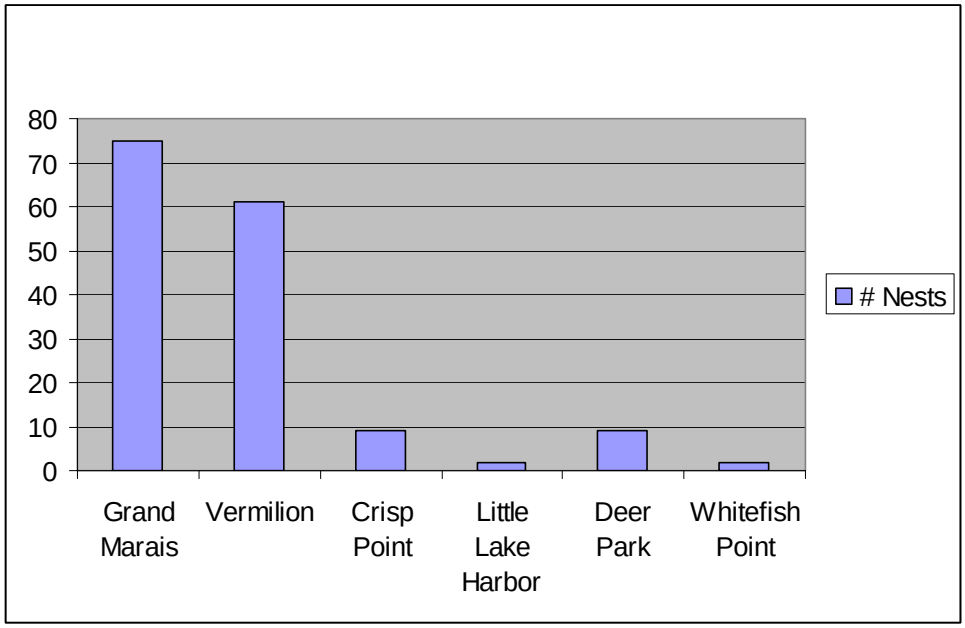

Figure 11. Total number of piping plover nests within critical habitat unit MI-1 (1979-2009)

The inland boundary of critical habitat extends 500 m (1640 ft) landward from the normal high water line. Approximately 3.4 linear miles of critical habitat are within the general action area, which represents approximately 6% of the total MI-1 unit. Approximately two miles, or 3.7% of the MI-1 unit is within the area directly affected by the breakwater project.

As previously indicated, critical habitat includes several PCEs. Within the action area, PCEs of total beach area, beach length, beach width, and distance to tree line all meet or exceed the minimum requirements for qualifying as critical habitat. More precisely, these PCEs exist at Superior Beach, Lonesome Beach and West Bay, all of which currently support nesting piping plovers.

Stressors to critical habitat in the action area are similar to those associated with the species, including shoreline development and human disturbance from beach use, and off-leash pets. The existing jetties that define the channel into the harbor also impact critical habitat by influencing the nearshore transport of sand and sediments within the area. The western jetty acts as a barrier to the eastern drift of sand along the shoreline, resulting in the accretion of sand at Superior Beach. Recent shoreline modeling suggests that Superior Beach has nearly reached its capacity to accrete sand, and sand now bypasses the jetty to downdrift areas (Baird and Associates 2006).

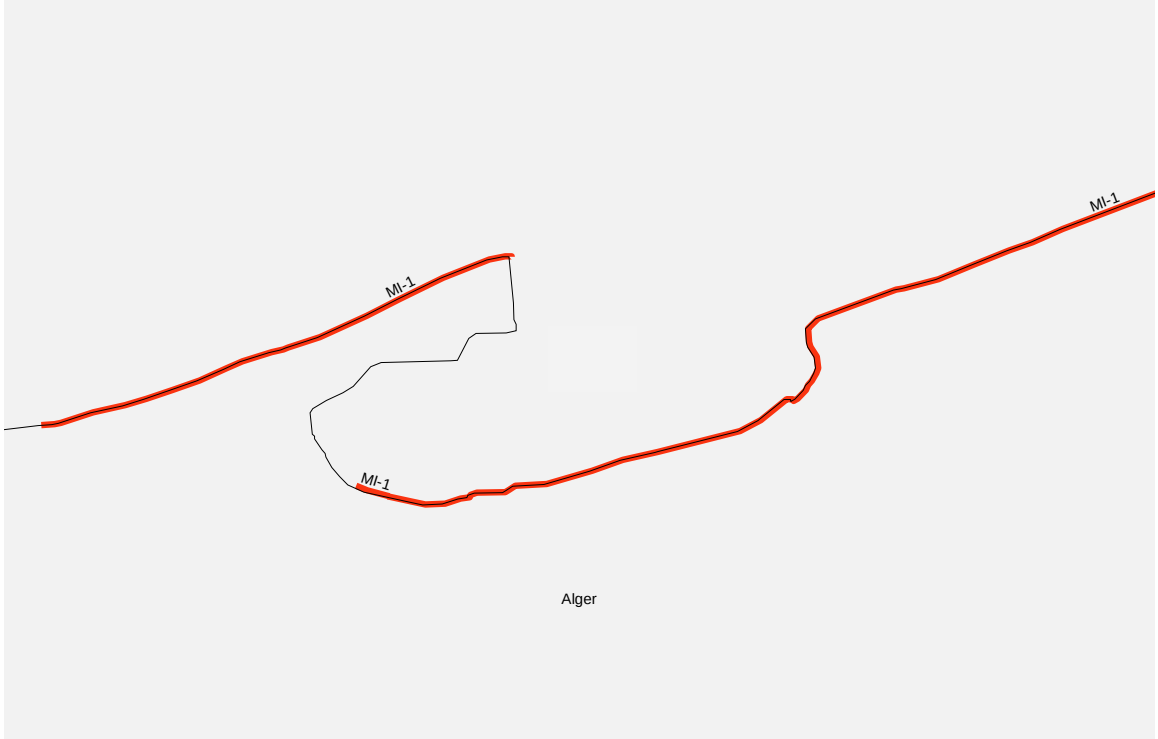

Figure 12. Great Lakes piping plover critical habitat (MI-1) within the action area[2]

This downdrift of sand currently influences beach conditions at sites along West Bay and Lonesome Beach. These areas are also subject to the dynamic processes of wind, waves, and changes in Lake Superior water levels. Together, these factors regularly act to modify beach width, length, and total area on nearly an annual basis.

The mouth of Sucker River also influences critical habitat in portions of the action area. Regular shifting of the mouth location due to Lake Superior water levels has led to a dynamic peninsula of beach with varying degrees of width and length. Driftwood and other debris have also accumulated at this location. Piping plovers have responded positively to this dynamic condition, frequently selecting this site for nesting.

Predicted future conditions in the Action Area

Shoreline conditions within the action area are expected to change in the future due to natural sediment deposition and shoreline processes. Baird and Associates (2006) modeled changes within the action area to estimate future shoreline configuration over a 30-year time period both with and without the proposed breakwater project. Their modeling efforts (using 2006 conditions, estimates of sediment inputs, and other factors) provide an estimate of future shoreline conditions at 5, 10, 20, and 30 years into the future (Figure 3).

[2] Critical habitat boundaries do not precisely match the current shoreline configuration due to shoreline changes since publication of the final rule.

The Baird model results suggest changes are likely to occur from the west side of the bay (near Town Beach) eastward to at least the eroding bluff at Lonesome Point, as a result of the longshore movement of sediment along the shoreline. Erosion at Lonesome Point bluff will likely continue. In addition, a large area of accreted sand will likely form along the eastern portions of the West Bay (Figure 3). The accreted sand will eventually form an extension of the shoreline, or "peninsula", into the harbor (Baird and Associates, 2006). The future condition of each of the major piping plover nesting areas in the project area are discussed in more detail below.

The West Bay area will continue to provide open beach shoreline habitat, comprised of sparse vegetation and exposed loose sand and small rocks, as the processes of sediment movement and waves continue to act upon the shoreline. Although the Revised BA, indicates that habitat to the west of the proposed breakwater location will be eliminated after the peninsula forms, our review and analysis suggests habitat to the west of the future peninsula will persist. We base this conclusion on the predicted shoreline condition in the Baird Modeling Report as well as expert opinion we received in an independent review of the report. That analysis and review also suggests that future shoreline conditions will allow longshore sediment transport and waves to reach the West Bay area and that the future land peninsula will be dynamic based on lake levels and wind and wave conditions. The Carpenter Creek mouth (whether in a north channel or a west channel) is also expected to continue to provide an open beach and stream interface suitable for foraging shorebirds.

Within the Lonesome Beach area, longshore sediment will continue to move west along the shoreline, depositing sands along the beach and in the remaining deep portions of the harbor. Sand deposition and waves will likely maintain similar beach widths and profiles as currently present along this portion of shoreline. In five years, shoreline processes will continue to maintain the shoreline in approximately the same current locations (USACE 2009a) (Figure 3). At 30 years, however, habitat will shift westward in part due to erosion on the eastern end of Lonesome Beach and accretion of sediment along the future peninsula (USACE 2009a) (Figure 3). Wave forces of Lake Superior and continuous deposition of sediment will maintain the leading edge of the peninsula shoreline as open beach. The areas behind the active beach will become vegetated and will eventually become part of the dunes currently observed along this shoreline. Although the Baird Modeling Report suggests a "creation" of habitat along the peninsula, we expect that normal shoreline processes will simply maintain open shoreline habitat, rather than create additional areas.

Shoreline analysis also suggests that woody debris accumulation along Lonesome beach appears to have increased from 2006 to 2009 and will likely continue into the future (USACE 2009a). Large woody debris, resulting from large trees which have fallen off Lonesome Bluff into Lake Superior, is currently prevalent on the eastern end of Lonesome Beach. This debris has adversely affected piping plover open beach habitat and facilitated vegetation establishment.

The Sucker River mouth remains an important piping plover habitat feature, and its migration is expected to continue, with the potential for the mouth to reach West Bay (USACE 2009a). The "peninsula" that may form in the future may reduce the westward migration of the river mouth but will not likely block it completely (USACE 2009a). The dynamics of river switching will be maintained, with the exact location of the mouth driven mostly by water levels in Lake Superior. During high water years, the mouth may be further away from open beach habitat. As lake levels recede, the river mouth is expected to migrate again to the west and flow through open beach habitat.

In summary, we anticipate the major components of critical habitat, i.e., the PCEs, to persist within the action area and that future shoreline conditions will support similar or slightly more piping plover nests than are currently present (Appendix 1). In total, six to eight nesting pairs may be present, with up to five pairs within the area directly affected by the breakwater project. This includes two pairs in the West Bay area (west of the proposed breakwater) and three pairs in the Lonesome Beach area (east of the proposed breakwater).

Effects of the Action

Effects of the action refer to direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action that will be added to the environmental baseline. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

Analytical Framework

Our analytical approach entailed assessing the measurable and detectable responses of piping plover exposed to the proposed action and the environmental impacts associated with the proposed action. In determining the biological response of piping plover, we focused on the impacts to individual fitness responses (i.e., individual annual and life-time survival rates and annual and life-time reproductive potential). Once we anticipated the individual fitness responses, we then examined how these individual responses affected the reproduction, number, and distribution of piping plover throughout the Great Lakes population. As indicated in the Description of the Action section, several conservation measures are part of the proposed action. Our effects analysis takes into account full implementation of these conservation measures.

As discussed under the Baseline, our understanding of predicted shoreline changes stem from the Baird Modeling Report, Revised BA, and our interaction with various experts. Several assumptions and caveats are inherent in the modeling results or are otherwise pertinent to our analysis of effects:

1. Our analysis addresses potential impacts to piping plover and piping plover critical habitat over the 30-year time frame covered in the Baird Modeling Report.

2. Baird utilized two models, HYDROSED and COSMOS, to determine nearshore currents and longshore sediment transport. We had the Baird Modeling Report reviewed by two coastal engineering experts who confirmed that the output and results seemed reasonable (Jeff Williams, USGS, pers. comm. 2009; Gene Clark, University of Wisconsin Sea Grant, pers. comm. 2009).

3. We assumed figures in the Baird Modeling Report provided general depictions of the future shoreline conditions under the no action and preferred breakwater alternatives. The authors of the Baird Modeling Report and White Paper cautioned that their predictions were approximate and that uncertainty of the exact shoreline configuration increased further into the future. We, therefore, concluded that the figures did not provide adequate precision to determine the length of future shoreline under either the baseline or breakwater condition.

4. The Corps has concluded that the Sucker River mouth is likely to remain east of the proposed breakwater (J. Selegean, Corps hydraulic engineer, pers. comm. 2009). As the river provides important foraging habitat, its location in relation to suitable nesting habitat is important in our analysis.

Effects of the Action on Piping Plover

We have separated our discussion of the effects on piping plover into impacts associated with construction and post construction.

Construction

Several potential environmental impacts during breakwater construction could adversely affect the piping plover. Breakwater construction includes all the components of the action that are necessary to put the breakwater in place, including moving and staging equipment and materials as well as physically placing rock along the breakwater alignment. As the Corps expects completion of breakwater construction in less than one year, we anticipate that exposure of piping plover to any of these impacts would occur over only one nesting season. Appendix 2 provides details of all the components of construction and their potential impacts to piping plover. For purposes of our discussion, we have separated the components into general construction and sediment excavation and deposition.

First, general construction activities could produce noise and water disturbance in the area. This could result in loss of or reduction in reproductive success if these activities occur in close proximity to piping plover breeding areas. Depending on the activity's timing and duration, these disturbances could lead to adults deserting the area prior to nesting or abandoning nests or young. Sporadic disturbances may not result in complete abandonment of the site but could induce adults to leave eggs exposed or not to brood chicks when necessary. Both of these impacts would likely result in loss of eggs or chicks.

The Corps incorporated Conservation Measures 1, 2, 3, 5, and 6 (described under Project Description above) into the project to avoid impacts to piping plover habitat and to avoid disturbance of breeding piping plover. These measures eliminate construction activities on the shoreline and keep all water-based work at least 250 feet away from the shore during the piping plover nesting season. Additionally, monitoring of piping plover in the vicinity will occur during construction. This monitoring will help ensure early detection of disturbances to piping plover so that the Corps may stop or adjust construction activities.

An oil or hazardous chemical spill from the vessels or other equipment used in the harbor poses another potential environmental impact during general construction. Direct exposure to these hazardous materials could result in death of piping plover adults and chicks if these chemicals washed on shore during the piping plover breeding season. If adults were incubating eggs or brooding chicks at the time, the eggs or young could also die. The threat of an oil spill occurring as a result of this project, however, remains small. In 15 years of reviewing spill incident reports, few reports have related to construction activities (L. Williams, USFWS, pers. comm. 2009). The potential for impacts to the shoreline and piping plover are even smaller, especially with implementation of Conservation Measure #4, which ensures development of an oil spill response plan with specific measures to protect piping plover and piping plover habitat as part of the contract for this project.

The action also includes excavation of 5,000 cubic yards of material and deposition of this dredged material off site. We expect the excavation will have similar disturbance impacts as described under general construction above. Although a portion of the excavation will occur within 250 feet of the shoreline, this activity will not occur between April 15 and September 1 (per Conservation Measure # 3) when breeding plover are present. In addition to the excavation, the deposition of sediment may occur 1.3 miles east of Grand Marais in water depths between 4 and 8 feet. A Google Earth (2007) image shows this area as a narrow beach immediately backed by forest. Piping plover do not currently nest near this location, and the area does not appear to contain the necessary habitat components for piping plover. Offshore deposition of sediment in this location should have no impact on piping plover.

Provided that the stated conservation measures are fully implemented, we believe that construction activities associated with the breakwater are not likely to adversely impact piping plover.

Post Construction

Appendix 3 summarizes all the post construction elements we analyzed and their potential impacts to piping plover. Once constructed, the breakwater will likely alter the dynamics of the harbor, resulting in shoreline changes, increased predator nesting habitat, increased vulnerability to storm events, and increased public access. These effects will alter future piping plover habitat and disturb nesting piping plover. We discuss the specific effects to piping plover fitness from each of these four environmental impacts in detail below.

Predicted Shoreline Changes

As discussed under Environmental Baseline, results from the Baird Modeling Report formed the basis for predictions on future shoreline conditions with the breakwater. Figure 4 shows the overall shoreline configuration at 5, 10, 20, and 30 years post breakwater construction. Below, we briefly describe the shoreline changes anticipated west and east of the proposed breakwater and the consequent impacts on piping plover.

To its west side, the breakwater will block all longshore sediment movement and waves from entering the harbor (West Bay). Without the wave disturbance along the shoreline and the sediment for deposition, vegetation will encroach on the open beach and the beach will narrow (USACE 2009a). This encroachment of vegetation will eliminate open shoreline habitat from the breakwater west to Town Beach (USACE 2009a). The Revised BA also indicates that the mouth of Carpenter Creek will become vegetated and will experience less potential for migration. Furthermore, Carpenter Creek may become stabilized in its current north channel, which provides only a short length of interface between the open beach shoreline and the creek.

The Revised BA summarized rates of vegetation advancement observed at Grand Marais from 1974 – 2004. From photo interpretation, the Revised BA estimated that vegetation generally advanced from three to nine meters per year during low Lake Superior water levels. These rates are conservative as complete blockage of waves and sediment will likely accelerate vegetation establishment; however, we chose to use the nine meters per year estimate. The current open shoreline width in the West Bay area is approximately 50 m (Google Earth 2009). With an advancement rate of nine meters per year, it would take approximately five growing seasons for the open beach to reach a width less than seven meters.

The increased growth of vegetation on the beach will result in the loss of piping plover breeding habitat as nesting plovers will likely abandon the area after the vegetative cover exceeds 50% and beach width narrows to less than seven meters. This loss of habitat will happen gradually, with open beach widths of less than seven meters likely occurring at six years post construction. We anticipate that without the proposed project this habitat area would support up to two piping plover pairs. Thus, with the proposed action, we believe that subsequent stabilization of the beach west of the breakwater will adversely impact piping plover by eliminating nesting habitat capable of supporting up to two breeding pairs.

Additionally, we anticipate a loss of foraging habitat at Carpenter Creek. Without the project, the modeling results indicate that open beach habitat remains, and we anticipate that Carpenter Creek would continue to provide foraging habitat throughout the 30-year time period. With the proposed action, however, vegetation encroachment would eliminate this area as suitable foraging habitat. Observations indicate that nesting pairs at Superior Beach often forage at Carpenter Creek. In 2009, three nesting pairs (six adults) nested on Superior Beach. Considering this baseline, we anticipate the project will result in loss of foraging habitat capable of supporting six adult piping plovers. We expect the

reduction in foraging area will have minimal impact on the fitness of these birds, however, as they will likely select other nearby areas for foraging. We conclude that the impact of losing Carpenter Creek as foraging habitat is insignificant and not likely to adversely affect piping plover.

On its east side at Lonesome Beach, the breakwater will block longshore sediment movement, resulting in the deposition of approximately 105,000 cubic yards of sediment on the shoreline or in Lake Superior to the east of the breakwater (Lonesome Beach). This blockage would substantially change the shoreline from approximately 10 to 30 years after construction (USACE 2009a) (Figure 4). The Baird Modeling Report depicts lakeward shoreline advancement of about 0.25 mile, shifting the open beach habitat significantly north. At 30 years post construction, only the leading edge of shoreline would have open beach characteristics. Further, as sediment and wave forces decline with distance from Lake Superior, the back beach areas will become vegetated and dunes will form. This process has already occurred on the far eastern end of Lonesome Beach where once open beach shoreline has succeeded into vegetation and dunes. We expect a similar process will occur east of the breakwater, but at a faster pace due to the higher amounts of sediment deposition.

The Baird Modeling Report predicts that erosion of the shoreline, driftwood deposition, and dynamics of Sucker River will occur at Lonesome Beach. The eastern portion of Lonesome Beach will continue to erode, although the model predicts erosion of a shorter length of shoreline than under baseline conditions (Figures 3 and 4). Lonesome Point bluff will also continue to erode, depositing driftwood on the shoreline. We assume that, similar to baseline conditions, deposition of driftwood would occur immediately west of the erosion zone. Although the breakwater structure and the significant amount of accreted sand east of the breakwater will limit the far western migration of Sucker River, the river mouth will continue to switch its location, based on the fluctuations of lake levels.

As noted, the Baird Modeling Report indicates that sand will accrete on the east side of the breakwater. In the Revised BA, the Corps interprets the figures in the Baird Modeling Report as indications that the breakwater would create a longer segment of open beach habitat, and subsequently a longer length of piping plover habitat, than currently exists. Our interpretation of the Baird Modeling Report, however, leads to a different conclusion.

Through our analysis, we concluded that the breakwater would maintain the same amount of open beach habitat suitable for piping plover as is currently present. We base our conclusion on three primary factors. First, the model and resulting figures lack precision (as discussed previously in the Analytical Framework section above). We contend that Figures 3 and 4 depict the relative location of the future shoreline, but they lack precision to warrant using them for exact shoreline measurements. Second, although the figures generally depict a longer shoreline than under the baseline, the Revised BA did not consider factors affecting suitability of that shoreline for piping plover. For example, the Revised BA did not incorporate the amount of shoreline impacted by woody debris

accumulation. The shoreline covered with large woody debris would not be suitable for piping plover and would reduce the amount of suitable piping plover habitat. Third, similar to the baseline condition, we assume the continued interaction with Lake Superior (waves, sediment deposition, and ice) would maintain at least a similar length of shoreline as currently observed. For these reasons, we concluded that the breakwater would maintain the same amount of piping plover habitat at Lonesome Beach, and we expect continued use of the area by up to three piping plover pairs.

Additionally, we expect maintenance of piping plover foraging habitat east of the breakwater. Although the breakwater will limit the western migration of Sucker River, the river will not reach West Bay due to the breakwater and sand accretion (USACE 2009a). We do not expect this will have an adverse affect on piping plover. As the West Bay area will no longer provide conditions suitable for nesting or foraging piping plover, as previously discussed under West of the Breakwater, the full western migration of Sucker River would provide no utility to piping plover. Thus, the narrowed range of river mouth migration will continue to ensure that important foraging habitat stays in close juxtaposition to suitable nesting habitat. We conclude that the contraction of the Sucker River mouth migration is not likely to have an adverse impact on piping plover.

Predator Nesting Habitat

Conditions suitable for predator nesting habitat represent the second potential impact of the breakwater. Ring-billed and herring gulls may nest on breakwater structures and could predate piping plover eggs and chicks. The Revised BA acknowledges, for example, gulls nesting on the breakwater could impact piping plover but concludes that gulls are not a major predator of the species along Lake Superior. The Revised BA provides no other analysis of this potential impact.

We evaluated the potential of the breakwater creating gull habitat and predicted the future gull predation rate and its impact on piping plover. First, we expect that the breakwater would provide nesting habitat for gulls. The breeding habitat requirements for both ring-billed and herring gulls include artificial and natural islands or peninsulas with rock or sand substrates (Pierotti and Good 1994; Wires et al. 2005; Ryder 1993). Observations show that gulls use artificial structures in the Great Lakes. Waterbird surveys conducted from 1997 to 1999 indicate that 19% of herring gull and 26% of ring-billed gull colonies were on artificial structures (Cuthbert et al. 2002). In fact, "Breakwall" was part of the site name for several herring and ring-billed gull colonies. Based on the colony site names, we infer at least one gull colony in Lake Superior utilized a breakwall (Cuthbert et al 2002; Cuthbert and Wires 2008). We conclude, therefore, that the breakwater structure would provide appropriate nesting substrate for these two species.

Second, we anticipate that gull nesting will increase at Grand Marais in response to the new nesting habitat on the breakwater. Historical evidence suggests that a larger colony once existed at Grand Marais. Between the 1930s and 1960s, herring gull chicks were banded at an island in Grand Marais harbor (Ludwig 1963). Additionally, the local residents of Grand Marais refer to this island as "Gull Island", but topographic maps identify it as Lost Island (www.saveyourharbor.com; www.agatelady.com; USGS 1968).

The island disappeared after the pile breakwater deteriorated. Currently, gulls nest on the remaining portion of the timber crib breakwater (USACE 2009). Given that waterbird surveys did not detect this colony (Cuthbert et al. 2002), the site likely has a small gull population (< 5 pairs). The breakwater will provide a larger nesting area than the remaining pile breakwater and could result in increased gull nesting. Based on data on gull nesting in Lake Superior and expertise from a waterbird expert, we expect that the colony size would be relatively small, approximately 50 pairs, and would likely be comprised of mostly herring gulls (Cuthbert et al. 2002; Cuthbert pers. comm. 2009). A small gull colony could form rapidly within five years of breakwater construction.

Finally, we anticipate the gull nesting colony will likely increase gull predation of piping plover chicks at both Lonesome Beach and Superior Beach. Multiple references indicate that gulls are known or potential predators of piping plover eggs and chicks (USFWS 2003; Powell and Cuthbert 1992; Lauro and Tanacredi 2002; Melvin et al. 1992; MacIvor et al. 1990). We anticipate that continued deployment of nest protection measures in a timely fashion at Grand Marais will protect nests from gull predation. Chicks, however, are mobile and leave the nest exclosure shortly after hatching, leaving them vulnerable to gulls. The exact number of chicks that could be predated by gulls over the 30-year timeframe is unknown, but past predator control activities lend some insights to future losses due to gull predation. Predator control on North Manitou Island improved piping plover fledging success by 20% (P. Ryan, USDA – Wildlife Services, pers. comm. 2009). As a variety of mammalian and avian predators (including gulls) were the target of the predator control, we are uncertain how gulls alone impacted fledging success, but for a worst case scenario, we used a reduction of 20% as a reasonable estimate. With six breeding pairs at Grand Marais (three at Superior Beach and three at Lonesome Beach), an average fledging rate of 1.5 chicks per pair, and a reduction in fledging rate of 20%, we anticipate the loss of approximately two chicks annually once the gull colony establishes.

Storm Events

Increased exposure to storm events represents the third environmental impact anticipated to occur. The orientation of the predicted shoreline east of the breakwater may increase the number of piping plover nest failures due to wave overwash. The Baird Modeling Report shows that north to northwest wave conditions predominate and occur approximately 52% of the time. Figure 13 shows the northwest wave pathway relative to the predicted shoreline after construction of the breakwater. Under the breakwater condition, northwest waves are likely strongest and have the greatest potential for overwash on two-thirds of the shoreline east of the breakwater. This wave condition also will likely impact the Superior Beach nesting area. Conversely, under the baseline condition, suitable piping plover habitat migrates to the west, which represents more protection from northwest waves (Figure 14).

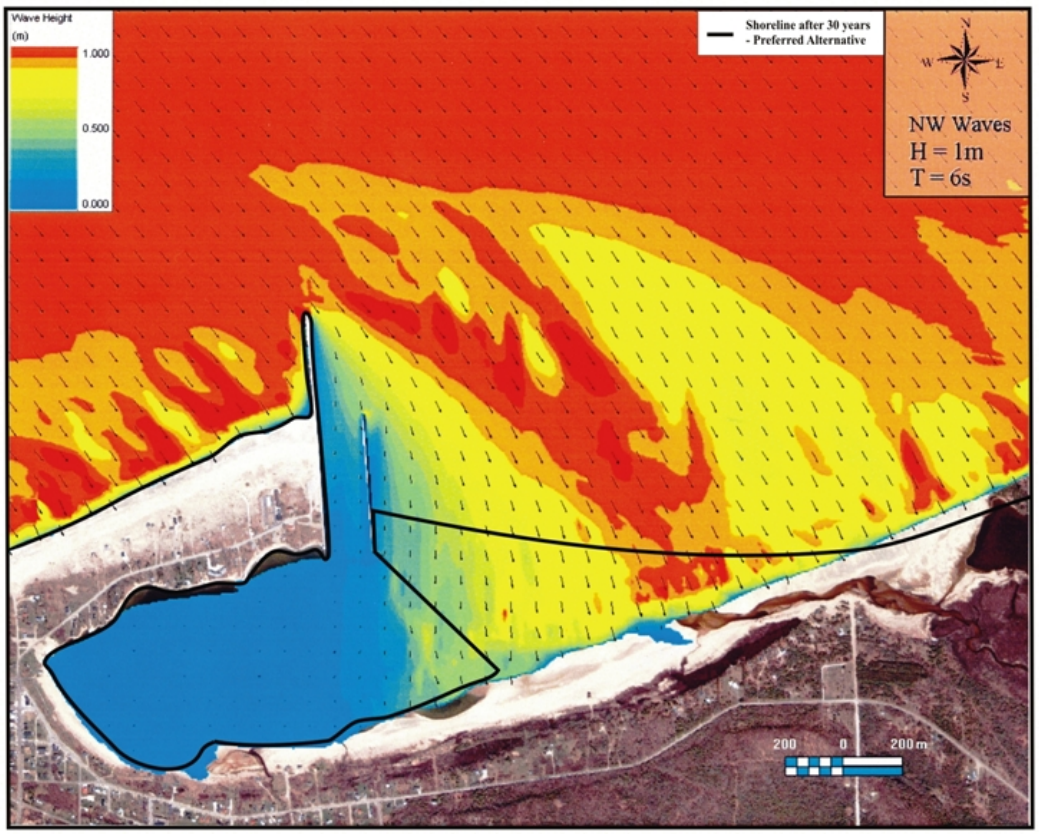

Figure 13. Wave pathway relative to the predicted shoreline after construction of the breakwater

Two recent observations at Grand Marais may provide insight regarding the severity of northwest wind and waves and the effects on piping plover nesting (Central Lake Superior Land Conservancy (CLSLC) 2006; CLSLC 2009). On both occasions, nesting areas became inundated. On May 21, 2006, waves inundated a piping plover nest at Lonesome Point and washed the eggs out of the nest cup (CLSLC 2006). On May 16, 2009, waves were up to the dune grass at Superior Beach and Lonesome Point (CLSLC 2009). Although egg-laying had not yet begun (eggs were found in three nests on May 19, 2009), these nests would have been lost had the wave event occurred just three days later.

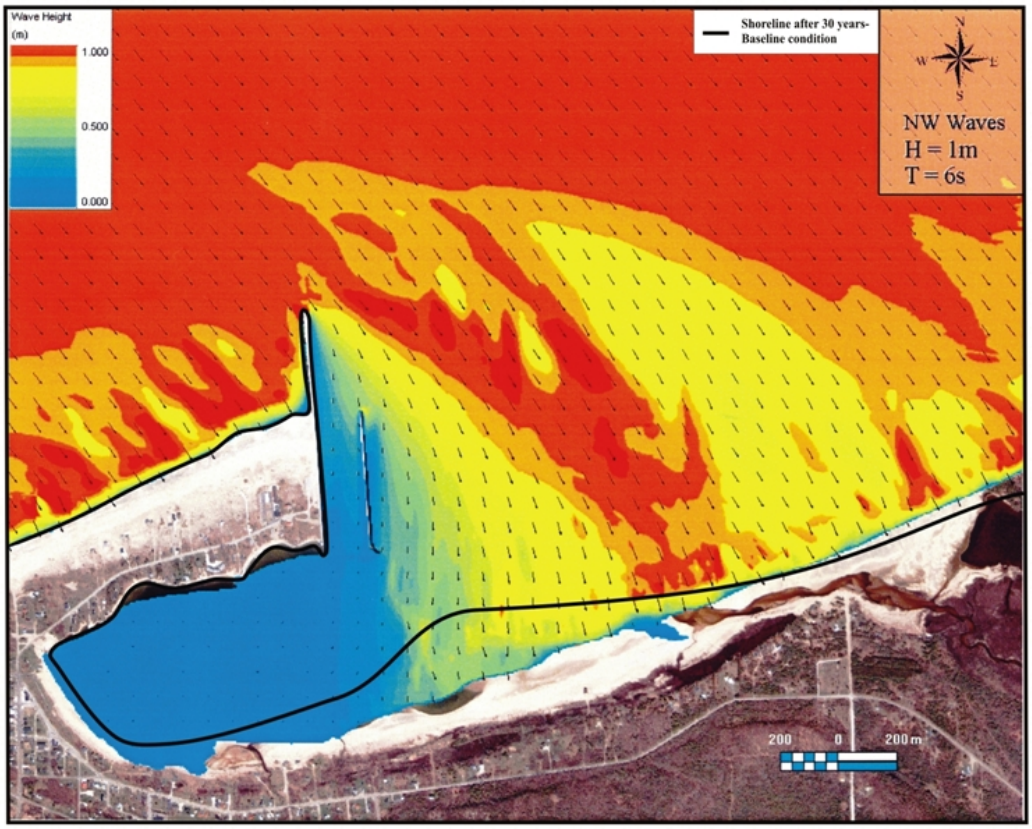

Figure 14. Wave pathway relative to the predicted shoreline under baseline conditions

We reviewed data provided on the National Weather Service website to identify the wave heights and winds experienced on these two days. Moored Buoy #45004, located in Lake Superior northwest of Grand Marais, reported at least 10 meter/second wind speeds and at least 2.66 meter wave heights. We queried the National Oceanic and Atmospheric Administration's (NOAA) archived on-line data for buoy #45004, looking for frequency and timing of storm events with at least these wind and wave conditions. We found that Northwest storms of this magnitude typically occur in spring (April/May) and fall (September/October). We identified five events that occurred during the piping plover egg laying and incubation season (May 15 – July 15) over the 30 years of data available, equating to a frequency of approximately one event every six years.

Using this information, we anticipate that northwest wave events could impact up to two-thirds of Lonesome Beach from one to 30 years post construction. Under the Shoreline Changes discussion above, we concluded that after breakwater construction Lonesome Beach would maintain habitat capable of supporting up to three pairs of piping plovers. Overwash events on two-thirds of the available nesting habitat would result in the loss of two nests every six years. Under the baseline, however, we also expect northwest waves to impact approximately two-thirds of Lonesome Beach until the habitat migrates west. At approximately ten years, westward habitat migration and eastward erosion will result in a habitat location protected from strong northwest waves. Conversely, under project conditions, northwest wave events associated with the breakwater will impact piping

plover nests beyond the ten-year mark. With significant storm events occurring every sixth year and two nests impacted per storm, this would result in the loss of seven piping plover nests (20 years x 1/6 = 3.3 storm events x 2 nests = 7 nests). When storm events occur, annual fledging success will decline from the baseline rate of 1.5 to 0.5 fledglings per pair at Lonesome Beach.

Recreational Uses

Lastly, the proposed action will likely result in changes in recreational use of Lonesome Beach. As described in our discussion of future shoreline changes resulting from the project at Grand Marais, the breakwater will block longshore sediment movement to the west, and approximately 105,000 cubic yards of sediment will deposit on the shoreline or in Lake Superior to the east of the breakwater. This blockage will substantially change the shoreline approximately ten to 30 years after construction (USACE 2009a) (Figure 4). Modeling results depict lakeward shoreline advancement of about 0.25 mile, shifting the open beach habitat significantly north. We anticipate these changes will affect recreational use patterns along the shoreline and in areas of future piping plover nesting habitat.

Currently, human recreational uses of piping plover habitat include beach walking, dog-walking, and occasional ATVs or other vehicle use. These activities have the potential to disturb adult nesting piping plovers by flushing birds off the nest during incubation, increasing foraging distances, and in the case of off-leash pets or All-Terrain Vehicles (ATVs), causing direct injury or even death. These activities also significantly affect newly hatched piping plover chicks, as the chicks are unable to fly and less able to avoid people, pets, and ATVs. Studies from the Atlantic Coast have found a negative correlation between the number of people present within 50 meters of piping plovers and the amount of time plovers spent foraging (Burger 1991). Plovers may spend only 50 percent of their foraging time actually feeding when people are present, compared to 90 percent in less disturbed areas (Burger 1994). Flemming et al. (1988) found productivity correlated to the level of disturbance, with 2.9 chicks per pair in areas of low disturbance compared to 2.3 chicks per pair in areas of moderate human disturbance; however, Hoopes et al. (1992) found no correlation between disturbance and productivity rates and attributed this to intensive management of recreational activities within his study area, including restrictions on dogs and off-road vehicles and use of symbolic fences to protect nests and provide refuge areas for chicks.

As Lonesome Beach advances northward a change in recreational use from pedestrian to ATV traffic is likely. As the distance from access points and residences increases, we expect a reduction in pedestrian traffic. Correspondingly, the presence of dogs may also decline, although off-leash pets can roam considerable distances. The use of ATVs on Lonesome Beach, however, may increase as residences are further away from the shoreline. ATV use often impact some of the remote nesting sites because few people, homes, and law enforcement personnel are present to enforce restrictions.

We anticipate that the action area will continue to attract ATV users. Currently, the presence of private residences discourages ATVs, or individual landowners stop ATV use

across their shoreline. As a result, the area has low ATV use, and we expect that to continue under baseline conditions. With the breakwater and the significant shoreline migration lakeward, we expect landowners will have a harder time observing and controlling ATV use on Lonesome Beach. Additionally, during high Lake Superior water levels, the Sucker River mouth will migrate east and Cemetery Road, a public road that connects to H-58, will provide direct access to Lonesome Beach.

For these reasons, we anticipate recreational use of Lonesome Beach will increase disturbance to piping plovers nesting in this area and result in a reduction in reproductive success from ten to 30 years post construction. Based on Flemming et al. (1988), we anticipate a reduction in reproductive success of up to 21% or 0.3 chicks per pair could occur. Incorporating a 20% reduction due to gull predation, the Lonesome Beach fledging success could fall to 0.95 fledglings per pair.

Synopsis of the Effects on Piping Plover from the Proposed Action

Within the action area, we expect adverse impacts to piping plover related to building the breakwater. These impacts will affect the number of nesting pairs and reproductive success of piping plover within the action area.

First, we expect a loss of habitat capable of supporting up to two piping plover pairs in the action area. As explained above, the habitat quality at West Bay will deteriorate due to vegetation encroachment and narrowing of open beach habitat. By approximately six years post construction, we expect plovers will no longer use this area for breeding. We expect this will permanently reduce the potential number of breeding piping plovers in the action area by two pairs.

Second, we anticipate adverse impacts to piping plover reproduction due to increased exposure to gull predation, storm events, and recreational use. Wave overwash could impact up to seven nests over 20 years. When storm events occur, reproductive success will decline from the baseline fledgling rate of 1.5 fledglings per pair to 0.5 fledglings per pair at Lonesome Beach. Additional loss of chicks due to gull predation (0.3 fledgling per pair reduction at Superior Beach) and the combination of gull predation and ATV disturbance (0.55 fledgling per pair reduction at Lonesome Beach) could annually reduce fledgling rate to as low as 1.1 fledglings per pair in the action area.

Effects of the Action on Piping Plover Critical Habitat

The Species and Critical Habitat Description section provides a description of piping plover critical habitat and the related PCEs. PCE numbers provided below refer to the bulleted list within the Critical Habitat Description section of this Opinion. Due to the interrelated nature of many of the PCEs, our analysis logically separates into two issues: 1) ecosystem processes and habitat impacts and 2) human disturbance concerns. We have summarized in Appendices 1, 2, and 3 the likely impacts to piping plover critical habitat with and without the breakwater.

Ecosystem Processes and Habitat

One PCE specifically mentions the need for continued dynamic shoreline processes, including lake level changes, erosion, accretion, and periodic storm events. These processes are necessary for the creation and maintenance of PCEs 1-7, which relate to habitat quality; therefore, we combined our analysis of PCEs 1-7 and 9 because they act in concert to provide suitable piping plover breeding habitat.

The shoreline processes of wind, waves, and sediment transport have provided the above PCEs in the action area over the last 50+ years. Without the proposed breakwater, we expect these processes will continue, and the PCEs will persist in the future. Completion of the project, however, will interrupt these shoreline processes west of the breakwater. As discussed previously, we expect the lack of waves and sediment west of the breakwater will lead to increased vegetation on the shoreline and a narrowing in shoreline width. This will directly impact PCEs 1-4, 6, 7, and 9 by altering the vegetation, exposed substrate, and beach width, but will not impact PCE 5. Overall, many of the PCEs would no longer exist. This would ultimately reduce the length of critical habitat and, as discussed under Effects of the Action to Piping Plover, would subsequently reduce the action area's nesting population by up to two pairs.

East of the breakwater, however, shoreline processes will continue to act upon the shoreline and provide beaches that sustain PCEs 1-7 and 9. In this area, we expect PCEs to shift lakeward and follow the leading edge of the shoreline. At 30 years, this will result in a shift in critical habitat approximately one-quarter mile northward. Although its location will shift, the critical habitat east of the breakwater will maintain habitat for up to three pairs of piping plover. As discussed under the Effects of the Action on Piping Plover, the pairs nesting in this area after breakwater construction may experience higher levels of gull predation, which we expect will reduce productivity from 1.5 to 1.2 fledglings per pair.

Human Disturbance

Low levels of human activity and disturbance are also a primary constituent of critical habitat (PCE 8). We discussed the impact to PCE 8 under the Effects of the Action on Piping Plover. Due to lakeward shoreline advancement and a reduced ability to control ATV use, we conclude that disturbance levels will increase east of the breakwater and thus adversely affect this element of critical habitat. This impact will further reduce productivity to 0.95 fledglings per pair.

Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Future non-federal actions which are reasonably certain to occur within the project area include the eventual construction of new homes on the newly accreted areas east of the

breakwater (USACE 2009a). Due to a court case and current State law, the Corps expects that much of the accreted land at Lonesome Beach have private ownership, and that current riparian owners will have rights to this new land (D. Erwin, Corps, pers. comm. 2009). As a result, current or future landowners may develop new residences closer to the water. In general, home construction along the Great Lakes shoreline has occurred in areas following construction of navigational structures and the eventual accretion of new upland. In Grand Marais, for example, the shoreline along Superior Beach moved northward approximately some 600 feet between 1880 and 1990, due to the construction and lengthening of the west breakwater. In the early 1970s, there were fewer than five cottages constructed beyond the treeline in the beach-grass area. By the 1990s, landowners built dozens of homes and a resort, putting the owners and resort users closer to the lake (USACE 2009a).

We do not expect that direct impacts to piping plover habitat would occur as a result of home development. Building of homes does not typically occur below the Ordinary High Water Mark (OHWM) where piping plovers nest. (If a landowner proposed to construct a home below the OHWM, they would need a permit through the Corps. The permit issuance would represent a Federal action requiring section 7 consultation.) Indirectly, however, home development could increase human disturbance and pets in the area. As discussed under Human Disturbance above, this could result in reductions in fledging success. New home construction may also reduce the value of the Sucker River mouth for foraging and nesting.

We would expect a similar level of human disturbance associated with these new residences as observed with baseline conditions. We expect the density of residences and distance from residences to piping plover habitat will remain similar to current conditions in the action area; therefore, we do not expect additional adverse impacts due to future home development.

Conclusion

Jeopardy Analysis

After reviewing the current status of the Great Lakes piping plover, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the Great Lakes piping plover.

Adverse effects are likely for the Great Lakes piping plover in the action area as a result of the proposed action. We expect adverse effects in the form of reduced numbers of breeding pairs and a reduction in reproductive success of remaining breeding pairs. To assess whether such effects are likely to jeopardize the continued existence of the Great Lakes piping plover, we evaluated how the action area impacts affect the reproduction, numbers, and distribution of the piping plover population in the Great Lakes.

We do not expect the loss of breeding habitat for up to two adult piping plover pairs over time to reduce adult survival or the total number of breeding pairs in the Great Lakes population because the affected piping plovers are likely to find suitable nesting habitat

elsewhere within the critical habitat unit MI-1. Thus, we do not believe that the anticipated loss of breeding habitat within the action area will reduce the likelihood of achieving the current recovery goal of 150 breeding pairs.

As described in the Effects section, we anticipate a reduction in the fledging rate of 0.4 chicks per pair in the action area as a result of increased exposure to predation, storm events, and human disturbance. Because the numbers of pairs affected are so few, this reduction in fledging rate at the action area level will not detectably reduce the overall reproductive success rate of the Great Lakes population; therefore, this reduction in fledging rate will not appreciably reduce the likelihood of achieving the current recovery goal of a five-year average fecundity rate of 1.5-2.0 fledglings per pair per year in the Great Lakes population. For these reasons, we conclude that the proposed action, taken together with cumulative effects, would not directly or indirectly reduce the likelihood of both the survival and recovery of the Great Lakes piping plover by reducing the species' reproduction, numbers, or distribution.

Analysis of Destruction or Adverse Modification of Critical Habitat

After reviewing the current status of the Great Lake piping plover, designated critical habitat unit MI-1, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the project, as proposed, is not likely to destroy or adversely modify designated Great Lakes piping plover critical habitat.

As described in the Environmental Baseline section, the action area lies within critical habitat unit MI-1. The action area is one of the most productive sites and currently supports the highest number of breeding pairs within the critical habitat unit. The proposed action will adversely affect both the quality and quantity of critical habitat within the action area.

Following implementation of the proposed action, approximately 3,800 feet of MI-1 will be lost over 30 years; this loss equates to 1.4 % of the MI-1 unit. As explained in the Effects of the Action on Piping Plover Critical Habitat section, we anticipate that the impacts to critical habitat will reduce the number of breeding pairs and productivity within the action area, particularly in areas west of the future breakwater. Losses within this area, however, are likely to result in only minor reductions in the total value of the critical habitat unit, as other unoccupied areas will compensate for this loss. Areas west of the proposed breakwater have also been less productive, compared to the other breeding sites in the action area. Lakeward accretion of sand will maintain the extent of piping plover habitat on the east side of the breakwater where historically productivity has been highest. These areas, along with the remaining unoccupied portions of critical habitat within MI-1, will provide suitable habitat for successful nesting such that the impacts within the action area will not noticeably affect the current and future breeding potential of the critical habitat unit. For this reason, we believe the proposed project will not appreciably reduce the overall conservation value of the critical habitat unit, and thus, is not likely to adversely modify or destroy critical habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), take that is incidental to and not intended as part of the agency action is not considered to be prohibited under the Act provided that such take is in compliance with the terms and conditions of this incidental take statement.

Section 9(a)(1) of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened fish and wildlife species without special exemption. The measures described below are non-discretionary, and must be implemented by the Corps in order for the exemption in section 7(a)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to adhere to the terms and conditions of the incidental take statement, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(a)(2) may lapse.

Amount or Extent of Take

We expect incidental take of up to 66 piping plover chicks in the form of death as a result of increased exposure to storm events, gull predation, and ATV disturbances over the life of the project (Table 3). From ten to 30 years post construction, we expect the loss of up to seven nests at Lonesome Beach (habitat east of the breakwater) due to storm events. With an average 1.5 fledglings per pair, the loss of seven nests is equivalent to a loss of approximately ten fledglings. Additionally, starting at five years post construction, we anticipate annual chick mortality from gull predation at both Lonesome Beach and Superior Beach. This will result in the loss of 27 chicks from both sites or a reduction in fledging rate of 0.3 fledglings per nest. From 10 – 30 years post construction, both gull predation and ATV disturbance will result in take of up to 29 fledglings at Lonesome Beach (reduction of 0.55 fledglings per pair).

Regulations require monitoring to measure actual incidental take associated with the proposed action. Periodic nest monitoring at Lonesome Beach would adequately determine nest loss due to storm events. For fledglings lost due to gull predation and ATV disturbance, the Corps must monitor nesting activity at both Superior Beach and Lonesome Beach. Unlike monitoring nest loss, direct observations of fledgling losses are problematic because predators quickly consume or remove the chicks from the beach. This makes detecting incidental take of chicks difficult, if not impossible. Monitoring the

number of fledglings produced in each nesting area, however, serves as an appropriate and effective surrogate for detecting the level of incidental. The difference between the number of fledglings expected without the project and the number of fledglings actually produced with the project represents the amount of incidental take. As annual reproductive success naturally varies, we recommend averaging five years of monitoring data to determine the actual reproductive success (number of fledglings).

Table 3. Incidental take of piping plover at breeding locations within the action area anticipated from the proposed action over 30 years.

Breeding Location (Potential Nesting Pairs)	Storm Events (Nests Lost)	Gull Predation (# of fledglings)	ATV disturbance + Gull Predation (# of fledglings)
Lonesome Beach (3)	2 nests every six years	4[b]	29[d]
Superior Beach (3)	None	23[c]	None
Incidental Take Anticipated	10 fledglings[a]	27	29

[a] Calculation: 20 years x 2 nests/6 years x 1.5 fledglings/nest = 10 fledglings
[b] Calcuation: 5 years x 3 nests (-1.7 nest lost to storms) x 0.3 fledglings/nest = 3.9 fledglings
[c] Calculation: 25 years x 3 nests x 0.3 fledglings/nest = 22.5 fledglings
[d] Calculation: 20 years x 3 nests (-7 nests lost to storms) x 0.55 fledglings/nest = 29.1 fledglings (Combines both gull predation and ATV disturbance from 10 – 30 years post construction.)

As described in the Reinitiation Notice below, if take due to storm events, gull predation, or ATV disturbance exceeds the levels of take authorized herein, then the Corps must reinitiate section 7 consultation. If the loss of up to two nests from storm events occurs more frequently than every sixth year, then the Corps must reinitiate consultation. For gull predation and ATV disturbance, the Corps must reinitiate consultation if the average number of fledglings produced at Superior Beach or Lonesome Beach declines below a certain value. The exact number that would trigger reinitiation depends on the site and the time period after construction. We expect Superior Beach and Lonesome Beach will continue to have three nesting pairs annually. Based on the reduced fledging rates, the average number of fledglings produced at Superior Beach must be at least 3.6 annually. From five to 10 years post construction, Lonesome Beach must produce an average of 3.6 fledglings per year. From 10 to 30 years post construction, an average of 2.9 fledglings per year must be produced. If the average number of fledglings at either Lonesome Beach or Superior Beach falls below these values, as determined by monitoring, incidental take may have been exceeded, and the Corps must reinitiate section 7 consultation.

Effect of Take

In the accompanying Opinion, we determined that the anticipated reduction in chicks is not likely to detectably affect the overall fledging success of the Great Lakes piping plover. Hence, the proposed action will not appreciably reduce the likelihood of recovery or survival of the Great Lakes population of piping plover. Therefore, we believe that the level of anticipated incidental take associated with construction of the proposed breakwater in Grand Marais is not likely to jeopardize the species.

Reasonable and Prudent Measures

The following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize incidental take of Great Lakes piping plover:

1. Ensure proper implementation of the conservation measures as described in Description of the Proposed Action. Inappropriate execution of these measures would result in a higher level of incidental take than we considered in our jeopardy analysis; therefore, proper implementation is necessary to avoid potential take associated with construction activities and with monitoring breeding piping plovers during construction. The Terms and Conditions for this RPM provide details regarding proper implementation of the conservation measures.

2. Implement measures that will minimize the incidental take of Great Lakes piping plovers as a result of increased predation and recreational uses of piping plover nesting habitat, pursuant to 50 CFR 402.14(i)(1)(ii). The breakwater project will result in increased predation and increased disturbance from recreational use; therefore, this RPM is necessary to minimize this take to the extent practicable.

3. Report on the progress of breakwater construction and its impact on the species, as required pursuant to 50 CFR 402.14(i)(3).

<u>Terms and Conditions</u>

Exemption from the prohibitions of section 9 of the ESA requires the Corps to comply with the following terms and conditions, which implement the RPMs described above and outline required reporting and monitoring requirements. Terms and conditions are non-discretionary.

The following terms and conditions implement the first RPM:

1.1. The Corps will notify all staff and breakwater contractors of the conservation measures described on pages 13 and 14 of this Opinion and ensure compliance with these measures.

1.2. The Corps will implement conservation measure #7 (Monitor piping plover during construction to detect disturbance or harassment associated with construction) in adherence to the following:

   a. Piping plover monitors (Corps personnel or hired contractors) must have an educational background and experience in wildlife biology.

   b. Piping plover monitors will attend a one-day training session on piping plover conservation, hosted by the Service or Service-approved partner.

   c. Piping plover monitors will follow Service protocols, provided during the training session, related to monitoring piping plover during the breeding season (April 15 – September 1).

   d. Monitoring will include the documentation of locations of territorial or courting plovers, nest locations, and areas used by adults and chicks for foraging in the vicinity (0.25 mile) of construction.

   e. Monitors will record observations of any response of incubating piping plovers to construction-related disturbances (such as noise, heavy equipment usage, etc.) in the vicinity of the project site.

   f. Contact the Service immediately upon observation of changes to normal piping plover breeding behavior related to the aforementioned construction-related disturbances. Contact staff at the East Lansing Field Office (517) 351-2555 or Upper Peninsula Sub-Office (906) 226-1240.

1.3. The Corps will immediately halt construction activities that are observed to disrupt normal piping plover breeding behavior.

1.4. The Corps will ensure that contractors have a spill response plan and spill containment materials on site during construction. Contractors will have sufficient training to implement the response plan and will do so in the event of a spill.

1.5. The Corps will submit a report to our office within 60 days of completing breakwater construction. This report will describe the actions taken to implement each of the above terms and conditions and include the dates of actual construction activities.

The following terms and conditions implement the second RPM:

2.1. The Corps will install, or fund the installation of, a permanent ATV/off-road vehicle barrier at the end of Cemetery Road in Grand Marais. Construction of the barrier will occur within two years after construction of the breakwater and

upon obtaining all required state or local approvals.

2.2. The Corps will assess the number of gull nests on the breakwater at five, ten, and 15 years following construction. If more than 50 nests are found during the breeding season, the Corps or its agent will implement measures to reduce gull numbers. This may include lethal or non-lethal measures, such as hazing or placement of permanent gull nest deterrents.

2.3. The Corps will submit a report to our office within 60 days of completion of each of the terms and conditions described above under the second RPM. This report will describe the actions taken to implement the terms and conditions and include the dates of activities.

The following terms and conditions implement the third RPM:

3.1. The Corps or its agent will determine the average annual number of piping plover nests and the number of chicks fledged per pair as measures of incidental take within the action area at ten and 15 years post construction. Such a determination will require ten years of consecutive monitoring from five to 15 years post construction. To assist in meeting this requirement, we encourage the Corps to:

a. Coordinate with the Service by February 1 each year to determine if such information will be collected during the course of regular recovery program activities within the Great Lakes. If no such efforts are occurring in any given year within the action area, the Corps will be responsible for collecting the required information.

b. Secure an agreement with an entity, such as the National Fish and Wildlife Foundation, to facilitate long-term funding of monitoring.

3.2. The Corps will ensure that personnel or contractors monitoring piping plover under 3.1 will:

a. Possess an educational background and experience in wildlife biology.

b. Attend a one-day training session, annually, on piping plover conservation, hosted by the Service or Service-approved partner.

c. Follow Service protocols, provided during the training session, related to monitoring piping plover during the breeding season.

d. Document nest location, nest loss, and chicks fledged per nest east of the breakwater, west of the breakwater, and at Superior Beach.

e. Prepare and submit to the Service an annual report by December 31 of each year.

3.3. The Corps or project contractors shall immediately notify the Service upon locating an injured or dead piping plover or detecting the loss or abandonment of a piping plover nest. Report the discovery of a dead piping plover and/or an abandoned nest or non-viable egg specimen within 24 hours (48 hours if discovered on a Saturday) to the East Lansing Field Office (517) 351-2555 or Upper Peninsula Sub-Office (906) 226-1240.

Conservation Recommendations

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service has identified the following actions that, if undertaken by the Corps, would further the conservation and assist in the recovery of the piping plover:

1. Continue to work with local governments to develop and adopt a local ordinance to further the protection of piping plovers in the action area.

2. Conduct or fund invasive species control efforts within piping plover habitat in the Great Lakes. Species such as spotted knapweed and baby's breath threaten piping plover habitat.

3. Support piping plover outreach and education activities through development and placement of signs, brochures, or other materials.

4. Support research on Great Lakes piping plover population ecology, including studies on population demographics and effects of human disturbance on reproductive success.

In order to keep the Service informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

Reinitiation Notice

This concludes formal consultation on the breakwater project in Grand Marais, Michigan. In accordance with 50 CFR 402.16, reinitiation of formal consultation is required where Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals that the agency action may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an adverse effect to the listed species not

considered in this opinion or (4) a new species is listed or critical habitat is designated that may be affected by the action.

We expect take to begin occurring at approximately five years post construction. If either the 10- or 15-year post-construction evaluations indicate any of the following, this represents new information requiring reinitiation of consultation:

1. The rate of nest loss is more than two nests every six years due to wave inundation at Lonesome Beach (east of the breakwater).

2. The number of fledglings produced at Superior Beach falls below an average of 3.6 fledglings per year.

3. The number of fledglings produced at Lonesome Beach from five to ten years post construction falls below an average of 3.6 fledglings per year.

4. The number of fledglings produced at Lonesome Beach after ten years post construction falls below an average of 2.9 fledglings per year.

Literature Cited

Austin, J.A. and S.M. Colman. 2007. Lake Superior summer water temperatures are increasing more rapidly than regional air temperatures: A positive ice-albedo feedback. Geophysical Research Letters, Vol. 34.

Baird & Associates, W.F. 2006. Grand Marais shoreline evaluation modeling report. Report to United States Army Corps of Engineers, Detroit District. 76 pp.

Baird & Associates, W.F. and Applied Ecological Services. 2006. White paper on discussion of physical and biological impacts of the proposed Grand Marais breakwater alternatives versus the no project scenario. Report to United States Army Corps of Engineers, Detroit District. 15 pp.

Burger, J. 1991. Foraging behavior and the effect of human disturbance on the piping plovers (Charadrius melodus). Journal of Coastal Research 7:39-52.

Burger, J. 1994. The effect of human disturbance on foraging behavior and habitat use in the piping plover (Charadrius melodus). Estuaries 17(3):695-701.

Cairns, W. E. 1977. Breeding biology and behavior of the piping plover (*Charadrius melodus*) in southern Nova Scotia. M.S. thesis, Dalhousie University. 115 pp.

Cairns, W. E. 1982. Biology and behavior of breeding piping plovers. Wilson Bulletin 94:531-545.

Central Lake Superior Land Conservancy (CLSLC). 2006. Endangered Great Lakes piping plover protection and monitoring in Northern Michigan. A report submitted to the U.S. Fish and Wildlife Service. 13 pp.

Central Lake Superior Land Conservancy (CLSLC). 2009. Summary of piping plover season at Grand Marais. A report submitted to the U.S. Fish and Wildlife Service. 4 pp.

Cuthbert, F.J. and E.A. Roche. 2006. Piping plover breeding biology and management in the Great Lakes, 2006. Report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Cuthbert, F.J. and E.A. Roche. 2007a. Estimation and evaluation of demographic parameters for recovery of the endangered Great Lakes piping plover population. Unpublished report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Cuthbert, F.J. and E.A. Roche. 2007b. Piping plover breeding biology and management in the Great Lakes, 2007. Report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Cuthbert, F.J. and E.A. Roche. 2008a. The piping plover in Michigan: A 100 year perspective. Michigan Birds and Natural History 15(2): 29-38.

Cuthbert, F.J. and E.A. Roche. 2008b. Piping plover breeding biology and management in the Great Lakes, 2008. Report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Cuthbert, F.J. and E.A. Roche. 2009. Piping plover breeding biology and management in the Great Lakes, 2009. Report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Cuthbert F.J. and L. Wires. 2008. Long-term monitoring of colonial waterbird populations in the U.S. Great Lakes: Improving the scientific basis for conservation and management - Year 1 and 2 (2007-08) progress report. 33 pp.

Cuthbert, F.J., J. McKearnan, L.R. Wires, and A. Joshi. 2003. Distribution and abundance of colonial waterbirds in the US Great Lakes: 1997 - 1999. Report to USFWS.

Elias, S. P., J. D. Fraser, and P. A. Buckley. 2000. Piping plover brood foraging ecology on New York barrier islands. Journal of Wildlife Management 64:346-354.

Flemming, S.P., R.D. Chiasson, P.C. Smith, P.J. Austin-Smith, and R.P. Bancroft. 1988. Piping plover status in Nova Scotia related to its reproductive and behavioral responses to human disturbance. Journal of Field Ornithology 59(4):321-330.

Goldin, M. R. and J. V. Regosin. 1998. Chick behavior, habitat use, and reproductive success of piping plovers at Goosewing Beach, Rhode Island. Journal of Field Ornithology 69:228-234.

Gratto-Trevor, C., D. Amirault-Langlais, D. Catlin, F. Cuthbert, J. Fraser, S. Maddock, E. Roche, and F. Shaffer. 2009. Winter distribution of four different piping plover breeding populations. Report to U.S. Fish and Wildlife Service. 11 pp.

Haffner, C.D. 2005. Breeding season spatial requirements of Great Lakes piping plovers in Northern Lower Michigan. M.S. Thesis, University of Minnesota, St. Paul, Minnesota.

Haig, S. M. 1992. Piping plover. Pages 1-18 *in*: The birds of North America, No. 2 A. Poole, P. Stettenheim, F. Gill, editors. American Ornithologists' Union, Philadelphia, Pennsylvania.

Haig, S.M. and L. W. Oring. 1988. Mate, site, and territory fidelity in piping plovers. Auk 105:268-273.

Haig, S. M. and J. H. Plissner. 1993. Distribution and abundance of piping plovers: results and implications of the 1991 International Census. Condor 95:145-156.

Hoopes, E. M., C. R. Griffen, and S. M. Melvin. 1992. Relationships between human recreation and piping plover foraging ecology and chick survival. Unpublished report. Located at: the University of Massachusetts, Amherst. 77 pp.

Lambert, A. and B. Ratcliff. 1979. A survey of piping plovers in Michigan. Report located at the Michigan Department of Natural Resources, Lansing. 36 pp.

Lambert, A. and B. Ratcliff. 1981. Present status of the piping plover in Michigan. Jack Pine Warbler 59:44-52.

Lauro, B. and J. Tanacredi. 2002. An examination of predatory pressures on piping plover nesting at Breezy Point, New York. The International Journal of Waterbird Biology, 25 (4):401-409.

Loegering, J.P. 1992. Piping plover breeding biology, foraging ecology, and behavior on Assateague Island National Seashore, Maryland. M.S. thesis. Virginia Polytechnic Institute and State University, Blacksburg. 247 pp.

Loegering, J.P. and J.D. Fraser. 1995. Factors affecting piping plover chick survival in different brood-rearing habitats. Journal of Wildlife Management 59:646-655.

Ludwig, J.P. 1963. Return of herring gulls to natal colony. Bird Banding 34(2):68-72.

MacIvor, L.H., S.M. Melvin, and C.R. Griffin. 1990. Effects of research activity on piping plover nest predation. Journal of Wildlife Management, 54(3):443-447.

Melvin, S.M., L.H. MacIvor and C.R..Griffin. 1992. Predator exclosures: A technique to reduce predation at piping plover nests. Wildlife Society Bulletin 20:143-148.

Miller, M.P., S.M. Haig, C.Gratto-Trevor, and T.D. Mullins. 2009. Draft report: Molecular population genetic structure in the piping plover. USGS unpublished document.

Morris, R.D., D.V. Weseloh, and J.L. Shutt. 2003. Distribution and abundance of nesting pairs of Herring Gulls (*Larus argentatus*) on the North American Great Lakes, 1976 to 2000. J. Great Lakes Res. 29(3):400 – 426.

Palmer, R. S. 1967. Piping plover. Page 2 *in*: G. D. Stout, editor. The shorebirds of North America. Viking Press, New York, New York.

Pierotti, R. and T.P. Good. 1994. Herring gull (*Larus argentatus*). *In* The Birds of North America, No. 124 (A.Poole and F.Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

Pike, E. 1985. The piping plover at Waugoshance Point. Jack-Pine Warbler 63:36-41.

Powell, A. N. and F. J. Cuthbert. 1991. Piping plover breeding biology and management in the Lower Peninsula of Michigan. Unpublished report. Located at: the Michigan Department of Natural Resources, Lansing. 15 pp.

Powell, A.N. and F.J. Cuthbert. 1992. Habitat and reproductive success of piping plovers nesting on Great Lakes Islands. The Wilson Bulletin, 104(1):155-161.

Prater, A. J., J. H. Marchant, and J. Vuorinen. 1977. Guide to the identification and ageing of holarctic waders. British Trust for Ornithology Guide #17. Maund and Irvine Ltd., Tring, Herts, England. 168 pp.

Prindiville, E. M. 1986. Habitat selection and productivity of piping plovers in central North Dakota. M.S. Thesis. University of Missouri, Columbia. 34 pp.

Roche, E.A., J.B. Cohen, D.H. Catlin, D.L. Amirault, F.J. Cuthbert, C.L. Gratto-Trevor, J. Felio, and J.D. Fraser. 2009. Range-wide estimation of apparent survival in the piping plover. Report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Ryder, J.P. 1993. Ring-billed Gull. *In* The Birds of North America, No. 33 (A.Poole and F.Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.

Russell, R. 1983. The piping plover in the Great Lakes region. American Birds 37:951-955.

Stucker, J.H., F.J. Cuthbert, and C.D. Haffner. 2003. Piping plover breeding biology and management in the Great Lakes, 2003. Report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Stucker, J.H. and F.J. Cuthbert. 2004. Piping plover breeding biology and management in the Great Lakes, 2004. Report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Stucker, J.H. and F.J. Cuthbert. 2005. Piping plover breeding biology and management in the Great Lakes, 2005. Report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Sousounis, P. and P. Glick. 2000. Overview of the potential impacts of global warming on the Great Lakes region: Critical findings for the Great Lakes region from the first national assessment of the potential consequences of climate variability and change. Available online at http://www.climatehotmap.org/impacts/greatlakes.html.

U.S. Army Corps of Engineers, Detroit District (USACE). 2009a. Revised biological assessment for the pile breakwater reconstruction at Grand Marais Harbor, Michigan. 86 pp.

U.S. Army Corps of Engineers, Detroit District (USACE). 2009b. Addendum to Revised Biological Assessment for the Pile Breakwater Reconstruction at Grand Marais Harbor, Michigan. 2 pp.

U.S. Fish and Wildlife Service (USFWS). 1985. Determination of endangered and threatened status for the piping plover. Federal Register 50(238):50720-34.

U.S. Fish and Wildlife Service (USFWS). 2001a. Final determination of critical habitat for the Great Lakes breeding population of the piping plover. Federal Register 66(88):22938-69.

U.S. Fish and Wildlife Service (USFWS). 2001b. Final determination of critical habitat for wintering piping plovers. Federal Register 66(132):36038-143.

U.S. Fish and Wildlife Service (USFWS). 2003. Recovery plan for the Great Lakes piping plover (*Charadrius melodus*). Fort Snelling, Minnesota. viii + 141 pp.

U.S. Fish and Wildlife Service (USFWS). 2009. Piping Plover Five-year Review: Summary and Evaluation. Hadley, Massachusetts and Fort Snelling, Minnesota. 206 pp.

U.S. Geological Survey (USGS). 1968. Grand Marais Quadrangle, 7.5 minute series topographic map.

Wemmer, L. C. 2000. Conservation of the piping plover (*Charadrius melodus*) in the Great Lakes region: a landscape-ecosystem approach. Ph.D.Dissertation. University of Minnesota, Twin Cities. 160 pp.

Westbrock, M., E.A. Roche, F.J. Cuthbert, and J.H. Stucker. 2005. Piping plover breeding biology and management in the Great Lakes, 2005. Report submitted to the U.S. Fish and Wildlife Service, East Lansing, Michigan.

Wiens, T. P. 1986. Nest-site tenacity and mate retention in the piping plover. M.S. thesis. University of Minnesota, Duluth. 34 pp.

Wilcox, L. 1959. A twenty year banding study of the piping plover. Auk 76:129-152.

Wires, L. R., S. J. Lewis, F. Cuthbert, S. Matteson, D. Pence, R. P. Russell, M. Shieldcastle, G. J. Soulliere, and D.V. C. Weseloh. 2005. Draft Upper Mississippi River and Great Lakes Waterbird Conservation Plan. U.S. Fish and Wildlife Service, Fort Snelling, Minnesota.

Wires, L.R. 1994. The effect of human disturbance on foraging behavior and habitat use in the piping plover (Charadrius melodus). Estuaries 17(3):695-701.

Zonick, C., K. L. Drake, K. R. Drake, L. Elliot, and J. Thompson. 1998. The effects of dredged material on the ecology of the piping plover and the snowy plover. A report to the U.S. Army Corps of Engineers. Galveston, Texas. 147 pp.

Appendix 1. Baseline Conditions

Elements	Environmental Impacts			Piping Plover Exposure	Length of Exposure	Piping Plover Response	Grand Marais Piping Plover Population Response	Critical Habitat Response	Conservation Measure*
West Bay Shoreline Impacts	Longshore sediment movement and deposition	"Peninsula" forms but does not block sediment or waves	Open beach habitat remains unvegetated	nests, adults, and chicks	Expected through 30 year time period	Piping plovers continue to nest in this area	Habitat for up to 2 nesting pairs is maintained	Maintain PCEs 1-7, 9	NA
		Carpenter Creek	Carpenter Creek remains unvegetated; creek mouth switches location	adults and chicks	Expected through 30 year time period	Continued use of creek mouth for foraging	Reproductive rates and fitness similar to present	Maintain PCEs 1-7, 9	NA
Lonesome Beach Shoreline Impacts	Littoral transport of sand and sediment	Sand and sediment continues to migrate to the west	Sediment deposited along shoreline, providing open beach habitat	nests, adults, and chicks	Expected through 30 year time period	Nesting shifts westward and slightly lakeward due to erosion, woody debris, and sediment accumulation	Nesting habitat continues to support up to 3 breeding pairs	Maintain PCEs 1-7, 9	NA
			Stabilization of back beach and dune formation - at rate similar to present	nests, adults, and chicks	Expected through 30 year time period				NA
	Woody Debris Accumulation	Trapping of woody debris	Increase in large woody structure on beach	nests, adults, and chicks	Expected through 30 year time period				NA
	Erosion	Shoreline Erosion	Starts ~200 meters west of Cemetery Road and extends east	nests, adults, and chicks	Erosion of beach habitat gradual occurs over 30 year time period				NA

	Sucker River mouth migration	Migration of Sucker River continues in full range to west		adults and chicks	Expected over 30 year period	Plovers continue to forage at mouth	Reproductive rates and fitness similar to present - 1.5 fledglings per pair	Maintain PCEs 1-7, 9	NA
Predator Nesting Habitat	Creation of gull nesting habitat on breakwall	Increased gull nesting in area	No breakwall would exist and gull nesting habitat would not be created						
Storm Events	NW Waves	Strong northwest winds push waves onto shoreline	2/3 of Lonesome Beach and all of Superior Beach Impacted	nests	Superior Beach - throughout 30 year period; Lonesome Beach - Periodically until habitat shifts west at ~ Year 10	Loss of nests and reduction in fledging rate	Loss of three nests per event on Superior Beach; Loss of two nests per event at Lonesome Point	Maintain PCEs 1-7, 9	NA
Recreational Use	Human foot traffic	Access sites similar distance from shoreline as currently		nests, adults, and chicks	Expected over 30 year time period	Similar rates of disturbance as currently experienced	Similar fledging rate - 1.5 fledglings per pair	Maintain PCE 8; similar levels of human disturbance	NA
	ATV traffic	Access sites through private land and at Cemetery Road	Due to landowner policing; expect continued low levels of ATV use	Exposure to nests, adults, and chicks	Expected over 30 year time frame	Minimal disturbance to incubating adults, chicks	Similar fledging rate - 1.5 fledglings per pair	Maintain PCE 8; low level of ATV use	NA

* No conservation measures will be implemented without the project.

Appendix 2. Construction Effects

Project Elements		Environmental Impacts	Piping Plover Exposure	Length of Exposure	Critical Habitat Response	Piping Plover Response	Conservation Measures
Construction Effects	Mobilization of trailers to parking lot	Noise, physical disturbance in parking lot	exposure to adults and chicks	one nesting season	no measurable response expected due to CM; activity >250 ft away	no measurable response expected due to CM; all activity >250 ft away	#2, 3, 6, 7 (see below list)
	Unloading and Storage of stone at parking lot	Noise, physical disturbance in parking lot	exposure to adults and chicks	one nesting season	no measurable response expected due to CM; activity >250 ft away	no measurable response expected due to CM; all activity >250 ft away	#2, 3, 6, 7
	Loading of stone on barges; shuttle to and from equipment	Noise, boat activity in harbor	exposure to adults and chicks	one nesting season	no measurable response expected due to CM; activity >250 ft away	no measurable response expected due to CM; all activity >250 ft away	#1, 3, 5, 6
	Supply vessels coming in and out of harbor	Boat activity in harbor, potential for hazardous spill of oil/gas/etc	exposure to adults and chicks	one nesting season	no measurable response expected due to CM; activity >250 ft away	no measurable response expected due to CM; all activity >250 ft away	#1, 3, 5, 6, 7
	Tugs moving vessels into position and ferrying staff	Boat activity in harbor, potential for hazardous spill of oil/gas/etc	exposure to adults and chicks	one nesting season	no measurable response expected due to CM; activity >250 ft away	no measurable response expected due to CM; all activity >250 ft away	#1, 3, 5, 6, 7
	Demolition and disposal of existing timber crib breakwall	Noise, boat activity in harbor	exposure to adults and chicks	one nesting season	no measurable response expected due to CM; activity >250 ft away	no measurable response expected due to CM; all activity >250 ft away	#1, 3, 5, 6, 7

	Placing stone into water from a barge	Noise, water movement	exposure to adults and chicks	one nesting season	no measurable response expected due to CM;	no measurable response expected due to CM; activity will be conducted before April 15 or after Sept. 1	#1, 3, 5, 6, 7
	Anchoring vessels in harbor during non-work hours	Boat activity in harbor, potential for hazardous spill of oil/gas/etc	exposure to adults and chicks	one nesting season	no measurable response expected due to CM; activity >250 ft away	no measurable response expected due to CM; all activity >250 ft away	#5
	Supplies by truck in/out of town	Increased noise associated with roadways, boat ramp, and parking lots	exposure to adults and chicks	one nesting season	no measurable response expected due to CM; activity >250 ft away	no measurable response expected due to CM; all activity >250 ft away	#7
	Excavation of lake bottom sand near southern breakwater terminus in order to place stone	Dredging via clam shell and placement on barge - noise, sediment and water movement near shoreline	exposure to adults and chicks	one nesting season	no measurable response expected due to CM	no measurable response expected due to CM; all activity >250 ft away during the breeding season	#1, 3
	Moving excavated sand and deposition of sand east of Grand Marais	Boat activity in harbor and east of Grand Marais, water disturbance during disposal	exposure to adults and chicks	one nesting season	no response as PCEs not present in vicinity of disposal site	None expected as piping plovers not breeding or foraging near disposal site	No CM necessary

Relevant Conservation Measures

#1 - Construction will be water based. Most activities will be performed >250 feet away from the shoreline.
#2 - Staging area will be established in a parking lot near Superior Beach, no habitat will be impacted.
#3 - No construction or excavation within 250 feet of the lakeshore from April 15 to September 1.
#5 - Oil spill response plan (with specific measure to protect piping plover/shoreline) will be incorporated into the contract for services.
#6 - Contractors will be informed about the presence of piping plovers and the agreed upon measures to reduce the potential for disturbance. Contractors will attend one hour training session.
#7 - Piping plovers will be monitored during construction to ensure no disturbance or harassment associated with construction.

Appendix 3. Post Construction Effects

Elements	Environmental Impacts			Piping Plover Exposure	Length of Exposure	Piping Plover Response	Grand Marais Piping Plover Population Response[1]	Critical Habitat Response	Overall Impact to Piping plover
West Bay Shoreline Impacts	Longshore sediment movement and deposition	Breakwater blocks waves and major sediment inputs	Stabilization of shoreline through vegetation	nests, adults, and chicks	~ 6 - 30 years post construction	loss of nesting habitat for up to 2 nesting pairs	Loss of up to 2 pairs nesting in action area	Negative impacts to PCEs 1-4, 6, 7, & 9; habitat no longer suitable	Habitat Loss
		Carpenter Creek	Carpenter Creek becomes vegetated	adults and chicks	~ 6 - 30 years post construction	Birds forage at different site; no adverse impact expected	No impact	Negative impacts to PCEs 1-4, 6, 7, & 9; habitat no longer suitable	No Impact
Lonesome Beach Shoreline Impacts	Littoral Transport of sand, sediment	Breakwater blocks longshore sediment moving to the west	Open beach habitat forms lakeward	nests, adults, and chicks	Expected through 30 year time period	Nesting habitat shifts north and slightly west due to sediment accumulation, erosion and woody debris accumulation	Nesting habitat continues to support up to 3 breeding pairs	Maintains PCEs 1-7 & 9; Distance to treeline expected to increase	Habitat Maintained
			Stabilization of back beach and dune formation	nests, adults, and chicks	Expected through 30 year time period				
	Woody Debris Accumulation	Trapping of woody debris	Increase in large woody structure on beach	nests, adults, and chicks	Expected through 30 year time period				
	Erosion	Shoreline Erosion	Starts ~150 meters east of Cemetery Road extends east; less erosion than no action	nests, adults, and chicks	Erosion of beach habitat gradual occurs over 30 year time period				
	Sucker River mouth migration	Blockage of western migration of Sucker River mouth	Migration to the west is narrower	adults and chicks	Expected over 30 year time period	Plovers continue to forage at mouth	No impact	Maintains PCEs 1-7& 9	No Impact

Predator Nesting Habitat	Creation of gull nesting habitat on breakwater	Increased gull nesting in area		chicks	From 5 to 30 years post construction	Increased predation; fewer chicks survive to fledging	Superior Beach - reduction of 0.3 fledglings per year; Lonesome Beach - reduction of 0.3 fledglings per year from 5 - 10 years	No impacts to PCEs	Reduced Reproductive Success
Storm Events	NW waves	Strong northwest winds push waves onto shoreline	2/3 of Lonesome Beach Impacted	From Year 10 - Year 30	After Year 10, 1 event every 6 years	Loss of up to 2 nests per event and reduction in fledging rate that year	During year of storm, Lonesome Beach fledging rate reduced to 0.5 fledglings per pair	Maintains PCEs 1-7 & 9	Reduced Reproductive Success
Recreational Use	Human foot traffic	Access sites farther from shoreline		Exposure to nests, adults, and chicks	Expected once shoreline moves significantly to the north from ~ Year 10 to Year 30	Nesting continues with similar fledging rates	Maintains similar fledging rate as baseline of 1.5 fledglings per pair	Maintains PCE 8	No Impact
	ATV traffic	Access sites through private land and at Cemetery Road	Due to distance from landowner residences and uncertain ownership; ATVs usage may increase	Exposure to nests, adults, and chicks	Expected once shoreline shifts to the north from ~ 10 to 30 years post construction	Fewer chicks survive to fledging	With gull predation, Lonesome Beach fledging rate reduced by 0.55 fledglings per pair	Negatively impacts PCE 8; increased human disturbance through ATV impacts	Reduced Reproductive Success

[1]No Conservation Measures were proposed that would reduce or avoid post construction effects.