Indiana Dunes National Lakeshore
Indiana

National Park Service
U.S. Department of the Interior

Shoreline Restoration and Management Plan/ Final Environmental Impact Statement

August 2014

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
SHORELINE RESTORATION AND MANAGEMENT PLAN / FINAL ENVIRONMENTAL IMPACT STATEMENT
Indiana Dunes National Lakeshore, Porter, Indiana
EXECUTIVE SUMMARY

The *Shoreline Restoration and Management Plan / Final Environmental Impact Statement* (EIS) has been prepared to provide scientifically-based alternatives for the restoration of natural sediment movement along the southern shore of Lake Michigan within and adjacent to Indiana Dunes National Lakeshore. The purpose of the plan / final EIS is to provide comprehensive guidance for restoring natural shoreline processes, preserving shoreline ecosystems, and providing opportunities for quality visitor experiences at Indiana Dunes National Lakeshore. The intent of the plan / final EIS is not to provide specific and detailed answers to every issue facing the park, but rather to provide a framework to assist National Park Service (NPS) managers, stakeholders, and locals governing bodies in making current and future decisions.

For the purpose of the plan / final EIS the shoreline has been divided into four reaches based on sediment erosion and accretion. Due to the natural process-driven interconnectivity of these areas the final EIS is formatted so that reaches 1 and 2, which extend from Crescent Dune to Willow Lane, and reaches 3 and 4, which extend from Willow Lane to the Gary-U.S. Steel East Breakwater, are discussed in the context of two independent sediment transport cells. The National Park Service will consider a no-action alternative (alternative A) in all reaches as a baseline of current conditions and management practices.

For reaches 1 and 2 seven alternatives were initially developed including the no-action alternative. All alternatives provide for beach nourishment at Crescent Dune differing in the source of material (upland versus dredged), method of placement (hydraulic versus mechanical), and frequency of placement (every year or every five years). Additionally, one of the alternatives incorporates a permanent bypass system, and another incorporates the construction of a temporary submerged cobble berm. Through a value analysis process the alternative that incorporated the submerged cobble berm was selected as the preferred alternative for reaches 1 and 2 for the plan / draft EIS. This alternative provided the best combination of strategies resulting in a high level of protection of natural resources while providing for a wide range of beneficial uses of the environment. However, public comment on the plan / draft EIS (July 2012) was extensive and ranged from support for the goals of the project to concerns about a number of aspects of the draft alternatives. The public was generally supportive of beach nourishment but there was consistent, negative response to the proposed cobble berm in alternative E (preferred alternative in the draft EIS).

It was determined through the draft EIS process that all alternatives meet park purposes and objectives while protecting park resources by minimizing impacts, and are consistent with the legislative intent of Indiana Dunes National Lakeshore, applicable federal laws, policies, and regulations.

The only variation between the alternatives is in the consistency of the aggregate (sediment/rock), frequency of placement, and method of placement. Therefore a new hybrid alternative was designed that incorporated desired aspects of multiple alternatives, which would meet park purposes and objectives, yet

addresses public concern with the submerged cobble berm.

The criteria critical to the selection of alternative E as the draft EIS preferred alternative for reaches 1 and 2 focused on the restoration of native materials (sediment, gravel, rock) to the shoreline and not necessarily on the method of placement (i.e., creating a submerged berm). The new hybrid alternative would provide the identical materials to the shoreline only through a direct placement process. The majority of material used for beach nourishment would be obtained from fine and medium grained sediments that could be hydraulically dredged (as in alternative C-1). The specific source location of the nourishment material would be determined in coordination with Indiana Department of Natural Resources (IDNR) in areas of accretion so that dredging activities would not disturb areas of equilibrium. The additional gravel and rock component would be obtained by implementing a portion of alternative B-1. Rather than using the inland mined source to provide the entire spectrum of beach nourishment, only the coarse component (gravels and rock), proposed under alternative E, would be hauled to the beach and mixed on-site with the hydraulically dredged sediments. The new hybrid alternative F incorporates the benefit of the gravel and rock materials from alternative E using the inland mined and hauled sources outlined in alternative B-1 with the hydraulically dredged sands outlined in alternative C-1.

For reaches 3 and 4 four alternatives were developed including the no-action alternative. All alternatives provide for beach nourishment at Portage Lakefront and Riverwalk differentiated by the frequency of nourishment (every year or every five years), and one includes the development of a permanent bypass system. Only dredged material was considered for these alternatives, because no viable access to the nourishment site exists for trucking in upland materials. Through a value analysis process the alternative that provides sediment nourishment material every five years through a combination of mechanical and hydrologic means was selected as the preferred alternative for reaches 3 and 4 in the draft EIS. This alternative is cost efficient and provides the greatest potential for both foredune creation and protection from major storm events. While the public was generally supportive of beach nourishment for reaches 3 and 4, there was negative response to alternative C-5 that provided beach nourishment every five years during the public comment on the plan / draft EIS. In response to the public's concerns, the preferred alternative for reaches 3 and 4 has been changed to alternative C-1 that provides for beach nourishment annually.

The plan / draft EIS was available for public comment for a period of 60 days commencing when the U.S. Environmental Protection Agency published the Notice of Availability in the Federal Register on September 14, 2012. One public meeting was held on October 23, 2012.

A copy of the plan / final EIS is available on the internet on the NPS Planning, Environment, and Public Comment website at: http://www.parkplanning.nps.gov/indu. The plan / final EIS can also be accessed through the park's home page at: http://www.nps.gov/indu. In addition, a limited number of hardcopies and CDs are available at the Indiana Dunes National National Lakeshore headquarters located at 1100 North Mineral Springs Road in Porter, Indiana. If you have any questions, please call Charles Morris, Environmental Protection Specialist, at 219-983-1352.

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SUMMARY

PURPOSE OF AND NEED FOR ACTION

The purpose of this *Shoreline Restoration and Management Plan / Final Environmental Impact Statement* (EIS) is to provide comprehensive guidance for restoring natural shoreline processes, preserving the shoreline ecosystem, and providing opportunities for quality visitor experiences at Indiana Dunes National Lakeshore. The purposes of this plan / final EIS are as follows:

- Ensure that the foundation for decision-making has been developed in consultation with the public and is adopted by NPS leadership after sufficient analysis of the benefits and impacts of alternative courses of action.
- Develop strategies that would support the reestablishment of more sustainable shoreline sediment movement and a more natural ecosystem of shoreline vegetation, foredune and dune complexes.
- Define desired resource conditions for the shoreline, foredunes and dunes.
- Identify approaches for shoreline restoration and management that are consistent with a regional approach to management of the lakeshore that encourages maintenance of a natural shoreline and functioning ecosystems.

Prior to industrial and residential development along Lake Michigan, the shoreline was comprised of a highly diverse landscape including swamp and marsh lands, dunes, oak savanna, and prairies. The natural shoreline processes along southern Lake Michigan have been heavily impacted by the construction of numerous navigational harbors and hardened (man-made) structures that have greatly affected the integrity and sustainability of the natural landscape. These structures altered Lake Michigan's natural littoral drift, resulting in areas of sediment accretion (accumulation) east (updrift) of Michigan City and the Port of Indiana, and sediment starvation to the west (downdrift) of these same harbors. The lack of continued sediment replenishment from natural littoral drift has resulted in extensive beach and dune erosion which threatens both public and private resources. Although the U.S. Army Corps of Engineers (COE) conducts beach nourishment on an intermittent basis and the staff at Indiana Dunes National Lakeshore conduct certain resource management actions to protect resources (such as sensitive plant and animal habitats), no specific shoreline restoration plan exists, and the impact of severe shoreline and beach erosion would compromise the park's outstanding ecological and biological diversity found within its boundaries. This plan / final EIS is needed to:

- Address the severe shoreline and beach erosion and the impacts on dune ecology that are caused by interruptions to the natural processes along the shoreline, including the movement of sediment.
- Address the adverse impacts to the fragile shoreline ecosystem caused by the interrupted natural processes and sediment movement.
- Identify a series of management actions that can be implemented by park staff, as needed, to provide a balance between protection of the shoreline ecosystem and appropriate visitor enjoyment of the park.

OBJECTIVES IN TAKING ACTION

Objectives define what must be achieved for an action to be considered a success. Alternatives selected for detailed analysis must meet all objectives and must also resolve the purpose of and need for action.

Using the park's enabling legislation, mandates, and direction in other planning documents as well as NPS service-wide objectives, NPS *Management Policies 2006*, and the NPS *Organic Act of 1916*, the staff of Indiana Dunes National Lakeshore identified the following management objectives relative to shoreline management at the park.

Shoreline Restoration

- Develop strategies that would support the reestablishment of more sustainable shoreline sediment movement and a more natural ecosystem of shoreline vegetation, foredune and dune complex.

Exotic and Invasive Species

- Develop strategies to identify, manage, and remove aquatic and terrestrial nonnative and invasive species.
- Develop strategies to support ongoing management efforts to remove aquatic and terrestrial nonnative and invasive species, and to prevent conditions detrimental to those efforts.

Management Methodology

- Determine shoreline desired conditions that would serve as thresholds for management actions within Indiana Dunes National Lakeshore.
- Develop and implement an adaptive management approach for maintaining a sustainable shoreline ecosystem within Indiana Dunes National Lakeshore.

ALTERNATIVES CONSIDERED

For the purpose of this plan / final EIS, the shoreline has been divided into four reaches based on accretion and erosion rates. Proposed alternatives are presented for reaches 1 and 2 and reaches 3 and 4. Under all proposed action alternatives, the sediment used for beach nourishment would be compatible with native site sediment, meaning similar in terms of color, shape, size, mineralogy, compaction, organic content, and texture. Beach nourishment material would be free of harmful chemical contaminants, trash, debris, and large pieces of organic material. Placement of the nourishment material would be conducted in a manner to avoid or minimize potential impacts on both natural resources and visitors of the park. The alternatives considered addressed the public's main concerns of protecting habitat, maintaining a natural viewshed, and not causing additional disruptions to sediment movement in the area.

Once this plan is completed, several of the nourishment activities proposed under the alternatives could be implemented without further compliance or study. Other more detailed studies and plans would be needed before some specific actions could be implemented, including design specifications. These additional plans and studies would include an in-depth analysis of potential impacts.

Reaches 1 and 2

The National Park Service would continue current management practices. For the foreseeable future, there would be no new actions taken to restore the park shoreline. For reaches 1 and 2 seven alternatives were developed including the no-action alternative. All alternatives provide for beach nourishment at Crescent Dune differing in the source of material (upland versus dredged), method of placement (hydraulic versus mechanical), and frequency of placement (every year or every five years). Additionally, one of the alternatives incorporates a permanent bypass system, and another incorporates the construction of a temporary submerged cobble berm. Through a value analysis process the alternative that incorporated the submerged cobble berm was selected as the preferred alternative for reaches 1 and 2. This alternative provided the best combination of strategies resulting in a high level of protection of natural resources while providing for a wide range of beneficial uses of the environment.

Public involvement and comment on the plan / draft EIS was extensive, ranging from support to concern with various aspects of the alternatives presented. While the public was generally supportive of beach nourishment, there was consistent, negative response to the submerged cobble berm. Therefore the National Park Service chose to review the array of alternatives to determine the feasibility of both satisfying public concern and achieving the project goals through the development of a new hybrid alternative.

A new hybrid alternative was developed for reaches 1 and 2 that incorporates the full range of native materials using an approach other than the submerged berm would achieve the same objectives. The majority of material used for beach nourishment would be obtained from fine and medium grained sediments that would be hydraulically dredged. The additional gravel and rock component would be obtained from an upland source. Thus, a new hybrid alternative was created as the new preferred alternative for reaches 1 and 2.

Reaches 3 and 4

The National Park Service would continue current management practices. For the foreseeable future, there would be no new actions taken to restore the park shoreline. For reaches 3 and 4 four alternatives were developed including the no-action alternative. All alternatives provide for beach nourishment at Portage Lakefront and Riverwalk differentiated by the frequency of nourishment (every year or every five years), and one includes the development of a permanent bypass system. Only dredged material was considered for these alternatives, because no viable access to the nourishment site exists for trucking in upland materials. Through a value analysis process the alternative that provides sediment nourishment every five years through a combination of mechanical and hydrologic means was selected as the preferred alternative for reaches 3 and 4. This alternative is cost efficient and provides the greatest potential for both foredune creation and protection from major storm events. However, in response to public concerns related to the large volume of material that would be placed on the beach under the preferred alternative the frequency of placement was changed from every five years to annual beach nourishment activities. The preferred alternative for reaches 3 and 4 is now alternative C-1.

Terrestrial Management Actions

In addition to the shoreline restoration alternatives, natural resource management strategies are proposed for the protection and improvement of the park's terrestrial ecosystem. Plant communities and physiography are continually changing with the disturbance-prone habitats of the foredune complex. The foredune and dune complex encourages biological diversity unique to this region of the country. Migratory bird habitat, intradunal wetlands, and the various stages of dune succession are critical components of the park. The National Park Service is responsible for the protection of these sensitive habitats. Protection is currently accomplished with the following management strategies:

- preservation or restoration of sensitive habitat
- management of nonnative invasive plant species
- reduction of anthropogenic influences on native dune vegetation and critical habitat

ENVIRONMENTAL CONSEQUENCES

The analysis of environmental consequences considers the actions being proposed and the cumulative effects from occurrences inside and outside Indiana Dunes National Lakeshore. The analysis addresses the potential environmental consequences of the actions for coastal processes, including sediment transport and dune formation, aquatic fauna, terrestrial habitat, threatened and endangered species and species of concern, wetlands and pannes, soundscape, visitor experience, and park operations.

In analyzing the impacts on natural resources, all action alternatives would benefit coastal processes. There would be adverse effects on aquatic fauna, terrestrial habitat, threatened and endangered species and species of concern, and soundscape as a result of activities associated with the placement of nourishment material. The duration and intensity of these effects would vary depending on the source of the nourishment material (i.e., upland or dredged) and the volume of nourishment material proposed under each alternative. Under the NPS preferred alternative (alternative F) in reaches 1 and 2, effects on all resources would be no greater than moderate and adverse. Under the NPS preferred alternative (alternative C-1) in reaches 3 and 4, effects would be no greater than short-term, minor, and adverse on all resources.

However, under all the action alternatives, the impacted resources (e.g., coastal processes, aquatic fauna, terrestrial habitat, threatened and endangered species and species of concern, and soundscape) would benefit in the long term from the reduction of severe shoreline and beach erosion and the creation of a more natural ecosystem of shoreline vegetation and foredune and dune complexes and processes.

CONTENTS

CHAPTER 2: THE ALTERNATIVES

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

SELECTED BIBLIOGRAPHY, INDEX, GLOSSARY, AND APPENDIXES

Figures

Maps

Tables

Acronyms

CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
COE	U.S. Army Corps of Engineers
CSSC	Chicago Sanitary and Ship Canal
CZMA	Coastal Zone Management Act
dBA	A-weighted decibel
E. coli	*Escherichia coli*
EA	environmental assessment
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ft./yr.	feet per year
FWS	U.S. Fish and Wildlife Service
GHG	greenhouse gas
IDNR	Indiana Department of Natural Resources
LIDAR	Light Detection and Ranging
LWD	Low Water Datum
m^3	cubic meters
$mtCO_2e$	metric tons of carbon dioxide equivalent
NEPA	National Environmental Policy Act of 1969, as amended
NHPA	National Historic Preservation Act, as amended
NIPSCO	Northern Indiana Public Service Company
NPS	National Park Service
PEPC	Planning Environment and Public Comment
SHPO	state historic preservation officer
U.S.	United States
USC	United States Code
USGS	U.S. Geological Survey
yd^3	cubic yards

A GUIDE TO THIS DOCUMENT

This *Shoreline Restoration and Management Plan / Draft Environmental Impact Statement* (EIS) is organized into five chapters plus appendixes. Each section is described briefly below.

The "Purpose and Need for Action" chapter describes the context for the entire final EIS. It explains why this plan is being prepared and what issues it addresses. It provides guidance (e.g., park purpose, significance, resources and values, special mandates, and service-wide laws and policies) for the alternatives that are considered. The "Purpose and Need for Action" chapter also describes how this plan relates to other plans and projects and identifies impact topics to be discussed relative to the no-action alternatives. It also includes a discussion of impact topics that were dismissed from detailed analysis.

"The Alternatives" chapter discusses management zones and the management alternatives. Mitigating measures for minimizing or eliminating impacts of some proposed actions are presented. A section on the selection of the preferred alternative and environmentally preferable alternative follows.

The "Affected Environment" chapter describes areas and resources that would be affected by actions that are part of the various alternatives — including coastal processes, aquatic fauna, terrestrial habitat, threatened and endangered species and species of concern, wetlands and pannes, soundscape, visitor experience, and park operations.

The "Environmental Consequences" chapter analyzes the impacts of implementing the alternatives. Approaches used to assess impacts are outlined at the beginning of the "Environmental Consequences" chapter.

The "Consultation and Coordination" chapter describes the history of public and agency coordination during the planning effort; it also lists agencies and organizations that will receive copies of the final EIS.

The appendixes present information on enabling legislation, technical references, species lists, and initial agency consultation.

CHAPTER 1
Purpose and Need for Action

INTRODUCTION

Indiana Dunes National Lakeshore was created by the United States (U.S.) Congress in 1966, and is one of four national lakeshores in the U.S., all on the Great Lakes. Legislation providing for the establishment of the Indiana Dunes National Lakeshore is included in Appendix A: Enabling Legislation. These national lakeshores share certain challenges associated with balancing impacts of human actions within fragile natural environments. Indiana Dunes National Lakeshore faces challenges unique among national lakeshores in managing and operating within a natural environment that has been considerably altered.

Prior to industrial and residential development along Lake Michigan, the shoreline was comprised of a highly diverse landscape including swamp and marsh lands, dunes, oak savanna, and prairies. The natural shoreline processes along southern Lake Michigan have been heavily impacted by the construction of numerous navigational harbors and hardened (man-made) structures that have greatly affected the integrity and sustainability of the natural landscape. These structures outside of Indiana Dunes National Lakeshore altered Lake Michigan's natural east-to-west littoral drift (or longshore drift, defined as movement of sediment along the coast). Lake Michigan's waves usually surge onto the beach at an oblique angle with their swash taking sediment up and along the beach, resulting in areas of sediment accretion (accumulation) east (updrift) of Michigan City and Port of Indiana, and sediment starvation to the west (downdrift) of these same harbors. The lack of continued sediment replenishment from natural littoral drift has resulted in extensive beach and dune erosion which threatens both public and private resources.

The continued erosion along Indiana Dunes National Lakeshore west of Michigan City and Port of Indiana has been mitigated to a certain degree through beach nourishment and offshore placement of sediment conducted by the U.S. Army Corps of Engineers (COE) (see "The Alternatives" chapter for details). Beach nourishment or replenishment is a process by which sediment lost through littoral drift or erosion is replaced from sources outside of the eroding beach. Due to the continuing issue of erosion along the lakeshore and the lack of a systematic means of finding a remedy, the National Park Service decided to address the issue with a shoreline restoration management plan.

The National Park Service began public involvement early. Conversations have been held for years with state, federal, and municipal entities within the boundaries of the Indiana Dunes National Lakeshore about the problems. Once the decision was made to move forward with the development of a plan, the National Park Service began a formal scoping process, which is an open process for determining the scope of a proposed action or project and for identifying issues related to the project (see the "Consultation and Coordination" chapter for more detail). The National Park Service actively engaged the public, stakeholders, and government officials at the federal, state, and local levels through the use of public meetings and project newsletters and by providing the opportunity to provide comments.

The National Park Service invited the COE and the State of Indiana to be cooperating agencies on this plan / final EIS to give them the opportunity to provide information in their areas of technical expertise and to review and comment on early versions of this plan / final EIS. The COE agreed to be a cooperating agency and a Memorandum of Understanding was executed between the National Park Service and the COE (included in Appendix B: Initial Agency Coordination). The State of Indiana declined to participate as a cooperating agency.

The development of this plan / final EIS was facilitated by funds provided to the National Park Service through the Great Lakes Restoration Initiative, administered by the U.S. Environmental Protection Agency (EPA). The Great Lakes Restoration Initiative, the largest investment in the Great Lakes in two decades, involves a task force of 11 federal agencies which developed a plan to cover five urgent focus areas, including:

- cleaning up toxins and areas of concern
- combating invasive species
- promoting nearshore health by protecting watersheds from polluted run-off
- restoring wetlands and other habitats
- working with partners on outreach

PURPOSE AND NEED FOR THE PLAN

PURPOSE

The purpose of this plan is to provide comprehensive guidance for restoring natural shoreline processes, preserving the shoreline ecosystem, and providing opportunities for quality visitor experiences at Indiana Dunes National Lakeshore. The approved plan will guide the National Park Service (NPS) in best fulfilling the park's purpose.

This plan describes how the National Park Service generally proposes to manage the shoreline at Indiana Dunes National Lakeshore for the next 20 years or more. In particular it describes approaches to beach nourishment within the park and proposes additional strategies to address the shoreline management issues. Additional planning and environmental compliance would be completed as necessary to implement this plan. The plan should:

- Ensure that the foundation for decision-making has been developed in consultation with the public and is adopted by NPS leadership after sufficient analysis of the benefits and impacts of alternative courses of action.
- Develop strategies that would support the reestablishment of more sustainable shoreline sediment movement and a more natural ecosystem of shoreline vegetation, foredune and dune complexes.
- Define desired resource conditions for the shoreline, foredunes and dunes.
- Identify approaches for shoreline restoration and management that are consistent with a regional approach to management of the lakeshore that encourages maintenance of a natural shoreline and functioning ecosystems.

NEED

The plan is needed to:

- Address the severe shoreline and beach erosion and the impacts on dune ecology that are caused by interruptions to the natural processes along the shoreline, including the movement of sediment.
- Address the adverse impacts to the fragile shoreline ecosystem caused by the interrupted natural processes and sediment movement.
- Identify a series of management actions that can be implemented by park staff, as needed, to provide a balance between protection of the shoreline ecosystem and appropriate visitor enjoyment of the park.

GOALS AND OBJECTIVES FOR TAKING ACTION

Any plan the park develops must be consistent with the laws, regulations, and policies that guide the National Park Service. Objectives are "what must be achieved to a large degree for the action to be considered a success" (NPS 2001). All alternatives selected for detailed analysis must meet all objectives to a large degree, and they must resolve the purpose and need for action. Objectives for shoreline restoration must be grounded in the park's enabling legislation, purpose, significance, and mission goals, and they must be compatible with the direction and guidance provided by the park's Statement for Management. See Appendix A: Enabling Legislation for additional information. The following objectives related to shoreline restoration were developed for this plan.

Shoreline Restoration

- Develop strategies that would support the reestablishment of more sustainable shoreline sediment movement and a more natural ecosystem of shoreline vegetation, foredune and dune complexes.

Exotic and Invasive Species

- Develop strategies to identify, manage, and remove aquatic and terrestrial exotic and invasive species; and
- Develop strategies to support ongoing management efforts to remove aquatic and terrestrial exotic and invasive species, and to prevent conditions detrimental to those efforts.

Management Methodology

- Determine shoreline desired conditions that would serve as thresholds for management actions within Indiana Dunes National Lakeshore; and
- Develop and implement an adaptive management approach for maintaining a sustainable shoreline ecosystem within Indiana Dunes National Lakeshore.

To meet the goals and objectives of the project, this plan proposes and analyzes various alternatives and their respective impacts on the environment. This final EIS has been prepared in accordance with the National Environmental Policy Act of 1969, as amended (NEPA) and regulations of the Council on Environmental Quality (CEQ) (40 Code of Federal Regulations [CFR] 1508.9).

PROJECT LOCATION

Indiana Dunes National Lakeshore is approximately 50 miles southeast of Chicago, Illinois, in the counties of Lake, Porter, and LaPorte in northwest Indiana's industrial-urban corridor. The project area encompasses 21 miles of the shoreline (see Map 1-1: Park Map). The park is located at the southernmost point of Lake Michigan. Under this plan, the National Park Service would implement specific restoration and management actions within its boundaries. As shown on Map 1-1: Park Map, Indiana Dunes National Lakeshore shares its boundaries with various residential, agricultural, and industrial developments.

The project area for this plan / final EIS does not include the entire Indiana Dunes National Lakeshore; it includes only the shoreline, foredunes, and dunes as generally shown on the Project Area Map (Map 1-2). For purposes of analysis and the development of shoreline restoration actions, the project planning team considered the entirety of the Lake Michigan shoreline along Indiana Dunes National Lakeshore. The project encompasses the area from the water's edge outward to the depth at which sediment on the lake bottom is no longer affected by wave action, and from the water's edge inland to include the foredune and dune complexes. Foredunes are low, very active dunes that parallel the beach and are named for their position as the first (fore) dunes inland from the beach.

Legend

Indiana Dunes National Lakeshore

State and Local Parkland

N

6,000 0 6,000 Feet

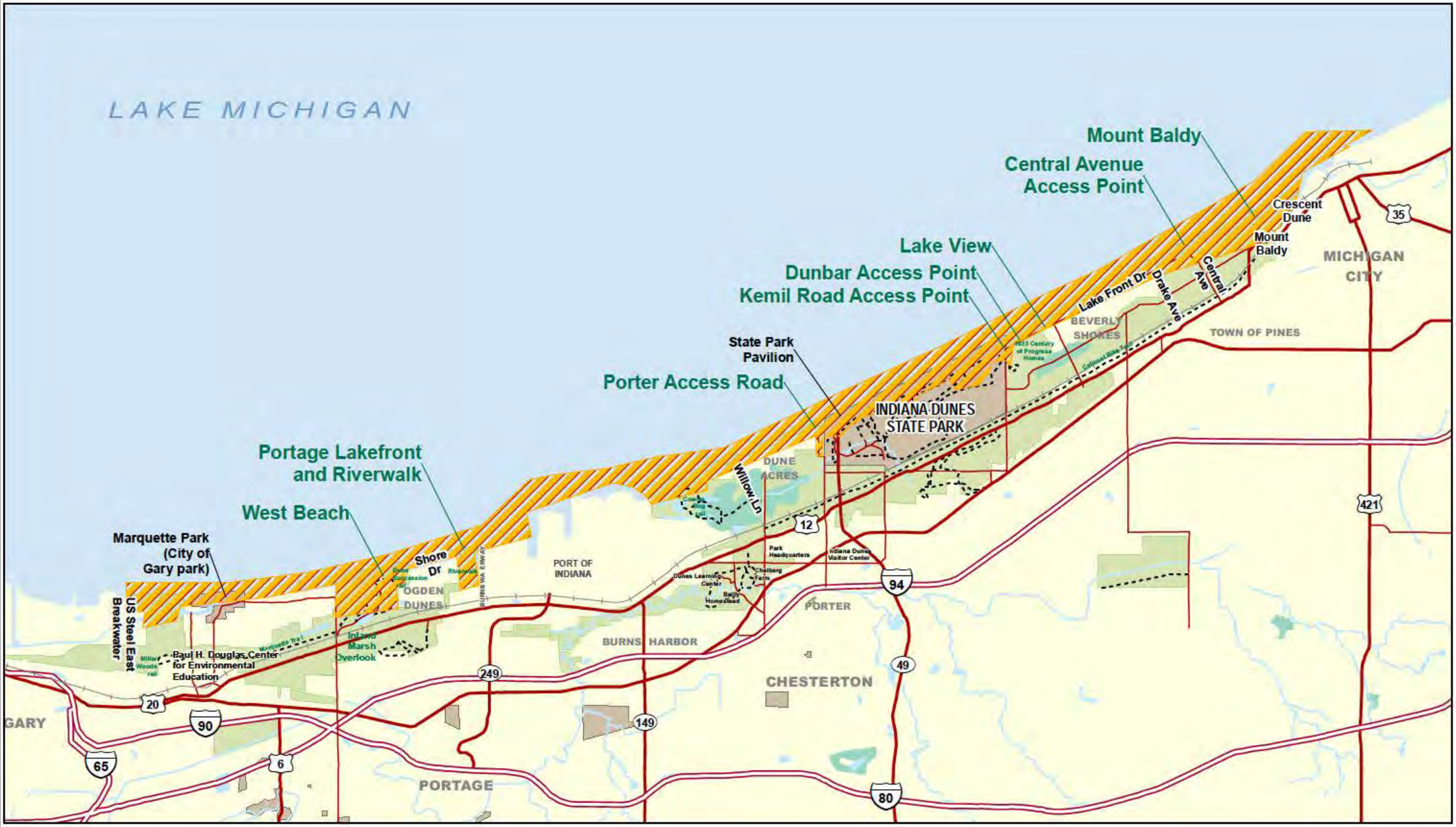
1 inch = 12,000 feet

MAP 1-1
PARK MAP

Indiana Dunes National Lakeshore Shoreline Restoration and Management Plan / Environmental Impact Statement

National Park Service / U.S. Department of the Interior

March 2012



Legend

Project Area

N

6,000 0 6,000 Feet

1 Inch = 12,000 feet

MAP 1-2
PROJECT AREA MAP

Indiana Dunes National Lakeshore
Shoreline Restoration and Management
Plan / Environmental Impact Statement

National Park Service / U.S. Department of the Interior
March 2012

PARK BACKGROUND

HISTORY OF INDIANA DUNES NATIONAL LAKESHORE

Henry Cowles, a botanist from the University of Chicago who long championed the study of plant ecology, helped bring international attention to the intricate ecosystems of Indiana's dunes. Residents of the area and the region recognized the value of the dunes, and first proposed a national park in 1915. While supporters of the idea continued to pursue this effort for the next 50 years, other parties sought industrial uses and proposed the creation of the Port of Indiana.

In 1963, President John F. Kennedy proposed "the Kennedy Compromise" that allowed both a national park and a port. In 1966, Illinois Senator Paul H. Douglas sponsored legislation (Public Law 89-761) that authorized Indiana Dunes National Lakeshore, which included 8,330 acres of land and water.

Indiana Dunes National Lakeshore enabling legislation was passed by Congress on November 5, 1966 to:

> Preserve for the educational, inspirational, and recreational use of the public certain portions of the Indiana Dunes and other areas of scenic, scientific, and historic interest and recreational value in the State of Indiana.

Four subsequent expansions (1976, 1980, 1986, and 1992) increased the size of the park to more than 15,000 acres.

OVERVIEW OF THE PARK'S ECOSYSTEM

Biological diversity is one of the most important features of Indiana Dunes National Lakeshore. This diversity is many times greater than that of most areas of similar size because the park is in several ecological transition zones, including where the northern conifers meet the temperate hardwood forests of the northern and eastern U.S. and the tallgrass prairies of the Midwest. Indiana Dunes National Lakeshore contains more than 1,445 species of vascular plants, of which 1,135 are native. Indiana Dunes National Lakeshore ranks third highest with respect to floristic diversity within all national park system units. This exceptional biological diversity was a primary reason for the establishment of Indiana Dunes National Lakeshore.

Indiana Dunes National Lakeshore is located in the midst of an urban and industrial setting. The setting, combined with increased visitation at the park, has resulted in potential threats to the park's ecosystem. For example, a number of sensitive and rare plant species have been extirpated from the park due to human impacts.

INDIANA DUNES NATIONAL LAKESHORE'S PURPOSE AND SIGNIFICANCE

Park Purpose

The park purpose is a clear statement of why Congress established Indiana Dunes National Lakeshore. Statements of purpose are grounded in a thorough analysis of the park's legislation and legislative history. Purpose statements go beyond a restatement of the law to document shared assumptions about what the law means in terms specific to the park.

The purpose of Indiana Dunes National Lakeshore is to preserve, restore, and protect outstanding ecological and biological diversity along with geologic features that characterize the southern shore of Lake Michigan. The park also provides opportunities for the public to experience natural scenic open spaces, historic features, and educational, scientific, inspirational, and recreational opportunities in proximity to urban areas.

Park Significance

- The park contains exceptional biological diversity and outstanding floral richness, resulting from the combination of complex geologic processes and the convergence of several North American life zones.
- The park's cultural resources represent the cultural evolution of northern Indiana from prehistoric times to the present day.
- The park's extensive reach of undeveloped dunes provides educational, inspirational, and recreational opportunities within a one-hour drive of a large metropolitan area.
- The park offers outstanding opportunities for scientific research due to the diversity and complexity of its natural systems and its history as a dynamic laboratory for early plant succession and faunal studies.
- The dunes provide a striking physical and emotional relief to the surrounding highly developed and flat landscape.

RELATIONSHIP OF PARK PLANNING DOCUMENTS TO OTHER GUIDING LAWS, POLICIES, PLANS, AND CONSTRAINTS

FEDERAL LAWS AND ORDERS

Several federal laws and orders influence the actions presented in this plan / final EIS and must be considered and adhered to. The following sections present federal laws and orders that are relevant to this plan / final EIS.

Endangered Species Act of 1973, as Amended

The purpose of the Endangered Species Act is to conserve "the ecosystems upon which endangered and threatened species depend" and to conserve and recover listed species. Endangered means a species is in danger of extinction; threatened means a species is likely to become endangered. The law also requires federal agencies to consult with the U.S. Fish and Wildlife Service (FWS) to ensure that the actions they take, including actions chosen under the proposed alternatives presented in the final EIS, do not jeopardize listed species or designated critical habitat.

Coastal Zone Management Act of 1972

The Coastal Zone Management Act (CZMA) encourages the management of coastal zone areas and provides grants to be used in maintaining coastal zone areas. It requires that federal agencies be consistent in enforcing the policies of state coastal zone management programs when conducting or supporting activities that affect a coastal zone. It is intended to ensure that federal activities are consistent with state programs for the protection and, where possible, enhancement of the nation's coastal zones. The Act's definition of a coastal zone includes coastal waters extending to the outer limit of state submerged land title and ownership, and adjacent shorelines and land extending inward to the extent necessary to effectively manage shorelines. A coastal zone includes islands, beaches, transitional and intertidal areas, and salt marshes.

To comply with the CZMA, the federal agency must identify activities that would affect the coastal zone defined above, including restoration projects, and review the state coastal zone management plan to determine whether the activity would be consistent with the plan.

Executive Order 11990, "Protection of Wetlands"

Executive Order 11990, "Protection of Wetlands" directs the National Park Service to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.

NPS LAWS, POLICIES, AND GUIDANCE

NPS Organic Act of 1916

By enacting the *NPS Organic Act of 1916*, Congress directed the National Park Service to manage units of the national park system "to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations" (16 *United States Code* [USC] 1). The Redwood National Park Expansion Act of 1978 reiterates this mandate by stating that the National Park Service must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 USC 1a-1).

National Park Service *Management Policies 2006*

The National Park Service *Management Policies 2006* provides further interpretation and policy guidance relative to laws, proclamations, executive orders, regulations, and specific directives. Several sections from NPS *Management Policies 2006* are relevant to aquatic and terrestrial ecological management in Indiana Dunes National Lakeshore, as described below.

The National Park Service *Management Policies 2006* instructs park units to:

- "Develop effective strategies, methods, and technologies to (1) restore disturbed resources, and (2) predict, avoid, or minimize adverse impacts on natural and cultural resources and on visitors and related activities."
- "Determine the causes of natural resource management problems and identify alternative strategies for potentially resolving them" (NPS 2006, section 4.2.1).

The National Park Service *Management Policies 2006* also instructs park units to maintain, as part of the natural ecosystems of parks, all native plants and animals. The National Park Service achieves this maintenance by "preserving and restoring the natural abundances, diversities, dynamics, distributions, habitats, and behaviors of native plant and animal populations and the communities and ecosystems in which they occur" (NPS 2006, section 4.4.1).

Furthermore, the National Park Service "will adopt park resource preservation, development, and use management strategies that are intended to maintain the natural population fluctuations and processes that influence the dynamics of individual plant and animal populations, groups of plant and animal populations, and migratory animal populations in parks" (NPS 2006, section 4.4.1.1).

Whenever the National Park Service identifies a possible need for reducing the size of a park plant or animal population, the decision is based on scientifically valid resource information that has been obtained through consultation with technical experts, literature review, inventory, monitoring, or research. The planning team was assembled to complete this task (NPS 2006, section 4.4.2.1).

Also, "whenever possible, natural processes will be relied upon to maintain native plant and animal species, and to influence natural fluctuations in populations of these species. The [National Park Service] may intervene to manage individuals or populations of native species"…management is necessary to protect specific cultural resources of parks; and to protect rare, threatened, or endangered species (NPS 2006, section 4.4.2).

The National Park Service *Management Policies 2006* indicates, "Natural shoreline processes (such as erosion, deposition, dune formation, overwash, inlet formation, and shoreline migration) will be allowed to continue without interference. Where human activities or structures have altered the nature or rate of natural shoreline processes, the National Park Service will, in consultation with appropriate state and federal agencies, investigate alternatives for mitigating the effects of such activities or structures and for restoring natural conditions. The National Park Service will comply with the provisions of Executive Order 11988, 'Floodplain Management,' and state coastal zone management plans prepared under the Coastal Zone Management Act of 1972" (NPS 2006, section 4.8.1.1). The language in section 4.8.1.1 goes on to state that the National Park Service will use the most feasible and effective methods to achieve natural resource management objectives while minimizing impacts.

Impairment. In addition to requiring the restoration of disturbed resources and the resolution of natural resource management problems, NPS *Management Policies 2006* (Section 1.4) requires analysis of potential effects to determine whether proposed actions would impair a park's resources and values.

The purpose of the national park system, established by the *Organic Act of 1916* and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. National Park Service managers must seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values. However, the laws do give the National Park Service management discretion to allow impacts on park resources and values when necessary and appropriate to fulfill the purposes of the park. That discretion is limited by the statutory requirement that the National Park Service must leave resources and values unimpaired unless a particular law directly and specifically provides otherwise.

The prohibited impairment is an impact that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including opportunities that would otherwise be present for the enjoyment of those resources or values (NPS 2006). Whether an impact meets this definition depends on the particular resource(s) that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects in relation to the impact.

An impact on any park resource or value may, but does not necessarily, constitute impairment. An impact would be more likely to constitute impairment to the extent that it affects a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park
- key to the natural or cultural integrity of the park or to opportunities for enjoyment of the park
- identified in the park's General Management Plan or other relevant NPS planning documents as being of significance

An impact would be less likely to constitute impairment if it is an unavoidable result of an action necessary to preserve or restore the integrity of park resources or values and could not be further mitigated.

Impairment can result from visitor activities, NPS administrative activities, or activities undertaken by concessioners, contractors, and others operating in the park. Impairment can also result from sources or activities outside the park. Impairment findings do not apply to visitor experience, socioeconomics, public health and safety, environmental justice, land use, and park operations because impairment findings relate back to park resources and values. A determination of impairment will be prepared and made part of the Record of Decision for this plan / final EIS.

Director's Order 12: *Conservation Planning, Environmental Impacts Analysis, and Decision-making*

NPS Director's Order 12: *Conservation Planning, Environmental Impacts Analysis, and Decision-making* and its accompanying handbook (NPS 2001) lay the groundwork for how the National Park Service complies with NEPA. Director's Order 12 and the handbook set forth a planning process for incorporating scientific and technical information and establishing an administrative record for NPS projects.

Director's Order 12 requires that impacts on park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision makers to understand the implications of those impacts in the short and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists.

Natural Resource Management Reference Manual 77

The Natural Resource Management Reference Manual 77 provides guidance for NPS employees responsible for managing, conserving, and protecting the natural resources found in national park system units.

Director's Order 77-1: Wetland Protection and Procedural Manual #77-1

The purpose of Director's Order 77-1: *Wetland Protection* and *Procedural Manual #77-1* is to establish NPS policies, requirements, and standards for implementing Executive Order 11990, "Protection of Wetlands" (42 CFR 26961). Executive Order 11990 was issued in 1977 in order "to avoid to the extent possible the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative."

Temporary impacts to the existing beach wetlands would be unavoidable within the specific site where the shoreline would be nourished. The post-restoration shoreline would be expected to result in the same acreage of the same wetland type as exists now, but shifted northward (or at least maintained in its present position) because a comparable shoreline profile is expected to develop. Since there would be no net loss of the beach wetland habitat, the project could be considered under the Restoration Exception in section 4.2.1 (h) of NPS Director's Order 77-1: *Wetland Protection* and *Procedural Manual #77-1*.

Draft NPS Procedure Manual – Sediment Restoration and Beach Nourishment Guidelines (2011)

The purpose of the sediment restoration and beach nourishment guidelines is to assist NPS staff in planning and managing coastal sediment restoration projects. It focuses on shoreline and nearshore projects. The manual provides tools for resource managers to use in interfacing with partners that are completing technical designs to protect park resources. The guidelines provide a unified approach to coastal sediment management.

The information presented in this manual is focused on regions where extensive information was available. The recommendations presented are meant to be useful to parks considering coastal sediment restoration, but do not represent official NPS policy.

PARK PLANNING DOCUMENTS FOR INDIANA DUNES NATIONAL LAKESHORE

Indiana Dunes National Lakeshore does not exist separately from its surroundings. Several plans for areas within or near Indiana Dunes National Lakeshore could influence or be influenced by actions presented in this plan / final EIS and must be considered. These relevant plans and studies are described below.

General Management Plan, 1997

The General Management Plan for Indiana Dunes National Lakeshore (1997a) is a comprehensive document for the park that combines the West Unit General Management Plan Amendment (1992), the Little Calumet River Corridor Plan (1991), and the East Unit General Management Plan Amendment (1997b). It defines the management philosophy and goals for the park for the next 20 years.

The 1997 General Management Plan summarizes and consolidates revisions made to the 1980 General Management Plan and discusses current and desired conditions related to natural resource management, transportation and parking, river access, and visitor use for each area of the park.

Implementation of the proposed project for shoreline restoration and management is consistent with the park's General Management Plan.

Fire Management Plan, 2004

The National Park Service *Management Policies 2006* require that all NPS areas with vegetation capable of sustaining fire develop a Fire Management Plan (USDA, USDI, *et al.* 1998). The purpose of this plan is to outline actions that would be taken by the park in meeting the fire management goals established for the park.

A Fire Management Plan is a detailed program of action to implement fire management policy and objectives. This plan outlines how wildland fires would be safely suppressed in an efficient, cost-effective manner; the role wildland fire management plays in the protection and management of natural and cultural resources; and how public and private property is to be protected from the impacts of wildland fires.

Invasive Plant Management Plan, Ongoing

The National Park Service is in the process of preparing an environmental assessment (EA) for a Great Lakes Invasive Plant Management Plan for Indiana Dunes National Lakeshore and several other national parks in the Great Lakes region.

The Invasive Plant Management Plan /EA is based on integrated pest management. Integrated pest management is defined as a decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage by cost-effective means, while posing the least possible risk to people and park resources. The scope of the Great Lakes Invasive Plant Management Plan /EA would be to identify long-term invasive plant management tools that would reduce the impacts of (or threats from) invasive plants to natural and cultural resources and provide opportunities for restoring native plant communities and cultural landscapes. The Invasive Plant Management Plan /EA would provide strategies for park staff to manage terrestrial and emergent wetland invasive plants on NPS-managed lands within the designated boundaries of the parks.

Memorandum on Mount Baldy Management Actions, 2011

The memorandum on Mount Baldy Management Actions from the Superintendent of Indiana Dunes National Lakeshore (NPS 2011a) describes current issues and potential management strategies for protection of Mount Baldy, the single most popular site for visitors to the park, from continued erosion. Similar problems elsewhere at the park were also cited, although the initial focus of management actions would be on Mount Baldy.

This memorandum describes the findings of an October 2010 management workshop on the subject, and outlined a series of goals with potential response strategies for each, as follows:

- stop people from going up or down the south slope
- restore areas denuded of vegetation by human actions
- designate an appropriate route from the top of the dune back to the parking lot to reduce damage to vegetation and the

potential for injuries caused by going down the south slope
- reduce social trail impacts to the resource
- achieve visitor compliance through education

OTHER PLANNING DOCUMENTS FOR SOUTHERN LAKE MICHIGAN

A number of existing external plans pertaining to the southern Lake Michigan shoreline area in northwest Indiana provide important context for this plan / final EIS. While this plan / final EIS need not be entirely consistent with these external plans and documents, a general consistency facilitates regional cooperation and collaboration opportunities. The key documents are identified and described below.

Marquette Plan, Phase I (2005) and Phase II (2008)

The Marquette Plan is a regional plan that creates a comprehensive land use vision for the Lake Michigan drainage basin and a strategy for implementation of that vision. The Marquette Plan established primary goals of increasing public access and developing the urbanized area.

Phase I of the Marquette Plan: The Lakeshore Reinvestment Strategy, was completed in 2005 and addressed public access and redevelopment of the lakeshore from the Illinois state line to the Port of Indiana. Phase II was completed in 2008 and compiled a range of general frameworks and recommendations for land use, green infrastructure at the watershed level, and transportation and access along the lakeshore from the Port of Indiana to the Michigan-Indiana state line.

Marquette Park Lakefront East Master Plan, City of Gary, 2008

The City of Gary recently received funding for the development of a plan for renovation and improvements to Marquette Park, which is located at the far west end of Indiana Dunes National Lakeshore. These capital improvements provide access to and circulation within the park, preserve and strengthen the park's natural features, provide new recreation and education amenities, and restore the park's signature historic facilities. Initial improvements have begun and completion is slated for 2012.

PROPOSED PLAN FOR IMPLEMENTATION

The proposed plan presents the first steps in a long-term process to return Indiana Dunes National Lakeshore to its natural condition.

For instance, various hardened structures have been placed along the shoreline as a result of industrial, federal, and residential development. These structures have historically provided protection for infrastructure from erosion and storm events. However, these structures were not always developed in a way that was beneficial to the entire shoreline. The purpose of this final EIS is to identify and develop strategies to restore the Indiana Dunes National Lakeshore shoreline and its processes. Reestablishment of more natural shoreline processes could eventually allow the current structures within the Indiana Dunes National Lakeshore boundaries along the lakeshore to be removed in the future without endangering the adjacent infrastructure. Note that additional study and compliance would be necessary in order to verify that the current structures could be removed.

ISSUES AND IMPACT TOPICS

PLANNING ISSUES AND IMPACT TOPICS

Climate Change

Climate change refers to any substantial changes in average climatic conditions, such as average temperature, precipitation, or wind. Climate change also refers to considerable changes in climatic variability, such as seasonality or storm frequencies, which last for an extended period of time (decades or longer). The National Park Service recognizes that the main drivers of climate change are outside the control of the agency; climate change is a phenomenon with impacts that cannot be discounted, and which is likely already affecting Indiana Dunes National Lakeshore.

What scientists know is that higher air and water temperatures are already reducing winter ice cover on the Great Lakes, a trend which is expected to accelerate. Scientists believe that Lake Michigan may have some winters with no ice cover in as soon as 10 years. With less ice and more open waters, the lake will have more waves in winter than before, especially during strong storms, increasing erosion threats to park shorelines and structures. Also, because snow and ice cover protect dunes, beaches, and other shoreline features from erosion (by keeping them effectively frozen in place), shorelines are at greater risk of erosion in the future.

The U.S. Geological Survey (USGS), in partnership with the National Park Service, has assessed the possible effects of lake-level declines on the shorelines of three national lakeshores, Indiana Dunes, Sleeping Bear Dunes, and Apostle Islands, much as the U.S. Geological Survey has evaluated possible effects of sea-level rise on some coastal national parks. For these three national lakeshores, the U.S. Geological Survey identified the likelihood of changes in shorelines based on six factors: erosion and accretion (build-up) rates, coastal slopes, relative projected lake-level changes, average wave heights, average ice cover, and geologic stability or susceptibility to changes. The shoreline at Indiana Dunes National Lakeshore has a high or very high potential of shoreline change. The vulnerable areas, mostly in the eastern portions of the lakeshore, include the Central Avenue access point and the beaches below Mount Baldy.

Recent climate change trends in the region of the park include:

- an increase in annual temperatures of 0.25°C per decade
- a progressive advance in the date of the last spring freeze
- increases in autumn precipitation
- doubling of frequencies of heavy rainfall events and an increase in the number of individual rainy days and week-long heavy rainfall events
- increased flooding
- an increase in the number of heat waves and record-high temperatures (Hayhoe *et al.* 2010)

While it is well accepted that climate change is occurring, the rate and severity of impacts at the park is, as yet, undefined. Extreme weather events have historically been documented in the area of the park, specifically in 1998 and 2010. The anticipated increased frequency and intensity of storm events have the potential to exacerbate the loss of sediment along the shoreline, thereby accelerating the accumulation of sediment on accreting shoreline reaches. These likely future conditions add emphasis to the need for an effective, long-term, beach restoration plan.

The issue of climate change is addressed in this plan to recognize its role in the changing environment, and to provide an understanding of its impacts on the park and the surrounding environment. The potential influences of climate change are described in the "Affected Environment" chapter. While climate change would alter resource conditions within Indiana Dunes National Lakeshore, the type and intensity of these changes is uncertain.

IMPACT TOPICS RETAINED FOR DETAILED ANALYSIS

NPS Director's Order 12: *Conservation Planning, Environmental Impact Analysis, and Decision-making* (2001) lists mandatory topics that must be considered in a NEPA document. The impact topics retained for further analysis and their associated issues presented below are described in more detail in the "Affected Environment" chapter, and impacts on each resource are analyzed in the "Environmental Consequences" chapter. If impact topics (resources) are unaffected by the project or if the impacts to the resources from the project are at a low to very low level, then the topic was eliminated from further analysis, as described under the "Impact Topics Dismissed from Further Consideration" section of this chapter.

Coastal Processes

Sediment Transport Processes. A coastal zone is a dynamic region where land is sculpted and shaped by wave action and currents. The coastal processes of Lake Michigan historically have shaped Indiana Dunes National Lakeshore, and continue to have an effect on the natural features vital to the park, such as beaches and dunes. As the shoreline was modified by human activity over the last century, so too was the effect of the coastal processes on Indiana Dunes National Lakeshore.

Due to the presence of various industrial and navigational structures along Lake Michigan's southern shore, the transport of sediment along the shoreline has been interrupted. This has resulted in areas of accretion, in which the beach appears to be increasing in size as more sediment becomes trapped, and areas of erosion, in which sediment is carried away from the shoreline and transported downdrift. The alternatives presented in this plan describe a variety of approaches to mitigate accretion and erosion.

Dune Formation Processes. Dune development occurs when the lake level remains relatively constant, and sediment is deposited, trapped, and held onshore by vegetation. It is vital that the appropriate quantity of sediment be present in the system to allow for such processes to occur. The alternatives presented allow for additional sediment to be placed into the lake system via a variety of approaches. It is important to evaluate the effectiveness of these alternatives on the development of foredune and dune complexes.

Aquatic Fauna

Native Species. An abundance of benthic communities live and flourish in Lake Michigan. Many of these species use the nearshore environment along Indiana Dunes National Lakeshore during some stage of their lives. As these species are an important resource for the park, the National Park Service has responsibility to protect them to the extent possible. The alternatives presented in this plan would affect these species.

Invasive and Nonnative Species. There are several species of invasive and nonnative benthic organisms and fish known to populate the waters along the southern Lake Michigan shoreline. As these species encroach on the park's waters, the native benthic communities are increasingly at risk of displacement. It is important to assess the potential for the alternatives presented in this plan to introduce, or augment, the spread of the invasive and nonnative species.

Terrestrial Habitat

Native Plant Communities. The National Park Service *Management Policies 2006* requires the National Park Service to protect and conserve native plant and vegetative communities that would be affected by visitors, management actions, and external sources. Actions and alternatives presented in this plan would affect these natural resources. Resource managers are currently tasked with the preservation and restoration of the park's unique natural features.

Invasive and Nonnative Plant Species. The National Park Service defines nonnative and invasive plant species as "those that occur in a given place as a result of direct or indirect, deliberate, or accidental actions by humans." Nonnative invasive plant species are pervasive throughout the park and surrounding lands. Resource managers must contend not only with current threats posed by nonnative invasive plant species but emerging threats as well. Nonnative invasive plant species have already influenced the various reaches and plant communities in the park. Species of special concern, particularly threatened and endangered species, are detrimentally impacted by the encroachment of invasive plants. National Park Service staff are currently monitoring and managing invasive species that pose direct or indirect impacts to species of special concern and critical habitat. It is important to assess the potential for the alternatives presented in this plan to introduce, or augment, the spread of the invasive and nonnative plant species.

Threatened and Endangered Species and Species of Concern

The Endangered Species Act of 1973, as amended, requires an examination of impacts on all federally listed threatened or endangered plant and animal species. It is a responsibility of the park to conform to this legislation, and to extend protection to state-listed threatened, endangered, or rare species.

The park supports a relatively high concentration of biodiversity, and in turn supports many federal and state threatened and endangered species and species of concern. It provides a mosaic of habitats for terrestrial plants and wildlife in a relatively small area. Many of Indiana's plant species of conservation concern are found at the park, including the federal and Indiana threatened Pitcher's thistle (*Cirsium pitcher*). Of concern are the Karner blue butterfly (*Lycaeides melissa samuelis*), Indiana bat (*Myotis sodalis*), piping plover (*Charadrius melodus*), and eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*).

In this final EIS the park assesses whether proposed actions and alternatives have no effect; may affect, but are not likely to adversely affect; or are likely to adversely affect federally threatened or endangered species and candidate species. The park is also using this final EIS to determine if the proposed action and alternatives would destroy or adversely modify critical habitat to the extent that the action would appreciably diminish the value of the critical habitat for the survival and recovery of the species.

Wetlands and Pannes

The aquatic and panne habitats that are contained in the wetland habitats within the project area provide tremendous scientific, educational, and inspirational opportunities. They serve as a transition between Lake Michigan and the beach, and the foredune and dune complexes.

Despite their rarity and relatively small size, pannes hold a vast amount of vascular plant diversity. Many of the plant species found within pannes are located nowhere else in Indiana. They also support numerous insect, mammal, and bird species. These wetlands depend on lake level fluctuation and precipitation for their hydrology, therefore proposed actions and alternatives are reviewed in light of their impacts to the preservation of function and structure of the aquatic and panne wetland habitats.

Soundscape

The National Park Service *Management Policies 2006* recognize that natural soundscapes are a park resource and call for the National Park Service to preserve, to the extent possible, the natural soundscapes of the parks. It is the responsibility of the park to protect the natural soundscape from degradation due to sounds, which is defined as undesirable human-caused sound or noise. Unnaturally occurring sounds can adversely affect the natural soundscape and other park resources. It can also adversely affect the visitor experience along the shoreline. While Indiana Dunes National Lakeshore is situated within an urban setting with industrial and other facilities adjacent to park boundaries, the soundscape within the project area is dominated not only by human components, but by natural components as well. The alternatives presented in this final EIS may potentially increase noise levels within portions of the project area.

Visitor Experience

The Indiana Dunes National Lakeshore provides a wide range of recreational opportunities and experiences for visitors. Enjoyment of the beaches and dunes along the shoreline are common pastimes for visitors coming to the park. The natural viewshed afforded to those within the park is also a key resource to be considered. As the alternatives presented in this final EIS may result in changes to these experiences.

Park Operations

Park management and operations refers to the current staff available to adequately protect and preserve vital park resources and provide for an effective visitor experience. Shoreline restoration and management activities have the potential to impact staffing levels, staff workloads, and the budget necessary to conduct park operations.

IMPACT TOPICS DISMISSED FROM FURTHER CONSIDERATION

Due to the scope of this project, several impact topics have been considered and ultimately dismissed from further discussion because of the low to very low level of impacts.

Air Quality

Since 1988, the EPA, in coordination with state and federal land management agencies, has conducted monitoring of air pollution and visibility at a number of national parks and wilderness areas across the country. The park is located within a class II air quality area because of the heavy industrialization of northwest Indiana. Class I areas have pristine air quality. Class II areas have higher incremental air quality limits than class I areas due to less pristine background air quality, and are allowed moderate air quality deteriorations. The actions associated with the alternatives presented in this plan would not violate air quality standards or result in a cumulative net increase of criteria pollutants under federal or state ambient air quality standards. Emissions from actions in the alternatives would result in negligible effects on air quality, and Indiana Dunes National Lakeshore's class II air quality would be unaffected. This topic has been dismissed from further analysis because there would only be negligible effects on air quality.

Carbon Footprint

For the purpose of this planning effort "carbon footprint" is defined as the sum of all emissions of carbon dioxide and other greenhouse gases (GHG) (e.g., methane and ozone) that would result from implementation of the proposed alternatives.

The proposed action alternatives vary widely in terms of use of vehicles involved in the project and as such the focus of the GHG emissions analysis associated with the alternatives in this final EIS is on emissions from land- and water-based vehicles (heavy-duty trucks and barges, respectively). Thus, the most energy intensive alternatives were evaluated as shown in Table 1-1: Annual Greenhouse Gas Emissions, for annual GHG emissions using emission factors and calculation methodologies recommended by the EPA Climate Leaders in *GHG Inventory Protocol Core Module Guidance, Direct Emissions from Mobile Combustion Sources* (EPA 2008) for estimating direct GHG emissions resulting from mobile sources. The two most energy intensive alternatives involve 50 to 80 heavy-duty diesel trucks entering the park each day for a period of up to four months during an annual cycle, or up to 18 months during a five-year cycle. The highest expected annual GHG emissions from mobile sources for these alternatives is approximately 3,500 metric tons of carbon dioxide equivalent ($mtCO_2e$) per year. Other alternatives discussed in this document involve the use of a barge and minimal construction equipment for periods of six or eight weeks. As barges are more efficient at moving dry goods on a ton-per-mile basis, emissions for the remaining alternatives are expected to be much lower.

The 3,500 $mtCO_2e$ GHG emission level is well below the CEQ guidance level of 25,000 $mtCO_2e$ recommended for developing further detailed analysis. To provide a context for these numbers, the total GHG emissions for Indiana Dunes National Lakeshore in 2008 were approximately 5,220 $mtCO_2e$; GHG emissions for the U.S. Steel Midwest Plant (adjacent to the park) in 2010 were 317,627 $mtCO_2e$; and the GHG emissions for the state of Michigan in 2002 were 62.5 million $mtCO_2e$ (no GHG inventory has been conducted for the state of Indiana). Thus, the greatest potential GHG emissions from the project, when compared to park baseline emissions in 2008, larger regional and state emissions, and CEQ guidance, are minimal. Therefore, the actions associated with the alternatives presented in this final EIS are unlikely to produce more than minor GHG emissions. This topic has been dismissed from further analysis because there would only be minor or less effects from GHG emissions.

TABLE 1-1. ANNUAL GREENHOUSE GAS EMISSIONS

Source	Annual GHG Emissions (Million Metric Tons CO_2e)	Year
Alternative B-5	0.0035	N/A
Indiana Dunes National Lakeshore	0.0052	2008
CEQ Guidance	0.0250	N/A
U.S. Steel Midwest Plant (adjacent to the park)	0.3176	2010
State of Michigan	62.5	2002

SOURCES: Mid-Atlantic Diesel Collaborative 2010; EPA 2008

Cultural Resources

All projects with the potential to affect cultural resources would be carried out consistent with Section 106 of the National Historic Preservation Act (NHPA), as amended, to ensure that the effects would be adequately addressed. Reasonable measures would be taken to avoid, minimize, or mitigate adverse effects in consultation with the Indiana state historic preservation officer (SHPO), Tribal historic preservation officers, and, as necessary, the Advisory Council on Historic Preservation, and other interested parties. In addition to adhering to the legal and policy requirements for cultural resource protection and preservation, the National Park Service would also undertake mitigation measures listed in the "Mitigation Measures Common To All Action Alternatives" section of "The Alternatives" chapter to further protect the park's resources. Per Section 106 of NHPA, the National Park Service would seek a determination of "no adverse effects" to historic or archeological resources from the Indiana SHPO.

Historic Resources. There are several historic structures within the park including five houses located along Lake Front Drive in Beverly Shores that were built for the 1933 Century of Progress exposition and the three houses known as the Solomon Enclave. There is one identified cultural landscape, the Solomon Enclave, located on Lake Front Drive in Beverly Shores. These resources are not located within the project area that is the focus of this plan. Historic structures and cultural landscapes at the park would not be impacted by the actions associated with the proposed alternatives, therefore historic structures and cultural landscapes have been dismissed from further analysis.

Submerged Resources. There are several historic shipwrecks offshore from the park, including one or more along the shoreline reaches under analysis for shoreline actions. A Coastal Historic and Cultural Resources Study of the Lake Michigan Watershed was conducted in 2000 for the Indiana Department of Natural Resources (IDNR) Division of Historic Preservation and Archaeology. The study was performed to assess the status of existing plans and current resources for public recreation access, including offshore shipwrecks, and to make recommendations on feasibility, management need, and demand on resources for recreation access to underwater resources in Lake Michigan. Although the Indiana territorial waters include only 225 square miles of Lake Michigan, previous investigations by the IDNR identified the potential for 50 historic vessels. A total of 14 known shipwrecks are listed in the Indiana Maritime Cultural Resource Inventory. Assessment and surveys indicate two of these sites, the Muskegon and the J.D. Marshall, have attributes for potential enhanced recreational value. The J.D. Marshall is located under 30 to 35 feet of water more than 3,000 feet offshore from Indiana Dunes National Lakeshore, while the Muskegon is located under 25 to 30 feet of water more than 1,000 feet offshore from Mount Baldy along the shoreline at Indiana Dunes National Lakeshore (The Office of Underwater Science 2000).

Shoreline restoration activities under analysis in this plan would be closer to the shoreline than most of the historic shipwrecks. A series of mitigation measures would be used to protect submerged resources during nourishment activities associated with the proposed alternatives. These measures would include the use of protective fences and buoys, and signs.

With protective measures in place to preserve submerged historic shipwrecks, these submerged resources would be minimally impacted by the actions associated with the proposed alternatives. Therefore, submerged historic resources have been dismissed from further analysis.

Archeological Resources. There could be archeological resources within the project area at Indiana Dunes National Lakeshore that are currently unknown, and which could become known prior to any beach nourishment activities that may result from this plan. In such instances a series of protection measures would be used to protect archeological resources. These measures would include the use of protective fences and signs. This topic has been dismissed from further analysis because these measures would result in no effect to archeological resources.

Environmental Justice

Presidential Executive Order 12898, "General Actions to Address Environmental Justice in Minority Populations and Low-income Populations," requires all federal agencies to incorporate environmental justice into their policies by identifying and addressing the disproportionately high and/or adverse human health or environmental effects of their programs on minorities and low-income populations and communities. The alternatives under consideration in this plan would have no appreciable impact on minorities or low-income populations or communities. The actions in the alternatives would not result in identifiable adverse human health effects, nor would they substantially alter the physical and social structure of the nearby communities. This topic has been dismissed from further analysis because actions associated with the proposed alternatives would have no adverse affect on minority or low-income populations.

Human Health Concerns

Both human and natural pathways that introduce and spread pathogens and other contaminants dangerous to human health exist at Lake Michigan. With increased visitor access to and use of Indiana Dunes National Lakeshore comes an increased risk of exposure to *Escherichia coli* (*E. coli*) and other pathogens. Dredging and sediment disturbance have the potential to release harmful bacteria such as fecal indicator bacteria (*E. coli*) and *Clostridium botulinum.* Berms and permanent bypass systems could attract exotic species (i.e., zebra mussels [*Dreissena polymorpha*] and quagga mussels [*Dreissena rostriformis bugensis*]) which may increase the risk of exposure to botulinum toxin. Botulinum toxin is a metabolic waste produced under anaerobic conditions by *Clostridium botulinum*, a bacteria that can be found in the tissue of bivalves (e.g., mussels). The risk of botulinum toxin exposure would be diminished as the exotic species would eventually be covered with sediment. It is outside the scope of this plan to control potential pathogens or similar impacts to water quality. To maintain compliance with the Clean Water Act of 1972, the National Park Service cannot knowingly implement actions that would have a detrimental effect on water quality. Therefore, while the alternatives presented in this plan do not propose to remove human health concerns from the waters of Lake Michigan, the proposed project would not be expected to adversely affect Lake Michigan water quality and/or introduce harmful pathogens.

Required permitting conducted prior to dredging, sediment placement, and berm or bypass construction activities would identify mitigation required to protect against human health concerns. Appropriate measures would be taken during the final planning and permitting stages to ensure that the actions conducted along the shoreline comply with the standards upheld by the National Park Service. Actions such as fencing, signs, and visitor education would be used to reduce visitor exposure to pathogens and contaminants. With required mitigation in place to protect human health from harmful bacteria released from dredging and sediment placement activities, there would be negligible impacts to human health. This topic has been dismissed from further analysis because actions associated with the proposed alternatives would have negligible effects on human health.

Socioeconomic Resources

NPS Director's Order 12: *Conservation Planning, Environmental Impact Analysis, and Decision-making* requires consideration of potential direct and indirect impacts to the local economy, including impacts to neighboring businesses in the general project vicinity. The No-action alternative, the preferred alternative, and the other action alternatives considered as part of this plan would not change local and regional land use, nor would they appreciably impact local businesses or other agencies. This resource has been dismissed from further analysis because none of the actions associated with the proposed alternatives has the potential to impact the socioeconomic environment of the area.

Water Quality

Indiana Dunes National Lakeshore, because of the fragmented nature of the lakeshore, the beach, dune complexes, and terrestrial habitats along the shoreline, is impacted by both permitted and nonpoint discharges into Lake Michigan which can directly affect park aquatic resources. It is beyond the scope of this plan to address these discharges into Lake Michigan. The National Park Service cannot knowingly implement actions that would have a detrimental effect on water quality. However, the alternatives in this plan have a very low probability of improving or adversely affecting the water quality of Lake Michigan. Any action taken as part of the implementation of this plan would be subject to any and all appropriate measures to comply with water quality standards. Because the probability of effects to water quality from actions associated with the proposed alternatives is very low, water quality has been dismissed from further analysis.

CHAPTER 2
The Alternatives

INTRODUCTION

In general, the shoreline at Indiana Dunes National Lakeshore naturally functions as a dynamic environment. A dynamically stable shoreline is one that has experienced either minor or no positioning changes over a long period of time (i.e., 50 years or greater). Wave action maintains the beach profile by supplying and collecting sediment along the shoreline. Wind action and major storm events work in conjunction with lake processes to create the dune complex. As dunal succession is wind driven, the presence or absence of vegetation on the dune face can influence the speed at which the dunes move. Vegetation established on a dune reduces the amount of sediment blown away by wind action, thus slowing down the movement of the dune. With the introduction of urban development along the lakeshore came disruptions to the intricate coastal processes of Lake Michigan's southern shoreline. This *Shoreline Restoration and Management Plan / Final Environmental Impact Statement* (EIS) addresses the restoration of certain natural processes within the context of a modified system. The proposed alternatives represent the range of possible actions the park is considering, consistent with NPS policy, Indiana Dunes National Lakeshore's purpose, and the interest of the public. The alternatives have been designed to be implemented at specific areas of the shoreline during approximately the next 20 years. Full implementation would require cooperation and coordination between local, state, and federal agencies. In addition, the plan anticipates that these alternative actions would be implemented in all reaches of the project area at the same time, rather than only in one reach at one time.

As discussed in detail below, alternative A is a continuation of current management practices and is included as the baseline for comparing the consequences of each alternative. Alternatives B through D represent variations of beach nourishment activities. Alternatives B-1 and B-5 include beach nourishment using material trucked to the shoreline from an upland source in one- and five-year frequencies, respectively. Beach nourishment via dredged materials in one- and five-year frequencies is proposed under alternatives C-1 and C-5, respectively. Alternative D outlines nourishment activities achieved through a permanent bypass system. The use of a submerged cobble berm in conjunction with annual nourishment is discussed as alternative E. Finally, a hybrid of alternatives C-1, B-1, and E, which includes annual beach nourishment with a mix of small natural stone, dredged sediment, and coarse upland material at the shoreline, is discussed as alternative F.

It is important to include terrestrial management practices when discussing shoreline restoration alternatives, as terrestrial and aquatic habitats are directly affected by similar processes. For example, dune-stabilizing vegetation historically present along the beach has been trampled, thus disrupting the delicate balance of dune formation processes. As the park is a popular destination for millions of people, the impacts of human actions on the natural resources of the park are ever present. The purpose of terrestrial management actions in the park is resource protection. Actions that could introduce nonnative invasive species are constantly present as visitors arrive by foot, in vehicles, and by train and bring pets and materials into the park. Habitat for endangered and threatened species and species of concern becomes more at risk as recreational uses of the park for activities such as hiking, cross-country skiing, snowshoeing, and horseback riding have extended further into the fall and winter seasons.

PROJECT AREA DEFINITION

For the purpose of this plan / final EIS, the shoreline has been divided into four reaches based on sediment accretion and erosion rates of the shoreline. The project area consists of reaches 1 through 4, numbered in an east-to-west direction. The shoreline within the park is not contiguous, but rather is interrupted by industrial and other properties. These reaches include industrial and navigational structures, as well as portions of the shoreline armored with revetment walls and other hardened structures. The alternatives developed for this plan were developed to benefit the entire shoreline as opposed to a single land owner. As depicted on Figure 2-1: Shoreline Reaches, the designated reaches encompass the following shoreline areas:

- reach 1, Crescent Dune to the east end of Lake Front Drive
- reach 2, east end of Lake Front Drive to Willow Lane
- reach 3, Willow Lane to Beach Lane
- reach 4, Beach Lane to the Gary-U.S. Steel East Breakwater

The direction of net transport of sediment moving along the park shoreline is from east-to-west. There are three primary man-made structures in and around the project area that constitute barriers to littoral drift and affect the park. These structures are federal and industrial harbors that impact the natural sediment transport by disrupting the natural sediment flow and generally result in accretion to the east (updrift) and erosion to the west (downdrift).

The three harbors adjacent to, and within, the project area are:

- to the east, the Michigan City Harbor (initial construction in 1834, harbor completed in the early 1900s)
- the Burns International Harbor (constructed in the late 1960s)
- to the west, the Gary-U.S. Steel Harbor (constructed in the early 1900s)

The preliminary analysis to estimate the total volume of sediment trapped by development was based on detailed aerial photographs from representative pre-harbor conditions to present. In addition, the analysis considered quantities dredged and the volume of sediment bypassing the shoreline because of the harbor structures to calculate (for reach 1) and estimate (for reach 3) sediment volume trapped. Based on preliminary calculations, the total quantities of accreted sediment (from pre-harbor conditions to present) on the east adjacent to the harbors are:

- Michigan City Harbor has approximately 28.2 million cubic meters (m^3) (36.8 million cubic yard [yd^3]) of accreted sediment. This quantity does not include the volume of sediment dredged in the navigation channel and artificially bypassed.
- Burns International Harbor has approximately 3.5 million m^3 (4.6 million yd^3) of accreted sediment. This quantity does not include sediment dredged and artificially bypassed, which totals 1.7 million m^3 (2.2 million yd^3).
- Gary-U.S. Steel has approximately 2.2 million m^3 (2.9 million yd^3) of accreted sediment. This quantity is based on the current shoreline orientation defined by the confined disposal facility constructed post-1950.

The restoration alternatives set forth are particularly relevant to reaches 1 and 3 along the park shoreline (see Figure 2-1: Shoreline Reaches). Reach 1, located at the easternmost end of the park shoreline, is an actively eroding area, particularly at the base of Mount Baldy. As the natural net sediment transport extends from east-to-west in the project area, the Michigan City Harbor structure updrift of the project area interrupts the littoral drift, creating an accreting beach fillet on the east side of the harbor, and erosion within the area of Mount Baldy (which is downdrift). Reach 3 denotes the stretch of shoreline in the central portion of the project area and includes a shipping harbor. Harbor structures associated with this property extend into Lake Michigan, creating a sediment accretion area to the east, and an erosion area at Portage Lakefront and Riverwalk. Each of these areas exhibit the extreme effects of interruption to the littoral drift along the park shoreline; therefore, it is important to focus restoration efforts in these areas, provide beach nourishment material, and provide conditions for distribution of the nourishment material via natural lake processes to the extent possible. This plan assumes that these restoration efforts would be implemented in both reaches 1 and 3 at the same time in order to best mimic natural dynamics.

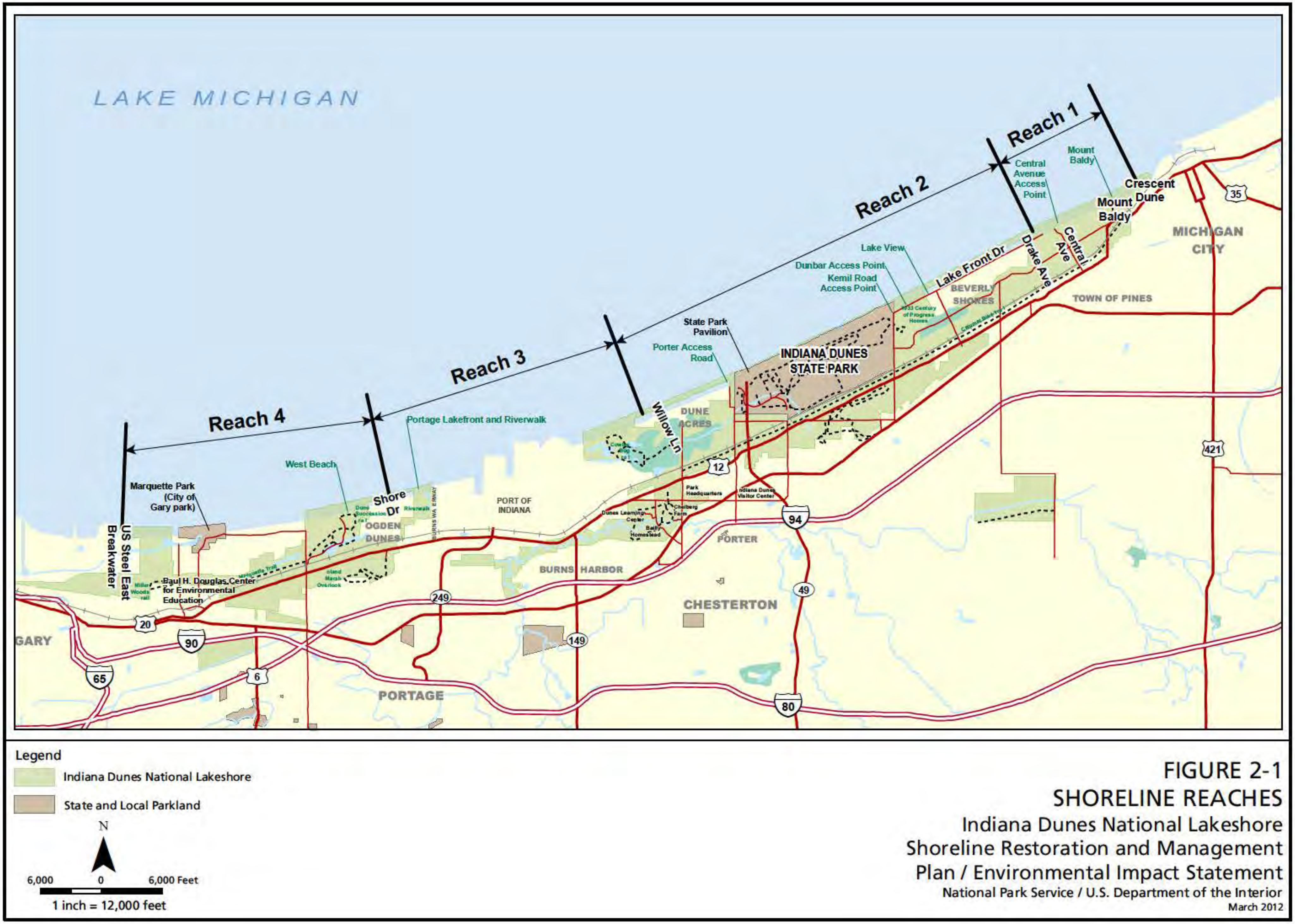


FIGURE 2-1
SHORELINE REACHES
Indiana Dunes National Lakeshore
Shoreline Restoration and Management Plan / Environmental Impact Statement
National Park Service / U.S. Department of the Interior
March 2012

ALTERNATIVES DEVELOPMENT PROCESS

TECHNICAL ANALYSIS

In September and October 2010, NPS park staff and consultant engineers and scientists observed and documented the existing shoreline conditions. Photographs and limited measurements were taken. In addition, a review of various reports and other documents focused on local conditions of Lake Michigan's southern shoreline was conducted to gather information on coastal processes, shoreline evolution, sediment sampling and analysis, dredging, and beach nourishment history. Additional information regarding this literature review is provided in Appendix C: Technical References.

The technical analyses completed for the project area are described below.

Shoreline Evolution

Analysis of the shoreline from 1951–1952 to 2010 was conducted to quantify long-term changes in shoreline position as depicted on Figure 2-2: Shoreline Comparison. The 1950 aerial year was chosen as representative of the pre-harbor conditions and represents the baseline shoreline "natural" conditions. This analysis considered the dredging and beach nourishment events in the project area that took place during this timeframe. The shoreline initially was divided into reaches based on areas of general accretion, erosion, and dynamically stable areas. The long-term highest erosion rates along the lakeshore were calculated at Mount Baldy (4.5 feet per year [ft./yr.]), and at Portage Lakefront and Riverwalk (2.7 ft./yr.). The highest accretion rates were identified at the Burns International Harbor East Fillet Beach (7.6 ft./yr.) and at the Gary-U.S. Steel Harbor East Fillet Beach (5.1 ft./yr.). These areas are depicted in Figure 2-3: Shoreline Erosion and Accretion Zones. Additional detailed information is provided in Appendix C: Technical References.

Water Level and Wave Climate

A probability analysis of recorded water levels and computer modeling of the Lake Michigan wave climate was conducted. This analysis provided useful data for formulating conceptual design alternatives and other details such as the required beach fill materials, slope and extents, and location/water depths for placement. The stability of beach nourishment would be directly affected over the plan's life by the water levels and storm events. The 100-year storm event was selected as the conceptual design condition for the shoreline improvements, along with a lake level of 584.7 feet (+7.2 feet International Great Lakes Low Water Datum IGLD85). Wave height is controlled by water depth. For example, a maximum wave height of 10.7 feet at a reference 6-foot water depth (at Low Water Datum, or total water depth of 13.2 feet at design condition) was calculated.

Longshore Sediment Transport

Waves breaking along the shoreline and the wave-induced currents generate movement of beach sediment known as longshore transport or littoral transport. Sediment movement along the shoreline is referred to as littoral drift and is expressed in yd^3 per year. Longshore sediment transport primarily consists of sediment suspended within the water column. Based on the variability of wind and wave directions, sediment transport is often reported as a net volume indicating the sum of all transport values directions (positive and negative). Longshore transport can be interrupted/impacted by coastal structures extending into the lake, which can block sediment transport.

A two-dimensional numerical model (COSMOS) was used to calculate sediment transport rates along the shoreline at selected intervals of 1.25 miles for current and historic pre-harbor conditions. The beach profiles extended out to a depth of approximately 15 meters (or approximately 49 feet) below chart low water datum (LWD). It was determined that the net longshore sediment transport gradually decreases from New Buffalo (200,000 yd^3 updrift of Michigan City) east to the Burns International Harbor. The longshore sediment transport rate is estimated at less than 30,000 yd^3 per year near the Gary-U.S. Steel Harbor.

Sediment Budget at Mount Baldy

This analysis used the findings of a previous investigation performed for the Michigan City area (Baird 2004). A hydrodynamic and sediment transport analysis was completed to improve the understanding of the hydrodynamics at the Michigan City Harbor, patterns of sediment transport, bypassing rates around the harbor structures, and the role the Michigan City Harbor plays on the Mount Baldy sediment budget. A two-dimensional hydrodynamic and sediment transport model (HYDROSED) was applied to the analysis of the existing wave conditions, nearshore currents, and sediment transport rates at Michigan City. The model was then used to quantify the sedimentation and bypassing rates in the area. With the combined results of the COSMOS and HYDROSED modeling, a sediment budget assessment was completed. The sediment budget accounts for all sediment sinks, sources, inputs, and outputs of sediment within a confined cell or boundary. This approach provides the framework to describe and understand long-term morphological changes, such as erosion and sedimentation rates. The annual long-term average trucked quantities of beach nourishment at Mount Baldy and quantities of Michigan City dredged and mechanically bypassed material were included in the sediment budget. It was determined that the area around Mount Baldy has a calculated sediment budget deficit of 105,000 yd^3 of sediment per year due to the sediment trapped at Michigan City.

Light Detection and Ranging (LIDAR)

Based on existing (2010) detailed LIDAR bathymetry (or underwater survey data) used for this study, the data coverage is good overall. However, the topographic (land-based data) is scarce in reach 3. For reach 3, one-foot contours were interpolated and an average beach slope was estimated between the 570.0 (-7.5 feet LWD) and 580.0 (+2.5 feet LWD).

FORMULATION OF THE ALTERNATIVES

The alternatives, developed as a result of the technical analysis, focus on what restoration metrics or desired conditions should be achieved. Alternatives for managing Indiana Dunes National Lakeshore were developed by identifying different ways to address the planning issues identified in the "Purpose and Need for Action" chapter in context with the park's purpose and significance. In developing this range of alternatives, the National Park Service carefully considered the national lakeshore's purpose and significance as well as the national lakeshore's enabling legislation.

NEEDED FUTURE STUDIES AND PLANS

Once this plan is completed, many of the nourishment activities proposed under the alternatives could be implemented without further compliance or study. Other more detailed studies and plans could be needed before some specific actions would be implemented, such as specific techniques for mixing a full range of nourishment materials on-site.

Additional environmental compliance (National Environmental Policy Act of 1969, as amended [NEPA], National Historic Preservation Act, as amended [NHPA], and other relevant laws and policies) and public involvement would also be conducted, as required.

N

600 0 600

Feet

1 inch = 1,200 feet

Airphoto: 2003 (summer)

Spatial Reference UTM zone 16

FIGURE 2-2
SHORELINE COMPARISON

Indiana Dunes National Lakeshore
Shoreline Restoration and Management
Plan / Environmental Impact Statement

National Park Service / U.S. Department of the Interior

March 2012

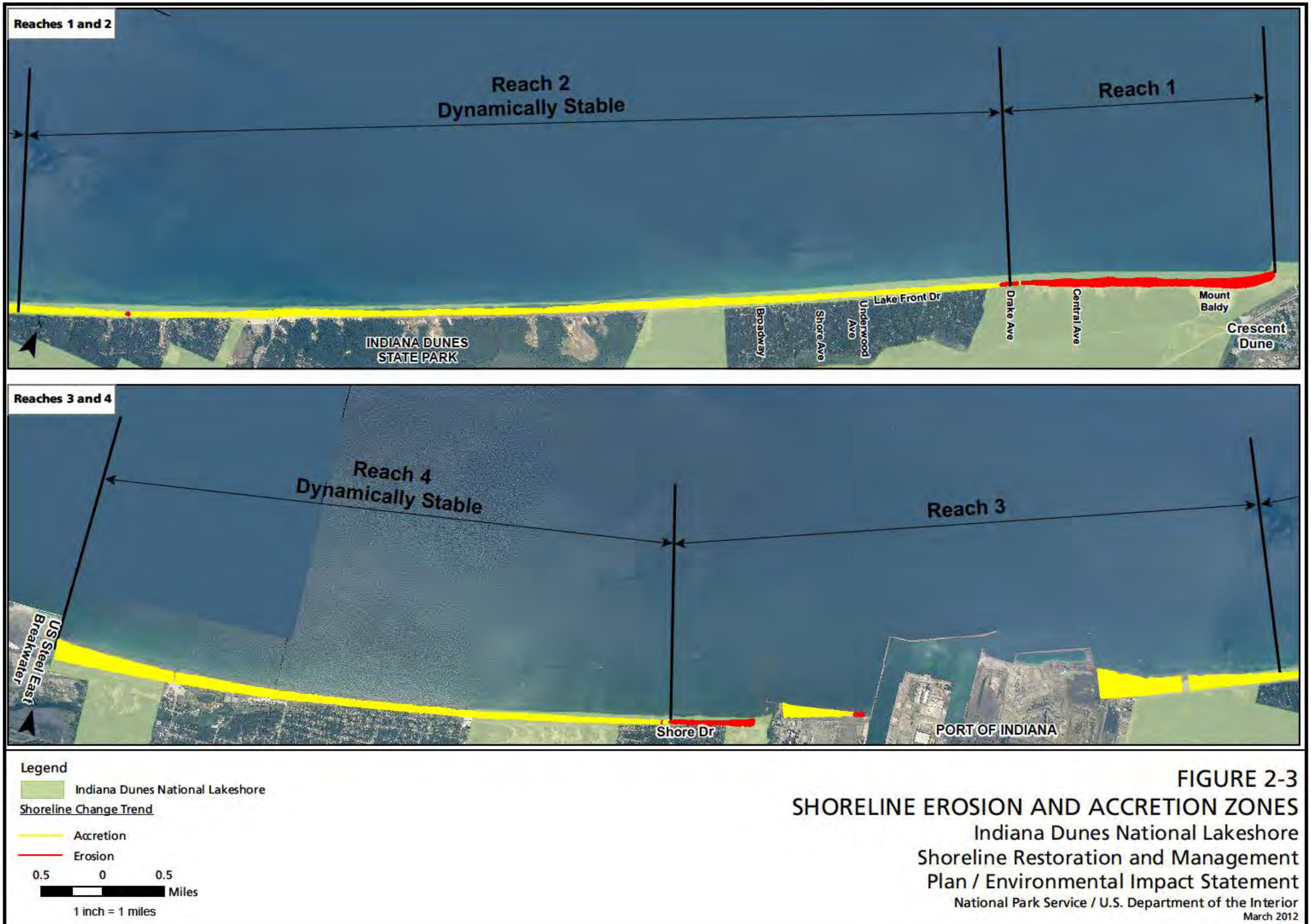


FIGURE 2-3
SHORELINE EROSION AND ACCRETION ZONES
Indiana Dunes National Lakeshore
Shoreline Restoration and Management
Plan / Environmental Impact Statement
National Park Service / U.S. Department of the Interior
March 2012

CHOOSING BY ADVANTAGE PROCESS

Selection of the NPS preferred alternative involved evaluating the alternatives using an objective analysis process called Choosing by Advantages. This process included a three-day workshop in which 17 participants, including a representative from the Chicago District U.S. Army COE, consultant engineers and scientists, and NPS park staff representing a variety of divisions in the park, worked together to identify the preferred alternative. Through this process the planning team identified and compared the relative advantages of each alternative according to a set of factors. These factors were selected based on the key differences or decision points for each alternative in relation to fulfilling the purpose of the plan, while addressing the planning issues identified in the "Purpose and Need for Action" chapter. These factors included the following:

- factor 1 – addresses attributes of beach nourishment
- factor 2 – provides for protection of eroding areas
- factor 3 – provides for promoting foredune development
- factor 4 – provides habitat opportunities for desired native species
- factor 5 – discourages establishment of nonnative/invasive species
- factor 6 – maintains and enhances the shoreline's recreation beach
- factor 7 – provides for restoration of the shoreline to a condition that mimics natural conditions

In addition to the factors identified above, the planning team identified the following assumptions regarding the alternatives evaluated:

- the nourishment material would meet NPS requirements to the extent possible
- work would be scheduled to minimize impacts on visitors and park resources
- the proposed plan would be the beginning of a longer term process to return Indiana Dunes National Lakeshore to its natural condition as described in the "Proposed Plan for Implementation" section
- appropriate safety measures for the beach nourishment activities and work site(s) would be articulated in required permits

Decisions made during the Choosing by Advantages process were based on the importance of advantages between the alternatives. This involved identifying the attributes or characteristics of each alternative relative to the factors described above, determining the advantages for each alternative for each factor, and then assessing the importance of each advantage. The relationship between the advantages and costs of each alternative were also considered. This information was used to identify the alternative that provides the National Park Service and the public the greatest advantage for the most reasonable cost.

The results of the Choosing by Advantages process identified alternatives that provide the best combination of strategies to protect the national lakeshore's unique resources and visitor experience while improving the operational sustainability within each reach. These alternatives also offer advantages to the neighboring communities. Overall, the preferred alternatives originally selected for the plan / draft EIS provide the National Park Service with the greatest overall benefits for each identified factor at the most reasonable cost.

However, in response to public concerns expressed during the review of the plan / draft EIS, the preferred alternatives were revised in order to satisfy public concern and still achieve the project goals.

SELECTION OF ALTERNATIVES FOR IMPLEMENTATION

Nourishment is the single-most important feature of this plan to restore a more natural sediment transport regime. The planning team considered that the two most likely sources for sediment that would reasonably be available for nourishment activities were upland sources and dredged sources. In terms of the action alternatives needed to address the deficit of sediment in the sediment transport regime, the sediments used for nourishment of the shoreline are required to match the conditions of the existing beach. These alternatives describe ideal conditions where the correct mix of sediment can be found from a single source to match existing beach conditions. In reality, there would be a need to mix sediment sources to achieve the correct sediment composition. This means that, should it become necessary to mix nourishment sources (upland and dredged) to meet the desired beach conditions, the National Park Service would do so without further analysis.

In identifying the preferred alternative for reaches 1 and 2, the one-year nourishment regime along with the submerged cobble berm was identified as providing the greatest advantage during alternative development. because the berm would act both as a temporary buffer and as a means of replacing a missing component of the nearshore habitat in reach 1. The annual nourishment component of that alternative addressed the need to restore the transport of sediment. The remaining action alternatives analyzed within this final EIS, each providing nourishment, were determined to perform equally in terms of providing value to the restoration process. However, public comment on the plan / draft EIS (July 2012) was extensive and ranged from support for the goals of the project to concern about a number of aspects of the draft alternative. The public was generally supportive of beach nourishment, but there was consistent, negative response to the proposed cobble berm in alternative E (preferred alternative in the draft EIS). While the potential impacts of the submerged cobble berm were addressed in the draft EIS, the public concern was such that the National Park Service chose to review the array of alternatives to determine the feasibility of both satisfying public concern and achieving the project goals through the development of a new hybrid alternative.

The criteria critical to the selection of the submerged cobble berm as the draft preferred alternative focused on the restoration of native materials (sediment, gravel, rock) to the shoreline and not necessarily on the method of placement (i.e., creating a submerged berm). The new hybrid alternative would provide the identical materials to the shoreline only through a direct placement process. The majority of material used for beach nourishment would be obtained from fine and medium grained sediments that can be hydraulically dredged from areas of accretion (as in alternative C-1). The additional gravel and rock component would be accomplished by also implementing a portion of alternative B-1. Rather than using the inland mined source to provide the entire spectrum of beach nourishment, only the coarse component (gravels and rock), proposed by alternative E, would be hauled to the beach and mixed on-site with the hydraulically dredged sands. Thus, the new hybrid alternative F, which incorporates the benefit of the gravel and rock materials from alternative E, the inland mined and hauled sources outlined in alternative B-1, with the hydraulically dredged sands outlined in alternative C-1.

In selecting the preferred alternative for reaches 3 and 4, the five-year nourishment regime provided the greatest advantage during initial alternative development because the five-year nourishment addressed the need to restore the transport of sediment and was the most cost efficient. The remaining action alternatives analyzed within the final EIS provided similar advantages during alternative development with the exception of cost. Costs would initially be greater under the five-year alternative but would ultimately be lower over the life of the alternative.

However, as a result of comments received during public review of the plan / draft EIS expressing concern about the large volume of nourishment material associated with the five-year nourishment regime, the preferred alternative for reaches 3 and 4 was changed to annual beach nourishment.

RESTORATION METRICS AND DESIRED CONDITIONS

The alternatives were designed to balance sediment movement along the shoreline with the following:

- protect eroding areas of the shoreline
- provide habitat opportunities
- allow for natural processes to continue
- restore the shoreline in a cost-effective manner

To determine if the goals of the plan have been achieved, the National Park Service identified desired conditions. The desired conditions articulate the ideal conditions the National Park Service is striving to attain. Table 2-1: Desired Conditions, presents the restoration desired condition by resource for this plan.

TABLE 2-1. DESIRED CONDITIONS

Resource	Desired Conditions
Sediment Transport Process	Sediment supply would be increased to a quantity that would fulfill the calculated/estimated sediment budget deficit. This process would be implemented in a manner that mimics natural processes to the greatest extent possible. Sediment transport is important for the sustainability of the shoreline, foredunes and dunes. The long-term erosion of the shoreline's current position would be prevented.
Dune Formation	Sediment supply would be sufficient for foredune creation along the Indiana Dunes National Lakeshore. The additional sediment placed on the beach would allow wind action to deposit material on the beach, creating foredunes.
Aquatic Fauna	The National Park Service *Management Policies 2006* requires that the natural resources within the park be managed to a high degree of ecological integrity. Actions taken to improve sediment transport along the shoreline would encourage desired native species to establish in the nearshore environment in healthy populations. An increase in the nonnative species populations relative to current assemblages would result in the need for corrective actions to be taken.
Terrestrial Habitat	A biologically diverse terrestrial vegetation community is a natural resource of vital importance to Indiana Dunes National Lakeshore. Several sensitive habitats within the project area include rare plant varieties. Native species would establish in communities, and would be enjoyed by the public without being disturbed or damaged such as by trampling. An increase in the nonnative species populations relative to current quantities would result in the need for corrective actions to be taken.

TABLE 2-1. DESIRED CONDITIONS

Resource	Desired Conditions
Threatened and Endangered Species and Species of Concern	Indiana Dunes National Lakeshore is home to several threatened and endangered species and species of concern. It is the policy of the National Park Service to protect threatened and endangered species and species of concern, to reduce the risk of injury or harm to habitats colonized by these species, and to provide suitable habitat and refugia. There would be a continued presence and establishment of threatened and endangered species and species of concern within the park. By reclaiming and providing habitat, the existence of special status species within the park would be enhanced.
Wetlands and Pannes	The wetlands and pannes in the park are rare habitats characterized by a high floristic quality that would be maintained and protected. Continued inventory of wetlands and pannes within the project area would allow park managers to determine to what extent these habitats are being protected. Threats to wetlands and pannes would be identified and effectively managed to encourage the establishment of native species.
Soundscape	Natural soundscapes would be preserved and noise of the surrounding urban development would be minimized to the extent practicable. Many areas along the shoreline of Indiana Dunes National Lakeshore provide an opportunity to experience the park with less prevalent industrial and vehicular sounds. Management measures would be implemented to ensure that the desired soundscape is maintained to the greatest extent possible.
Visitor Experience	Visitors could experience park opportunities consistent with the purpose and significance of Indiana Dunes National Lakeshore. Visitor experience would include the education that provides for optimal visitor enjoyment while protecting the natural resources of the park. Visitors would actively contribute to the betterment of shoreline health through appropriate use and behavior. The public would be educated in the reasons for use management to encourage stewardship. The visual quality of the natural viewshed and landscapes would provide park visitors with an immediate and lasting experience that conveys the character of Indiana Dunes National Lakeshore. Key vistas would be identified and preserved.

APPROACHES TO ADAPTIVE MANAGEMENT

Each of the alternatives for the shoreline and beach complex and the proposed actions for the foredune and dune complex employs an adaptive element involving monitoring and evaluation. This means that although each alternative includes predictions as to the effectiveness of the restoration actions, ultimately some of those actions may change as knowledge is gained through implementation of the preferred alternatives. The National Park Service would monitor and evaluate the shoreline's response to the implementation of the preferred alternative and would periodically inform the public about shoreline management via newsletters or public meetings. These updates would include any changes or deviations in the management actions prompted by the results of monitoring and evaluation.

Because the issues addressed in this plan are complex, management of the proposed actions would likely require some adaptation as the preferred alternatives are implemented. For example, the beach nourishment program would be evaluated to determine its effectiveness over the course of the plan's lifespan. Monitoring of the shoreline profile and nearshore habitats would be conducted to ensure that park resources are not negatively impacted by the implementation of the preferred alternatives, and that the beach nourishment activities are meeting the goals of the plan. This adaptive process would allow the National Park Service to evaluate the relative success of the actions and to suggest changes in the amount and/or frequency of beach nourishment to ensure that the integrity of the shoreline system is preserved and that the effects of the beach nourishment are positive, while allowing for resource protection and a continued high quality visitor experience.

MITIGATION MEASURES COMMON TO ALL ACTION ALTERNATIVES

National Park Service staff routinely evaluate and implement mitigation measures when conditions occur that would adversely affect the sustainability of NPS resources. Mitigation measures are the practicable and appropriate approaches that would be used under the action alternatives to avoid and/or minimize harm to park natural and cultural resources and visitor experience.

Within the context of this plan, the mitigation measures described below would be used to avoid or minimize potential impacts from the implementation of the action alternatives. These measures would be applied to all of the action alternatives. Additional mitigation would be identified as part of implementation planning and for individual projects to further minimize impacts to park resources.

MINED NOURISHMENT MATERIAL

Nourishment material used during the implementation of the proposed restoration alternatives would be similar to the existing beach material to mimic natural processes. Selection and assessment of mine site material would be conducted prior to placement of the material. Mine site material would be similar in grain size distribution to the existing native beach material. The chemistry of sediment at the mine site would closely match that of the natural beach sediment and would be low in pollutants, silts, and clays.

NATURAL RESOURCES

General

Indiana Dunes National Lakeshore's resources, including air, water, soils, vegetation, and wildlife, would be inventoried and monitored as appropriate to provide information needed to avoid or minimize impacts of future work in the park.

- During plan implementation, NPS natural resource staff would identify areas to be avoided.
- Fencing or other means would be used to protect sensitive resources adjacent to nourishment activity areas.
- Nourishment activities would be monitored by resource specialists, as needed.
- Construction materials would be kept in work areas, especially if the work takes place near water bodies.
- Best management practices would be employed to reduce the introduction of invasive species during construction work and other soil-disturbing activities.
- Food-related items or rubbish brought into the park would be removed.

Air Quality

- Measures to manage dust during beach nourishment would be implemented and would include the following: stabilize soils with water, minimize vegetation clearing, revegetate with native species, cover haul trucks, and employ speed limits on unpaved roads.
- Equipment and vehicle emissions would be minimized by the following measures: limit idle times (by either shutting equipment off when not in use or restricting the time of idling), maintain equipment in proper working condition according to manufacturer's specifications, use the proper size of equipment for the work being performed, and train equipment operators in proper use of equipment.
- The use of equipment with new technologies (e.g., repowered engines, electric drive trains) and use of alternative fuels for generators (e.g., propane or solar) would be encouraged.

Soundscapes

- Sound abatement measures would be implemented. These measures could include the following: a schedule to minimize impacts in sound-sensitive areas, use of the best available sound management techniques wherever feasible, use of hydraulically or electrically powered impact tools when practicable, and placement of stationary sound sources as far from sensitive use areas as possible.
- Facilities would be located and designed to minimize objectionable noise.
- The idling of motors (e.g., power tools, equipment, vehicles, etc.) would be minimized.

Soils

The following discussion of soils does not mean the same as nourishment sediment.

- Soil erosion would be minimized by limiting the time that soil is left exposed and by applying other erosion management measures, such as erosion matting, silt fencing, and sedimentation basins in work areas. These measures would reduce erosion, surface scouring, and discharge to water bodies.
- Between nourishment activities filter fabric, temporary vegetative cover, and/or other means would be used as necessary to ensure stabilization of disturbed soils.
- Disturbed areas would be monitored for invasive and nonnative plants.
- After work is completed, construction areas would be revegetated with native plants in a timely period.
- To minimize soil erosion on new trails, best management practices for trail work would be used. Examples include installing water bars, checking dams and retaining walls, contouring lands to avoid erosion, and minimizing soil disturbance.

Water Resources (including Wetlands)

- To prevent water pollution during construction, equipment would be regularly inspected for leaks of petroleum and other chemicals. The use of heavy equipment in waterways would be minimized.
- Best management practices, such as the use of silt fences, would be followed to ensure that work-related effects are minimal and to prevent long-term impacts on water quality, wetlands, and aquatic species.
- Caution would be exercised to protect water resources from activities that have the potential to cause damage, such as construction, including erosion and siltation. Measures would be taken to keep unintended discharges from escaping work areas, especially near water bodies.
- Stormwater management measures would be implemented to reduce non-point source pollution discharge from parking lots and other impervious surfaces. Such actions would include oil/sediment separators, street sweeping, infiltration beds, use of permeable surfaces, and vegetated or natural filters to trap or filter stormwater runoff.
- Activities involving dredging or the placement of fill material below the Ordinary High Water Mark of Lake Michigan would comply with requirements of sections 401 and 404 of the Clean Water Act and with other applicable state permit programs (e.g., Great Lakes Submerged Lands Act). Impacts from potential fill or dredge activities would be assessed further and specific mitigation measures would be identified as part of final design.

Terrestrial Vegetation

- Revegetation plans would be prepared for disturbed areas and would specify such features as seed/plant source, seed/plant mixes, soil preparation, fertilizers, and mulching. To maintain genetic integrity, whenever possible, native plants that grow in the project area or region would be used in restoration efforts. Monitoring would occur to ensure that revegetation was successful, plantings were maintained, and unsuccessful plant materials were replaced.

Nonnative and Invasive Vegetation

- Special attention would be devoted to preventing the spread of nonnative and invasive weeds and other nonnative plants. Standard measures would include the following: ensure equipment arrives on-site free of mud or seed-bearing material; certify seeds and straw material as weed free; identify areas of nonnative and invasive weeds before work is performed; treat nonnative and invasive weeds or nonnative and invasives weed topsoil before work is performed (e.g., topsoil segregation, storage, herbicide treatment); and revegetate with appropriate native species.
- Equipment would be pressure-washed to ensure that it was clean and weed free before entering the park.
- Vehicle parking would be limited to road shoulders, parking areas, and previously disturbed areas.
- Monitoring and follow-up treatment of nonnative vegetation in revegetated areas would occur for several years following completion of work. Follow-up treatments would include mechanical, biological, chemical, and/or additional revegetation treatments.

Wildlife

- Techniques would be employed to reduce impacts on wildlife from beach nourishment activities, such as scheduling, biological monitoring, erosion and sediment management, the use of fencing or other means to protect sensitive resources adjacent to work areas, the removal of food-related items and rubbish brought into the national lakeshore, topsoil salvage, and revegetation. These actions would include specific work monitoring by resource specialists, as well as treatment and reporting procedures.
- Measures would be taken to reduce the potential for wildlife to access human food.
- Visitor impacts on wildlife would be addressed through visitor education programs, restrictions on visitor activities, and park ranger patrols.

Threatened and Endangered Species and Species of Concern

Mitigation actions would occur during normal park operations as well as before, during, and after nourishment activities to minimize immediate and long-term impacts on rare, threatened and endangered species. These actions would vary by project and the area of the park affected, and additional mitigation would be added as appropriate depending on the specific action and location. Many of the measures listed above for vegetation and wildlife would also benefit rare, threatened and endangered species by helping to preserve habitat. Mitigation actions specific to rare, threatened and endangered species would include the following:

- Surveys would be conducted for rare, threatened and endangered species as warranted.
- Critical habitat features would be protected and preserved whenever possible.

- Work would be conducted outside critical periods (such as nesting) for the specific species when possible. Work in areas in or near suitable threatened and endangered bird habitat would occur as late as possible in the fall/winter.
- Facilities / actions would be located and designed to avoid adverse effects on rare, threatened and endangered species. If avoidance is impractical, actions would be taken to minimize and compensate for adverse effects on rare, threatened and endangered species as appropriate and in consultation with the appropriate resource agencies. Work would be conducted outside critical periods for the specific species.
- Restoration and/or monitoring plans would be developed and implemented as warranted. These plans would include approaches for implementation, performance standards, monitoring criteria, and adaptive management techniques.
- Measures to reduce adverse effects of nonnative plants and wildlife on rare, threatened and endangered species would be implemented.
- Management practices to protect piping plover (*Charadrius melodus*) nesting areas would continue to be implemented, such as closing and fencing off beach areas from visitor use, monitoring the nesting areas throughout the breeding season, and minimizing trash along the beach that attracts piping plover predators. The National Park Service would continue to work cooperatively with the U.S. Fish and Wildlife Service (FWS) and other agency partners to identify and implement appropriate mitigation measures to protect piping plover nesting areas and critical habitat within the national lakeshore.

CULTURAL RESOURCES

All projects with the potential to affect cultural resources would be carried out consistent with Section 106 of the NHPA, as amended, to ensure that the effects would be adequately addressed. Reasonable measures would be taken to avoid, minimize, or mitigate adverse effects in consultation with the Indiana state historic preservation officer (SHPO), Tribal historic preservation officers, and, as necessary, the Advisory Council on Historic Preservation, and other interested parties. In addition to adhering to the legal and policy requirements for cultural resource protection and preservation, the National Park Service would also undertake the measures listed below to further protect the park's resources.

- Areas selected for construction and beach nourishment activities would be surveyed to ensure that cultural resources (i.e., archeological sites, historic structures, and cultural landscapes) in the area of affect are identified and protected by avoidance or, if necessary, mitigation measures.
- Additional analysis would be conducted prior to construction / beach nourishment activities to verify that submerged resources would not be adversely affected. Per Section 106 of NHPA, the National Park Service would seek a determination of "no adverse effects" to historic or archeological resources from the Indiana SHPO.
- If, during beach nourishment activities, previously undiscovered archeological resources were uncovered, work in the immediate vicinity of the discovery would be halted immediately until the resources were identified and documented, and an appropriate mitigation strategy was developed in consultation with the Indiana state historic preservation officer and, if necessary, associated American Indian tribes.

- Cultural landscapes would be protected, and alterations and changes affecting cultural landscapes would follow the Secretary of the Interior's *Standards for the Treatment of Historic Properties, with Guidelines for the Treatment of Cultural Landscapes*. Actions being considered would incorporate compatible design guidelines to retain essential historic character and to mitigate potential adverse effects.

VISITOR EXPERIENCE

Measures to reduce adverse effects of beach nourishment activities on visitor safety and experience would be implemented, including project scheduling and the use of best management practices. Directional signs to orient visitors and education programs to promote understanding among visitors would continue.

Scenic Resources

Where appropriate, fencing would be used to route people away from sensitive natural and cultural resources while still permitting access to important viewpoints to the extent practicable.

HAZARDOUS MATERIALS

- Indiana Dunes National Lakeshore's spill prevention and pollution control program for hazardous materials would be followed and updated on a regular basis. Standard measures of this program include: hazardous materials storage and handling procedures; spill containment, cleanup, and reporting procedures; and limitation of refueling and other hazardous activities to upland/nonsensitive sites.
- Contract personnel would be directed to immediately stop work should suspected hazardous materials or wastes be encountered. National Park Service personnel would be notified, and appropriate remediation would be accomplished prior to resuming work.
- If appropriate, absorbent booms and other spill containment equipment and materials would be made available on-site during beach nourishment activities.

HUMAN HEALTH CONCERNS

- The source of dredged material would be determined in coordination with the Indiana DNR prior to implementation of beach nourishment activities.
- Nourishment material would be tested for *E. coli*.
- Other test parameters for nourishment material would be determined in coordination with the Indiana DNR prior to implementation of beach nourishment activities.

SHORELINE AND BEACH COMPLEX, REACHES 1 AND 2

The Indiana Dunes National Lakeshore shoreline within reach 1 is experiencing a high rate of erosion. The sandy substrate at the base of Mount Baldy has eroded away, exposing a clay layer that is now being undercut. The shoreline within reach 2 is considered dynamically stable, which means it has experienced little to no long-term changes. This stretch of shoreline contains sensitive aquatic and terrestrial habitats and is frequented by threatened and endangered species and species of concern. The natural processes of Lake Michigan have sustained the areas within reach 2; therefore, it is assumed that no direct sediment nourishment would be conducted in reach 2. The actions taken under the alternatives for reach 1 would also impact the shoreline in reach 2 (and a portion of reach 3), providing additional sediment as the nourishment material would travel downdrift via wave action and induced currents.

Proposed management actions related to terrestrial management would be conducted in conjunction with the shoreline and beach complex alternatives presented for reach 1.

ALTERNATIVE A: NO-ACTION

Under the no-action alternative, the National Park Service would continue current management practices and for the foreseeable future, there would be no new actions taken to restore the park shoreline. Alternative A establishes a baseline for evaluating changes and impacts under the other action alternatives.

Since 1974 the COE has conducted beach nourishment within reach 1 on an intermittent basis. Nourishment was made available through specific funding obtained from Congress and given to the COE to implement, but there was no program funding for routine nourishment along the shoreline. Between 1974 and 2008, approximately 1 million yd^3 of sediment, an annual average of approximately 31,500 yd^3, has been placed along the shoreline at Crescent Dune. The sediment placed has been mined from a permitted upland borrow site and transported to the lakeshore by truck. An access road has been constructed at the eastern end of Indiana Dunes National Lakeshore to facilitate placement of the upland material. There is no known designated funding source for additional nourishment activities, but the no-action alternative assumes some sort of intermittent nourishment over the next several years at about the same rate as in previous years.

The sediment (coarse material) chosen for the COE nourishment program was selected to increase retention time, but was not compatible with native materials and was not of sufficient quantity to offset the continuing erosion in reach 1. Under the no-action alternative, an estimated average quantity of 31,500 yd^3 of sediment is to be placed annually in reach 1. This quantity of sediment represents a fraction of the calculated 105,000 yd^3 of sediment budget deficit as a result of sediment trapped updrift of the Michigan City Harbor. Over the course of the 20-year timeframe of this plan, actions associated with the no-action alternative would allow for placement of approximately 630,000 yd^3 of material from upland sources. The estimated calculated sediment budget deficit for the same timeframe is approximately 2.1 million yd^3.

Despite nourishment efforts, erosion would continue along the easternmost end of the park shoreline under the no-action alternative as the quantity of material currently being placed is insufficient relative to the calculated sediment budget. Figure 2-4: Alternatives for Shoreline and Beach Complex, Reaches 1 and 2, depicts the no-action alternative. The Net Present Value (NPV) cost of the current nourishment activities under alternative A is estimated to be approximately $9.5 million over the 20-year lifetime of this plan.

ALTERNATIVE B-1: BEACH NOURISHMENT VIA UPLAND SOURCES, ANNUAL FREQUENCY

Under alternative B-1, there would be an increase in the annual quantity of sediment placed at Crescent Dune to account for the calculated sediment budget deficit. A total of 136,500 yd^3 of nourishment material would be mined and placed on the beach each year from a permitted upland source. This quantity is the total calculated sediment budget for reach 1 (the net sediment deficit is 105,000 yd^3, obtained by subtracting the annual long-term average beach nourishment). The material would be transported to Indiana Dunes National Lakeshore via truck, using the existing access road on the eastern end of the park, and would be dispersed along the shoreline with heavy equipment. With the exception of the quantity of sediment placed, activities would be conducted in a manner similar to the current beach nourishment program conducted by the COE. The placement of the sediment on the beach in reach 1 would take approximately four months to complete every year. The placement of the nourishment material would be conducted during a time of year deemed appropriate to minimize impacts on both natural resources and visitors of the park. Figure 2-4: Alternatives for Shoreline and Beach Complex, Reaches 1 and 2, depicts alternative B-1.

The implementation of the actions associated with alternative B-1 would maintain the current shoreline position as the calculated sediment budget deficit would be fulfilled. Additional sediment placed on the beach would result in an initial increase in beach width at the base of Mount Baldy. The 136,500 yd^3 of sediment would be sufficient to prevent additional erosion of the current shoreline for one year, as natural wave action and storm events would continue to erode the sediment after placement. The shorelines downdrift of Mount Baldy would receive an infusion of sediment following the material placement at Crescent Dune, thus affecting not only reach 1, but reach 2 and a portion of reach 3 as well.

The sediment used for beach nourishment would be selected to be compatible with native site sediment, meaning similar in terms of color, shape, size, mineralogy, compaction, organic content, and texture. Any beach nourishment material would be free of harmful chemical contaminants, trash, debris, and large pieces of organic material. The total estimated NPV cost of implementing alternative B-1 would be approximately $43.8 million over the 20-year lifetime of this plan.

ALTERNATIVE B-5: BEACH NOURISHMENT VIA UPLAND SOURCES, FIVE-YEAR FREQUENCY

Under alternative B-5, the amount of sediment material deposited in reach 1 would fulfill the calculated sediment budget deficit. Rather than conducting annual nourishment activities as proposed under alternative B-1, the actions associated with alternative B-5 would place a total of 682,500 yd^3 of sediment in reach 1 every five years. As under alternative B-1, the nourishment material would be mined from a permitted upland source, transported to the park via truck, and dispersed along the shoreline with heavy equipment. With the exception of the quantity of sediment placed, activities would be conducted in a manner similar to the current beach nourishment program conducted by the COE. The placement of sediment on the beach in reach 1 would take approximately 18 months to complete every five years. Due to the sediment volume and duration of the placement activities, mitigation measures, which would include restricting access to the beach for approximately 18 months every five years, would be required to protect natural resources and to maintain the safety of park visitors and employees.

As is the case under alternative B-1, the implementation of the actions associated with alternative B-5 would maintain the current shoreline position, as the calculated sediment budget deficit would be fulfilled. Additional sediment placed on the beach would result in an initial increase in beach width at the base of Mount Baldy. The 682,500 yd^3 of sediment would be sufficient to prevent additional erosion of the current shoreline for up to five years, as natural wave action and storm events would continue to erode the sediment after placement. The shorelines downdrift of Mount Baldy subsequently would also receive an infusion of sediment following the material placement at Crescent Dune, thus affecting not only reach 1, but reach 2 and a portion of reach 3, as well.

The sediment used for beach nourishment would be compatible with native site sediment, meaning similar in terms of color, shape, size, mineralogy, compaction, organic content, and texture. Any beach nourishment material should be free of harmful chemical contaminants, trash, debris, or large pieces of organic material. The total estimated NPV cost of implementing alternative B-5 would be approximately $35.5 million over the 20-year lifetime of this plan.

ALTERNATIVE C-1: BEACH NOURISHMENT VIA DREDGED SOURCES, ANNUAL FREQUENCY

Under alternative C-1, the amount of sediment material deposited in reach 1 would fulfill the calculated sediment budget deficit. Sediment would be dredged from an updrift location. The specific location of the dredging source would be determined during the permitting process, in coordination with IDNR and based on consultation with local stakeholders and engineering constraints. A total of 136,500 yd^3 of sediment would be placed annually on the beach in reach 1 to account for the calculated sediment budget deficit. The placement of sediment on the beach in reach 1 would take approximately two months to complete every year.

As previously mentioned in the discussion of alternative B-1, the implementation of alternative C-1 would maintain the current shoreline position as the calculated sediment budget deficit would be fulfilled. Additional sediment placed on the beach would result in an initial increase in beach width at the placement area. The 136,500 yd^3 of sediment would be sufficient to prevent additional erosion of the current shoreline for up to one year on average, as natural wave action and storm events would continue to erode the sediment after placement. The shorelines downdrift of Mount Baldy subsequently would receive an infusion of sediment following the material placement at Crescent Dune, thus affecting not only reach 1, but reach 2 and a portion of reach 3, as well. Figure 2-4: Alternatives for Shoreline and Beach Complex, Reaches 1 and 2, depicts alternative C-1.

Sediment compatibility between the proposed borrow material and the native beach were assessed by comparing grain size distribution curves. A potential location within the lakeshore where beach nourishment is proposed is east, updrift, of the Michigan City Harbor structure, and the native site (i.e., the site that would provide sediment similar in terms of color, shape, size, mineralogy, compaction, organic content, and texture to the existing beach sediment) for proposed nourishment is located to the west, downdrift, of the Michigan City Harbor approximately 1.5 miles at Mount Baldy. Sediment samples used to characterize both borrow and nourishment locations were collected from the beach/shoreline area at or immediately adjacent to each location and are representative of that material (NPS 2011b). The sediment located in the borrow site for reach 1 was similar in color to the material at the native site, and no substantial levels of contaminants were present in the borrow materials (Simon and Morris 2011). The specific source location of the nourishment material would be determined in coordination with IDNR prior to implementation of a proposed alternative.

It is anticipated that the nourishment material would be placed by hydraulically pumping a sediment/water slurry onto the beach. Heavy equipment would then be used to distribute the sediment, creating the appropriate grade along the shoreline. Based on the short travel distance from Michigan City to the eastern end of reach 1, as well as the cost of removing and placing the sediment, it is estimated that alternative C-1 would be less expensive to implement and maintain than alternatives B-1 and B-5. The total estimated NPV cost of implementing alternative C-1 would be approximately $22.9 million over the 20-year lifetime of this plan.

ALTERNATIVE C-5: BEACH NOURISHMENT VIA DREDGED SOURCES, FIVE-YEAR FREQUENCY

The actions proposed under alternative C-5 include a beach nourishment program using sediment dredged from an updrift location. The specific location of the dredging source would be determined during the permitting process, based on coordination with IDNR and in consultation with local stakeholders and engineering constraints. A total of 682,500 yd^3 of sediment would be placed every five years on the beach in reach 1 under this alternative to account for the calculated sediment budget deficit. The placement of sediment on the beach in reach 1 would take approximately 10 months to complete every five years.

The implementation of alternative C-5 would maintain the current shoreline profile as the calculated sediment budget deficit would be fulfilled. Additional sediment placed on the beach would result in an initial increase in beach width at the placement area. The 682,500 yd^3 of sediment would be sufficient to prevent additional erosion of the current shoreline for up to five years on average, as natural wave action and storm events would continue to erode the sediment after placement. The shorelines downdrift of Mount Baldy subsequently would receive an infusion of sediment following the material placement at Crescent Dune, thus affecting not only reach 1, but reach 2 and a portion of reach 3, as well. Figure 2-4: Alternatives for Shoreline and Beach Complex, Reaches 1 and 2, depicts alternative C-5.

Sediment compatibility between the proposed borrow material and the native beach were assessed by comparing grain size distribution curves. A potential location within the lakeshore where beach nourishment is proposed is east, updrift, of the Michigan City Harbor structure, and the native site for proposed nourishment is located to the west, downdrift of the Michigan City Harbor approximately 1.5 miles at Mount Baldy. Sediment samples used to characterize both borrow and nourishment locations were collected from the beach/shoreline area at or immediately adjacent to each location and are representative of that material (NPS 2011b). The sediment located in the borrow site for reach 1 was similar in color to the material at the native site and no substantial levels of contaminants were present in the borrow materials (Simon and Morris 2011). The specific source location of the nourishment material would be determined in coordination with IDNR prior to implementation of a proposed alternative.

It is anticipated that the nourishment material would be placed by hydraulically pumping a sediment/water slurry onto the beach. Heavy equipment would then be used to distribute the sediment, creating the appropriate grade along the shoreline. Based on the short travel distance from Michigan City to the eastern end of reach 1, the cost of removing and placing the sediment, and the reduced frequency of nourishment as compared to alternative C-1, it is estimated that the actions associated with alternative C-5 would be less expensive to implement and maintain than the previously described alternatives. The total estimated NPV cost of implementing alternative C-5 would be approximately $18.6 million over the 20-year lifetime of this plan.

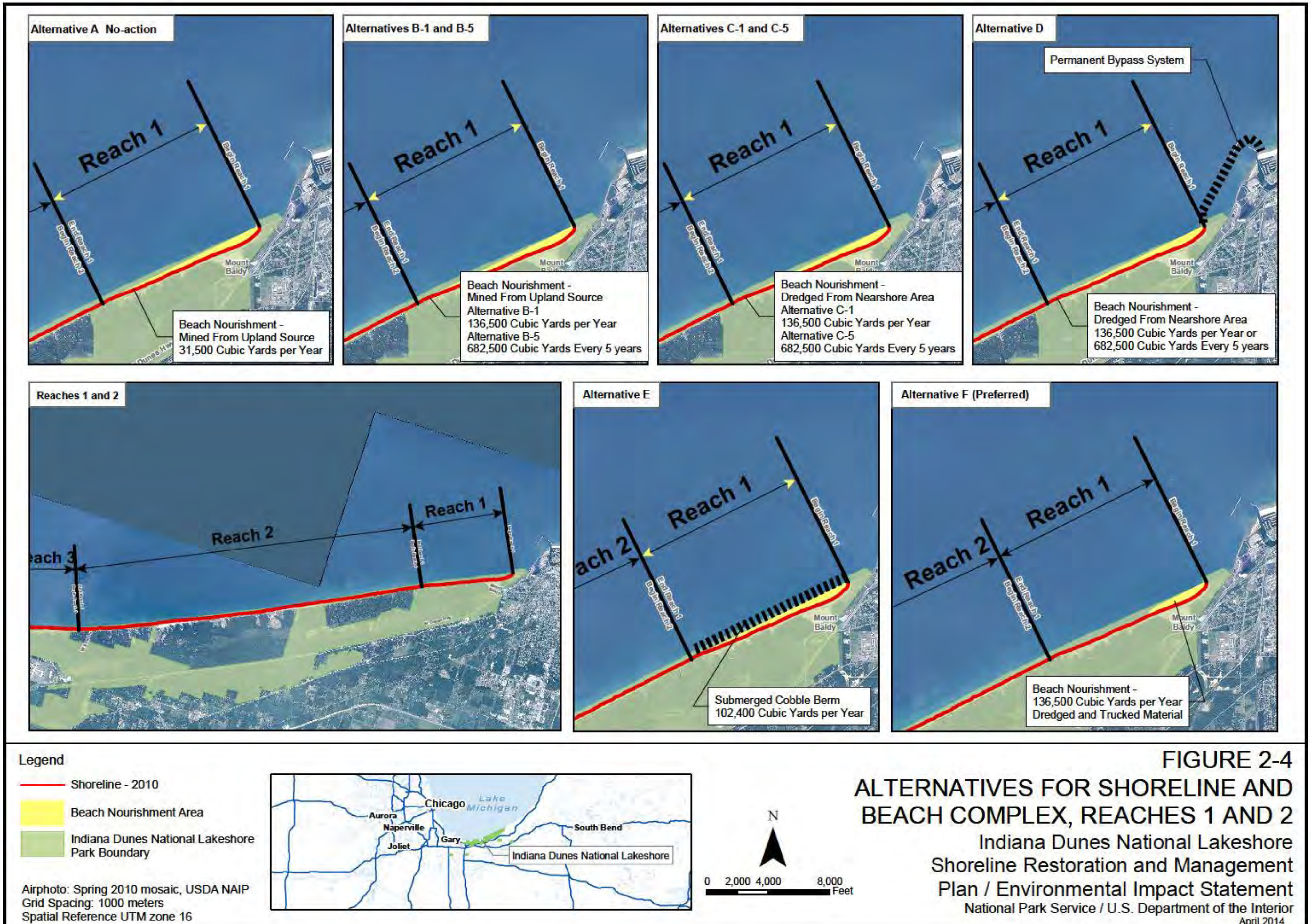


FIGURE 2-4
ALTERNATIVES FOR SHORELINE AND BEACH COMPLEX, REACHES 1 AND 2
Indiana Dunes National Lakeshore
Shoreline Restoration and Management Plan / Environmental Impact Statement
National Park Service / U.S. Department of the Interior
April 2014

ALTERNATIVE D: BEACH NOURISHMENT VIA PERMANENT BYPASS SYSTEM

Under alternative D, the amount of sediment material deposited in reach 1 would fulfill the calculated sediment budget deficit. Under alternative D, a permanent bypass system would be constructed and operated to transport sediment from updrift of the Michigan City Harbor to reach 1. On average, a total of 136,500 yd^3 of sediment would be bypassed annually to account for the calculated sediment budget deficit. A sediment trap would be created by initially dredging a quantity of sediment (to be determined) near the Michigan City Marina, at the end of the east jetty. An additional rubble-mound jetty modification could be required to develop an efficient sediment trap. This bypass system would be constructed along the lake bottom, around or under the existing harbor structures. Once the bypass system was constructed and operational, some annual maintenance would be required.

A system of pump and lift stations would hydraulically pump the 136,500 yd^3 of sediment to the downdrift shoreline and place it on the beach at Crescent Dune. Heavy equipment would disperse the sediment along the shoreline to create the desired beach grade to mimic natural conditions. The hydraulically placed sediment would be sufficient to maintain the current shoreline profile as the calculated sediment budget deficit would be fulfilled. Additional sediment placed on the beach would result in an initial increase in beach width at the placement area. The 136,500 yd^3 of sediment would be sufficient to prevent additional erosion of the current shoreline for up to one year on average, as natural wave action and storm events would continue to erode the sediment after placement. The shorelines downdrift of Mount Baldy subsequently would receive an infusion of sediment following the placement of nourishment material at Crescent Dune, thus affecting not only reach 1, but reach 2 and a portion of reach 3, as well.

As sediment is transported from the Michigan City Harbor vicinity to reach 1, the storage capacity of the east beach fillet would increase. Sedimentation in the federal navigation channel between the east pier of the Michigan City Harbor and the offshore breakwater would decrease slightly, resulting in a reduction in dredging requirements. The National Park Service would coordinate with stakeholders in order to implement this alternative. Additional analysis and compliance would be necessary prior to implementation of the actions associated with alternative D. The cost of implementing the actions associated with alternative D include the initial construction of the permanent bypass system, as well as maintenance and operation of the system over the 20-year lifetime of this plan. Implementing alternative D has a NPV cost of approximately $35.4 million. Figure 2-4: Alternatives for Shoreline and Beach Complex, Reaches 1 and 2, depicts alternative D.

ALTERNATIVE E: SUBMERGED COBBLE BERM AND BEACH NOURISHMENT, ANNUAL FREQUENCY

Under alternative E, the amount of sediment material deposited in reach 1 would fulfill the calculated sediment budget deficit. Under this alternative, a submerged cobble berm would be constructed parallel to the shoreline in approximately 10 feet of water depth at low water datum, between the western terminus of the Northern Indiana Public Service Company (NIPSCO) seawall and the eastern terminus of reach 2. The submerged cobble berm would be used in conjunction with a beach nourishment program to restore reach 1 of Indiana Dunes National Lakeshore. The objectives of constructing the submerged cobble berm would be to stabilize the shoreline downdrift of the Michigan City Harbor by reducing the quantity of sediment needed for beach nourishment, to enhance aquatic habitat by diversifying the nearshore substrate, and to improve shoreline protection during storm events.

A quantity of up to 102,400 yd^3 of sediment obtained from a dredged source would be hydraulically placed on the beach in reach 1 annually to provide nourishment and protection of the shoreline. The source location of the nourishment material would be determined in coordination with IDNR in areas of accretion so that dredging activities would not disturb areas of equilibrium. The submerged cobble berm would be comprised of appropriate-sized aggregate material from local glacial deposits which would dissipate over time via natural coastal processes such as wave action and storm events. This dispersion process would take up to five years, after which the aggregate material would cover the clay lakebed, protecting it against further down-cutting (process of deepening of the nearshore area due to wave scour). The length of time necessary for breakdown of the submerged cobble berm would depend largely on the final design, including the size of the aggregate material used, and also future lake processes (e.g., frequency and intensity of storm events). Until the aggregate material dissipates, the submerged cobble berm would temporarily present a possible safety concern to vessels traveling near the shoreline. Signs would be installed to warn the public of potential hazards. Over time, the submerged cobble berm would have a natural appearance and would not adversely alter the viewshed from elevated heights. Based on the offshore location, which would be along the existing 10-foot water depth contour, the submerged cobble berm would not present safety concerns for beach users.

The potential effectiveness of a submerged cobble berm has been analyzed in previous physical and numerical modeling studies (Baird 2000). Various dimensions and sizes of aggregate material were tested. Based on the results of the investigations, a 2- to 9-inch diameter aggregate submerged cobble berm placed at 10 feet below low water datum with a crest approximately 4 feet below low water datum was identified as a feasible conceptual design to be considered. Some cobbles would get pushed landward toward the beach; however, most of the berm material would remain offshore of the 5-foot to 6.5-foot contour from the beach, and the area from the shore to this contour would remain generally free of cobbles.

The submerged cobble berm proposed under alternative E would reduce shoreline erosion by breaking wave energy in the nearshore, thus allowing for greater sediment retention along the beach (Baird 2000). As previously described, the submerged cobble berm would break down over time and become part of the shoreline sediment mix. As a result, a reduced quantity of beach nourishment would be required to fulfill the calculated sediment budget deficit (25% material reduction over the projected life of the berm). The specific reduced quantity of sediment needed in conjunction with the submerged cobble berm has not been calculated; however, the amount would be determined with additional analysis prior to implementation of the actions associated with alternative E.

The total estimated cost of implementing alternative E would be approximately $24.8 million over the 20-year lifetime of this plan.

Additional analysis would be required prior to implementation of the actions associated with alternative E, particularly in the design phase. Figure 2-5: Alternative E: Submerged Cobble Berm and Beach Nourishment, Annual Frequency for Reaches 1 and 2, depicts alternative E.

ALTERNATIVE F: BEACH NOURISHMENT, ANNUAL FREQUENCY WITH A MIX OF SMALL NATURAL STONE AT THE SHORELINE (PREFERRED ALTERNATIVE)

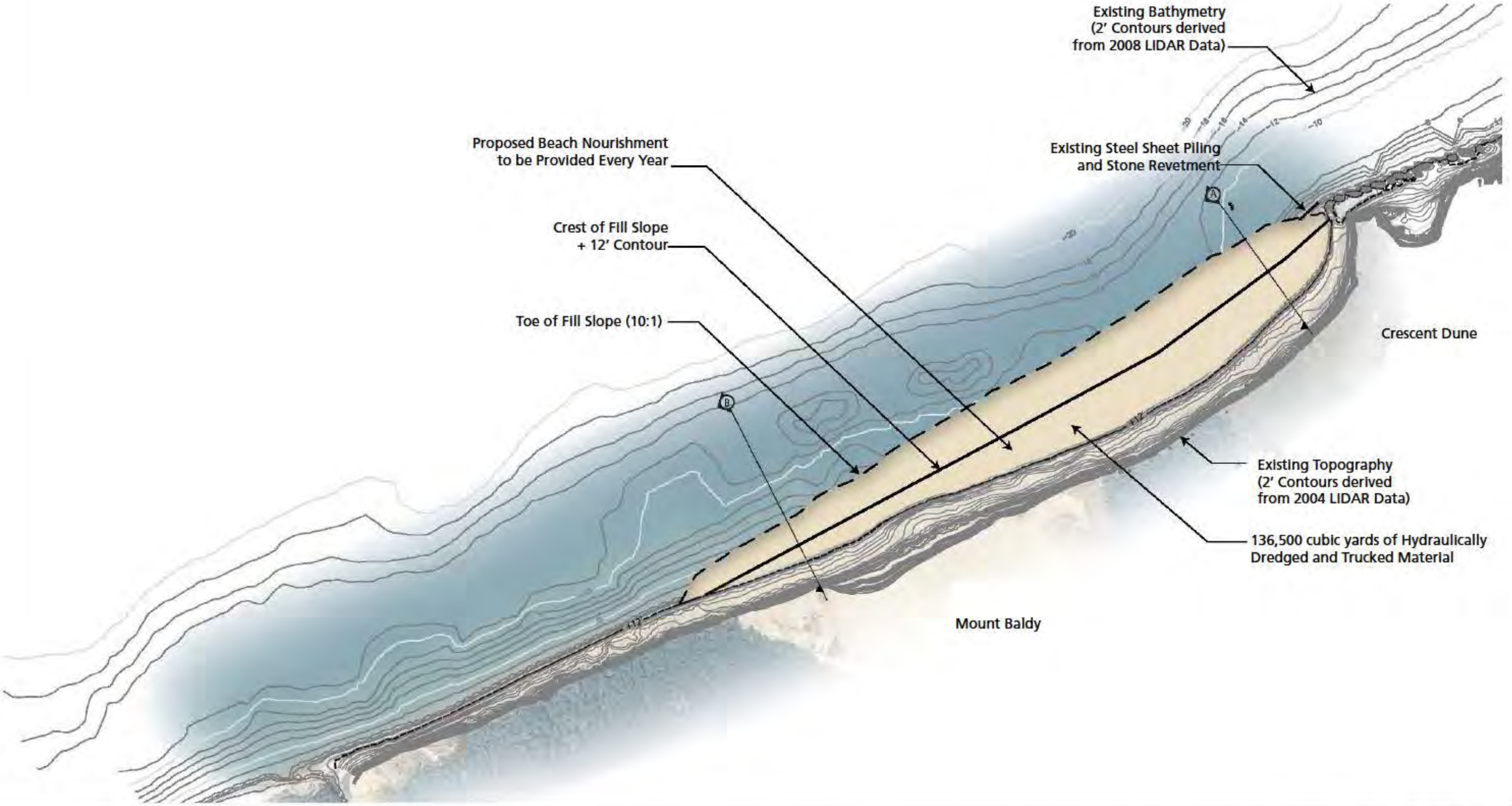
Under alternative E, the amount of dredged sediment material deposited in reach 1 would fulfill the calculated sediment budget deficit. Potential sources for dredge materials lack the full spectrum of coarse sediment and stone sizes (Simon *et al.* 2013) necessary to achieve the desired grain size distribution in the nourishment material. Therefore, under this alternative an additional volume of small native stones to the shoreline region would be added to the dredged materials at the shoreline. These small native stones would be consistent in size and volume with those presently found downdrift in the project's dynamically stable beach zones (Simon *et al.* 2013). The expectation would be that the mineralogy, physical shape, and consistency of these small native stones would be indistinguishable from the existing pebbles and small flat stones found along the shoreline.

Sediment would be dredged from an updrift location. The specific location of the dredging source would be determined during the permitting process, in coordination with IDNR and based on consultation with local stakeholders and engineering constraints. It is anticipated that the nourishment material would be placed by hydraulically pumping a sediment/water slurry onto the beach. Heavy equipment would then be used to distribute the sediment, creating the appropriate grade along the shoreline. The placement of dredged sediment would slowly widen the beach. Native stone would be brought to the site by truck and placed close to the water's edge and mixed with hydraulically delivered sand. Wave action, particularly high wave events, would mix and distribute the sediment and stone along the shoreline. It is expected that a portion of the placed coarse material could migrate in the nearshore area.

The combination of dredged and trucked in materials would be used to nourish the beach and restore reach 1 of Indiana Dunes National Lakeshore. The objectives of adding the native stone to the nourishment materials would be to stabilize the shoreline downdrift of the Michigan City Harbor by providing a more erosion resistant component and to enhance aquatic habitat by diversifying the nearshore substrate consistent with dynamically stable reaches.

A quantity up to 86,000 yd^3 of fine and medium sands would be hydraulically dredged and placed on the beach in reach 1 to protect the shoreline. Additional fractions of coarse upland material and small native stones (up to 51,000 yd^3 combined) would be added to the sediment nourishment. The total quantity of provided beach nourishment (136,500 yd^3) would be sufficient to fulfill the calculated sediment deficit in reach 1 and to maintain the existing shoreline position for one year. Using an adaptive management strategy, reach 1 would be monitored annually to determine if the desired mix of sediment and stone has been achieved (Morris *et al.* 2014; Morris and Eshlemen 2011). Because natural stone would not move downdrift as fast as sand, the addition of small native stones would cease once the desired natural condition is achieved. If monitoring shows that a substantial percentage of the stone has moved out of the system, more stone could be added as conditions warrant in later years. The combination of stone, coarse upland material, and dredged sediment would reduce shoreline erosion by providing a mix that is consistent with dynamically stable shoreline materials more resistant to wave energy.

The total estimated cost of implementing alternative F would be approximately $26.0 million over the 20-year lifetime of this plan.



Note: All elvations reference Verical Datum IGLD85 (0=557.5')

FIGURE 2-5
ALTERNATIVE F: BEACH NOURISHMENT, ANNUAL FREQUENCY WITH A MIX
OF SMALL NATURAL STONE AT SHORELINE (PREFERRED ALTERNATIVE) FOR REACHES 1 AND 2

Indiana Dunes National Lakeshore
Shoreline Restoration and Management
Plan / Environmental Impact Statement
National Park Service / U.S. Department of the Interior
April 2014

SHORELINE AND BEACH COMPLEX, REACHES 3 AND 4

Reach 3 of the park shoreline encompasses areas of both accretion and accelerated erosion. This disproportionate distribution of sediment is the result of interruptions to the littoral drift. In addition to the industrial and navigational harbors along Lake Michigan's southern shoreline, several sections of beach have been reinforced with hardened structures.

The park shoreline within reach 4 is considered dynamically stable. Therefore, it is assumed that no beach nourishment would be needed to allow natural lake processes to continue unassisted. The actions proposed under the action alternatives for reach 3 would impact the shoreline in reach 4, and provide additional sediment as the nourishment material would travel downdrift via natural lake processes.

ALTERNATIVE A: NO-ACTION

Under the no-action alternative, the National Park Service would continue current management practices. There would be no additional actions taken to restore the park shoreline.

The shoreline along the western portion of reach 3 is armored by approximately 2,100 linear feet of vertical steel sheet piling, an additional 1,500 linear feet of vertical steel sheet piling with toe stone, and 580 feet of stone revetment, which protects an industrial complex (see Figure 2-6: Alternatives for Shoreline and Beach Complex, Reaches 3 and 4). Approximately 120 linear feet of shoreline within this reach is unarmored and representative of the natural open shoreline appearance.

Severe storm events, including those documented in 1998 and 2010, have resulted in substantial shoreline erosion and structural damages to the protection structures in front of the Town of Ogden Dunes. Even during times of low lake levels, this portion of the shoreline is comprised of a very narrow beach. Severe erosion would be expected to continue in this area, ultimately affecting the dune habitat immediately south of the beach.

Due to a high rate of accretion on the updrift side of the Burns International Harbor (NIPSCO/Bailly intake area), maintenance dredging needs to be performed. The Burns International Harbor has been subject to maintenance dredging to maintain a safe navigation depth in the federal channels. A summary of the dredging performed in these three areas is presented below.

The area around the NIPSCO/Bailly intake has been dredged to a depth of 21 feet at low water datum by NIPSCO (1980 to 1999), and by the COE (2006 to 2009). Between 1999 and 2006, no dredging occurred around this intake. For several reasons, the maintenance program has been irregular, making planning predictions of future dredging a challenge. From 2006 through 2009, an average annual quantity of 118,000 yd^3 was removed from the intake area and placed in the nearshore in front of Ogden Dunes.

The Burns International Harbor dredging records (1985, 2000, and 2009) indicate approximately 282,000 yd^3 of dredged sediment was placed on the beach to the west of the harbor breakwater (1985, 2000) as well as in the nearshore area of Ogden Dunes (2009). Historic dredging records for the Burns International Harbor between 1986 and 2009 indicate that a total of 537,000 yd^3 of sediment was dredged and disposed in open-water, offshore of the harbor.

On a long-term annual average basis between 1986 and 2009, approximately 74,000 yd^3 were placed at Ogden Dunes in the nearshore area. It is assumed that this volume represents the baseline condition and future quantity to be placed annually. The nearshore nourishment in front of Ogden Dunes began in 1986 and consisted of material placed approximately 1,500 feet offshore, and 1,500 feet west of the Burns International Harbor's inner breakwater. The sediment is currently permitted to be placed in 12 to 18 feet of water (at low water datum), a depth considered as safe draft for opening split-hull barges bottom hull, but yet shallow enough to prevent the placed sediment from migrating offshore (COE 2010).

The no-action alternative assumes the continuation of the maintenance dredging of 74,000 yd^3 of sediment per year around the intake. The dredged material would be placed in the nearshore at Portage Lakefront and Riverwalk, while sediment from the Burns International Harbor would have an offshore, open-water placement.

Based on the compiled historic dredging data and the shoreline evolution analysis, and despite the ongoing maintenance dredging operations, the NIPSCO/Bailly accretion area would continue to grow, and the shoreline at Portage Lakefront and Riverwalk would continue to erode under the no-action alternative. In the future, the NIPSCO/Bailly accretion area would achieve a stable profile, allowing sediment to bypass the Arcelor-Mittal breakwater. Sediment would be captured by the federal channel at the Burns International Harbor. The accreting sediment at the west end of the beach would affect the industrial warm-water discharge location, extending it to the east toward the park shoreline. As the area of sediment accretion grows, so too would the maintenance dredging requirements for the federal channel. Excessive sedimentation around the intake would inhibit the use of the cold-water intake structure, resulting in emergency plant shutdowns. Figure 2-6: Alternatives for Shoreline and Beach Complex, Reaches 3 and 4, depicts alternative A. The cost of continuing with the existing actions associated with alternative A would be approximately $13.3 million over the 20-year lifetime of this plan.

ALTERNATIVE C-1: BEACH NOURISHMENT VIA DREDGED SOURCES, ANNUAL FREQUENCY (PREFERRED ALTERNATIVE)

Under alternative C-1 (preferred alternative), the amount of sediment material deposited in reach 3 would fulfill the estimated sediment budget deficit. Under this alternative, sediment would be dredged from an updrift location in Lake Michigan. A total of 74,000 yd^3 of sediment would be placed annually on the beach at Portage Lakefront and Riverwalk to account for the estimated sediment budget deficit. The placement of sediment on the beach in reach 3 would take approximately two months to complete every year. A potential sediment source of dredged material was identified as the area around the NIPSCO/Bailly intake. The specific location of the dredging source would be determined during the permitting process, based on coordination with the IDNR and consultation with local stakeholders and engineering constraints.

Despite ongoing maintenance dredging operations, the accreting beach updrift of the NIPSCO/Bailly complex would continue to grow under alternative C-1. The beach would potentially achieve a stable profile, allowing sediment to bypass the Arcelor-Mittal breakwater. Sediment would be captured by the federal channel at the Burns International Harbor. The accreting sediment at the west end of the beach would affect the industrial warm-water discharge location, extending it to the east toward the park shoreline. As the area of sediment accretion grows, so too would the need for maintenance dredging for the federal channel.

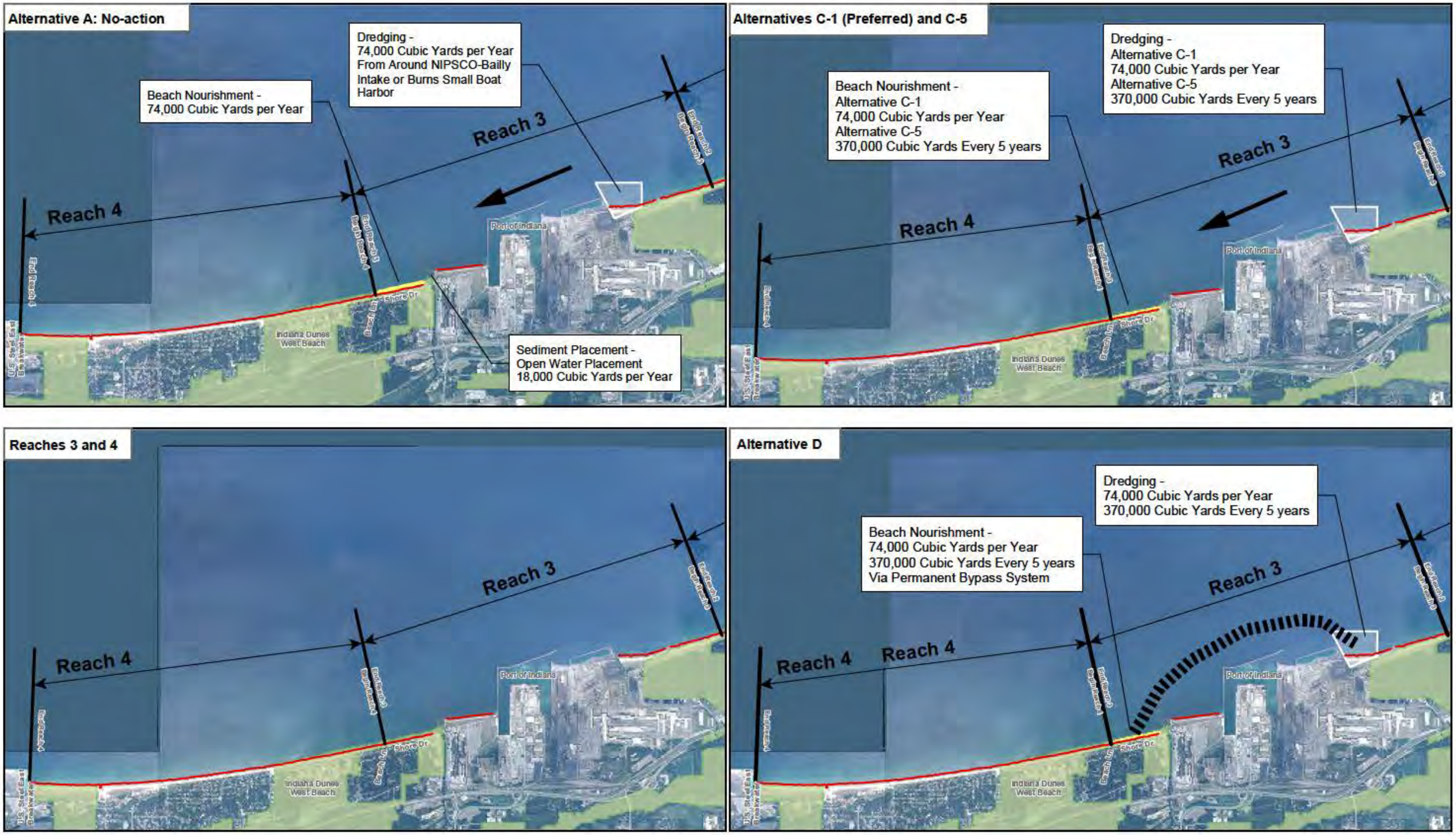


FIGURE 2-6
ALTERNATIVES FOR SHORELINE AND BEACH COMPLEX, REACHES 3 AND 4
Indiana Dunes National Lakeshore
Shoreline Restoration and Management Plan / Environmental Impact Statement
National Park Service / U.S. Department of the Interior
April 2014

The implementation of the actions associated with alternative C-1 would maintain the current shoreline position as the estimated sediment budget deficit would be fulfilled. Additional sediment placed on the beach would result in an initial increase in beach width at the placement area. The 74,000 yd^3 of sediment would be sufficient to prevent additional erosion of the current shoreline for up to one year on average, as natural wave action and storm events would continue to erode the sediment after placement. The shoreline downdrift of Portage Lakefront and Riverwalk subsequently would receive an infusion of sediment following the material placement, thus affecting not only reach 3, but reach 4, as well. Figure 2-6: Alternatives for Shoreline and Beach Complex, Reaches 3 and 4, depicts alternative C-1 (preferred alternative).

Sediment compatibility between the proposed borrow material and the native beach were assessed by comparing grain size distribution curves. A potential location within the lakeshore where beach nourishment is proposed is northeast of the Port of Indiana industrial complex and the native site for proposed nourishment is located to the west, downdrift, approximately 3.5 miles at Portage Lakefront and Riverwalk. Sediment samples used to characterize both borrow and nourishment locations were collected from the beach/shoreline area at or immediately adjacent to each location and are representative of that material (NPS 2011c). The sediment located in the borrow site for reach 3 was similar in color to the material at the native site and no substantial levels of contaminants were present in the borrow materials (Simon and Morris 2011).

Under alternative C-1, the dredged material would be placed directly on the beach, thereby increasing the sediment retention time at the placement location and the efficiency of shoreline protection. It is anticipated that the nourishment material would be placed by hydraulically pumping a sediment/water slurry onto the beach. Heavy equipment would then be used to distribute the sediment, creating the appropriate grade along the shoreline. Within reach 3, it is estimated that the actions associated with alternative C-1 would be more expensive to implement and maintain than alternative A. The total estimated NPV cost of implementing alternative C-1 would be approximately $25.0 million over the 20-year lifetime of this plan.

ALTERNATIVE C-5: BEACH NOURISHMENT VIA DREDGED SOURCES, FIVE-YEAR FREQUENCY

Under alternative C-5, the amount of sediment material deposited in reach 3 would fulfill the estimated sediment budget deficit. As with alternative C-1, sediment would be dredged from an updrift location in Lake Michigan, such as near the NIPSCO/Bailly intake. The specific location of the dredging source would be determined during the permitting process, based on coordination with the IDNR and consultation with local stakeholders and engineering constraints. A total of 370,000 yd^3 of sediment would be placed every five years on the beach in reach 3 to account for the estimated sediment budget deficit. The placement of sediment on the beach in reach 3 would take approximately six months to complete every five years. The footprint of the placement area would be the entire length west of the Burns International Harbor, with an increase in beach elevation to approximately 12 feet above low water datum.

Despite ongoing maintenance dredging operations, the accreting beach updrift of the NIPSCO/Bailly complex would continue to grow under alternative C-5. The beach would potentially achieve a stable profile, allowing sediment to bypass the Arcelor-Mittal breakwater. Sediment could be trapped by the federal channel at the Burns International Harbor, which could increase maintenance dredging costs. The accreting sediment at the west end of the beach would also affect the industrial warm-water discharge location, extending it to the east further toward the park shoreline. As the area of sediment accretion grows, so too would the need for maintenance dredging for the federal channel. Implications for the long-term shoreline placement of dredged sediment on the beach are unknown; however, additional analysis would be conducted in a later phase of the planning process.

The implementation of the actions associated with alternative C-5 would maintain the current shoreline position as the estimated sediment budget deficit would be fulfilled. Additional sediment placed on the beach would result in an initial increase in beach width at the placement area. The 370,000 yd^3 of sediment would be sufficient to prevent additional erosion of the current shoreline for up to five years on average, as natural wave action and storm events would continue to erode the sediment after placement. The shoreline downdrift of Portage Lakefront and Riverwalk subsequently would receive an infusion of sediment following the material placement, thus affecting not only reach 3, but reach 4, as well. Figure 2-7: Alternative C-5 Beach Nourishment via Dredged Sources, Five-Year Frequency for Reaches 3 and 4, depicts alternative C-5.

Sediment compatibility between the proposed borrow material and the native beach were assessed by comparing grain size distribution curves. A potential location within the lakeshore where beach nourishment is proposed is northeast of the Port of Indiana in and the native site for proposed nourishment is located to the west, downdrift, approximately 3.5 miles at Portage Lakefront and Riverwalk. Sediment samples used to characterize both borrow and nourishment locations were collected from the beach/shoreline area at or immediately adjacent to each location and are representative of that material (NPS 2011c). The sediment located in the borrow site for reach 3 was similar in color to the material at the native site and no substantial levels of contaminants were present in the borrow materials (Simon and Morris 2011).

Under alternative C-5, the dredged material would be placed directly on the beach, thereby increasing the sediment retention time at the placement location and the efficiency of shoreline protection. The nourishment material would be placed by hydraulically pumping a sediment/water slurry onto the beach. Heavy equipment would then be used to distribute the sediment, creating the appropriate grade along the shoreline. Within reach 3, it is estimated that the actions associated with alternative C-5 would be less expensive to implement and maintain than alternative C-1. The total estimated NPV cost of implementing alternative C-5 would be approximately $20.3 million over the 20-year lifetime of this plan.

ALTERNATIVE D: BEACH NOURISHMENT VIA PERMANENT BYPASS SYSTEM

Under alternative D, the amount of sediment material deposited in reach 3 would fulfill the estimated sediment budget deficit. A permanent bypass system would be constructed and operated under this alternative to transport sediment from updrift of the NIPSCO/Bailly complex to Portage Lakefront and Riverwalk. A total of 74,000 yd^3 of sediment would be bypassed annually to account for the estimated sediment budget deficit. A sediment trap would be created by initially dredging a quantity of sediment (to be determined) east of the NIPSCO intake. An additional rubble-mound jetty modification could be required to develop an efficient sediment trap. The permanent bypass system would be constructed along the lake bottom, around the existing harbor structures. After the permanent bypass system was constructed and operational, some annual maintenance would be required.

Under alternative D, a permanent bypass system of pump and lift stations would hydraulically pump the 74,000 yd^3 of sediment to the downdrift shoreline and place it on the beach in the vicinity of Portage Lakefront and

Riverwalk. Heavy equipment would disperse the sediment along the shoreline to create the appropriate beach grade. The hydraulically placed sediment would be sufficient to maintain the current shoreline position as the estimated sediment budget deficit would be fulfilled. Additional sediment placed on the beach would result in an initial increase in beach width at the placement area. The 74,000 yd^3 of sediment would be sufficient to prevent additional erosion of the current shoreline for up to one year on average, as natural wave action and storm events would continue to erode the sediment after placement. The shorelines downdrift of Portage Lakefront and Riverwalk subsequently would receive an infusion of sediment following the placement of nourishment material, thus affecting not only reach 3, but reach 4, as well.

As sediment was transported from the NIPSCO/Bailly complex to Portage Lakefront and Riverwalk via the permanent bypass system, the storage capacity of the east beach fillet would increase. Under alternative D, there would be an increase in the beach nourishment material retention time. A target of 74,000 yd^3 of material would be bypassed annually; however, the actual volume would fluctuate based on natural factors, such as sediment supply and the local wave climate. Additional analysis and compliance would be necessary prior to implementation of the actions associated with alternative D.

The costs of implementing the actions associated with alternative D would include the initial construction of the permanent bypass system as well as maintenance and operation of the system over the 20-year lifetime of this plan. Alternative D would cost approximately $23.3 million to implement. Figure 2-6: Alternatives for Shoreline and Beach Complex, Reaches 3 and 4, depicts alternative D.

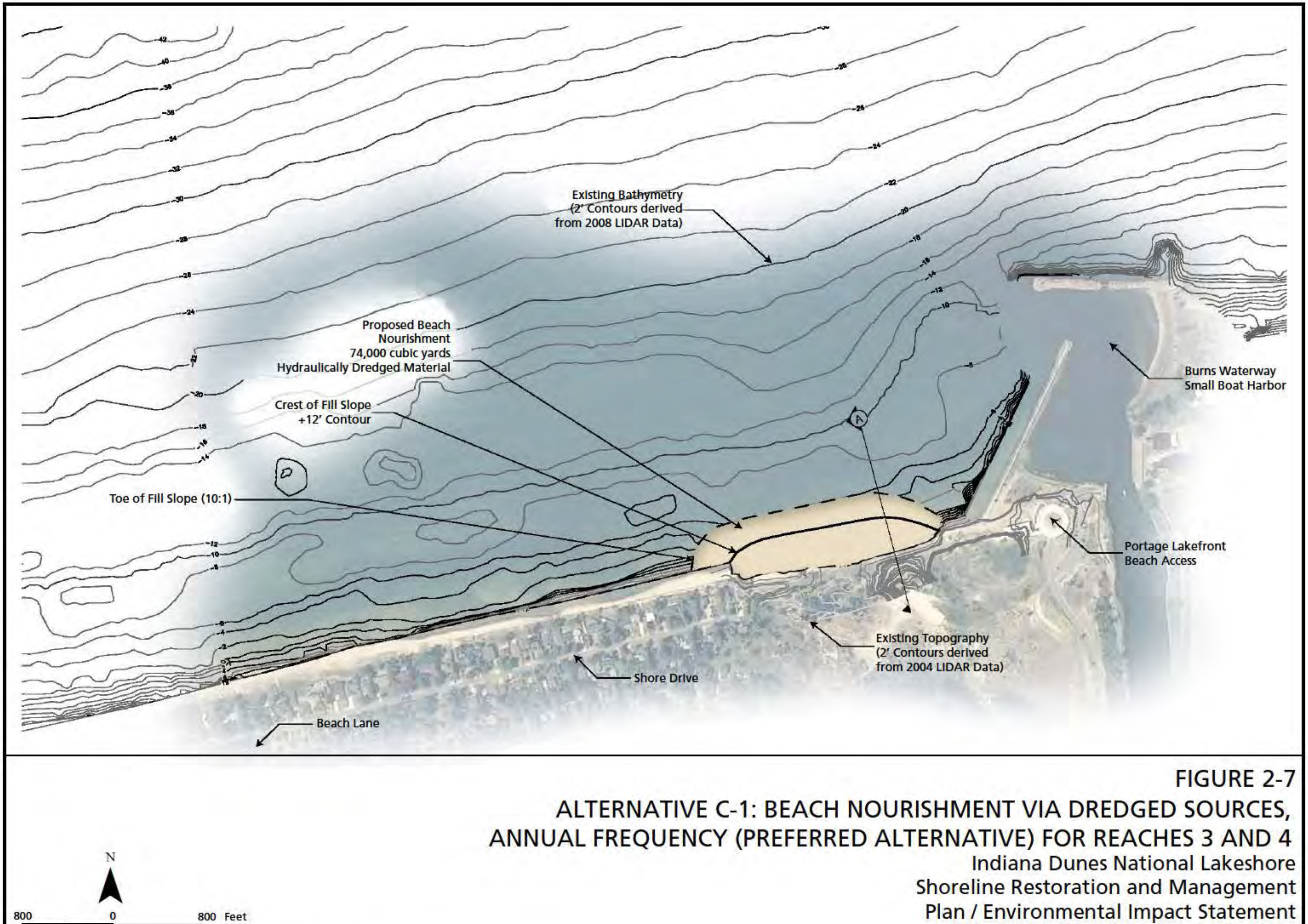


FIGURE 2-7

ALTERNATIVE C-1: BEACH NOURISHMENT VIA DREDGED SOURCES, ANNUAL FREQUENCY (PREFERRED ALTERNATIVE) FOR REACHES 3 AND 4

FOREDUNE AND DUNE COMPLEX

In addition to the shoreline restoration alternatives, this plan includes natural resource management strategies for the protection and improvement of the park's terrestrial ecosystem within the project area. Plant communities and physiography are continually changing with the disturbance-prone habitats of the foredune complex. The foredune and dune complex encourages biological diversity unique to this region of the country. Migratory bird habitat, intradunal wetlands, and the various stages of dune succession are critical components of the park. The National Park Service is responsible for the protection of these sensitive habitats. Protection is currently accomplished with the following management strategies:

- preservation and restoration of sensitive habitats
- management of nonnative invasive plant species
- reduction of anthropogenic influences on native dune vegetation and critical habitat

The National Park Service is currently in the process of preparing an environmental assessment (EA) for a Great Lakes Invasive Plant Management Plan for parks located in the Great Lakes region. The National Park Service is proposing to use integrated pest management strategies to guide the development of the Great Lakes Invasive Plant Management Plan / EA. The National Park Service defines integrated pest management "as a decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, by cost-effective means, while posing the least possible risk to people and park resources" (NPS 2011c). Integrated pest management employs physical, chemical, mechanical, cultural, biological, and education methodologies to effectively manage and minimize the impacts of invasive plants. Once completed, the Great Lakes Invasive Plant Management Plan would establish a long-term management strategy to mitigate the current and emerging ecological effects of invasive plants within the Great Lakes region.

Nonnative invasive plant species are currently affecting sensitive habitats and species of special concern. According to the park's Invasive Plant Management Strategy (NPS 2011d), more than 130 species of special concern have the potential to be affected by nonnative invasive plant species. Species of special concern, including threatened and endangered species, as well as critical habitat, would be monitored and protected under all alternatives of this plan.

An adaptive terrestrial management approach would account for future uncertainties and maximize the outcomes of resource management activities. The lakeshore area, including the foredune and dune complex, faces numerous issues related to invasive species and coastal processes. Park resource managers would have flexibility regarding management actions and strategies to produce desired conditions within the project area under this plan.

The park is an attractive destination for visitors and local residents. Mount Baldy (located in reach 1) is the only dune in the lakeshore where climbing is allowed on designated trails. Visitors hike the dune and from the top, on a clear day, can view Chicago's skyline and the southern Lake Michigan shoreline. However, numerous social trails have developed in non-designated areas on Mount Baldy and other areas of the park. West Beach (located in reach 4) is one of the most popular and highly visited entry points in the park. Numerous social trails extend from the parking lots to the beach. Portage Lakefront and Riverwalk (located in reach 3) has also become a popular destination for visitors and local residents, and social trails that cut across the dunes to access the beach have increased substantially. As a result, ecologically sensitive areas, such as highly erodible dune slopes, have been affected. These social trails are accelerating erosion and habitat degradation while serving as pathways for nonnative invasive plant species. As visitor use increases, so does the trampling of native vegetation.

The park currently utilizes management tools such as closing trails, developing new trails, realigning trails, fencing, signs, ticketing/fining, and visitor education to manage anthropogenic influences.

FOREDUNE AND DUNE COMPLEX, REACH 1

Mount Baldy, located at the eastern terminus of reach 1, is one of the most popular and highly visited dunes in the park. It is best characterized by stabilized dune forests with a degraded and highly eroded foredune complex. The beach width is relatively narrow in this area compared to other reaches. Mount Baldy has gone through drastic changes recently. The dune is moving landward and burying leeward trees and herbaceous vegetation. The erosion is in large part caused by off-trail anthropogenic disturbances, loss of dune vegetation, and a sediment supply deficit (Dillon 2011). Over the last several years, park officials at Indiana Dunes National Lakeshore have noted that Mount Baldy has begun moving inland at an alarming pace. Left unchecked, the dune could start to cover over its own parking lot in as few as seven years. The reason for the increased movement seems to be a combination of too little dune grass on top of Mount Baldy and too many people climbing its southern slope. The lack of dune grass, also known as Marram grass, allows the wind to more easily move the sediment. In addition, every footstep up and down the dune helps push sediment down the steeper southern slope toward the parking lot while also killing off Marram grass attempting to take root.

Crescent Dune is located directly behind the revetment wall at the eastern terminus of reach 1, and demonstrates moderate floristic quality compared to the other pannes at the West Beach and Miller units. The National Park Service has documented numerous species of special concern at this panne, including five stated-listed plant species. See Appendix D: Species Lists, for additional information on these species.

The western terminus of reach 1, defined by East Lakefront Drive and the rock revetments, has been infested with nonnative trees such as Siberian elm (*Ulmus pumila*) and black locust (*Robinia pseudoacacia*). This stretch of beach/foredune demonstrates the lowest floristic quality and poorest characteristic plant assemblages for the foredune complex in the project area.

Current Management Actions

Sensitive Habitat Restoration. Sensitive habitat restoration includes: preserving the panne by maintaining natural processes and providing nonnative invasive species management; restoring the foredune and dune complex by stabilizing select areas of eroded dunes with native vegetation; and fencing off highly eroded and environmentally sensitive areas on Mount Baldy and revegetating with American beachgrass (*Ammophila breviligulata*).

Invasive Vegetation Management. Invasive vegetation management includes: managing sand ryegrass (*Leymus arenarius*) and spotted knapweed (*Centaurea maculosa*) in the foredune complex; managing purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), and hybrid cattail (*Typha* x *glauca*) in the panne; and managing some woody invasive vegetation such as Siberian elm, black locust, and tree-of-heaven (*Ailanthus altissima*).

Anthropogenic Influence. Management of anthropogenic influences includes: protecting the leeward slope of Mount Baldy by installing fencing; maintaining an appropriate designated route to and from Mount Baldy from the parking lot; reducing social trails;

and providing education and outreach to visitors.

Proposed Management Actions

Sensitive Habitat Restoration. Proposed management of sensitive habitat restoration includes the continuation of current management actions by preserving the pannes and restoring the foredune and dune complex through native plant revegetation.

Invasive Vegetation Management. Proposed invasive vegetation management includes continued current management actions in addition to: implementation of an early detection and rapid response program and protocols; implementation of an invasive plant management plan; providing education and outreach about the impacts of nonnative invasive plant species to visitors; managing sand ryegrass and spotted knapweed in the foredune complex and outlying areas; and managing nonnative invasive plant species along East Lakefront Drive.

Anthropogenic Influence. Proposed management of anthropogenic influences includes continue current management actions by protecting the south slope from pedestrian use; designating appropriate routes to and from parking lots to popular visitor sites; reducing social trails; and providing education and outreach to visitors. In addition, proposed management actions include: consideration of the realignment of trails; development and implementation of a mitigation plan for new proposed access points or trails to Crescent Dune; and enforcement of pedestrian access routes.

FOREDUNE AND DUNE COMPLEX, REACH 2

Reach 2 supports a dynamically stable foredune complex. The majority of blowouts in the project area are located in this reach. The best example of a Pitcher's thistle (*Cirsium pitcheri*) metapopulation is located in reach 2 of the project area. Many of the foredunes in reach 2 eventually intergrade into mature, stabilized dune forests. In addition, natural coastal processes, foredune development, and dune succession are readily observed in reach 2. Piping plovers often use shoreline habitat that is most influenced by natural processes, such as sediment deposition, natural rates of shoreline erosion, and scouring for maintenance (FWS 2003a). The U.S. Fish and Wildlife Service has determined that reach 2 is the only segment along the Indiana shoreline that currently has the physical conditions suitable for piping plover breeding activities.

The encroachment of nonnative species, particularly invasive plants, is a substantial problem that affects habitats within reach 2. A large population of Lombardy poplar (*Populus nigra*) and other invasive trees has invaded the Porter Beach unit and has the potential to invade the foredune and dune complex, including Keiser Blowout. Spotted knapweed, oriental bittersweet (*Celastrus orbiculatus*), cypress spurge (*Euphorbia cyparissias*), and garlic mustard (*Alliaria petiolata*) have also been documented in this reach.

Current Management Actions

Sensitive Habitat Restoration. Sensitive habitat restoration includes preserving the existing ecological conditions by sustaining natural coastal processes.

Invasive Vegetation Management. Invasive vegetation management includes managing existing nonnative invasive plant species. Targets include the following: sand ryegrass on the foredune; Lombardy popular along the roads; and invasive shrubs and trees, such as autumn olive (*Elaeagnus umbellata*) and black locust, at parking lots. Current management also includes the mapping and monitoring of treated nonnative invasive plant species.

Anthropogenic Influence. Management of anthropogenic influences includes providing education and outreach to visitors.

Proposed Management Actions

Sensitive Habitat Restoration. Proposed management of sensitive habitat restoration includes continued current management actions in addition to preserving the foredune and dune complex (including blowouts), and restoring Pitcher's thistle habitat and piping plover habitat.

Invasive Vegetation Management. Proposed invasive vegetation management includes continued current management actions in addition to implementation of an early detection and rapid response program and protocols; and implementation of integrated pest management strategies.

Anthropogenic Influence. Proposed management of anthropogenic influences includes the continuation of current management actions in addition to designating an appropriate route to the beach from the Kemil Road parking lot, and reducing social trails on the foredune complex, including blowouts, at the Kemil Road access point.

FOREDUNE AND DUNE COMPLEX, REACH 3

A drastically altered shoreline, including artificial harbors, lakefill revetments, detached breakwaters, and a hardened shoreline, separates the NIPSCO/Bailly unit from Portage Lakefront and Riverwalk. Portage Lakefront and Riverwalk has an intact panne and foredune complex with degraded beach plant communities. Pitcher's thistle populations are located in respective blowout communities in this reach. The high accretion zone at the revetment at the NIPSCO/Bailly beach fillet allows for lakeward development of the foredunes.

The mouth of the Burns International Harbor intake is located at Portage Lakefront and Riverwalk. The banks are extremely erodible, because it was constructed with steep slopes and sandy substrate. The erosion is jeopardizing species of special concern, including the state rare bearberry (*Arctostaphylos uva-ursi*). Portage Lakefront and Riverwalk has become a popular destination for visitors and local residents since its recent opening. As a result, visitor use and other anthropogenic influences have increased substantially in this reach. In addition, social trails that cut across the dunes to access the beach have increased substantially.

Invasive species are prevalent at Portage Lakefront and Riverwalk. Spotted knapweed, yellow sweet clover (*Melilotus officinalis*), and prairie sunflower (*Helianthus petiolaris*) have invaded roadside and trail edges through the unit. Purple loosestrife and common reed have also invaded the panne. Sand ryegrass has been observed throughout the foredune complex. In addition, oriental bittersweet and black locust trees are also encroaching upon areas within the dune complex in reach 3.

Current Management Actions

Sensitive Habitat Restoration. Sensitive habitat restoration includes preservation of the panne and the foredune complex by maintaining natural processes, and preservation of Pitcher's thistle populations at blowouts, including Portage Lakefront and Riverwalk.

Invasive Vegetation Management. Invasive vegetation management includes managing existing nonnative invasive plant species in the panne.

Anthropogenic Influence. Management of anthropogenic influences includes providing education and outreach to visitors.

Proposed Management Actions

Sensitive Habitat Restoration. Proposed management of sensitive habitat restoration includes continued current management actions in addition to restoring the foredune and dune complex by stabilizing select areas of eroded dunes with native vegetation, and preserving existing ecological conditions by sustaining natural coastal processes.

Invasive Vegetation Management. Proposed invasive vegetation management includes continued current management actions in addition to implementation of an early detection and rapid response program and protocols, and implementation of integrated pest management strategies.

Anthropogenic Influence. Proposed management of anthropogenic influences includes the continuation of current management actions in addition to reducing social trails and other anthropogenic influences on the foredune complex.

FOREDUNE AND DUNE COMPLEX, REACH 4

The foredune complex is generally more extensive in reach 4, compared to the stabilized, closed-canopy structure of the dune forests in reaches 1 and 2. Reach 4 subsequently supports a dynamically stable foredune complex. The foredune complex at the Miller unit is interrupted by leeward pannes and aquatic plant communities. The largest concentration of high quality pannes in the project area is located within West Beach. Beach pea restoration and reintroduction has also occurred in the foredune complex at the Miller unit.

West Beach is one of the most popular and highly visited entry points in the park. Numerous social trails extend from the parking lots to the beach. These trails traverse through sensitive habitat within the foredune complex.

Common reed, purple loosestrife, and white cattail (*Typha glauca*) are among the greatest concerns to the pannes in reach 4. The foredune complex is being invaded by sand ryegrass, spotted knapweed, and nonnative bush honeysuckle (*Lonicera* sp.). Yellow sweet clover and prairie sunflower nonnative invasive plant species are also invading the roadside and parking lot edges at West Beach.

Current Management Actions

Sensitive Habitat Restoration. Sensitive habitat restoration includes the preservation of the pannes at the West Beach and Miller units by managing nonnative invasive plant species, targeting purple loosestrife, common reed, and hybrid cattail.

Invasive Vegetation Management. Invasive vegetation management includes managing existing nonnative invasive plant species. Targets include: common reed, purple loosestrife, and white cattail in the pannes; sand ryegrass on the beach and foredunes; and yellow sweet clover and prairie sunflower. Current management also includes the mapping and monitoring of treated nonnative invasive plant species.

Anthropogenic Influence. Management of anthropogenic influences includes providing education and outreach to visitors.

Proposed Management Actions

Sensitive Habitat Restoration. Proposed management of sensitive habitat restoration includes continued current management actions in addition to restoring the foredune and dune complex by stabilizing select areas of eroded dunes with native vegetation, and fencing off highly eroded and environmental sensitive areas in the foredune complex to allow for ecological recovery of natural communities.

Invasive Vegetation Management. Proposed invasive vegetation management includes continued current management actions in addition to implementation of an early detection and rapid response program and protocols, and implementation of integrated pest management strategies.

Anthropogenic Influence. Proposed management of anthropogenic influences includes the continuation of current management actions in addition to designating and enforcing an appropriate route to and from the parking lots to the beach; reducing social trails; and fencing off highly eroded and environmental sensitive areas in the foredune complex, including the pannes, to reduce trampling of native vegetation.

ACTIONS AND ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

During the preparation of this plan, various approaches to restore Indiana Dunes National Lakeshore were discussed. Some actions and alternatives were proposed and eliminated from further consideration. The rationale for the dismissal of alternatives is provided below.

REACH 3, BEACH NOURISHMENT VIA UPLAND SOURCES

The planning team considered the possibility of conducting beach nourishment at Portage Lakefront and Riverwalk by trucking in material from an upland source. As is the case for reach 1, this alternative would have looked at conducting nourishment on an annual or frequency.

The proposed alternatives for conducting beach nourishment using an upland sediment source in reach 3 were dismissed because of the limited construction accessibility to the potential work area, lack of an appropriate haul road, and high costs associated with transporting materials over land. Maintenance dredging has occurred in the vicinity of the NIPSCO/Bailly intake since the 1980s. The COE intermittently operates a dredging program to manage sedimentation around the intake. If this program were interrupted, the sediment would continue to accrete in the area updrift of the industrial complex, pushing the adjacent warm-water discharge point farther east and north, potentially affecting the aquatic habitat along the shoreline. The sediment accumulation would result in operational concerns for NIPSCO as sediment enters its systems via the cold-water intake, and could cause emergency shutdowns and dredging activities. In the future, the NIPSCO/Bailly beach fillet may potentially achieve a stable profile, allowing natural sediment bypassing of the harbor structures. This could result in sediment accumulation in the navigational channel, consequently increasing the federal maintenance dredging. Compared to other nourishment activities proposed for reach 3, relatively high costs would be expected under this alternative in association with nourishment from upland sources due to the required travel distance and the need to construct an access road with associated staging areas. Due to the expected impacts of interrupting the maintenance dredging activities at the NIPSCO/Bailly complex and the high costs, nourishment from upland sources was not considered for reach 3.

REACH 3, ENGINEERED STRUCTURES

Initially, the planning team considered the possibility of constructing permanent submerged engineered structures along the shoreline in front of Portage Lakefront and Riverwalk. These structures would be designed as permanent detached breakwaters constructed parallel to the shoreline. Unlike the submerged cobble berm proposed for reach 1, this alternative considered placing several segmented structures that would not break down or dissipate, but that would remain in place. These breakwaters would facilitate a nourishment program by retaining sediment along the shoreline for longer periods of time.

This proposed alternative was dismissed from further consideration for several reasons. The beach along Portage Lakefront and Riverwalk would eventually expand, forming a scalloped shoreline profile. Such a beach appearance is an unnatural condition and therefore unsupported. Additionally, a scalloped beach profile would occur as sediment from the beach extended into the lake and connected to the segmented breakwaters. This new access to the breakwaters would pose a safety concern to visitors, potentially drawing inexperienced swimmers to waters deeper than they would typically enter. The permanent submerged structures would also pose a safety concern to recreational boaters traveling near the shoreline. Despite the additional signs that would have been used to warn the public and boaters about the safety issue, as the crest of the structures would be approximately two to four feet above the LWD, the potential for accidents would have persisted.

In addition to the concerns associated with the beach profile and safety, the permanent structures associated with this alternative would also impact the visitor's viewshed. While the berms would have been constructed beneath the water surface, they would have been seen from elevated heights. Due to the expected impacts of implementing the permanent structures, this alternative was dismissed from further consideration in reach 3.

NATIONAL PARK SERVICE PREFERRED ALTERNATIVES

During the Choosing by Advantages process (previously described under "Choosing by Advantage Process" section) attributes, or characteristics, of each alternative were used to identify the alternatives that provide the National Park Service and the public the greatest advantage for the most reasonable cost. These advantages were the largest determining considerations in identifying the agency's preferred alternatives. Overall, the draft preferred alternatives provide the National Park Service with the greatest overall benefits at the most reasonable cost.

The National Park Service identified alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency) for reaches 1 and 2, and alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency) for reaches 3 and 4, as the agency's draft preferred alternatives. These alternatives provide the best combination of strategies to protect the park's unique resources and visitor experience, while improving the park's operational sustainability within each reach. These alternatives also offer advantages to the neighboring communities. Actions under alternative E in reaches 1 and 2 provide for the greatest level of beach nourishment and habitat opportunities for desired native species. Actions under alternative C-5 in reaches 3 and 4 provide the best, and most cost-efficient method of foredune creation, and the greatest level of protection from major storm events.

However, public comment on the plan / draft EIS (July 2012) was extensive and ranged from support for the goals of the project to concerns about a number of aspects of the draft alternatives. The public was generally supportive of beach nourishment, but there was consistent, negative response to the proposed cobble berm in alternative E (preferred in the draft EIS) and the large volume of nourishment material associated with alternative C-5 (draft preferred alternatives).

While the potential impacts of the submerged cobble berm were addressed in the draft EIS, the public concern was such that the National Park Service chose to review the array of alternatives to determine the feasibility of both satisfying public concern and achieving the project goals through the development of a new hybrid alternative.

For Reaches 1 and 2 seven alternatives were initially developed including the no-action alternative. The only variation between the alternatives are in the consistency of the aggregate (sediment/rock), frequency of placement, and method of placement. Therefore a new hybrid alternative that incorporates desired aspects of multiple alternatives which would meet park purposes and objectives, yet addresses public concern with the draft preferred alternative E was developed.

The selection of alternative E was primarily due to the added benefits provided by the additional rock materials for both armoring the clay lakebed and providing a native range of substrate materials (sediment, gravel, rock) to promote a more natural ecologically diverse and sustainable shoreline and not necessarily the method of placement. Therefore, a new hybrid alternative which incorporates the full range of natural sediment aggregate using an approach other than the submerged cobble berm would still achieve the same objectives and provide the best combination of strategies to protect the lakeshore's unique resources and visitor experience, while satisfying public concerns.

As a result of public concern with the five-year beach nourishment volume in alternative C-5 for reaches 3 and 4 (draft preferred alternative), the National Park Service changed the preferred alternative in reaches 3 and 4 to alternative C-1. This alternative both achieves the project goals and satisfies public concerns.

ENVIRONMENTALLY PREFERABLE ALTERNATIVES

The National Park Service is required to identify the environmentally preferable alternative in its NEPA documents for public review and comment. Guidance from the Council on Environmental Quality (CEQ) "Forty Most Asked Questions,"(Q6a) defines the environmentally preferable alternative as "the alternative that causes the least damage to the biological and physical environment; it also means the alternative which best protects, preserves, and enhances historic, cultural, and natural resources" (46 *Federal Register* 18026, Q6a). It should be noted that there is no requirement that the environmentally preferable alternative and the NPS preferred alternative be the same. The National Park Service has identified alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency) for reaches 1 and 2, and alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency) for reaches 3 and 4, as the environmentally preferable alternatives. These differ from the preferred alternatives selected in the plan / final EIS, which achieve the project goals and also satisfy public concerns.

In analyzing the impacts to natural resources, as summarized in tables 2-3 and 2-4, all action alternatives would benefit coastal processes. There would be adverse effects on aquatic fauna, terrestrial habitat, threatened and endangered species and species of concern, and the soundscape as a result of activities associated with the placement of nourishment material. The duration and intensity of these effects would vary depending on the source of the nourishment materials (i.e., upland or dredged) and the volume of nourishment material proposed under each alternative. Compared to the other alternatives, the NPS environmentally preferable alternatives would have similar adverse impacts on resources in the project area. Under alternative E in reaches 1 and 2, effects on all resources would be no greater than moderate adverse. Under alternative C-5 in reaches 3 and 4, effects would be no greater than short-term, moderate and adverse on all resources except aquatic fauna. There would be long-term, moderate to major, adverse impacts on aquatic fauna as fish would be displaced during nourishment activities, and fish life cycles would be interrupted. In addition, the larger footprint of the placement area under alternative C-5 in reaches 3 and 4 (when compared to the other action alternatives) would result in burial of benthic communities along most of reach 3. However, under all the action alternatives, the impacted resources (e.g., coastal processes, aquatic fauna, terrestrial habitat, threatened and endangered species and species of concern, and soundscape) would benefit in the long-term from the reduction of severe shoreline and beach erosion and the creation of a more natural ecosystem of shoreline vegetation and foredune and dune complexes and processes.

Among all action alternatives considered, the NPS environmentally preferable alternatives offer a high level of protection of natural resources along the shoreline. As a result, implementation of the NPS environmentally preferable alternatives would better mimic natural shoreline processes, and better protect the beach, foredunes, and dunes from erosion, and would better support the development of foredunes and dunes than under the no-action alternatives. The implementation of alternative E for reaches 1 and 2 would also provide potential habitat opportunities for desired native aquatic and terrestrial species to a greater degree than the other alternatives. The implementation of alternative C-5 in reaches 3 and 4 would provide the greatest potential for foredune creation and the greatest protection from major storm events when compared to the other alternatives. In addition, under both of the NPS environmentally preferable alternatives, the National Park Service would integrate resource protection and education with an appropriate range of visitor uses. For these reasons, alternative E for reaches 1 and 2 and alternative C-5 for reaches 3 and 4 are the environmentally preferable alternatives. These alternatives best protect, preserve, and enhance natural resources and natural processes in the park.

CONSISTENCY OF THE ALTERNATIVES WITH THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969, AS AMENDED

The National Environmental Policy Act of 1969, as amended requires an analysis of how each alternative meets or achieves the purposes of the act, as stated in section 101(b). Each alternative analyzed in a NEPA document must be assessed as to how it meets the following purposes:

1. fulfill the responsibilities of each generation as trustee of the environment for succeeding generations
2. assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings
3. attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences
4. preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choices
5. achieve a balance between population and resource use, which would permit high standards of living and a wide sharing of life's amenities
6. enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources

The CEQ has promulgated regulations for federal agency implementation of NEPA (40 Code of Federal Regulations [CFR], parts 1500–1508). Section 1500.2 states that federal agencies shall, to the fullest extent possible, interpret and administer the policies, regulations, and public laws of the United States (U.S.) in accordance with the policies set forth in the act (sections 101(b) and 102(1)); therefore, other acts and NPS *Management Policies 2006* are referenced as applicable in the following discussion.

Criterion 1. Fulfill the Responsibilities of Each Generation as Trustee of the Environment for Succeeding Generations

All alternatives considered in this plan / final EIS, including alternative A, must comply with law and NPS policy (e.g., the *Organic Act of 1916* and NPS *Management Policies 2006*) that require the agency to manage park units by such means and in such a manner "that will leave them unimpaired for the enjoyment of future generations." Each alternative meets this criterion, although the "action alternatives" (alternatives B-1, B-5, C-1, C-5, D, E, and F in reaches 1 and 2; and alternatives C-1, C-5, and D in reaches 3 and 4) provide enhanced stewardship and trusteeship of the park's resources in comparison to alternative A. The no-action alternatives in reaches 1 and 2 and reaches 3 and 4 do not provide comprehensive management direction for shoreline restoration efforts and also do not provide for adequate nourishment to offset the continuing erosion along the park's shoreline.

Criterion 2. Assure for All Americans Safe, Healthful, Productive, and Aesthetically and Culturally Pleasing Surroundings

Under all alternatives, the National Park Service would strive to provide for safe, healthful, productive, and aesthetically and culturally pleasing surroundings. The ability of the park to achieve this purpose would be enhanced under all action alternatives when compared to alternative A for reaches 1 and 2 and alternative A reaches 3 and 4 by reducing shoreline erosion, creating conditions that more closely mimic natural coastal processes, and providing for enhanced development of foredune and dune complexes and processes.

Criterion 3. Attain the Widest Range of Beneficial Uses of the Environment Without Degradation, Risk of Health or Safety, or Other Undesirable and Unintended Consequences

All the action alternatives promote a wide range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences. The action alternatives would allow an appropriate range of beach and lakeshore experiences for park visitors while providing additional resource protection than under the no-action alternatives for reaches 1 and 2 and reaches 3 and 4. All action alternatives include proposals to reduce social trails and other anthropogenic influences in the park. Compared to the no-action alternatives, the preferred alternatives (alternative F in reaches 1 and 2 and alternative C-1 in reaches 3 and 4) would better provide for the enhancement of natural shoreline processes, better protect the foredunes, dunes, and shoreline from erosion, and better support the development of foredune and dune complexes and processes. Ample visitor use opportunities would be available under all alternatives, and activities that promote natural processes and minimize environmental impacts would continue.

Criterion 4. Preserve Important Historic, Cultural, and Natural Aspects of Our National Heritage and Maintain, Wherever Possible, An Environment that Supports Diversity and Variety of Individual Choice

The preservation of important historic, cultural, and natural aspects of our national heritage would be maintained under the implementation of all alternatives. As discussed in the "Impact Topics Dismissed from Further Consideration" section in the "Purpose and Need for Action" chapter, the implementation of this plan would not affect historic, submerged, or archeological resources. In addition, mitigation measures (as described previously in "The Alternatives" chapter) would be implemented for the action alternatives to minimize unanticipated adverse effects to cultural resources. Under all of the action alternatives, there would be no appreciable impact on minorities or low-income populations or communities. This plan focuses on the shoreline as a whole. The alternatives were developed in consideration of the park's neighboring communities and the effects on not only park property, but also on neighboring community properties.

Criterion 5. Achieve a Balance Between Population and Resource Use that will Permit High Standards of Living and a Wide Sharing of Life's Amenities

All action alternatives would provide enhanced opportunities for visitors to access and experience the Indiana Dunes National Lakeshore's unique and diverse landscape. The NPS preferred alternatives achieve a balance between satisfying public concern and providing a high level of protection of natural resources while also providing a wide range of neutral and beneficial uses of the environment. Compared to the no-action alternatives, the preferred alternatives better provide for enhanced natural shoreline processes, protection of the foredunes and dunes, from erosion, and development of foredune and dune complexes and processes.

Criterion 6. Enhance the Quality of Renewable Resources and Approach the Maximum Attainable Recycling of Depletable Resources

In accordance with NPS *Management Policies 2006*, all the action alternatives incorporate measures to ensure that actions are conducted in an environmentally responsible and sustainable manner. The park staff would continue to demonstrate environmental leadership in implementing these shoreline restoration activities and execution of park operations would maximize the attainable recycling of depletable resources.

HOW ALTERNATIVES MEET OBJECTIVES

All action alternatives selected for analysis must meet all objectives to a large degree. The action alternatives must also address the stated purpose of taking action and resolve the need for action; therefore, the alternatives were individually assessed in light of how well they would meet the objectives of this plan / final EIS, which are stated in the "Purpose and Need for Action" chapter. This process is the foundation for determining the NPS preferred alternative. Alternatives that did not meet the objectives were not analyzed further (see the "Actions and Alternatives Eliminated from Further Consideration" section of "The Alternatives" chapter). Tables 2-2A and 2-2B: Comparison of Alternatives, compares how each of the alternatives described in "The Alternatives" chapter would meet the objectives of this plan. Table 2-3: Alternatives Impacts Table, Reaches 1 and 2, and Table 2-4: Alternatives Impacts Table, Reaches 3 and 4 summarizes the impacts under each alternative on each resource, as described in the "Environmental Consequences" chapter.

TABLE 2-2A. COMPARISON OF ALTERNATIVES, REACHES 1 AND 2

Alternative Element	Alternatives							
	Alternative A No-action	Alternative B-1 Beach Nourishment via Upland Sources, Annual Frequency	Alternative B-5 Beach Nourishment via Upland Sources, Five-Year Frequency	Alternative C-1 Beach Nourishment via Dredged Sources, Annual Frequency	Alternative C-5 Beach Nourishment via Dredged Sources, Five-Year Frequency	Alternative D Beach Nourishment via Permanent Bypass System	Alternative E Submerged Cobble Berm and Beach Nourishment, Annual Frequency	Alternative F Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline (Preferred Alternative)
Shoreline and Beach Complex, Reaches 1 and 2								
Average Sediment Placed	31,500 yd³/year	136,500 yd³/year	682,500 yd³/every five years	136,500 yd³/year	682,500 yd³/every five years	136,500 yd³/year	102,400 yd³/year	136,500 yd³ /year
Where Sediment Obtained From	Mined from a permitted upland borrow site or dredged from an offshore location near Michigan City	Mined from a permitted upland borrow site	Similar to alternative B-1	Dredged from an updrift location to be determined in coordination with IDNR in areas of accretion so that dredging activities would not disturb areas of equilibrium	Similar to alternative C-1	Bypassed from updrift of the Michigan City Harbor, such as near the Michigan City Marina, at the end of the east jetty	Submerged cobble berm would be constructed between the western terminus of the NIPSCO seawall and the eastern terminus of reach 2 and used in conjunction with beach nourishment activities similar to alternative C-1	Sediment dredged from an updrift location and coarse material and small native stones mined from a permitted upland borrow site.
Method of Placement	Sediment transported via truck along existing access road / heavy equipment would distribute sediment	Sediment transported via truck along existing access road / heavy equipment would distribute sediment and create appropriate gradations	Similar to alternative B-1	Sediment-water slurry hydraulically pumped on to beach / heavy equipment would distribute sediment and create appropriate beach grade	Similar to alternative C-1	Sediment would be transported via a permanent bypass system / a sediment trap would be created by initially dredging a TBD quantity of sediment / pump and lift stations would hydraulically pump sediment on to beach / heavy equipment would distribute sediment and create appropriate gradations	The submerged cobble berm would be comprised of appropriate-sized stone material from local glacial deposits which would gradually dissipate and cover the lakebed in the nearshore area	Sediment-water slurry hydraulically pumped on to beach. Coarse material and small native stones transported via truck along existing access road. Heavy equipment would mix sediment, coarse material and small native stones and distribute nourishment material to create appropriate gradations
Sediment Placement	For onshore, placed along shoreline at Crescent Dune/or offshore, deposited nearshore off reach 1	Placed along shoreline of beach in reach 1	Similar to alternative B-1	Similar to alternative B-1	Similar to alternative B-1	Placed on the beach at Crescent Dune	Lakebed-cobble, beach nourishment at Crescent Dune	Similar to alternative B-1
NPV Over 20 Years	$9.5 million	$43.8 million	$35.5 million	$22.9 million	$18.6 million	$35.4 million	$24.8 million	$26.0 million
Foredune and Dune Complex, Reach 1								
Sensitive Habitat Restoration								
	Preserve pannes by maintaining natural processes and providing nonnative invasive species management.							
	Restore the foredune and dune complex by stabilizing select areas of eroded dunes with native plant vegetation. Fence-off highly eroded and environmental sensitive areas on Mount Baldy, and revegetate with American beach grass.							
Invasive Vegetation Management								
	Manage sand ryegrass and spotted knapweed in the foredune complex	Continue current management actions. Manage sand ryegrass and spotted knapweed in the foredune complex and outlying areas. In addition, implement an early detection and rapid response program and strategies; implement an Invasive Plant Management Plan; and provide education and outreach about the impacts of nonnative invasive plant species to visitors.						
	Manage purple loosestrife, common reed, and hybrid cattail in the panne							

TABLE 2-2A. COMPARISON OF ALTERNATIVES, REACHES 1 AND 2

Alternative Element	Alternatives							
	Alternative A No-action	Alternative B-1 Beach Nourishment via Upland Sources, Annual Frequency	Alternative B-5 Beach Nourishment via Upland Sources, Five-Year Frequency	Alternative C-1 Beach Nourishment via Dredged Sources, Annual Frequency	Alternative C-5 Beach Nourishment via Dredged Sources, Five-Year Frequency	Alternative D Beach Nourishment via Permanent Bypass System	Alternative E Submerged Cobble Berm and Beach Nourishment, Annual Frequency	Alternative F Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline (Preferred Alternative)
	Manage some woody invasive vegetation, such as Siberian elm, black locust, and tree-of-heaven							
Anthropogenic Influences								
	Maintain an appropriate designated route to and from Mount Baldy from the parking lot	Continue current management actions by: Protecting the south slope of Mount Baldy from pedestrian use. Designating appropriate routes to and from parking lots to popular visitor sites. Reducing social trails. Providing education and outreach to visitors. Consider the realignment of trails; develop a mitigation plan for any new proposed access points or trails to Crescent Dune; and enforce pedestrian access routes.						
	Designate an appropriate route to and from Mount Baldy from the parking lot							
	Reduce social trails							
	Provide education and outreach							
Foredune and Dune Complex, Reach 2								
Sensitive Habitat Restoration								
	Preserve existing ecological conditions by sustaining natural coastal processes	Continue current management actions. In addition, preserve the foredune and dune complex, including blowouts; and restore Pitcher's thistle habitat and piping plover habitat.						
Invasive Vegetation Management								
	Manage existing nonnative invasive plant species. Targets include the following: sand ryegrass on foredunes; Lombardy popular along the roads; and invasive shrubs and trees, such as autumn olive and black locust, at parking lots	Continue current management actions. In addition, implement an early detection and rapid response program and protocols, and implement integrated pest management strategies.						
	Map and monitor treated nonnative invasive plant species							
Anthropogenic Influences								
	Provide education and outreach to visitors	Continue current management actions. In addition, designate appropriate route to the beach from the Kemil Road parking lot; and reduce social trails on the foredune complex, including blowouts, at the Kemil Road access point; and provide education and outreach to visitors.						

TABLE 2-2A. COMPARISON OF ALTERNATIVES, REACHES 1 AND 2

Alternative Element	Alternatives							
	Alternative A No-action	Alternative B-1 Beach Nourishment via Upland Sources, Annual Frequency	Alternative B-5 Beach Nourishment via Upland Sources, Five-Year Frequency	Alternative C-1 Beach Nourishment via Dredged Sources, Annual Frequency	Alternative C-5 Beach Nourishment via Dredged Sources, Five-Year Frequency	Alternative D Beach Nourishment via Permanent Bypass System	Alternative E Submerged Cobble Berm and Beach Nourishment, Annual Frequency	Alternative F Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline (Preferred Alternative)
How the Alternatives Meet the Objectives of the Plan								
Shoreline Restoration Does the alternative develop strategies that would support the reestablishment of more sustainable shoreline sediment movement and a more natural ecosystem of shoreline vegetation and foredune and dune complexes?								
	No – Under the no-action alternative the park would not develop strategies for sustainable shoreline sediment movement.	Yes – Under the proposed action alternatives, strategies for sustainable shoreline sediment movement and a more natural ecosystem of the shoreline would be developed.						
Exotic and Invasive Species Does the alternative develop new strategies to identify, manage, and remove aquatic and terrestrial exotic and invasive species; and develop strategies to support ongoing management efforts to remove aquatic and terrestrial exotic and invasive species, and to prevent conditions detrimental to those effects?								
	No – Under the no-action alternative, no new strategies would be developed.	Yes – Under the proposed action alternatives, new strategies to identify, manage, and remove aquatic and terrestrial exotic and invasive species, and new strategies to support ongoing management efforts to remove aquatic and terrestrial exotic and invasive species would be developed.						
Management Methodology Does the alternative determine shoreline desired conditions that would serve as thresholds for management actions within Indiana Dunes National Lakeshore, and develop and implement an adaptive management approach for maintaining a sustainable shoreline ecosystem within Indiana Dunes National Lakeshore?								
	No – Under the no-action alternative, there would be no adaptive management approach.	Yes – Under the proposed action alternatives, desired conditions would be developed and an adaptive management approach would be implemented.						

Notes:

NPV = net present value

TBD = to be determined

yd^3 = cubic yards

TABLE 2-2B. COMPARISON OF ALTERNATIVES, REACHES 3 AND 4

Evaluation Criteria	Alternatives			
	Alternative A No-action	Alternative C-1 Beach Nourishment via Dredged Sources, Annual Frequency (Preferred Alternative)	Alternative C-5 Beach Nourishment via Dredged Sources, Five-Year Frequency	Alternative D Beach Nourishment via Permanent Bypass System
Shoreline and Beach Complex, Reaches 3 and 4				
Long-term Average Sediment Placed	74,000 yd^3/year	74,000 yd^3/year	370,000 yd^3/every five years	74,000 yd^3/year
Where Sediment Obtained From	Dredged from around the NIPSCO/Bailly intake or the Burns International Harbor	Dredged from an updrift location in Lake Michigan, to be determined in coordination with IDNR in areas of accretion so that dredging activities would not disturb areas of equilibrium.	Similar to alternative C-1	Bypassed from updrift of the NIPSCO/Bailly complex to Portage Lakefront and Riverwalk site
Method of Placement	Open water disposal between 12 and 18 feet of water depth at Low Water Datum	Sediment-water slurry would be hydraulically pumped on to beach / heavy equipment would distribute sediment and create appropriate beach grade	Similar to alternative C-1	Sediment would be transported via a permanent bypass system / a sediment trap would be created by initially dredging a TBD quantity of sediment / pump and lift stations would hydraulically pump sediment on to beach / heavy equipment would distribute sediment and create appropriate gradations
Sediment Placement	Open water disposal between 12 and 18 feet of water depth at Low Water Datum using open split-hull barges	Placed on the beach at Portage Lakefront and Riverwalk site	Similar to alternative C-1	Similar to alternative C-1
NPV Over 20 Years	$13.3 million	$25.0 million	$20.3 million	$23.3 million
Foredune and Dune Complex, Reach 3				
Sensitive Habitat Restoration				
	Preserve panne and foredune complex by maintaining natural processes	Continue current management actions. In addition, restore the foredune and dune complex by stabilizing select areas of eroded dunes with native vegetation, and preserve existing ecological conditions by sustaining natural coastal processes.		
	Preserve Pitcher's thistle populations at blowouts, including Portage Lakefront and Riverwalk			
Invasive Vegetation Management				
	Manage nonnative invasive plant species in the panne	Continue current management actions. In addition, implement an early detection and rapid response program and protocols, and implement integrated pest management strategies.		
Anthropogenic Influences				
	Provide education and outreach to visitors	Continue current management actions. In addition, reduce social trails and other anthropogenic influences on the foredune complex.		
Foredune and Dune Complex, Reach 4				
Sensitive Habitat Restoration				
	Preserve the pannes at the West Beach and Miller units by managing nonnative invasive plant species, targeting purple loosestrife, common reed, and hybrid cattail	Continue current management actions. In addition, restore the foredune and dune complex by stabilizing select areas of eroded dunes with native vegetation, and fence-off highly eroded and environmental sensitive areas on the foredunes to allow for ecological recovery of natural communities.		
Invasive Vegetation Management				
	Manage existing nonnative invasive plant species. Targets include the following: common reed, purple loosestrife, and white cattail in the pannes; sand ryegrass on the beach and foredunes; and yellow sweet clover and prairie sunflower.	Continue current management actions. In addition, implement an early detection and rapid response program and protocols, and implement integrated pest management strategies.		
	Map and monitor treated nonnative invasive plant species			

TABLE 2-2B. COMPARISON OF ALTERNATIVES, REACHES 3 AND 4

Evaluation Criteria	Alternatives			
	Alternative A No-action	Alternative C-1 Beach Nourishment via Dredged Sources, Annual Frequency (Preferred Alternative)	Alternative C-5 Beach Nourishment via Dredged Sources, Five-Year Frequency	Alternative D Beach Nourishment via Permanent Bypass System
Anthropogenic Influences				
	Provide education and outreach to visitors	Continue current management actions. In addition, designate and enforce appropriate routes to and from parking lots; reduce social trails; and fence-off highly eroded and environmental sensitive areas in the foredune complex, including pannes, to reduce trampling of native vegetation.		
How the Alternatives Meet the Objectives of the Plan				
Shoreline Restoration Does the alternative develop strategies that would support the reestablishment of more sustainable shoreline sediment movement and a more natural ecosystem of shoreline vegetation and foredune and dune complexes?				
	No – Under the no-action alternative, the park would not develop strategies for sustainable shoreline sediment movement.	Yes – Under the proposed action alternatives, strategies for sustainable shoreline sediment movement and a more natural ecosystem of the shoreline would be developed.		
Exotic and Invasive Species Does the alternative develop new strategies to identify, manage, and remove aquatic and terrestrial exotic and invasive species; and develop strategies to support ongoing management efforts to remove aquatic and terrestrial exotic and invasive species and to prevent conditions detrimental to those effects?				
	No – Under the no-action alternative, no new strategies would be developed.	Yes – Under the proposed action alternatives, new strategies to identify, manage, and remove aquatic and terrestrial exotic and invasive species, and new strategies to support ongoing management efforts to remove aquatic and terrestrial exotic and invasive species would be developed.		
Management Methodology Does the alternative determine shoreline desired conditions that would serve as thresholds for management actions within Indiana Dunes National Lakeshore; and develop and implement an adaptive management approach for maintaining a sustainable shoreline ecosystem within Indiana Dunes National Lakeshore?				
	No – Under the no-action alternative, there would be no adaptive management approach.	Yes – Under the proposed action alternatives, desired conditions would be developed and an adaptive management approach would be implemented.		

Notes:

NIPSCO = Northern Indiana Public Service Company
NPV = net present value
TBD = to be determined
yd^3 = cubic yards

TABLE 2-3. ALTERNATIVES IMPACTS TABLE, REACHES 1 AND 2

Impact Topic	Alternative A (No-action Alternative)	Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency)	Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency)	Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency)	Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)	Alternative D (Beach Nourishment via Permanent Bypass System)	Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency)	Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline) - Preferred Alternative
Coastal Processes								
Sediment Transport Process	Moderate, long-term, adverse impacts due to continued sediment budget deficit and shoreline erosion.	Moderate, long-term, beneficial impacts from balancing the sediment budget deficit and improved protection of the shoreline from erosion.	Moderate, long-term, beneficial impacts from balancing the sediment budget deficit and improved protection of the shoreline from erosion.	Moderate to major, long-term, beneficial impacts as the estimated sediment budget deficit would be provided from an updrift source, that would more closely mimic natural conditions.	Moderate to major, long-term, beneficial impacts as the estimated sediment budget deficit would be provided from an updrift source, that would more closely mimic natural conditions.	Moderate to major, long-term, beneficial impacts as the estimated sediment budget deficit would be provided from an updrift source, that would more closely mimic natural processes.	Moderate, long-term, beneficial impacts from a balanced sediment budget deficit, and additional protection of the shoreline and lake bottom from erosion.	Moderate, long-term, beneficial impacts from a balanced sediment budget deficit, and additional protection of the shoreline and lake bottom from erosion.
Foredune and Dune Formation Process	Moderate, long-term, adverse impacts due to the continued sediment budget deficit that creates a deficit of material for dune formation.	Moderate, long-term, beneficial impacts as the sediment placed on the beach would allow for additional sediment supply to create foredunes.	Moderate to major, long-term, beneficial impacts as the additional quantity of material on the beach would foster foredune development.	Moderate, long-term, beneficial impacts as the sediment placed on the beach would allow for additional sediment supply to create foredunes.	Moderate to major, long-term, beneficial impacts as the additional quantity of material on the beach would foster foredune development.	Moderate, long-term, beneficial impacts as the sediment placed on the beach would allow for additional sediment supply to create foredunes.	Moderate, long-term, beneficial impacts as the sediment placed on the beach would allow for additional sediment supply to create foredunes.	Moderate, long-term, beneficial impacts as the nourishment material placed on the beach would allow for additional sediment supply to create foredunes.
Aquatic Fauna	Minor, short-term, adverse impacts as fish would be temporarily displaced due to turbidity, and the benthic communities would be smothered during placement of sediment. Negligible, short-term, adverse impacts as nourishment activities would result in a disrupted environment, which would allow for the introduction/ establishment of invasive and nonnative species.	Minor, short-term adverse impacts as fish would be temporarily displaced due to turbidity. The benthic communities would be temporarily smothered during placement of sediment. Negligible, short-term, adverse impacts as nourishment activities would result in a disrupted environment, which would allow for the introduction/ establishment of invasive and nonnative species. Minor, long-term, beneficial impacts as there would be less environmental stress from erosion and no disturbance from dredging.	Moderate, long-term, adverse impacts due to the duration of placement activities. Fish would be displaced and fish life-cycles would be interrupted. The larger footprint of the placement area would result in smothering of benthic communities along the majority of reach 1. Negligible, short-term, adverse impacts as nourishment activities would result in a disrupted environment, which would allow for the introduction/ establishment of invasive and nonnative species. Minor, long-term, beneficial effects from reducing erosion in the area and enhancing the fish and benthic habitat.	Minor, short-term, adverse impacts as fish would be temporarily displaced due to turbidity. The benthic communities would be temporarily smothered during placement of sediment. Negligible, short-term, adverse impacts as nourishment activities would result in a disrupted environment, which would allow for the introduction/ establishment of invasive and nonnative species. Minor, long-term, beneficial effects from reducing erosion in the area and enhancing the fish and benthic habitat.	Moderate to major, short- and long-term, adverse impacts as fish would be displaced and fish life cycles would be interrupted. The larger footprint of the placement area would result in smothering of the benthic communities along the majority of reach 1. Negligible, short-term, adverse impacts as nourishment activities would result in a disrupted environment, which would allow for the introduction/ establishment of invasive and nonnative species. Minor, long-term, beneficial effects from reducing erosion in the area and enhancing the benthic and fish habitat.	Minor, short-term, adverse impacts as fish would be temporarily displaced due to turbidity. The benthic communities would be temporarily smothered during the placement of sediment. Negligible, short-term, adverse impacts as nourishment activities would result in a disrupted environment, which would allow for the introduction/ establishment of invasive and nonnative species. Minor, long-term, beneficial effects from reducing erosion in the area and enhancing the benthic and fish habitat.	Minor, short-term, adverse impacts as fish would be temporarily displaced during construction and nourishment activities. The benthic communities would be smothered during placement of the sediment. Minor, long-term, adverse impacts as the aggregate material - and associated interstitial spaces - in the submerged cobble berm would be an attractive habitat for invasive and nonnative species until the material had dissipated and was covered by sediment. Moderate, long-term, beneficial impacts as the aggregate material placed would create additional benthic and fish habitat and reduce the effects from erosion in the area.	Minor, short-term, adverse impacts as fish would be temporarily displaced during beach nourishment activities. The benthic communities would be smothered during placement of the sediment. Moderate, long-term, beneficial impacts as the coarse material and small native stones placed would create additional benthic and fish habitat and reduce the effects from erosion in the area.

TABLE 2-3. ALTERNATIVES IMPACTS TABLE, REACHES 1 AND 2

Impact Topic	Alternative A (No-action Alternative)	Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency)	Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency)	Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency)	Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)	Alternative D (Beach Nourishment via Permanent Bypass System)	Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency)	Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline) - Preferred Alternative
Terrestrial Habitat	Minor, short- and long-term, adverse impacts from the erosion and destabilization of habitat that would continue from taking no new actions in the park, including any actions to invite or deter invasive and nonnative plants. Taking no new actions in the park would not improve the ability of the beach to withstand storm events and preserve habitat.	Minor, short-term, adverse impacts from the introduction of invasive nonnative plant species into the park during sediment placement activities. Minor, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion. Negligible to minor, short-term, beneficial effects from the improved ability of the beach to withstand storm events and preserve terrestrial habitat for plants and animals.	Minor, long-term, adverse impacts from the introduction of invasive nonnative plant species into the park during sediment placement activities, and from the longer duration of nourishment activities and the larger footprint of sediment placed on the beach. Minor, long-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion, and from a reduction in the erosion and degradation of the foredune and colonization by invasive and nonnative plant species. Negligible to minor, long-term, beneficial effects from the improved ability of the beach to withstand storm events and preserve terrestrial habitat.	Negligible to minor, short-term, adverse impacts from re-vegetation efforts that would affect sensitive habitats. Minor, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion. Negligible to minor, short-term, beneficial effects from the improved ability of the beach to withstand storm events and preserve terrestrial habitat for plants, and since material dredged from the lake bottom would have no or limited viable nonnative invasive plant species seedbank.	Negligible to minor, short-term, adverse impacts from re-vegetation efforts that would affect sensitive habitats. Moderate, short-term, beneficial impacts from nourishment of the park shoreline. Moderate, long-term, adverse impacts from the longer duration of nourishment activities and the larger footprint of sediment placed on the beach. Negligible to minor, long-term, beneficial effects from the improved ability of the beach to withstand storm events and preserve terrestrial habitat for plants, and since material dredged from the lake bottom would have no or limited viable nonnative invasive plant species seedbank.	Negligible to minor, short-term, adverse impacts from re-vegetation efforts that would affect sensitive habitats. Minor, short-term, beneficial impacts from nourishment of the park shoreline, and from the decreased erosion and improved natural ecological setting for native plants and animals. Minor, short-term, adverse impacts as some beach vegetation would be smothered during placement activities. Negligible to minor, short-term, beneficial effects from the improved ability of the beach to withstand storm events and preserve terrestrial habitat.	Minor, long-term, beneficial impacts from dune stabilization and foredune development. Minor, long-term, adverse effects from interference with an already stable area in reach 2. Minor to moderate, long-term, beneficial impacts from restoration of the park shoreline, particularly in areas of accelerated erosion, and from the reduced consumption of material for nourishment activities. Negligible to minor, short-term, beneficial effects from the improved ability of the beach to withstand storm events and preserve terrestrial habitat for plants and animals.	Minor, long-term, beneficial impacts from dune stabilization and foredune development. Minor, long-term, adverse effects from interference with an already stable area in reach 2. Minor to moderate, long-term, beneficial impacts from restoration of the park shoreline, particularly in areas of accelerated erosion, and from the reduced consumption of material for beach nourishment activities. Negligible to minor, short-term, beneficial effects from the improved ability of the beach to withstand storm events and preserve terrestrial habitat for plants and animals.

TABLE 2-3. ALTERNATIVES IMPACTS TABLE, REACHES 1 AND 2

Impact Topic	Alternative A (No-action Alternative)	Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency)	Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency)	Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency)	Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)	Alternative D (Beach Nourishment via Permanent Bypass System)	Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency)	Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline) - Preferred Alternative
Threatened and Endangered Species and Species of Concern	Moderate, short-term, adverse impacts from continued erosion, loss of habitat for piping plover and Pitcher's thistle, and continued sediment budget deficit. May affect, and is likely to adversely affect piping plover and Pitcher's thistle because development of future habitat is not addressed and substantial erosion would continue. No effect on the Karner blue butterfly, Indiana bat, and eastern massasauga rattlesnake as beach nourishment activities would not affect their habitat.	Moderate to major, short-term, beneficial impacts on Pitcher's thistle and piping plover (threatened and endangered species), from the habitat restoration that would result from the expanded beach nourishment activities. Minor, short-term, adverse impacts as placement of nourishment material from an upland source would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. May affect, but is not likely to adversely affect piping plover and Pitcher's thistle as beach nourishment activities would result in habitat restoration. No effect on the Karner blue butterfly, Indiana bat, and eastern massasauga rattlesnake as beach nourishment activities would not affect their habitat.	Moderate to major, long-term, beneficial impacts on Pitcher's thistle and piping plover from the habitat restoration that would result from the expanded beach nourishment activities. Moderate, long-term, adverse impacts on these species as placement of nourishment material from an upland source would disturb the ability of piping plover to nest and for Pitcher's thistle to establish. May affect, but is not likely to adversely affect piping plover and Pitcher's thistle as beach nourishment activities would result in habitat restoration. No effect on the Karner blue butterfly, Indiana bat, and eastern massasauga rattlesnake as beach nourishment activities would not affect their habitat.	Moderate to major, short-term, beneficial impacts from the habitat restoration that would result from the expanded beach nourishment activities. Minor, short-term, adverse impacts as placement of nourishment material would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. May affect, but is not likely to adversely affect piping plover and Pitcher's thistle as beach nourishment activities would result in habitat restoration. No effect on the Karner blue butterfly, Indiana bat, and eastern massasauga rattlesnake as beach nourishment activities would not affect their habitat.	Moderate to major, long-term, beneficial impacts on Pitcher's thistle and piping plover from the habitat restoration that would result from the expanded beach nourishment activities. Minor to moderate, short-term, adverse impacts on these species as placement of nourishment material would disturb the ability of piping plover to nest and for Pitcher's thistle to establish. May affect, but is not likely to adversely affect piping plover and Pitcher's thistle as beach nourishment activities would result in habitat restoration. No effect on the Karner blue butterfly, Indiana bat, and eastern massasauga rattlesnake as beach nourishment activities would not affect their habitat.	Moderate to major, short-term, beneficial impacts from the habitat restoration that would result from the expanded beach nourishment activities. Minor, short-term, adverse impacts as placement of nourishment material would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish, and from the temporary visual intrusions being introduced in to the park during construction of the permanent bypass system. May affect, but is not likely to adversely affect piping plover and Pitcher's thistle as beach nourishment activities would result in habitat restoration. No effect on the Karner blue butterfly, Indiana bat, and eastern massasauga rattlesnake as beach nourishment activities would not affect their habitat.	Major, long-term, beneficial impacts on Pitcher's thistle and piping plover from the habitat restoration that would result from the placement of the submerged cobble berm. Minor, short-term, adverse impacts as placement of nourishment material would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. May affect, but is not likely to adversely affect piping plover and Pitcher's thistle as beach nourishment activities would result in habitat restoration. No effect on the Karner blue butterfly, Indiana bat, and eastern massasauga rattlesnake as beach nourishment activities would not affect their habitat.	Major, long-term, beneficial impacts on Pitcher's thistle and piping plover from the habitat restoration that would result from placement of the nourishment material Minor, short-term, adverse impacts as placement of nourishment material would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. May affect, but is not likely to adversely affect piping plover and Pitcher's thistle as beach nourishment activities would result in habitat restoration. No effect on the Karner blue butterfly, Indiana bat, and eastern massasauga rattlesnake as beach nourishment activities would not affect their habitat.
Wetlands and Pannes†	Not applicable (see note below).	Not applicable (see note below).	Not applicable (see note below).	Not applicable (see note below).	Not applicable (see note below).	Not applicable (see note below).	Not applicable (see note below).	Not applicable (see note below).
Soundscape	Minor, short-term adverse impacts from beach nourishment activities related to sound generated from the trucks hauling the sediment and equipment grading the nourishment material along the beach.	Negligible to minor, short-term, adverse impacts from beach nourishment activities related to sound generated from the trucks hauling the sediment and equipment grading the nourishment material along the beach.	Minor to moderate, long-term, adverse impacts from beach nourishment activities related to sound generated from trucks hauling sediment and equipment grading the nourishment material along the beach.	Negligible to minor, short-term, adverse impacts from beach nourishment activities related to sound generated from barges and equipment grading the nourishment material along the beach.	Minor to moderate, short-term, adverse impacts from beach nourishment activities related to sound generated from equipment grading the nourishment material along the beach and from dredging operations.	Negligible to minor, short-term, adverse impacts from the sound that would be generated from construction and associated operations of the permanent bypass system.	Negligible, short-term, adverse impacts from the beach nourishment activities related to sound generated from construction and beach nourishment activities and equipment grading the nourishment material along the beach.	Negligible to minor, short-term, adverse impacts from beach nourishment activities related to sound generated from the barges and the trucks hauling the stone and equipment mixing and grading the nourishment material along the beach.

TABLE 2-3. ALTERNATIVES IMPACTS TABLE, REACHES 1 AND 2

Impact Topic	Alternative A (No-action Alternative)	Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency)	Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency)	Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency)	Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)	Alternative D (Beach Nourishment via Permanent Bypass System)	Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency)	Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline) – Preferred Alternative
Visitor Experience	Minor to moderate, short- and long-term, adverse impacts from continued temporary beach closings and ongoing degradation of popular visitor amenities from continued shoreline erosion.	Minor, short-term, adverse impacts from temporary beach and trail closings for nourishment activities in reach 1, and the visual intrusions being introduced in to the park (i.e., grading equipment). Minor, short-term, beneficial impacts from the temporary increase in beach size, and the reduction in future trail closings.	Minor to moderate, long-term, adverse impacts from the visual intrusions being introduced into the park during beach nourishment activities (i.e., grading equipment), and from the beach and trail closings during placement work. Minor, short- and long-term, beneficial impacts from the temporary increase in beach size, and the future reduction in beach closings for nourishment activities due to the decrease in erosion.	Minor, short-term, adverse impacts from the temporary beach closings, and visual intrusions being introduced into the park during placement activities (i.e., grading equipment). Minor, short-term, beneficial impacts from the temporary increase in beach size, and the decrease in future beach closings that would result from less restoration work having to be performed (from reduced erosion.	Moderate, short-term, adverse impacts from temporary beach and trail closings during dredging and placement activities, and from the visual intrusions such activities and equipment would introduce into the visitor's viewshed. Minor, short- and long-term, beneficial impacts from the temporary increase in beach size and the decrease in future beach closings that would result from reduced erosion (and thus reduced maintenance/restoration activities that require beach closings).	Minor, short-term, adverse impacts from temporary beach closings, construction of the permanent bypass system, and hazards posed to nonconfident swimmers by the lift and pump stations. Minor, short-term, beneficial impacts from the reduction in future beach closings that would result from less cyclic maintenance and restoration work needing to be performed from reduced erosion, as well as from the temporary increase in beach size. Minor, long-term, adverse impacts from the visual intrusion the small lift stations would introduce to the park.	Minor, short- and long-term, adverse impacts from the temporary beach closings during construction of the submerged cobble berm, and from the visual intrusion the submerged cobble berm would introduce into the park and the safety concerns it would pose before dissipation. The park would consider implementing mitigation measures to offset safety concerns. Minor, short- and long-term, beneficial impacts from the reduced maintenance demands and reduced restoration demands that would result in fewer beach and trail closings.	Minor, short-term, adverse impacts from temporary beach and trail closings for nourishment activities in reach 1, and the visual intrusions being introduced in to the park (i.e., mixing and grading equipment). Minor, short-term, beneficial impacts from the temporary increase in beach size, and the reduction in future trail closings.

TABLE 2-3. ALTERNATIVES IMPACTS TABLE, REACHES 1 AND 2

Impact Topic	Alternative A (No-action Alternative)	Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency)	Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency)	Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency)	Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)	Alternative D (Beach Nourishment via Permanent Bypass System)	Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency)	Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline) – Preferred Alternative
Park Operations	Minor, long-term, adverse impacts from taking no new actions in the park and continuing with the existing clean sediment beach nourishment in reach 1, resulting in growing workload demands and maintenance operation costs for park staff.	Minor, short-term, adverse impacts from the increased demands that would be placed on park staff and budgets annually. Minor, short-term, beneficial impacts from the resulting reductions in annual cyclic maintenance/restoration work that the park performs.	Moderate, long-term, adverse impacts from the additional planning, execution, and monitoring tasks that would tax employees and operating budgets for approximately 18 months every five years during beach nourishment activities. Minor, long-term, beneficial impacts from reduced cyclic maintenance/restoration demands on park staff and park dollars over each five-year period.	Minor, short-term, adverse impacts from the increased demands that would be placed on staff and budgets each year during the approximate two-month period for beach nourishment activities. Minor, short-term, beneficial impacts from the annual decrease in maintenance/restoration work required by park staff and of park budgets.	Moderate, short-term, adverse impacts from the demands the associated beach nourishment activities would place on park staff and budgets. Minor, long-term, beneficial impacts from the resulting decrease in cyclic maintenance/restoration work performed in the park from the decrease in erosion.	Minor to moderate, short- and long-term, adverse impacts from the additional staff time and operating dollars the associated beach nourishment actions would require, especially the routine monitoring and maintenance of the permanent bypass system for the life of this plan. Minor, short-term, beneficial impacts from the decrease in maintenance/restoration work that would result from the decrease in erosion that would occur from the annual beach nourishment activities.	Minor, short-term, adverse impacts from the increase in park staff responsibilities and the increased demands placed on the park's operating budget during construction of the submerged cobble berm. Moderate, long-term, beneficial impacts from the reduced maintenance demands, reduced restoration demands, and lower operating budgets over the life of this plan.	Minor, short-term, adverse impacts from the increased demands that would be placed on park staff and budgets annually. Minor, short-term, beneficial impacts from the resulting reductions in annual cyclic maintenance/restoration work that the park performs.

Notes:

Short-term: days up to one year.

Long-term: greater than one year.

Additional impacts on the impact topics would result from the proposed management actions specific to the foredune and dune complex (as discussed in "The Alternatives" chapter. The proposed management actions would result in long-term, beneficial impacts as they are intended to improve the ecological quality of the terrestrial environment along Indiana Dunes National Lakeshore.

† The overall acreage or type of wetlands and pannes either within or outside of the project area would not be impacted by the shoreline and beach complex nourishment alternatives listed; rather, impacts on wetlands and pannes as a result of the proposed management actions (as discussed in "The Alternatives" chapter) would be long-term and beneficial.

TABLE 2-4. ALTERNATIVES IMPACTS TABLE, REACHES 3 AND 4

Impact Topic	Alternative A (No-action Alternative)	Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency) - Preferred Alternative	Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)	Alternative D (Beach Nourishment via Permanent Bypass System)
Coastal Processes				
Sediment Transport Process	Minor to moderate, long-term, adverse impacts from the continuation of an overall sediment budget deficit.	Moderate, long-term, beneficial impacts as the sediment budget deficit would be provided from an updrift source, that would more closely mimic natural conditions.	Moderate, long-term, beneficial impacts as the sediment budget deficit would be provided from an updrift source, that would more closely mimic natural conditions.	Moderate, long-term, beneficial impacts as the sediment budget deficit would be provided from an updrift source, that would more closely mimic natural conditions.
Foredune and Dune Formation Process	Moderate, long-term, adverse impacts due to a lack of beach sediment for foredune formation.	Moderate, long-term, beneficial impacts as the sediment placed on the beach would allow for additional sediment supply to create foredunes.	Moderate to major, long-term, beneficial impacts as the additional quantity of material on the beach would foster foredune development.	Moderate, long-term, beneficial impacts as the sediment placed on the beach would allow for additional sediment supply to create foredunes.
Aquatic Fauna	Minor, short-term, adverse impacts as fish would be temporarily displaced due to turbidity, and the benthic communities would be smothered during the placement of sediment. Impacts would be localized to the placement area. Negligible, short-term, adverse impacts as nourishment activities would result in a disrupted environment, which would allow for the introduction/establishment of invasive and nonnative species.	Minor, short-term, adverse impacts as fish would be temporarily displaced due to turbidity. The benthic communities would be temporarily smothered during placement of sediment. Negligible, short-term, adverse impacts as nourishment activities would result in a disrupted environment, which would allow for the introduction/establishment of invasive and nonnative species. Minor, long-term, beneficial effects from reducing erosion in the area and enhancing the fish and benthic habitat.	Moderate to major, short- and long-term, adverse impacts due to the nourishment placement activities. Fish would be displaced, and fish life cycles would be interrupted. The larger footprint of the placement area would result in smothering of the benthic communities along most of reach 3. Negligible, short-term, adverse impacts as nourishment activities would result in a disrupted environment, which would allow for the introduction/establishment of invasive and nonnative species. Minor, long-term, beneficial effects from reducing erosion in the area and enhancing the fish and benthic habitat.	Minor, short-term, adverse impacts as fish would be temporarily displaced due to turbidity. The benthic communities would be temporarily smothered during placement of sediment. Negligible, short-term, adverse impacts as nourishment activities would result in a disrupted environment, which would allow for the introduction/ establishment of invasive and nonnative species. Minor, long-term, beneficial effects from reducing erosion in the area and enhancing the benthic and fish habitat.
Terrestrial Habitat	Minor, short- and long-term, adverse impacts from the erosion and destabilization of habitat that would continue from taking no new actions in the park, including any actions to invite or deter invasive and nonnative plants. Taking no new actions in the park would not improve the ability of the beach to withstand storm events and preserve habitat for plants and animals.	Negligible to minor, short-term, adverse effects from re-vegetation that would affect sensitive habitat and as some beach vegetation would be smothered during placement. Minor, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion. Negligible to minor, short-term, beneficial impacts since material dredged from the lake bottom would have no or limited viable nonnative invasive plant species seedbank, and from the improved ability of the beach to withstand storm events and preserve terrestrial habitat for plants and animals.	Negligible to minor, short-term, adverse impacts from re-vegetation that would affect sensitive habitats. Moderate, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion. Moderate, long-term, adverse effects from the approximate six-month duration of placement activities every five years and the larger placement footprint. Negligible to minor, long-term, beneficial impacts since material dredged from the lake bottom would have no or limited viable nonnative invasive plant species seedbank, and from the improved ability of the beach to withstand storm events and preserve terrestrial habitat for plants and animals.	Negligible, short-term, adverse impacts from re-vegetation that would affect sensitive habitats. Minor, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion, and decreased degradation of the beach and consequently the foredune plant communities, resulting in improved terrestrial habitat for native plants and animals to thrive on. Minor, short-term, adverse impacts as some beach vegetation would be smothered during placement. Negligible to minor, short-term, beneficial impacts since material from an updrift location would have no or limited viable nonnative invasive plant species seedbank, and from the improved ability of the beach to withstand storm events and preserve terrestrial habitat for plants and animals.

TABLE 2-4. ALTERNATIVES IMPACTS TABLE, REACHES 3 AND 4

Impact Topic	Alternative A (No-action Alternative)	Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency) – Preferred Alternative	Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)	Alternative D (Beach Nourishment via Permanent Bypass System)
Threatened and Endangered Species and Species of Concern	Moderate, short-term, adverse impacts from continued erosion, loss of habitat for piping plover and Pitcher's thistle, and continued sediment budget deficit. May affect, and is likely to adversely affect piping plover and Pitcher's thistle because development of future habitat is not addressed and substantial erosion would continue. No effect on the Karner blue butterfly, Indiana bat, and eastern massasauga rattlesnake as beach nourishment activities would not affect their habitat.	Moderate to major, short-term, beneficial impacts from the habitat restoration that would result from the expanded beach nourishment activities. Coupled with beach nourishment, dredging would not be an adverse modification to the piping plover habitat. Minor, short-term, adverse impacts as placement of nourishment material would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. May affect, but is not likely to adversely affect piping plover and Pitcher's thistle as beach nourishment activities would result in habitat restoration. No effect on the Karner blue butterfly, Indiana bat, and eastern massasauga rattlesnake as beach nourishment activities would not affect their habitat.	Moderate to major, long-term, beneficial impacts from the habitat restoration that would result from the expanded beach nourishment activities. Coupled with beach nourishment, dredging would not be an adverse modification to the piping plover habitat. Minor to moderate, short-term, adverse impacts on these species as placement of nourishment material would disturb the ability of piping plover to nest and for Pitcher's thistle to establish. May affect, but is not likely to adversely affect piping plover and Pitcher's thistle as beach nourishment activities would result in habitat restoration. No effect on the Karner blue butterfly, Indiana bat, and eastern massasauga rattlesnake as beach nourishment activities would not affect their habitat.	Moderate to major, short- term, beneficial impacts as habitat loss would diminish and the possibility of the establishment of a natural ecosystem would be likely. Minor, short-term, adverse impacts during placement activities from the temporary disturbance to habitat, and from the visual intrusions being introduced in to the park during construction of the permanent bypass system. Coupled with beach nourishment, a permanent bypass system would not be an adverse modification to the piping plover habitat. May affect, but is not likely to adversely affect piping plover and Pitcher's thistle as beach nourishment activities would result in habitat restoration. No effect on the Karner blue butterfly, Indiana bat, and eastern massasauga rattlesnake as beach nourishment activities would not affect their habitat.
Wetlands and Pannes†	Not applicable (see note below).	Not applicable (see note below).	Not applicable (see note below).	Not applicable (see note below).
Soundscape	Minor, short-term adverse impacts from beach nourishment activities related to sound generated from the equipment grading the nourishment material along the beach.	Negligible to minor, short-term, adverse impacts from sound generated by barges and equipment grading the nourishment material along the beach.	Minor to moderate, short-term, adverse impacts from sound generated by barges and equipment grading the nourishment material along the beach.	Negligible to minor, short-term, adverse impacts from the sound that would be generated from construction and associated operation of the permanent bypass system.
Visitor Experience	Minor to moderate, short- and long-term, adverse impacts from continued temporary beach closings and ongoing degradation of popular visitor amenities from continued shoreline erosion.	Minor, short-term, adverse impacts from the visual intrusions introduced into the park (i.e., barges and grading equipment), and from the annual beach and trail closings that would be required during nourishment activities for safety reasons. Minor, short-term, beneficial impacts from the temporary increase in beach size in reach 3 (resulting in an expanded area for visitor use and enjoyment), and from reductions in the amount of maintenance/ restoration work required from decreased erosion (resulting in fewer beach closings).	Moderate, short-term, adverse impacts from extended beach closings, and from visual intrusions being introduced into the visitors' viewshed (i.e., barges and grading equipment). Minor, short- and long-term, beneficial impacts from the temporary increase in beach size (resulting in an expanded area for visitor use and enjoyment), providing visitors with an expanded area to use and enjoy, and from the reduction in future maintenance/restoration work in the park (which would reduce the number of beach and trail closings).	Minor, short-term, adverse impacts from temporary beach closings, and from the visual intrusions being introduced into the park during construction of the permanent bypass system. Minor, short-term, beneficial impacts from the reduction in future beach closings that would result from less cyclic maintenance and restoration work needing to be performed from reduced erosion, as well as from the temporary increase in beach size (resulting in an expanded area for visitor use and enjoyment). Minor, long-term, adverse impacts from the visual intrusion the pump and lift stations would introduce to the park.
Park Operations	Minor, long-term, adverse impacts from taking no new actions in the park and continuing with the existing clean sediment beach nourishment in reach 3, resulting in growing workload demands and maintenance operation costs for park staff.	Minor, short-term, adverse impacts from the additional demands that would be placed on park staff and park operating budgets to plan and carry out the required actions annually over an approximate two-month period. Minor, short-term, beneficial impacts from the savings and decreased workloads that would result from the reduced maintenance/restoration demands that would come with less shoreline erosion.	Moderate, short-term, adverse impacts from the additional demands that would be placed on park staff and park budgets (for approximately six months every five years) to carry out the actions associated with this alternative. Minor, long-term, beneficial impacts from the reductions in maintenance/ restoration work as the actions associated with this alternative would decrease erosion in the park.	Minor to moderate, short- and long-term, adverse impacts from the additional staff time and operating dollars the associated beach nourishment actions would require, especially the routine monitoring and maintenance of the permanent bypass system for the life of this plan. Minor, short-term, beneficial impacts from the associated erosion decrease and resultant decrease in required maintenance/restoration work by park staff (reducing operating budget drains).

Notes:
Short-term: days up to one year.
Long-term: greater than one year.
Additional impacts on the impact topics would result from the proposed management actions specific to the foredune and dune complex (as discussed in "The Alternatives" chapter. The proposed management actions would result in long-term, beneficial impacts as they are intended to improve the ecological quality of the terrestrial environment along Indiana Dunes National Lakeshore.
† The overall acreage or type of wetlands and pannes either within or outside of the project area would not be impacted by the shoreline and beach complex nourishment alternatives listed; rather, impacts on wetlands and pannes as a result of the proposed management actions (as discussed in "The Alternatives" chapter) would be long-term and beneficial.




CHAPTER 3
Affected Environment

INTRODUCTION

The "Affected Environment" chapter describes existing conditions for those elements of the natural environment that would be affected by the implementation of the actions considered in this *Shoreline Restoration and Management Plan / Draft Environmental Impact Statement* (EIS). The natural environment components addressed include coastal processes, aquatic fauna, terrestrial habitat, threatened and endangered species and species of concern, and wetlands and pannes. Soundscapes, visitor experience, and park operations are also addressed. Impacts for each of these topics are analyzed in the "Environmental Consequences" chapter.

INDIANA DUNES NATIONAL LAKESHORE BACKGROUND

Lake Michigan Geological Setting

Southern Lake Michigan lies within the western half of the Michigan basin, a geologic depression formed as a result of tectonic activity. Since the last glacial retreat began approximately 12,000 years ago, the southern Lake Michigan shoreline has been shaped by the forces of a dynamic environment, including lake level fluctuations, shoreline erosion, and sediment deposition. This glacial retreat, re-advance, and retreat from early Lake Michigan (paleo-Lake Chicago), referred to as the Wisconsin Glacial Episode of the Pleistocene Epoch (Pielou 1991), is responsible for many of today's geologic formations at Indiana Dunes National Lakeshore (Foster and Folger 1994). The geographical features, as such, were created through the interaction of lake recession, Lake Michigan surface winds, and erosion over time.

HYDROGEOLOGIC SETTING

The relationship between groundwater and surface water in the Great Lakes region is one that, while important, is not well understood. In most instances, the natural flow of a stream includes both a surface water runoff component and a groundwater inflow component. The groundwater component comprises most of the drainage into Lake Michigan; it is estimated that approximately 80% of the total annual flow of tributary streams to Lake Michigan originate as groundwater. This water tends to be nearly constant in temperature despite seasonal weather changes, and is therefore vital to ecosystem functions within Lake Michigan and its tributaries (Grannemann 2004). As the groundwater entering Lake Michigan is often a non-point source for contamination (e.g., stormwater runoff), anticipating and effectively managing potentially detrimental water quality issues is unlikely and often outside the capabilities of park staff at Indiana Dunes National Lakeshore.

CLIMATE CHANGE

As previously discussed in the "Purpose and Need for Action" chapter, recent climate change trends in the Indiana Dunes National Lakeshore vicinity include:

- an increase in annual temperatures of 0.25°C per decade
- a progressive advance in the date of the last spring freeze
- increases in autumn precipitation
- doubling of frequencies of heavy rainfall events and an increase in the number of individual rainy days and week-long heavy rainfall events
- increased flooding

- an increase in the number of heat waves and record-high temperatures (Hayhoe *et al.* 2010)

Climate change may have an effect on Lake Michigan coastal processes in the future, though specific effects in the park are difficult to predict. As summer temperatures continue to rise, evaporation has begun to greatly contribute to lake level changes for the first time (since 1980). Scientists believe that the level of Lake Michigan may continue to decrease because of this (USGCRP 1996). Additionally, recent studies of the Great Lakes region indicate that ice cover in the center of the lakes shrank by more than 30% between 1970s and 2002. Through 2009, ice cover across the entire surface of the lakes had fallen 15%. It is projected that Lake Michigan may have some winters with no ice cover in as soon as ten years (Rocky Mountain Climate Organization 2011). Decreasing ice cover would increase the impacts of storms on the nearshore, and on the foredune and dune complex. With reduced winter ice and snow cover, the dunes are afforded less protection against sediment blowing away from the dunes and beach, and against wave action undercutting the shoreline, increasing erosion rates. Conversely, greater wave action would also increase the deposition of sediment in some places, thereby increasing accretion areas and the need for maintenance (Rocky Mountain Climate Organization 2011). The combination of exacerbated erosion and deposition rates would alter the Indiana Dunes National Lakeshore beach profile.

In addition, climate change may have an effect on the native fish assemblages and benthic species in the nearshore environment along Indiana Dunes National Lakeshore. Scientists believe that distribution of fish may change according to the temperature of water. Warm water fish populations are projected to expand northward, while cold water fish populations would decrease, or disappear from the Great Lakes altogether. Increasing temperatures and stronger storm events would disrupt the shallow waters where many fish spawn, threatening population levels of native fish (USGCRP 1996). As fish are forced to move to deeper waters, they may be exposed to increased predation as they would lose the protection afforded by shallower waters. Additionally, higher water temperatures also lead to lower oxygen levels, promoting release of contaminants such as phosphorus and mercury, which become more soluble when oxygen levels decrease. When fish absorb these contaminants, they are a health hazard not only for predatory fish and animals, but also humans that consume them (Rocky Mountain Climate Organization 2011).

Warmer waters may also promote the replacement of native fish species by nonnatives able to thrive in varied or disturbed environmental conditions, as native species are often adapted to a narrower range of conditions that can be disrupted by a changed climate. If, for example, the Asian carp (*Hypophthalmichthys* spp.) established in Lake Michigan, this fish would consume massive amounts of plankton, reducing the food available for native fish (Rocky Mountain Climate Organization 2011). Additionally, zebra mussels add to increased productivity in lakes by outcompeting native species and increasing water clarity that leads to accelerated algae growth (USGCRP 1996).

While scientists expect climate change to have an effect on the park's vegetation, the rate and magnitude of potential modifications are not known. It is known, however, that the growing season in the park has been expanding as spring arrives sooner, and the first freeze is occurring later. Increasing variability of temperature and precipitation are harmful to vegetation and cause diebacks. Additionally, increasing levels of carbon dioxide affect the physiology of vegetation, and may increase the productivity of trees (USGCRP 1996).

Within Indiana Dunes National Lakeshore, climate change is likely to increase the threats posed to natural plant communities by nonnative invasive plants, since invasive plants typically thrive in a wider range of environmental conditions and can out-compete native plants for water, nutrients, and other plant essentials. A warmer climate would promote the spread of even more invasive plants into the park (Rocky Mountain Climate Organization 2011).

COASTAL PROCESSES

SEDIMENT TRANSPORT PROCESSES

Changes in Lake Michigan water levels have occurred since its formation. These fluctuations in levels affect both natural and manufactured resources. Flooding and shoreline erosion result in property damage, impact wetland acreage, and impact depths of navigation channels. Unusually high lake levels in the 1950s, 1970s, and mid-1980s led to numerous investigations to identify the causes of lake level fluctuations, and potential modifications to the lake system to resolve problems associated with the extreme levels (IDNR Division of Water 1994).

In an uninterrupted system, the amount of sediment erosion or deposition that occurs in any given year at a location along the shoreline is affected by such natural factors as physical configuration of the shoreline, wave approach angle, nearshore circulation, availability of sediment, prevailing wind direction, and seasonal differences in storm intensity. In general, seasonal differences in storm intensity result in a yearly cycle of narrow winter beaches and wide summer beaches. High lake levels and severe storms usually result in the highest erosion rates along unprotected portions of a shoreline (IDNR Division of Water 1994).

Two of the greatest changes to the shoreline at Indiana Dunes National Lakeshore are navigation structures and the existence of engineered peninsulas projecting into the lake, each created primarily for industrial expansion. Approximately 4,053 acres of man-made land was created, surveyed, and is now patented in Lake Michigan (IDNR Division of Water 1994). Such human modifications have interacted with natural shoreline processes over the last century, drastically altering the Lake Michigan shoreline profile and resulting in unstable conditions. Manufactured structures disrupt sediment movement along the shoreline and impede additional supplies of sediment from moving into the system. This interrupted sediment movement has resulted in erosion of the shoreline in some locations and accumulation of sediment in others. Examples of both situations exist within reaches 1 through 4 of Indiana Dunes National Lakeshore (IDNR Division of Water 1994).

Due to a high rate of accretion on the updrift side of the Northwest Indiana Public Service Company (NIPSCO)/Bailly industrial complex, various methods have been employed to maintain the associated shipping canals and the water intake. Maintenance dredging has occurred downdrift of the Port of Indiana industrial complex at Burns International Harbor.

To combat the increasing trend of interruptions to littoral drift, the U.S. Army COE has conducted beach nourishment activities at Crescent Dune, near Mount Baldy, annually since 1974. According to a 2006 study, the average annual background erosion rate for the Great Lakes is approximately 1 meter; the beach at the toe of Mount Baldy is eroding at a rate of approximately 3 meters annually (Przybyla-Kelly and Whitman 2006). In the past 26 years, more than 1.2 million cubic yards of material has been placed at Crescent Dune, and has moved downdrift via natural wave action

(COE, Bucaro, pers. comm. 2011a). Studies conducted since 1985 have shown that sediment placed at the eastern end of the park erodes entirely within two to five years (COE 1986; Horvath *et al*. 1999).

DUNE FORMATION PROCESSES

Foredune development occurs when the lake level remains relatively constant and sediment is deposited, trapped, and held onshore by vegetation. When natural geologic conditions exist, the dynamic nature of the Indiana Dunes National Lakeshore shoreline provides many opportunities for habitat succession. Habitat connectivity and natural shoreline processes are vital to the conservation of the foredune and dune complex at the park. Historically, sediment moved naturally from the beach throughout the foredune complex in the project area, thereby providing a key link between terrestrial ecosystems and coastal processes. As Lake Michigan receded over time, foredunes succeeded into mature, stabilized dune forests. A disruption to one part of the link (e.g., eliminating natural sediment supply), affects the ecological integrity and dynamic stability of the entire foredune and dune complex in the project area.

AQUATIC FAUNA

THE NEARSHORE ENVIRONMENT

For the purposes of this plan, the nearshore area is encompassed by water depths generally less than approximately 9 meters (30 feet). It includes both higher-energy coastal margin areas and lower-energy nearshore open-water areas. Nearshore open-water areas are subject to higher wave energies and associated littoral or nearshore processes during large storm events.

Historically, Indiana Dunes National Lakeshore nearshore waters served primarily as habitat for fish, wildlife, and the aquatic organisms that supported their production. A large number of Lake Michigan fish use the nearshore waters for one or more critical life stages or functions. The nearshore waters are areas of temporary feeding or nursery grounds for some species, a year-round residence for other fish, and migratory pathways for anadromous fish (i.e., fish born in fresh water that spend most of their life in the sea and return to fresh water to spawn).

Fish species diversity and production in the nearshore waters are higher than those in offshore waters and are generally highest in the shallower, more enriched embayments with large tributary systems (Edsall and Charlton 1997). Alterations to river mouths and modifications to the shoreline at Indiana Dunes National Lakeshore have interrupted flow paths and disrupted nearshore coastal processes that create and maintain nearshore habitats. Many native species require relatively shallow, well-oxygenated waters flowing though coarse gravel and cobble substrates with protected interstitial spaces. Spawning areas are often adjacent to nearshore nursery areas, and rely on regional circulation patterns to transport larval fish into adjacent nursery areas.

The nearshore waters are not only habitat for fish, but also for many other species. Nearshore waters are critical feeding and resting habitat for waterfowl such as ducks, geese, and swans, especially during the fall and spring migrations. Aquatic mammals, including muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), otter (*Lontra canadensis*), and mink (*Mustela vison*) can be found in some undisturbed, sheltered waters in the lower reaches of tributaries and near coastal wetlands. Great Lakes nearshore waters are critical habitat for threatened or endangered species and species of special concern, including the piping plover (*Charadrius melodus*), bald eagle (*Haliaeetus leucocephalus*), osprey (*Pandion haliaetus*), and freshwater mussels.

NATIVE SPECIES

The southern shoreline of Lake Michigan, specifically along Indiana Dunes National Lakeshore, offers a rare environment within the Midwest region of the country. The sandy substrate of the lakeshore provides for benthic species and fish assemblages intertwined in a delicate food web that is easily disrupted by external forces that include water quality concerns from surrounding industrial discharges, unequal distribution of sediment supply, and the introduction of nonnative species.

MUSKRAT

Meiofauna and Macroinvertebrates

In large oligotrophic lakes like Lake Michigan, abundance of the dominant groups of benthic organisms tends to be directly proportional to the amount of available food; increased amounts of phytoplankton lead to increased amounts of organic material settling to the lake bottom, thereby providing more potential food for macrobenthos (Madenjian *et al.* 2002). In the relatively high wave energy nearshore environment, at certain sediment-starved areas along the shoreline (particularly at the base of Mount Baldy), the clay substrate naturally found beneath the sediment has been exposed, and organic matter often found in calmer waters has been carried away from the shoreline. The kinetic nature of the nearshore environment, coupled with sediment deprivation from anthropogenic influences, has resulted in low-density and diversity within the benthic communities in the project area. One study, conducted from 1996 to 1998 in conjunction with a COE beach nourishment program, showed that relatively few species were detected in the benthic communities inhabiting sandy substrates in the nearshore area (Horvath *et al.* 1999). Benthic species such as roundworm (phylum *Nematoda*), aquatic worm (subclass *Oligochaeta*), seed shrimp (subclass *Ostracoda*), bloodworm (family *Chironomidae*), and copepods (*Calanus hyperboreus*) are among the most common invertebrates identified in the sandy substrates in the project area. Two main invertebrate groups, nematoda and oligochaeta, appear to be most abundant (Przybryla-Kelly and Whitman 2006). Generally, the meiobenthos outnumber the macrobenthos in the nearshore environment (Last *et al.* 1995). A summary of benthic species in the Lake Michigan nearshore is provided in Appendix D: Species List.

A 2004 study of the benthic invertebrate community of southern Lake Michigan was conducted to evaluate the effects of beach nourishment on the nearshore environment (Garza and Whitman 2004). As many of the benthic taxa identified in the Lake Michigan nearshore are part of the detrital food web (National Oceanic and Atmospheric Administration / Great Lakes Environmental Research Laboratory 2009), the increased stability afforded by deeper water may sustain a larger benthic community by allowing for a greater accumulation of organic matter (Garza and Whitman 2004). The study did reveal a notable decrease in mean invertebrate density downdrift from the site of beach nourishment, suggesting that sediment placement affected invertebrate populations. A subsequent study conducted in 2006, however, indicated that the benthos within the nearshore experienced a relatively high rate of recovery within 8 to 12 months after nourishment activities. The densities and total number of benthic taxa increased with depth, suggesting a lower impact of sediment drift and wave action in deeper waters (Przybryla-Kelly and Whitman 2006).

Fish of Lake Michigan

The Indiana Dunes National Lakeshore nearshore waters are key areas for nutrient exchange, and serve as important spawning and nursery habitat for one or more life stages of most Lake Michigan fish. The hard clay outcroppings along the shoreline at the base of Mount Baldy and the cobble/gravel areas in reach 2, are two examples of habitat ideal for fish spawning and nurseries, particularly for yellow perch (*Perca flavescens*). The nearshore area also provides such habitats for smallmouth bass (*Micropterus dolomieu*) and other important fish. Coastal wetland habitats support spawning and early life stages of bass, sunfish, northern pike (*Esox lucius*), walleye(*Sander vitreus*), and yellow perch. Thus, natural and anthropogenic threats (e.g., armoring of shorelines, contamination of water) that degrade or alter any of these habitats severely affect fish-community diversity and relative abundance (Rutherford 2008).

Nearshore fish include recreationally and commercially important species such as yellow perch, walleye, smallmouth bass, northern pike, catfish, and sunfish, as well as nongame species, including spottail shiner (*Notropis hudsonius*), slimy sculpin (*Cottus cognatus*), mottled sculpin (*Cottus bairdii*), trout perch (*Percopsis omiscomaycus*), and johnny darter (*Etheostoma nigrum*) (Clapp *et al.* 2005).

The yellow perch is a spiny-rayed fish that experiences a diet shift during its life cycle. As young and larval fish, yellow perch feed on microscopic organisms such as zooplankton, but with increasing size, macroinvertebrates (such as midges) comprise a larger portion of their diet. As adults, yellow perch diets include invertebrates, fish eggs, mysid shrimp (*Americamysis bahia*), and other fish such as minnows. Yellow perch are predominantly piscivorous, known in some cases to eat other members of the perch family (Hubbs and Lagler 1964; Bergman and Greenberg 1994). A decline in yellow perch populations in southern Lake Michigan was observed in the 1990s. Declines in prey beginning in the 1980s were noted in conjunction with the introduction of nonnative species such as the zebra mussel, round goby (*Neogobius melanostomus*), and alewife (*Alosa pseudoharengus*).

A summary of fish assemblages historically found in the Lake Michigan nearshore is provided in Appendix D: Species Lists.

INVASIVE AND NONNATIVE SPECIES

Background

Nearshore and coastal waters have provided habitat for the 184 nonnative species introduced to the Great Lakes since 1840. These habitats have been profoundly altered by nonnative species, with effects ranging from uprooting of wetland plants by common carp, to the creation of microhabitats by dreissenid mussels. The status of the Great Lakes nearshore waters with respect to nonnative and invasive species is poor. Since 1996, 18 new nonnative species have been discovered; a rate of 1.5 per year. This rate is higher than the long-term discovery rate (1.1 per year since 1840), though lower than the rate since the opening of the St. Lawrence Seaway in 1959 (1.8 per year). Despite a slightly lower discovery rate in the last 15 years, an increase in the number of nonnative species in the Great Lakes represents a deteriorating trend as additional nonnative and invasive species indicate further disruption of existing food webs, often in unpredictable and/or undesirable ways (Holeck *et al.* 2009).

Deteriorating conditions in the shallow water near the coastal zone is a fairly common theme in Lake Michigan. In general, for the last several decades offshore conditions have been improving, whereas nearshore conditions have worsened and/or failed to show sustained improvement (Mason 2009). Key invasive species identified in the Indiana Dunes National Lakeshore project area are discussed below.

Zebra and Quagga (*Dreissenid*) Mussels

Zebra mussels were first documented in Lake Michigan in 1989 and rapidly increased in nearshore rocky habitats. Quagga mussels were first documented in Lake Ontario, and were identified in Lake Michigan by 1997 (Detmers *et al.* 2008). Quagga mussels have greatly expanded their range in Lake Michigan since the early 2000s, and have replaced zebra mussels in many areas (Pothoven *et al.* 2009). Both zebra mussels and quagga mussels are natives of the Ponto-Caspian region, and are thought to have invaded the Great Lakes via ballast water.

Zebra mussels have the ability to filter water, allowing sunlight to penetrate to greater depths, potentially resulting in additional growth of algae blooms. These dreissenid mussels also may be partially responsible for the lack of improvement in nearshore water quality despite distinct improvements in offshore waters from the decline in phosphorus loadings. Some researchers suggest that dreissenids sequester phosphorus in nearshore areas through their filtering activity and through deposition of mucus covered pseudofeces (Holeck *et al.* 2009).

Dreissenid mussels compete directly with zooplankton for food because they filter phytoplankton from the water column. Since dreissenid mussels invaded Lake Michigan, zooplankton densities, when first-feeding of yellow perch larvae occurs, have declined, indirectly resulting in reduced numbers of age-0 yellow perch in the fall. It has been hypothesized that the recent decline in Diporeia (*Diporeia* spp.) populations in southern Lake Michigan is another apparent indirect effect of dreissenid mussels. This decline is relevant to the health of nearshore fish as Diporeia is an energy-rich food source and an important prey for several fish, including alewife, yellow perch, and slimy sculpin (Detmers *et al.* 2008).

Round Goby

The round goby is indigenous to the Black, Azov, and Caspian Seas (Kuhns and Berg 1999). This invader was first reported in Lake Michigan in 1993 and is an aggressive species that feeds on lake-bottom or benthic fish.

It has been suggested that round gobies have exerted both positive and negative impacts on the nearshore fish community. Despite a nearshore environment exhibiting a change in species composition as a result of invasive species, fish such as the yellow perch have been able to adapt their diet and respond positively by making round gobies a new food source for adult yellow perch (Truemper *et al.* 2006). Conversely, negative impacts from consumption of round gobies are also likely. Round gobies greater than 50 millimeters in length consume dreissenid mussels, and because of this, biomagnification of toxic substances (e.g., polychlorinated biphenyls and polychlorinated naphthalene) through the food web is likely. Additionally, round gobies have essentially eliminated important nearshore fish, including the mottled sculpin and johnny darter (Truemper *et al.* 2006; Detmers *et al.* 2008).

Potential Future Invasive and Nonnative Species in Lake Michigan

Other potential invaders may arrive during the next few years because of the high rate of commercial, industrial, and recreational use of Lake Michigan, particularly in areas adjacent to Indiana Dunes National Lakeshore. Of special concern is the possibility that silver carp (*Hypophthalmichthys molitrix*) and/or bighead carp (*Hypophthalmichthys nobilis*), collectively known as Asian carp, would enter Lake Michigan through the Chicago Sanitary and Ship Canal (CSSC), the live food trade, or other means. Three electric dispersal barriers were constructed by the COE in the CSSC to deter the interbasin transfer of invasive nonnative fish species between the Mississippi River and the Great Lakes basins. The barriers are formed of steel electrodes secured to the bottom of the CSSC, creating an electric field in the water to discourage fish from crossing (COE 2011b). Similarly, efforts among U.S. and Canadian agencies and legislative bodies are seeking to eliminate trade of live Asian carp (Detmers *et al.* 2008).

The northern snakehead (*Channa argus*) is another potential invader. This species escaped into the Potomac River basin, most likely from aquarium releases. Specimens have been collected by the Wisconsin Department of Natural Resources and the Michigan Department of Natural Resources from the non-Great Lakes waters of these states. One snakehead was collected by an angler while fishing in a Chicago harbor in October 2004. Based on an intensive sampling effort in the harbor, best estimates suggest that this snakehead was released from an aquarium and is not part of an established population. However, additional monitoring of Chicago harbors would continue to provide critical early warning signs. Other fish that would rise to pest status if they do establish in the Great Lakes include tyulka (*Clupeonella cultriventris*), Eurasian minnow (*Phoxinus*

phoxinus), Black sea silverside (*Atherina* spp.), European perch (*Perca fluviatilis*), and monkey goby (*Neogobius fluviatilis*) (Detmers *et al*. 2008).

TERRESTRIAL HABITAT

The park is within the Indiana natural region categorized as the Lake Michigan Natural Region and the Northwestern Morainal Natural Region (see Map 3-1). As shown on Map 3-1, the Lake Michigan Natural Region is entirely aquatic, comprised solely of Lake Michigan (Homoya 1985). The terrestrial portion of the project area is situated within the Northwestern Morainal Natural Region; specifically, within the Lake Michigan Border section and the Chicago Lake Plain section of this natural region.

The Lake Michigan Border section represents a narrow band immediately adjacent to Lake Michigan. It is the youngest of the morainal complexes in Northwest Indiana, representing a discontinuous dune ridge (Greenberg 2002). Beach, foredune, high dunes, and pannes are the most common natural communities within this section, with sand as the most common substrate (calcareous sand in pannes) and muck in interdunal depressions. The Chicago Lake Plain section is located farther from the lake, south and southeast of the Lake Michigan Border section, and is characterized by ridge-and-swale and lacustrine plain topography on mostly acidic sand substrates. The natural communities found most commonly in the Chicago Lake Plain section include marsh, lake, sand savanna, sand prairie, and swamp, while forests make up a less common portion of this section (Homoya 1985).

The onshore boundary of the project area encompasses portions of the dune complex and the entirety of the foredune complex within the authorized boundary of the park. The latter constitutes three distinct community types: beach, foredune, and blowout (Wilhelm 1990).

NATIVE PLANT COMMUNITIES

The park contains a great diversity of plant communities and plant species because of the influence of, and proximity to, Lake Michigan and the intersection of the prairie, boreal, and deciduous forest biomes. Littoral drift and sediment deposition have created beach ridges of various complexities, which have resulted in a concentration and juxtaposition of a wide range of natural communities (Greenberg 2002). Many plant species in the park are of conservation concern as they are located at the edge of their geographical ranges.

BEACH PEA

Foredune Complex

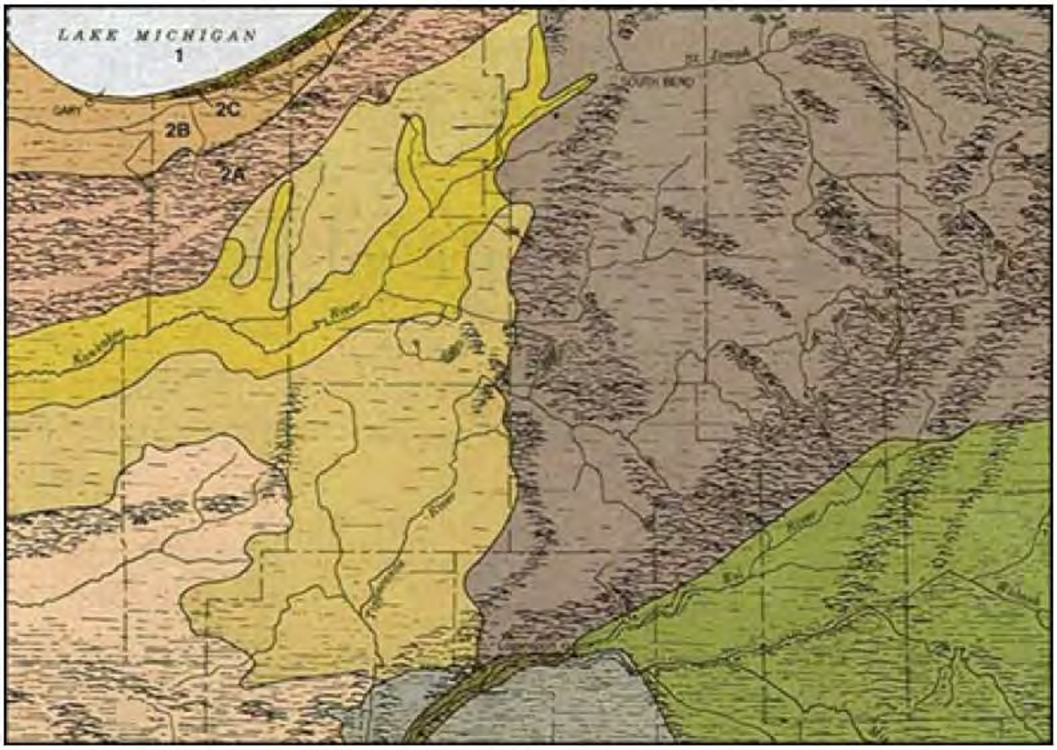
The physiography of the foredune complex is most directly influenced by natural erosion, sediment deposition, and winds produced by Lake Michigan (IDNR 2011). Three plant communities (beach, foredune, and blowout) are found within the foredune complex in the project area.

Beach Community. The beach plant community at Indiana Dunes National Lakeshore constitutes a narrow band that extends from the swash zone, the zone of wave action on the beach, to the farthest reach of storm waves. This area is also demarcated by the edge of Lake Michigan and the first line of dunes (Homoya 1985). It is influenced by wave action and shoreline dynamics and therefore, is constantly in flux. Plant species begin to colonize in the area just outside the influence of the swash zone and normal wave action. Characteristic beach plants are well adapted to the relatively harsh environmental conditions of the shoreline. American sea rocket (*Cakile edentula*) is the "vanguard of beach vegetation" (Swink and Wilhelm 1994) and today serves as one of the primary indicators of this distinct plant community. Other characteristic pioneer species of the beach plant community include American beachgrass or marram grass (*Ammophila breviligulata*), field wormwood (*Artemisia campestris* ssp. *caudata*), American bugseed (*Corispermum americanum*), and winged pigweed (*Cycloloma atriplicifolium*) (Homoya 1985; Swink and Wilhelm 1994). In addition to these beach colonizers, populations of silverweed cinquefoil (*Argentina anserine*) (an Indiana threatened species), seaside spurge (*Chamaesyce polygonifolia*)(an Indiana rare species), and beach pea (*Lathyrus japonicus* var. *maritimus*) (an Indiana endangered species) are rarely seen along the beach anymore.

Foredune Community. Foredunes are relatively small and sublinear in structure. If conditions allow, foredunes develop at the upper edge of the beach community and represent the first line of landward dune development (Wilhelm 1990). The foredune community in the project area is ranked as globally vulnerable (G3) and critically imperiled (G1) in the State of Indiana (IDNR 2011).

Foredune development is currently most active within the accretion zones in the project area along the Indiana shoreline, especially near Miller and West Beach. Foredunes generally increase in size moving from west to east (Wilhelm 1990). The foredune community intergrades with the beach community but is somewhat more stable than the latter due to the presence of established vegetation (Homoya 1985).

PITCHERS THISTLE



Legend

1 — 1. Lake Michigan Natural Region

2A / 2B / 2C — 2. Northwestern Morainal Natural Region
- A. Valparaiso Moraine Section
- B. Chicago Lake Plain Section
- C. Lake Michigan Border Section

MAP 3-1
MAP OF THE NATURAL REGIONS OF INDIANA CROPPED TO SHOW NORTHWEST INDIANA

Indiana Dunes National Lakeshore
Shoreline Restoration and Management Plan / Environmental Impact Statement

National Park Service / U.S. Department of the Interior

March 2012

Source: Hoyoma et al. 1997

American beachgrass is the primary colonizer of these embryonic dunes, and effectively stabilizes and traps windblown sediment. Other key foredune indicator species include but are not limited to the following: bearberry (*Arctostaphylos uva-ursi*), field wormwood, prairie sand reed (*Calamovilfa longifolia* var. *magna*), red-osier dogwood (*Cornus sericea*), Canada wild rye (*Elymus canadensis*), common juniper (*Juniperus communis* var. *depressa*), beach pea, jack pine (*Pinus banksiana*) (state rare), eastern cottonwood (*Populus deltoides*), fragrant sumac (*Rhus aromatica* var. *arenaria*) (state rare), heartleaf willow (*Salix cordata*) (state threatened), little bluestem (*Schizachyrium scoparium*), and Deam's goldenrod (*Solidago simplex* var. *gillmanii*) (state threatened) (Homoya 1985; Wilhelm 1990). Although now largely confined to blowouts, Pitcher's thistle (*Cirsium pitcheri*) historically occupied foredunes (FWS 2002). The number of species of conservation concern that are representative of the foredune plant community are an indication of the rarity of this plant community in the project area.

Blowouts. Blowouts found within the foredune complex are formed by wind action or some other disturbance mechanism. Species found within the beach-foredune complex, including blowouts, depend on a "dynamic microhabitat for their persistence in the dune flora" (FWS 2002). Stabilized foredunes in the project area are dominated by perennials (such as American beachgrass) and often contain at least some tree or shrub species. Conversely, the early successional stages of blowouts have an affinity towards annual, biennial, and short-lived perennial species (Wilhelm 1990). Hence, the short-lived Pitcher's thistle, which lives up to approximately seven years and dies shortly after flowering (FWS 2002), is found within this community. Other vascular plant species common in blowouts include lyrate rockcress or sand cress (*Arabis lyrata*), common milkweed (*Asclepias syriaca*), prairie sand reed, American bugseed, Canada wild rye, flowering spurge (*Euphorbia corollata*), little bluestem, and purple sand grass (*Triplasis purpurea*) (Wilhelm 1990). As blowouts stabilize, the vegetation within them becomes dominated by more long-lived perennial species including bearberry, American bittersweet (*Celastrus scandens*), seaside spurge, red-osier dogwood, common juniper, eastern cottonwood, sand cherry (*Prunus pumila*), heartleaf willow, eastern poison ivy (*Toxicodendron radicans*), and riverbank grape (*Vitis riparia*). The blowout communities thus begin to become indistinguishable from the foredune community (Wilhelm 1990). The largest concentration of blowouts along southern Lake Michigan is located within Indiana Dunes National Lakeshore. See Figure 3-1: Sensitive Habitats, for general locations of blowout communities.

Dune Complex

The dune complex includes a successionally advanced stage of foredunes that consists primarily of savanna and forest (Homoya 1985; Wilhelm 1990). Plant communities present within the dune complex include later successional foredunes, savanna, and small pockets of mesophytic forest; however, the primary components of the dune complex are the stabilized dune forest community and the lee side dune forest (Wilhelm 1990). The high dunes of Indiana are often irregular dune ridges produced by prevailing northerly winds. High dunes in the Mount Baldy vicinity of the project area tend towards mesic habitat dominated by northern red oak (*Quercus rubra*) and white oak (*Quercus alba*). Black oak (*Quercus velutina*) becomes more dominant as one moves west along the shoreline, especially near the Miller and West Beach units in the project area.

Stabilized Dune Forest. The stabilized dune forest community in the project area is located leeward of the foredune complex and is slightly more mesic (due to the greater availability of moisture) than the very similar leeside dune forest community (Wilhelm 1990). This community and the leeside dune forest community are often difficult to differentiate from the savanna and foredune communities with which they intergrade (Wilhelm 1990). Characteristic plant species in the stabilized dune forest community include red maple (*Acer rubrum*), American columbine (*Aquilegia canadensis*), roundleaf harebell (*Campanula rotundifolia*), flowering dogwood (*Cornus florida*), roundleaf dogwood (*Cornus rugosa*), eastern white pine (*Pinus strobus*), hairy Solomon's seal (*Polygonatum pubescens*), common hop tree (*Ptelea trifoliata* var. *mollis*), and northern red oak (Wilhelm 1990). Historically, the dune complex has been dominated by black oak, white pine, and jack pine (Whitman 1997).

Leeside Dune Forest. The leeside dune forest community is similar to the stabilized dune forest community in the park but is not quite as mesic, and the two communities often intergrade. Vascular plants characteristic of the leeside dune forest include downy serviceberry (*Amelanchier arborea*), smooth yellow false foxglove (*Aureolaria flava*), autumn coralroot (*Corallorrhiza odontorhiza*), white ash (*Fraxinus americana*), hairy bedstraw (*Galium pilosum*), eastern teaberry (*Gaultheria procumbens*), Indian pipe (*Monotropa uniflora*), tall rattlesnake root (*Prenanthes altissima*), white oak, and showy goldenrod (*Solidago speciosa*) (Wilhelm 1990).

Mesophytic Forest. Pockets of mesophytic forest are rarely encountered within the dune complex at Indiana Dunes National Lakeshore and have likely arisen as a result of a lack of fire in this area. These moist pockets are characterized by sugar maple (*Acer saccharum*), bristleleaf sedge (*Carex eburnea*), white ash, American witchhazel (*Hamamelis virginiana*), eastern hop hornbeam (*Ostrya virginiana*), American ginseng (*Panax quinquefolius*), northern red oak, wreath goldenrod (*Solidago caesia*), American basswood (*Tilia americana*), and mapleleaf viburnum (*Viburnum acerifolium*) (Wilhelm 1990).

INVASIVE AND NONNATIVE PLANT COMMUNITIES

The National Park Service defines nonnative invasive plant species as "a species occurring in a given place as a result of direct or indirect, deliberate, or accidental actions by humans." More than 300 different species of nonnative plants have been documented at the park. Resource managers have to contend not only with current threats posed by invasive plant species, but also with emerging ones. The encroachment of nonnative species, particularly invasive plants, is a substantial problem that affects all habitats within the project area. The National Park Service has developed a prioritization plan to protect certain rare and ecologically sensitive units within the park, including pannes. Priority is currently given to newly detected species, small and more easily managed invasive plant populations, and highly invasive plant species (NPS 2011d).

Although numerous nonnative plant species are found throughout the project area, some possess a tremendous propensity to invade natural areas. Sand ryegrass (commonly referred to as lyme grass) (*Leymus arenarius*), yellow sweet clover (*Melilotus officinalis*), spotted knapweed (*Centaurea maculosa*), as well as several nonnative, invasive trees pose ecological threats to the beach and foredune plant communities. Common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*) and hybrid cattail (*Typha x glauca*) have already invaded numerous wetland areas, and pose the most substantial threat to pannes. Baby's breath (*Gypsophila paniculata*) is an emerging threat and invades open dune habitats, such as blowouts. Left unchecked, Baby's breath would easily displace Pitcher's thistle and other species of special concern.

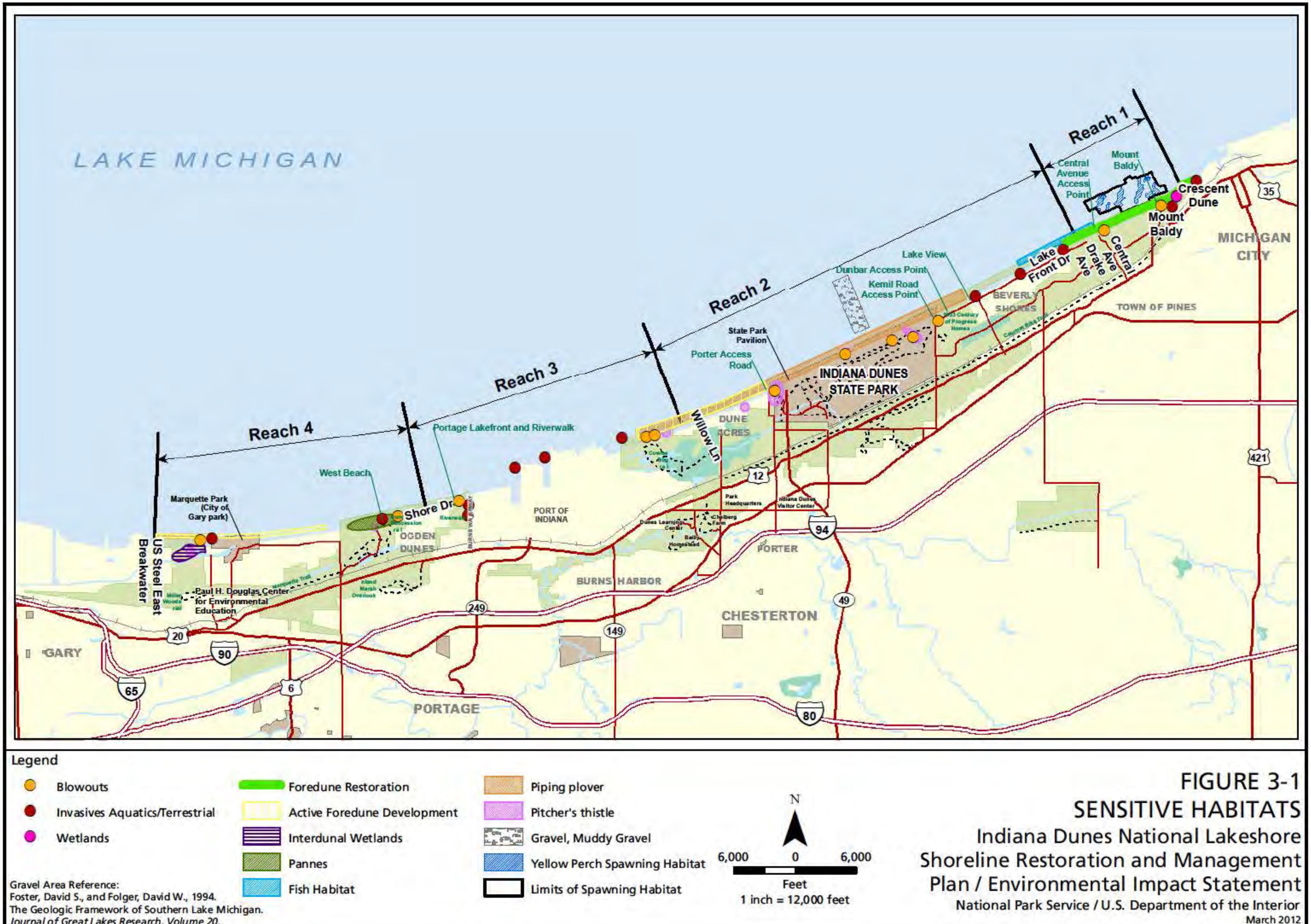


FIGURE 3-1
SENSITIVE HABITATS
Indiana Dunes National Lakeshore
Shoreline Restoration and Management Plan / Environmental Impact Statement
National Park Service / U.S. Department of the Interior
March 2012

Garlic mustard (*Alliaria petiolata*) and nonnative bush honeysuckle (*Lonicera* sp.) easily invade the understory of the dune complex in the project area, and are found throughout reaches 1 through 4. Numerous invasive trees, such as tree of heaven (*Ailanthus altissima*), Siberian elm (*Ulmus pumila*), and black locust (*Robinia pseudoacacia*) are found throughout the foredune and dune complex in the project area. Oriental bittersweet (*Celastrus orbiculatus*), one of the most highly invasive vines found in the upper Midwest, is located throughout the dune complex. It has the propensity to invade open areas of the foredunes.

TERRESTRIAL INVERTEBRATES, BIRDS, AMPHIBIANS AND REPTILES, AND MAMMALS

Terrestrial Invertebrates

There are perhaps thousands of species of terrestrial invertebrates that have the potential to occur at the park. Many species of invertebrates that have the potential to occur are either unknown to science or poorly understood. Anecdotal evidence suggests that the park is home to many distinct species of invertebrates that reside in specific habitats. Tiger beetles (*Cicindela ocellata rectilatera*), for example, are as diverse as the habitats in which they reside. Some beetles are found solely in the mature dune forests, while others may only be found in the foredune complex in the park (Daniel 1984).

Birds

Lake Michigan and its nearshore offer both respite and important habitat for numerous resident and migratory bird species. Well over 300 different species of birds have been observed in the nearshore and dune complex at the park (Brock 2011). More than 100 species are regular nesters at the park, and 24 more species were formerly known to nest in the area. The habitat suitability and location of the park are critically important for migratory birds. As Brock (1997) stated, "The shores of this enormous lake provide leading lines that control flight paths of migrants, and the vast open water draws legions of transitory and wintering birds." Lake Michigan itself and the associated beach habitat provide two rare, albeit vital, habitats for avian species. The nearshore provides habitat for open water species (i.e., bay and sea ducks) and the beach and foredune complex provide resting and feeding habitat for shorebirds. In the fall, legions of migratory birds, including rare periodic migrants, are "funneled" to the park. The variation in habitats at the park provides many species of birds a place to rest during migration and provides habitats that are rare in the Midwest (Brock 1997).

Amphibians and Reptiles

The abundance and concentration of different types of habitat within the park make it an important area for amphibians and reptiles in the Midwest. Amphibians require water to breed and the park provides many wetland habitats such as pannes, marshes, bogs, swamps, streams, vernal pools, and ponds for different species to use. The wetland habitat at Indiana Dunes National Lakeshore provides for a high concentration of amphibian and reptile species to occur within the park, which is not typically observed in other regions.

The park has up to 49 different species of amphibians and reptiles: 19 species of amphibians (eight salamander and 11 frog species) and 30 species of reptiles (nine turtle, 18 snake, and three lizard species) (Minton 2001). Even though there is a diverse group of amphibians and reptiles at the park, many populations are declining in number. This is in large part due to habitat degradation, environmental pollution, wetland loss, and hydro-modification of stream systems.

Mammals

Most mammal species move across many habitats during their daily and seasonal activities and likely use many of the unique habitats that occur at the park. Some small mammal species are specific to certain habitats and the juxtaposition of prairie, wetland, forest, and urban/disturbed habitats creates opportunities for many small mammals to occur within the park. Furthermore, with an abundance of small mammal species, predator populations that prey on small mammals can be maintained in the park ecosystem.

Thirty-seven species of mammals are known to occur at the park, with an additional five species not found but likely to occur. Nine mammal species have been extirpated from Indiana and from the park in the past 150 years: porcupine (*Erethizon dorsatum*), gray wolf (*Canis lupus*), red wolf (*Canis rufus*), black bear (*Ursus americanus*), fisher (*Martes pennant*), mountain lion (*Felis concolor*), lynx (*Lynx lynx*), elk (*Cervus elephus*), and bison (*Bos bison*). Some species have moved into the park area or have become more abundant in the last 150 years, such as coyote (*Canis latrans*) and raccoon (*Procyon lotor*). White-tailed deer (*Odocoileus virginianus*) were extirpated early from the park and later the rest of Indiana, but were reintroduced to Indiana in 1935 and are now prolific throughout the state (Whitaker 1994).

THREATENED AND ENDANGERED SPECIES AND SPECIES OF CONCERN

The unique environment at the park provides a mosaic of habitats for terrestrial plants and wildlife in a relatively small area. The park is located between the eastern deciduous forest, tall grass prairie, and Lake Michigan, creating a variety of soils and landscape features caused by the juxtaposition of all of these larger natural regions (Homoya 1985). Plant and wildlife diversity benefit from the variety, juxtaposition, and concentration of habitats. Many animal species spend different life stages in different habitats. In addition, the microclimate of the park varies considerably due to the effects of Lake Michigan. As a result, species such as bearberry, boreal relic, and prickly pear cactus (a southwestern relic), and other disparate floral elements are able to flourish in proximity to each other.

Approximately 130 plant species of conservation concern in Indiana, one federally threatened plant species (Pitcher's thistle), and one federally endangered butterfly (Karner blue butterfly [*Lycaeides melissa samuelis*]), have been documented at the park (NPS 2011d). The Eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*), a candidate for federal listing, is documented at the park. The Indiana bat (*Myotis sodalis*), a federally endangered species, has been found at the Heron Rookery Unit of the park, but is unlikely to be found in or adjacent to the project area because the beach and dunes do not provide suitable habitat. Critical habitat for the piping plover, a federally endangered bird species, has been designated along the shoreline between the NIPSCO / park boundary at the Dune Acres / Cowles Bog Unit next to Kemil Road at Beverly Shores, including Indiana Dunes National Lakeshore; this critical habitat is currently not known to be utilized for nesting but has been used during migration. Figure 3-1: Sensitive Habitats, shows general locations of sensitive habitats in the park. Unfortunately, numerous species have been extirpated over the last century, and many others are now declining or listed as endangered, threatened, or rare (see Appendix D: Species Lists).

VASCULAR PLANTS

The park supports an unusually high concentration of biodiversity, and therefore supports many globally and state important plant species. The park ranks near the top for parks in plant diversity within NPS lands. Scientists have documented more than 1,130 native vascular plants at the park (Yatskievych 2011). The Indiana Department of Natural Resources (IDNR) (2011) reports that 30% of Indiana's listed rare, threatened, endangered, and special concern plant species are known to occur at the park. There are more than 10 state-listed species found within the foredune complex of the project area. Pannes in the project area are even more diverse, with more than 200 different vascular plant species, of which 17 are listed as state endangered (see Appendix D: Species Lists).

Pitcher's Thistle

Pitcher's thistle is federally threatened and is one of the few plants endemic to post-Wisconsin glacial episode Great Lakes sand dunes. Populations of Pitcher's thistle indicate healthy dune ecosystems. Pitcher's thistle typically grows on foredunes with sparse vegetation. Six populations are located within the Indiana Dunes National Lakeshore (see Figure 3-1: Sensitive Habitats). The loss of foredune populations is largely attributable to the disruption of natural shoreline erosion processes and anthropogenic influences. Historically, populations were probably maintained in part by seed dispersal from adjacent foredune and blowout populations. The age at which Pitcher's thistle reproduces varies with environmental conditions, including drought, but generally ranges from five to eight years, although 10 to 12 years have been recorded (FWS 2005). Therefore, disturbance and foredune erosion must be frequent enough to prevent succession and species loss, but not so frequent as to limit juveniles from reaching maturity (FWS 2002). Such a disturbance regime refers to a dynamically stable foredune complex (such as that witnessed in reaches 2 and 4 of the project area).

In Indiana, Pitcher's thistle colonizes in several of the blowouts in the project area. In these systems, seed dispersal from remaining blowout refugia (isolated or relict populations) would not disperse quickly to all dune habitats due to the distance between suitable habitats. Blowouts that lose self-sustaining populations are less likely to be re-colonized than areas in the more intact, continuous dune complexes. Instead, dune building relies on natural shoreline processes that increase sediment supply. The physical structure of foredunes is an important consideration in determining the habitat suitability and restoration of the Pitcher's thistle. Plants require approximately 70% open sand for successful seedling establishment and survival (FWS 2002). Populations of Pitcher's thistle would be further compromised in the park if blowouts undergo natural succession into another plant community, increasing total plant cover of open sediment. In addition, remaining thistle populations would be further impacted by human trampling and other anthropogenic influences.

TERRESTRIAL INVERTEBRATES

Karner Blue Butterfly

The Karner blue butterfly was historically found in 12 states from Minnesota to Maine but is now only found in seven states, including Indiana. The populations at the park are relatively small and are most threatened by habitat degradation and fragmentation. Wild lupine, or sundial lupine (*Lupinus perennis* L.), is the butterfly's only source of larval food. Isolated lupine populations are found in the dune complex. The reproduction of the butterfly depends on the abundance of lupine and nectar plant species. The park has a variety of savanna and savanna-like habitat in the dune complex, providing butterfly preferred habitat. The adults feed on the nectar of a variety of wildflowers and can be found in both wetlands and uplands at the park (FWS 2003b).

A population of Karner blue butterflies at West Beach is within the project area, and the Miller Woods population is adjacent to the project area, but the remaining populations are further inland and not included within the project area.

KARNER BLUE BUTTERFLIES

BIRDS

Piping Plover

Piping plovers are federally endangered. They breed and raise their young on sparsely vegetated beaches, cobble pans, and sand spits of glacially formed sand dune ecosystems along the Great Lakes shoreline. In similar context to Pitcher's thistle, piping plovers serve as an indicator of a healthy beach and foredune complex. Unfortunately, beach and foredune degradation is pervasive throughout the Great Lakes basins, and has reduced overall habitat suitability for many shoreline birds, including piping plovers. Human disturbances and contaminants, in addition to the genetic and geographic consequences of small population size, pose additional threats.

Historical nesting has occurred at the park, but no breeding populations have recently been documented (FWS 2003a) even though segments of the shoreline demonstrate physical characteristics suitable for piping plover breeding (see Figure 3-1: Sensitive Habitats). Critical habitat for the piping plover has been designated along the shoreline between the NIPSCO / park boundary at the Dune Acres / Cowles Bog Unit next to Kemil Road at Beverly Shores.

While transient individuals have been observed within the project area on an annual basis, anthropogenic influences, such as recreational beach activity at the park, may discourage re-establishment of breeding piping plover populations (FWS 2003a).

Bald Eagle

The bald eagle has been delisted under the Endangered Species Act, but the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act continue to afford the bird protection. The Bald and Golden Eagle Protection Act, passed in 1940, provides for the protection of the bald eagle and the golden eagle (*Aquila chrysaetos*) by prohibiting the take, possession, sale, purchase, barter, offer to sell, purchase or barter, transport, and export or import of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit. "Take" includes pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb. The Migratory Bird Treaty Act is a federal law that carries out the U.S.'s commitment to four international conventions with Canada, Japan, Mexico, and Russia. Those conventions protect birds that migrate across international borders. The Migratory Bird Treaty Act prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests except as authorized under a permit (FWS 2005).

Bald eagles currently do not nest at the park, but the population in Indiana and other Great Lakes states has been increasing, so they could nest in the park area in the future, since suitable habitat is available.

AMPHIBIANS AND REPTILES

Eastern Massasuaga Rattlesnake (*Sistrurus catenatus catenatus*)

The Eastern massasuaga rattlesnake is now a candidate for federal threatened or endangered listing. Historically, the massasuaga rattlesnake was found from central New York to eastern Iowa, and from southern Ontario to southern Illinois and Missouri (Minton 2001). In the past, the elusive rattlesnake was found at the park in greater numbers but may have become rare due to habitat degradation. The massasuaga rattlesnake prefers a variety of wetlands but can be found in upland habitats if prey species become scarce or thermoregulatory requirements must be satisfied. The massasuaga rattlesnake is found in high quality wetlands in the spring and fall, and may move to more upland sites in the summer. In the winter, they hibernate in small mammal burrows, crayfish holes, vegetation hummocks, or tree root masses near the water table (Glowacki 2005). Individuals have been observed within suitable habitats inland from the project area, although sightings are rare.

MAMMALS

Indiana Bat

The Indiana bat is federally listed as an endangered species mostly due to loss of habitat. This bat species ranges over most the eastern U.S. from New England, excluding much of the Atlantic Coast, to the Mississippi Valley, including most of the Midwest (FWS 2007a). During hibernation, Indiana bats form large groups of thousands of individuals. In the spring, females migrate to summer maternity colonies in dead or dying trees with exfoliating bark while males migrate to bachelor colonies. During the summer residency, the females give birth to their young and raise them until they are able to fly. In the fall the newly volant young (able to fly) and adults migrate back to hibernacula or hibernation areas where mating takes place during fall swarming (Whitaker 1998). Roosting activities have been observed around dead cottonwood trees with loose peeling bark. Deciduous forest edges also provide viable habitat for foraging activities (Whitaker 1994). Habitat loss and urbanization are largely responsible for population declines throughout the region (Sparks 2005). Indiana bats have been found within the Heron Rookery Unit of the park but not within the project area, where suitable habitat is unlikely to be present.

WETLANDS AND PANNES

There are two wetland features specific to the park and the project area. These include the aquatic and panne communities. The aquatic areas include a wetland plant community which is exposed to water year-round. The plants are largely submersed, or the plants have stems topped by leaves and flowering parts extending to the water surface. The substrate may be sandy, gravelly, or mucky. The pannes are intradunal wetlands found in proximity to the shoreline, usually just behind the first or second set of dunes (Homoya 1985). Pannes are seasonally inundated areas where the substrate may be sandy or may comprise marl formed by an accumulation of calcium carbonate produced by the alga stonewort (*Chara* spp.) when inundated for long periods of time. Further discussion follows.

AQUATIC COMMUNITIES

The aquatic community tends to be wet most or all of the year and grades into the slightly drier marsh community. Common vascular plants found in the aquatic community in the Indiana Dunes National Lakeshore project area include: watershield (*Brasenia schreberi*), coontail (*Ceratophyllum demersum*), yellow pond lily (*Nuphar lutea* ssp. *advena*), American white water lily (*Nymphaea odorata* ssp. *tuberosa*), colored swampweed (*Polygonum amphibium* var. *emersum*), pickerel weed (*Pontederia cordata*), grassy pondweed (*Potamogeton gramineus*), Illinois pondweed (*Potamogeton illinoensis*), small pondweed (*Potamogeton pusillus*), and common arrowhead (*Sagittaria latifolia*) (Wilhelm 1990).

PANNES

Pannes are distinct calcareous, sand-based, intradunal wetlands found close to the shoreline, usually just behind the first or second set of dunes as one moves away from Lake Michigan (Homoya 1985). Naturally occurring pannes are extremely rare in the Great Lakes region, and are considered globally imperiled and critically imperiled in the State of Indiana. In addition, pannes are nutrient poor, with vegetation suggestive of a fen (Homoya 1985). Rhizomatous sedges such as smooth sawgrass (*Cladium mariscoides*) provide the dominant cover type (Chicago Wilderness 1999). There is a total of 20 pannes located within the project area. The largest concentration of naturally occurring pannes is located within reach 4 at West Beach. One isolated panne is located just east of Mount Baldy.

Despite their rarity and relatively small size, pannes demonstrate comparatively high floristic quality and diversity. Many of the plant species found within the panne community are found nowhere else in Indiana (Wilhelm 1990), and are considered relicts of the Atlantic coastal plain (Swink and Wilhelm 1994). Many of the species found in the pannes are of conservation concern because of this distribution. In addition to smooth sawgrass, pannes' characteristic plant species in the project area include golden sedge (*Carex aurea*), elk sedge (*C. garberi*), green sedge (*C. viridula*), shrubby cinquefoil

WEST BEACH PANNE

(*Dasiphora floribunda*), fringed gentian (*Gentianopsis crinita*), Kalm's St. Johnswort (*Hypericum kalmianum*), Baltic rush (*Juncus balticus* var. *littoralis*), yellow wide-lip orchid (*Liparis loeselii*), brook lobelia (*Lobelia kalmii*), horned beakrush (*Rhynchospora capillacea*), rosepink (*Sabatia angularis*), low nutrush (*Scleria verticillata*), prairie goldenrod (*Solidago ptarmicoides*), seaside arrowgrass (*Triglochin maritumum*), and horned bladderwort (*Utricularia cornuta*) (Homoya 1985; Swink and Wilhelm 1994; Wilhelm 1990). Some pannes, such as those within reach 4, are characteristically surrounded by jack pine. The deeper water zones within pannes are often dominated by algae species in the genus *Chara*.

SOUNDSCAPE

The soundscape of the shoreline and dunes area of the park includes both human and natural components. The latter consists of the sounds of the wind, sediment blowing against vegetation and waves, and sounds created by birds, insects, and other animals. The human component is generated by voices, pets, vehicles, boats, airplanes, recreational vehicles, and those sounds associated with activities at the park visitor's facility, nearby residential areas, and industrial operations. Transportation corridors, including the interstate highways near Indiana Dunes National Lakeshore and the Northern Indiana Commuter Transportation District (the South Shore Railroad), present soundscape intrusions from vehicle and track sounds and train whistles.

The park is bordered on the east and west by Michigan City and Gary, respectively, and it surrounds the industrial operations of the Port of Indiana and NIPSCO (which emit a rhythmic mechanical, industrial sound). In addition, there are three communities within the boundaries of the park: Town of Ogden Dunes, Town of Dune Acres, and Beverly Shores. At Beverly Shores, Lakefront Drive runs parallel to the beach and carries both park and local residential traffic.

Private cars, light trucks, and motorcycles, the type of vehicles that are most likely to use Lakefront Drive and other park-area beach and dune roads, emit noise levels ranging from 65 to 75 A-weighted decibels (dB[A]) at 7.5 meters. Similarly, noise levels for recreational boats with underwater exhausts typically range from approximately 75 to 85 dBA measured at a 50-foot bypass. However, depending on engine size and design (above or below water exhaust), recreational boat sound can be much higher. 2011 was the third consecutive year for the Super Boat Grand Prix sponsored by Michigan City, which is a high-speed offshore boat race. A high speed boat can produce sounds up to 170 dBA.

The sound environment of the park and project area changes seasonally. The project area experiences heaviest use in the summer season with commensurate levels of human and animal sound. While there may be more forceful wave and wind-related sound in the winter and fewer animal sounds, there are also fewer visitors to generate and experience sounds.

People perceive sound subjectively and may seek areas within the park and along the shoreline where they can experience the "natural quiet" (i.e., areas with little anthropogenic influence). Other people may prefer to enjoy the park near the more congested visitor's facilities, where human-generated sounds dominate.

In the project area, human-generated sounds dominate areas around: Mount Baldy and Central Avenue access point in reach 1; Lake View, Dunbar access point, Kemil Road access point, Porter access road, and State Park pavilion in reach 2; Portage Lakefront and Riverwalk in reach 3; and West Beach and Marquette Park in reach 4. In these areas, due to the high concentration of visitors, human-generated sounds dominate with human and vehicle sounds intruding into the natural soundscape. Figure 3-2: Visitor Access Points and Areas of Concentrated Use depicts areas within the project area with average high concentrations of park visitors. Other areas of the lakeshore provide natural quiet. Natural quiet can be experienced within areas of reaches 2, 3, and 4, where there are low concentrations of visitors.

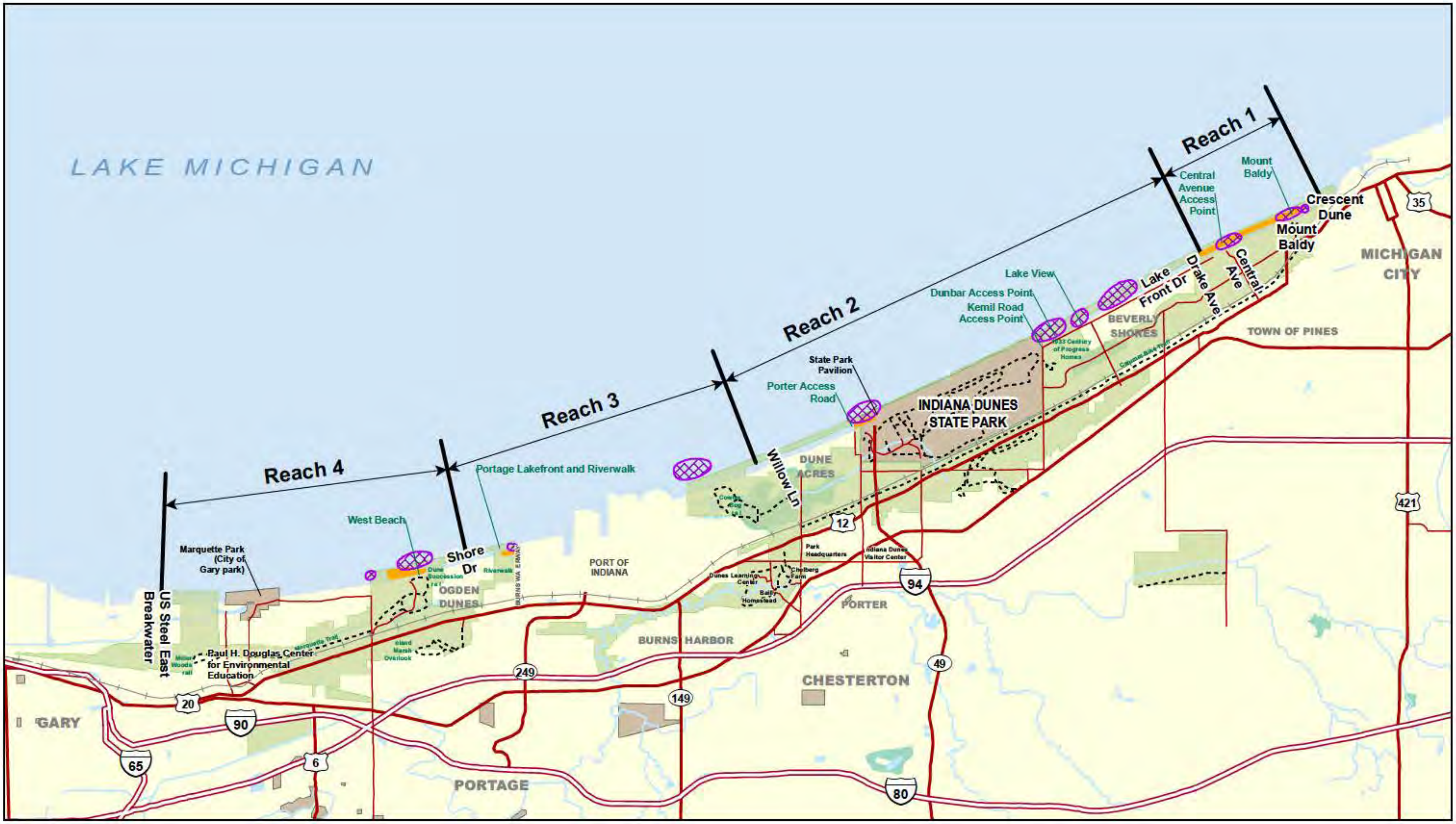
VISITOR EXPERIENCE

About two million people visit Indiana Dunes National Lakeshore each year, making it the most-visited outdoor recreation area in the region.

Visitor opportunities at Indiana Dunes National Lakeshore include hiking the dune trails; enjoying scenic views along the Lake Michigan shoreline, including the view across Lake Michigan of the Chicago skyline; enjoying the Lake Michigan beach and water access; swimming; using nonmotorized water craft; experiencing quiet, solitude, and naturalness; learning about the natural and cultural heritage of the area (e.g., glacial phenomena, diverse habitats, and human history); and understanding the complex natural history of the ecosystems that have evolved along the southern Lake Michigan shoreline.

Visitors tend to congregate at access points in the park that are interspersed along the lakefront. These include Mount Baldy, Central Avenue access point, Lake View picnic area, Dunbar access point, Kemil and Porter access points, and West Beach. See Figure 3-2: Visitor Access Points and Areas of Concentrated Use for locations of these areas. Access points and other areas of the park that experience a high concentration of visitors have more apparent and extensive anthropogenic influences, like vegetation trampling and introductions of nonnative and invasive weeds. Such influences have to be monitored and managed by the park to prevent destruction and degradation of natural resources.

In addition, there are a number of interpretive learning centers throughout the park, though not within the project area. Park staff participate in ongoing planning activities to improve visitor's experience while balancing the potential impacts to the natural environment.



Legend

Access Points with a High Concentration of Visitors

Visitor Impact Area

N

6,000 0 6,000 Feet

1 inch = 12,000 feet

FIGURE 3-2

VISITOR ACCESS POINTS AND AREAS OF CONCENTRATED USE

Indiana Dunes National Lakeshore
Shoreline Restoration and Management Plan / Environmental Impact Statement

National Park Service / U.S. Department of the Interior

March 2012

PARK OPERATIONS

Management of the park is organized from the superintendent's office into five functional divisions, including Interpretation and Education, Resource and Visitor Protection, Facility Management, Resource Management, and Administration (Business Services). The superintendent is responsible for overall park management. In addition to responsibilities for overall leadership and coordination of the park, staff are responsible for public and external affairs, planning and compliance, and safety, all of which relate to the actions proposed under all the action alternatives in this plan / final EIS. Shoreline erosion and associated restoration efforts result in greater personnel demands for resource protection.

The Interpretation and Education Division includes education services for diverse audiences. This division is responsible for visitor education and outreach in the park, and providing opportunities for visitors to connect with park resources and to learn how to protect park resources. Interpretive rangers provide educational information to the public and become more actively involved with the public depending on the level of public interest. Due to the duration of beach closings that would be associated with each of the action alternatives presented in this plan / final EIS, public interest is anticipated to be high and would require additional park staff and budget to provide the public with ongoing updates and interpretive programs during the life of this plan.

The Resource and Visitor Protection Division of the park is responsible for visitor and employee safety and resource protection, as well as visitor education. This division oversees beach closings during nourishment activities to ensure both visitor and employee safety. Division staff would have increased responsibilities related to safety and resource protection during the additional beach nourishment activities proposed under this plan, placing additional burdens on the park's operating budget.

The Facility Management Division maintains the park, performing routine upkeep of facilities, structures, and landscapes, including the park's shoreline and forested dunes. Ongoing erosion and degradation of the shoreline and dunes taxes park staff and budgets with added responsibilities related to resource protection and restoration activities.

The Resources Management Division of the park is responsible for natural resource inventory and monitoring, managing natural resources research, protecting threatened and endangered species and species of concern, restoring disturbed sites, managing invasive nonnative species, and protecting and preserving cultural resources including historic structures, cultural landscapes, archeological resources, ethnographic resources, and museum objects. Park resources are actively monitored and managed during beach nourishment activities and would continue to be with any of the additional nourishment activities proposed under any of the action alternatives presented in this plan / final EIS. Increasing the duration or frequency of such activities through the beach nourishment activities proposed under this plan would incrementally add to park staff workloads and place additional drains on park budgets.

CHAPTER 4
Environmental Consequences

INTRODUCTION

This "Environmental Consequences" chapter analyzes both beneficial and adverse impacts that would result from implementing any of the alternatives considered in this *Shoreline Restoration and Management Plan / Final Environmental Impact Statement* (EIS). The "Environmental Consequences" chapter also includes the methodology and definitions of impact thresholds (e.g., negligible, minor, moderate, and major), methods used to analyze impacts, the analysis used for determining cumulative effects, and a cumulative impacts scenario. A summary of the environmental consequences for each alternative is provided in tables 2-3 and 2-4, which can be found in "The Alternatives" chapter. The resource topics presented in the "Environmental Consequences" chapter, and the organization of the topics, correspond to the resource discussions contained in the "Affected Environment" chapter.

GENERAL METHODOLOGY FOR ESTABLISHING IMPACT THRESHOLDS AND MEASURING EFFECTS BY RESOURCE

The following elements were used in the general approach for establishing impact thresholds and measuring the effects of the alternatives on each resource category:

- general analysis methods as described in the guiding regulations
- basic assumptions used to formulate the specific approaches used in this analysis
- thresholds used to define the intensity of impact resulting from each alternative
- methods used to evaluate the cumulative effects of each alternative in combination with unrelated factors or actions affecting park resources

These elements are described in the following sections.

General Analysis Methods

The analysis of impacts follows CEQ guidelines and Director's Order 12: *Conservation Planning, Environmental Impact Analysis, and Decision-making* procedures (NPS 2001) and is based on the underlying goals of restoring natural shoreline processes, preserving the shoreline ecosystem, and providing opportunities for quality visitor experiences consistent with the purpose and significance of the park. This analysis incorporates the best available scientific literature applicable to the region and setting and the actions being considered in the alternatives.

The National Park Service has created an interdisciplinary team to provide important input to the impact analysis. For each resource topic addressed in the "Environmental Consequences" chapter, the applicable analysis methods are discussed.

Assumptions

Several guiding assumptions were made to provide context for this analysis. These assumptions are described below.

Analysis Period. For goals, objectives, and specific implementation actions needed to restore and manage the shoreline at Indiana Dunes National Lakeshore, a 20-year lifespan of each alternative was assumed. Thus, the analysis period used for assessing impacts in this plan / final EIS is 20 years.

The National Park Service assumes that beach nourishment via any of the alternatives would require time to monitor and oversee the actions associated with each of the alternatives for the duration of the plan (i.e., 20 years).

Duration and Type of Impacts

The following assumptions were used for all impact topics (the terms "impact" and "effect" are used interchangeably throughout this document):

- Short-term impacts are impacts that would be temporary, lasting for one year or less following an action.
- Long-term impacts are impacts that would last longer than one year and that would be permanent.
- Direct impacts are impacts that would be directly caused by a shoreline management action which would occur when and where the action was implemented.
- Indirect impacts are impacts that would occur from shoreline management actions that would occur later in time or farther in distance than when and where the action was implemented.

Geographic Area Evaluated for Impacts.

The geographic project area for this plan includes beach reaches 1 through 4 in Indiana Dunes National Lakeshore, as described in "The Alternatives" chapter.

For the alternatives assessed, it is assumed that providing several thousands of cubic yards of nourishment material to reach 1 would affect not only reach 1, but reach 2 and a portion of reach 3, as well. Likewise, providing several thousands of cubic yards of nourishment material to reach 3 would indirectly affect downdrift shorelines within reach 4. The additional nourishment material in reach 3 would be transported downdrift by natural processes (i.e., wave action and storm events).

Future Trends. Visitor use and demand are anticipated to follow trends similar to recent years. The number of yearly visitors to Indiana Dunes National Lakeshore is about two million. In the absence of notable anticipated changes in visitation and park staffing, the impact analysis assumes these levels would remain similar to present levels.

IMPACT THRESHOLDS

Determining impact thresholds is a key component in applying NPS *Management Policies 2006* and Director's Order 12. These thresholds provide the reader with an idea of the intensity of a given impact within a specific topic. The impact threshold is determined primarily by comparing the effect to a relevant standard based on regulations, scientific literature and research, or best professional judgment. Intensity definitions are provided separately for each impact topic analyzed in this document because definitions of intensity vary by impact topic. Intensity definitions are provided throughout the analysis for negligible, minor, moderate, and major impacts.

CUMULATIVE EFFECTS ANALYSIS METHOD

The CEQ regulations for implementing the National Environmental Policy Act of 1969, as amended (NEPA) require an assessment of cumulative effects in the decision-making process for federal projects. Cumulative impacts are defined as "the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 Code of Federal Regulations [CFR] 1508.7). These actions were identified, and cumulative impacts were determined, by combining the impacts of alternatives with those of the other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects at Indiana Dunes National Lakeshore and, if applicable, the surrounding region. The geographic scope for this analysis includes elements mostly within the shoreline of southern Lake Michigan, while the temporal scope includes projects within a range of approximately 20 years. Given this, the following projects were identified for the purpose of conducting the cumulative effects analysis.

CUMULATIVE IMPACT SCENARIO

Past Actions Within and Around Indiana Dunes National Lakeshore

- Three man-made structures that constitute barriers to littoral drift and affect the park were constructed in and around the project area. These structures are federal and industrial harbors that impact the natural sediment transport by disrupting water flow and producing accretion to the east (updrift) and erosion to the west (downdrift). These include the east adjacent Michigan City Harbor (initial construction in 1834, harbor completed in the early 1900s), the Port of Indiana industrial complex (constructed in the late 1960s), and the west adjacent Gary-U.S. Steel breakwater (constructed in the early 1900s).
- A permanent electric barrier was constructed by the U.S. COE in the Chicago Sanitary and Ship Canal to deter movement by invasive nonnative fish species across this artificial connection between the Mississippi River and Great Lakes drainages.
- The park designated the appropriate route to and from Mount Baldy from the parking lot in an effort to reduce social trails in reach 1 of the beach.
- The initial Marquette Plan: The Lakeshore Reinvestment Strategy (IDNR *et al.* 2005) was completed in 2005 and addressed public access and redevelopment of Indiana Dunes National Lakeshore from the Illinois state line to the Port of Indiana, with funding by the cities of Whiting, East Chicago, Hammond, Gary, and Portage. Portage Lakefront and Riverwalk are results of this plan.
- Industrial complexes in the area, like the Northern Indiana Public Service Company (NIPSCO), were constructed and became operational.
- Transportation corridors were constructed within and around the park.

Present Actions Within and Around Indiana Dunes National Lakeshore

- Clean sediment nourishment is accepted from upland sources on an intermittent basis in reach 1.
- The park is restoring the foredune and dune complex by stabilizing select areas of eroded dunes with native vegetation, fencing off highly eroded and environmentally sensitive areas, and providing expanded visitor outreach and education opportunities about these actions.
- The park installs fencing to protect the leeward slope of Mount Baldy to limit anthropogenic influences in reach 1.
- The park manages invasive vegetation, currently targeting sand ryegrass (*Leymus arenarius*) and spotted knapweed (*Centaurea maculosa*) in the foredune complex; purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), and hybrid cattail (*Typha* x *glauca*) in the panne; and some woody invasive vegetation, such as Siberian elm (*Ulmus pumila*), black locust (*Robinia pseudoacacia*), and tree-of-heaven (*Ailanthus altissima*), throughout these complexes in reaches 1 and 2.
- Clean sediment nourishment is accepted from lake dredging projects on an intermittent basis in reach 3.
- At blowout locations, including Portage Lakefront and Riverwalk, some invasive plant management is performed to help protect Pitcher's thistle (*Cirsium pitcheri*) populations in reaches 3 and 4; the U.S. Geological Survey monitors these populations.

- Nonnative invasive plant species are being managed in the panne in reaches 3 and 4. These efforts target spotted knapweed, yellow sweet clover (*Melilotus officinalis*), and prairie sunflower (*Helianthus petiolaris*) at Portage Lakefront and Riverwalk; purple loosestrife and common reed in the panne; and sand ryegrass in the foredune complex. In addition, some management of oriental bittersweet (*Celastrus orbiculatus*) (that is encroaching on the dune complex) is performed.
- The park is currently preserving the pannes at West Beach and Miller by managing invasive nonnative plant species, targeting purple loosestrife, common reed, and hybrid cattail in reach 4.
- Ongoing planned facility upgrades are performed in the park.
- To limit anthropogenic influences in the park, the staff provides education and outreach to visitors.
- Current resource protection and restoration projects in the park include an early detection and rapid response program and an Invasive Plant Management Plan.
- The park maps and monitors treated nonnative invasive plant species in Indiana Dunes National Lakeshore.
- The park provides education and outreach about the impacts of invasive nonnative plant species.
- The Northern Indiana Commuter Transportation District (the South Shore Railroad) traverses the park.
- The Super Boat Grand Prix, a high-speed offshore boat race sponsored by Michigan City, is held annually near the park.
- The Calumet Harbor and River project involves dredging various segments of the Calumet River to maintain channel depth (allowing continued commodity exchange and transport). The Calumet Harbor, which is the second largest port on the Great Lakes, is the primary link between the Inland-Waterway system, foreign ports, and the Great Lakes (and is one of only two possible routes between these) (COE 2011c).
- Ships' ballast water has accounted for 55% to 70% of reported aquatic invasive species introductions in to the Great Lakes since 1959, when the St. Lawrence Seaway opened and provided a route in to the Great Lakes for trade (National Academy of Sciences 2008).

Reasonably Foreseeable Future Actions Within and Around Indiana Dunes National Lakeshore

- The park proposes to develop a picnic area near the Porter access point.
- NIPSCO is going to realign the outflow at the Bailly Generating Station.
- The town of Michigan City proposes to build a parking lot east of Mount Baldy for access to Crescent Dune.
- Phase II of the Marquette Plan (IDNR *et al.* 2005), which focuses on Indiana Dunes National Lakeshore from the Port of Indiana to the Michigan-Indiana state line, is being funded through a grant from the Indiana Department of Natural Resources (IDNR) Lake Michigan Coastal Program with matching funds from the Gaylord and Dorothy Donnelley Foundation, the cities of La Porte and Michigan City, and La Porte County. This plan focuses on identifying the needs of the smaller communities and creating a vision that would identify and protect greenways, identify possible trails in the region, and address the needs of smaller communities.
- The park is considering realigning some trails, as well as developing a mitigation plan for new/proposed access points and trails to Crescent Dune to limit anthropogenic influences.
- The park plans to enforce visitor use of approved trails in the park in all reaches to limit anthropogenic influences.
- To help limit social trails in reach 1, the park plans to designate an appropriate route to the beach from the Kemil Road parking lot, and to the foredune complex, including blowouts, from the Kemil Road access point.

- The park proposes to restore the foredune and dune complex by stabilizing eroded dunes with native vegetation, and fencing off highly eroded and environmentally sensitive areas on the foredune to allow for ecological recovery of natural communities.
- The park proposes to expand current public education and outreach efforts.
- Outside of the proposed project area, no additional modifications to the shoreline are likely, as the harbors and breakwaters associated with the adjacent federal and industrial harbors have already been constructed. It cannot be predicted whether owners of adjacent properties would continue to armor or otherwise modify their respective beachfronts. In the event that additional shoreline structures are constructed, the littoral drift along Lake Michigan's shoreline would continue to be disrupted and result in additional challenges to the natural and human environment at Indiana Dunes National Lakeshore.
- Future introductions of aquatic invasive species from ships' ballast water may be effectively managed through ballast water management techniques, such as ballast water exchange, saltwater flushing, or shipboard treatment, and through restricting access to the Great Lakes to vessels that have taken protective measures like these to ensure they do not harbor aquatic invasive species.

COASTAL PROCESSES

METHODOLOGY

Resource specialists conducted site visits to the park to observe existing conditions and assess the potential effectiveness of the alternatives in addressing the issues involved in the restoration of natural coastal processes. Various technical documents were reviewed to understand the history of beach nourishment activities and the factors involved in coastal processes, sediment transport, and dune formation. Alternatives were evaluated based on the potential to respond to the desired future conditions, including the effectiveness of the alternative in balancing the quantities of sediment throughout the project area, fulfilling the estimated sediment budget deficit, preventing continued erosion in critical areas of the shoreline, and providing for the natural processes of dune formation.

Impact Intensity Level Definitions

Intensity level thresholds for coastal processes are defined as follows:

Negligible: The impact is barely detectable, and would result in no noticeable or perceptible changes to the sediment transport and/or dune formation processes.

Minor: The impact is slight but detectable, and would result in small but noticeable changes to the sediment transport and/or dune formation processes.

Moderate: The impact is readily apparent, and would result in easily detectable changes to the sediment transport and/or dune formation processes.

Major: The impact is severely adverse, or exceptionally beneficial, and would result in appreciable changes to the sediment transport and/or dune formation processes.

SHORELINE AND BEACH COMPLEX, REACHES 1 AND 2

Alternative A (No-action Alternative)

Sediment Transport Processes. The dunes, the swash zone, and the nearshore area are dynamic high-energy areas, subject to the forces of wind and waves. Sediment is moved offshore in the winter and returns onshore in the spring and summer. Sediment placed on the shoreline during beach nourishment activities is re-distributed between the zones in a more stable profile. Despite current nourishment efforts to stabilize the shore, erosion of the shoreline would continue as the quantity of material currently being placed is less than the estimated sediment budget deficit. The accretion area at Michigan City would continue to grow because sediment is being transported to the shoreline from upland sources, as sediment supply meant to drift naturally along the shoreline is blocked by the existing navigational structure (i.e., Michigan City Harbor).

Although the existing program of beach nourishment has had a positive effect in reducing the annual sediment budget deficit, the amount of sediment being placed along the shoreline is substantially less than the estimated loss, leaving the sediment budget deficit. Therefore, selection of the no-action alternative would result in a moderate, long-term, adverse impact, due to the continued sediment budget deficit and shoreline erosion.

Dune Formation Processes. The current nourishment program includes placing material primarily on the beach at Crescent Dune, and using heavy equipment to grade the material into a more natural topography. Shoreline sediment is transported by natural processes (i.e., wave action, wind) to the foredune area where it provides material for dune formation. The amount of material placed during current beach nourishment activities is less than the annual sediment loss, resulting in continued erosion. The existing nourishment program has helped reduce impacts on dune formation; however, due to the sediment budget deficit, dune erosion would continue under the no-action alternative. Therefore, the no-action alternative would result in moderate, long-term, adverse impacts on dune formation processes.

Cumulative Impacts. The "Cumulative Impact Scenario" section of the "Environmental Consequences" chapter describes the past, present, and reasonably foreseeable future actions in or surrounding the project area. Many of these actions have affected coastal processes, including the construction of man-made structures, which have impacted the natural littoral drift along the lakeshore. The main structure affecting reaches 1 and 2 is the Michigan City Harbor. Construction of the harbor resulted in areas of accretion (east of the harbor) and areas of erosion (west of the harbor). Additionally, the Calumet Harbor and River project and its associated dredging activities affect littoral drift in the Great Lakes resulting in sediment accretion and sediment budget deficits along shorelines in the project area. Present beach nourishment activities have provided some sediment in the areas of erosion, but volumes are inadequate to account for the annual sediment budget deficit, and do not address issues of sediment accretion. No future modifications to the shoreline have been identified within reaches 1 and 2, as surrounding and adjacent federal and industrial harbors and other man-made shoreline structures have already been constructed. Cumulative impacts on coastal processes under alternative A would be moderate, long-term and adverse.

Conclusion. Despite the continuation of the current nourishment program by the COE, under the no-action alternative, sediment budget deficit and erosion would continue to affect Indiana Dunes National Lakeshore's sandscapes and shorelines, resulting in an overall moderate, long-term, adverse impact. As erosion continued, the integrity of cultural and natural resources along the shoreline, as well as nearby infrastructure would be threatened. Additionally, existing navigational and industrial structures along the lakeshore would continue to disrupt sediment transport. Cumulative impacts on coastal processes under alternative A would be moderate, long-term and adverse. Actions under alternative A would provide no incremental increase to the overall cumulative impacts.

Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency)

Sediment Transport Processes. Under alternative B-1, sediment would be mined and placed on the beach each year from a permitted upland source. Placing additional sediment on the beach in reach 1 would initially increase beach size within the placement area in front of Crescent Dune and Mount Baldy. The additional nourishment material would be sufficient to maintain the current shoreline position for approximately one year, as natural wave action would continue to erode the sediment after placement. The shorelines downdrift of Crescent Dune and Mount Baldy would receive a large infusion of sediment following the material placement, affecting not only reach 1, but reach 2 and a portion of reach 3, as well. The accretion area at Michigan City would continue to grow because sediment would be transported to the beach from an upland source and sand supply meant to drift naturally along the shoreline would be blocked by the existing navigational structure.

Implementing alternative B-1 would result in moderate, long-term, beneficial impacts as the estimated sediment budget deficit quantity would be provided.

Dune Formation Processes. Under alternative B-1, sediment would be mined and placed on the beach each year from a permitted upland source. The placed sediment would erode over the course of approximately one year. Placement of the sediment would provide additional material available on land for aeolian (wind) transport, thus encouraging foredune development. Beach placement also would provide some buffering against storm events. The additional sediment on the beach would protect the current shoreline profile from increased erosion resulting from intense wave action, particularly during storm events.

The actions associated with alternative B-1 would result in moderate, long-term, beneficial impacts as the sediment placed on the beach, in conjunction with wind action, would allow for additional sediment supply to create foredunes.

Cumulative Impacts. Cumulative impacts would generally be similar to those described for alternative A, with the exception that beach nourishment activities would include the amount of sediment needed to balance the annual sediment budget deficit. Cumulative impacts on coastal processes would be negligible to minor, long-term and adverse. The existing man-made structures would persist and continue to create areas of accretion and sediment budget deficit, which would require continued beach nourishment activities to mitigate.

Conclusion. Placing the proposed quantity of sediment on the beach in reach 1 would account for the estimated sediment budget deficit, and thereby maintain the current shoreline profile. Actions under alternative B-1 would also provide additional sediment to encourage foredune development along the shoreline, resulting in moderate, long-term, beneficial impacts on coastal processes. Cumulative impacts on coastal process would be negligible to minor, long-term and adverse.

Actions under alternative B-1 would provide incremental beneficial increases to the overall adverse cumulative impacts described under alternative A. Despite these actions, existing navigational and industrial structures along the lakeshore would continue to disrupt the natural littoral drift along the lakeshore.

Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency)

Sediment Transport Processes. Under alternative B-5, a five-year quantity of sediment would be mined and placed on the beach every five years, initially increasing beach size along the length of reach 1. The additional nourishment material would be sufficient to maintain the current shoreline position for approximately five years, as natural wave action would continue to erode the sediment after placement. The shorelines downdrift of reach 1 would receive a large infusion of sediment following the material placement, affecting not only reach 1, but reach 2 and a portion of reach 3, as well. The accretion area at Michigan City, and the beach at Washington Park, would continue to grow because sediment would be transported from upland sources and sediment supply meant to drift naturally along the shoreline would be blocked by the existing navigational structure.

The actions associated with alternative B-5 would result in moderate, long-term, beneficial impacts, as the estimated sediment budget deficit quantity would be provided.

Dune Formation Processes. A five-year quantity of mined sediment on the beach in reach 1 would erode over the course of approximately five years. Placement of the sediment would provide additional material available on land for aeolian (wind) transport, thus encouraging foredune development. Placing a five-year quantity of sediment on the beach would result in additional protection against storm events. The additional sediment would help protect the current shoreline profile against increased erosion from intense wave action, particularly during storm events. The actions associated with alternative B-5 would result in moderate to major, long-term, beneficial impacts as the additional material on the beach, in conjunction with wind action, would encourage foredune development. The additional material would also provide more buffering against intense storm events than the smaller amount of sediment provided for under an annual program of beach nourishment.

Cumulative Impacts. Cumulative impacts would generally be as described for alternative A, with the exception that beach nourishment activities would include the amount of sediment needed to balance the annual sediment budget deficit. Cumulative impacts on coastal processes would be negligible, long-term and adverse. The impacts of the existing man-made structures would persist, continuing to create areas of accretion and erosion, which would require the continued beach nourishment activities to mitigate.

Conclusion. Placing the proposed quantity of sediment on the beach in reach 1 every five years would account for the estimated sediment budget deficit, and thereby maintain the current shoreline profile. The actions associated with alternative B-5 would also provide a large quantity of sediment on the beach to facilitate foredune development along the shoreline, resulting in major, long-term, beneficial impacts on coastal processes. Cumulative impacts on coastal process would be negligible, long-term and adverse.

Actions under alternative B-5 would provide incremental beneficial increases to the overall adverse cumulative impacts described under alternative A. Despite these actions, existing navigational and industrial structures along the lakeshore would continue to disrupt the natural littoral drift along the lakeshore.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency)

Sediment Transport Processes. Under alternative C-1, sediment would be dredged from an updrift location and be placed along the beach in reach 1. As under alternative B-1, placing additional sediment on the beach in reach 1 would result in an initial increase in beach size within the placement area at Crescent Dune. The additional nourishment material would be sufficient to maintain the current shoreline position for approximately one year, as natural wave action would continue to erode the sediment after placement. The shorelines downdrift of Crescent Dune and Mount Baldy would receive a large infusion of sediment, originating from Lake Michigan, following the material placement, affecting not only reach 1, but reach 2 and a portion of reach 3, as well.

Transporting sediment from an updrift to a downdrift location would mimic natural processes as the material used would remain within the Lake Michigan system. Implementing alternative C-1 therefore would result in moderate to major, long-term, beneficial impacts as the estimated sediment budget deficit would be provided from an updrift source, more closely mimicking natural processes.

Dune Formation Processes. Under alternative C-1, additional sediment would be dredged from an updrift location and placed at Crescent Dune. This sediment would erode over the course of approximately one year. Placement of the sediment would provide additional material available on land for aeolian (wind) transport, thus encouraging foredune development. Beach placement would provide some buffering against storm events. The additional sediment on the beach would protect the current shoreline profile from increased erosion resulting from intense wave action, particularly during storm events.

Implementing alternative C-1 would result in moderate, long-term, beneficial impacts as the sediment placed on the beach, in conjunction with wind action, would allow for additional sediment supply to create foredunes.

Cumulative Impacts. Cumulative impacts under alternative C-1 would generally be as described for alternative A, with the exception that beach nourishment activities would include the amount of sediment needed to balance the annual sediment budget deficit. Additionally, sediment would be taken from an updrift location that would more closely mimic the natural coastal processes as the material used would remain within the Lake Michigan system. Cumulative impacts on coastal processes would be negligible to minor, long-term and adverse.

Conclusion. Placing the proposed quantity of sediment on the beach in reach 1 would account for the calculated sediment budget deficit, and thereby maintain the current shoreline profile. Additionally, dredging sediment from an updrift location would more closely mimic natural processes, as compared to using material from upland sources. Implementing alternative C-1 would also provide additional sediment to encourage foredune development along the shoreline, resulting in moderate to major, long-term, beneficial impacts on coastal processes. Cumulative impacts on coastal process would be negligible to minor, long-term and adverse.

Actions under alternative C-1 would provide incremental beneficial increases to the overall adverse cumulative impacts described under alternative A. Despite these actions, existing navigational and industrial structures along the lakeshore would continue to disrupt the natural littoral drift along the lakeshore.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

Sediment Transport Processes. As described under alternative C-1, sediment would be dredged from an updrift location and would be placed along the beach in reach 1; however, under alternative C-5, a five-year quantity would be used to nourish the beach. Placing a five-year quantity of sediment in reach 1 would initially increase beach size along the length of reach 1. The additional nourishment material would be sufficient to maintain the current shoreline position for approximately five years, as natural wave action would continue to erode the sediment after placement. The shorelines downdrift of reach 1 would receive a large infusion of sediment, originating from Lake Michigan, following the material placement, affecting not only reach 1, but reach 2 and a portion of reach 3, as well.

Transporting sediment from an updrift to a downdrift location would mimic natural processes, as material used would remain within the Lake Michigan system. Implementing alternative C-5 therefore, would result in moderate to major, long-term, beneficial impacts as the estimated sediment budget deficit would be provided from an updrift source, more closely mimicking natural processes.

Dune Formation Processes. Under alternative C-5 a five-year quantity of sediment would be dredged from an updrift location and placed at Crescent Dune, providing additional sediment along the majority of reach 1. This sediment would erode over the course of approximately five years. Placement of the sediment would provide additional material available on land for aeolian (wind) transport, thus encouraging foredune development. Placing a five-year quantity of sediment on the beach would provide additional protection against storm events. The additional sediment on the beach would protect the current shoreline profile from increased erosion resulting from intense wave action, particularly during storm events. Implementing alternative C-5 would result in moderate to major, long-term, beneficial impacts as the additional quantity of material on the beach, in conjunction with wind action, would encourage foredune development. The additional quantity of material would also provide buffering against intense storm events.

Cumulative Impacts. Cumulative impacts under alternative C-5 would generally be as described for alternative A, with the exception that beach nourishment activities would include the amount of sediment needed to balance the annual sediment budget deficit. Additionally, there would be a reduction in areas of accretion, which would be used as sources of sediment for beach nourishment operations. Cumulative impacts on coastal processes would be negligible, long-term and adverse.

Conclusion. Placing the proposed quantity of sediment on the beach in reach 1 every five years would account for the estimated sediment budget deficit, and thereby maintain the current shoreline profile. Implementing alternative C-5 would also provide a large quantity of sediment on the beach from an updrift source to facilitate foredune development along the shoreline, resulting in moderate to major, long-term, beneficial impacts on coastal processes. Cumulative impacts on coastal process would be negligible, long-term and adverse.

Actions under alternative C-5 would provide incremental beneficial increases to the overall adverse cumulative impacts described under alternative A. Despite these actions, existing navigational and industrial structures along the lakeshore would continue to disrupt the natural littoral drift along the lakeshore.

Alternative D (Beach Nourishment via Permanent Bypass System)

Sediment Transport Processes. Under alternative D, sediment would be placed along the beach in reach 1 from updrift of the Michigan City Harbor, and transported to the shoreline via a permanent bypass system. As with the previously described alternatives, placing additional sediment on the beach in reach 1 would result in an initial increase in beach size within the placement area at Crescent Dune. The additional nourishment material would be sufficient to maintain the current shoreline position for approximately one year, as natural wave action would continue to erode the sediment after placement. The shorelines downdrift of Crescent Dune and Mount Baldy would receive an infusion of sediment following the material placement, affecting not only reach 1, but reach 2 and a portion of reach 3, as well.

Transporting sediment from an updrift to a downdrift location in this manner would mimic the natural processes, as material used in beach nourishment would remain within the Lake Michigan system. Implementing alternative D therefore, would result in moderate to major, long-term, beneficial impacts as the estimated sediment budget deficit would be provided from a source updrift, more closely mimicking natural processes.

Dune Formation Processes. Under alternative D, sediment would be transported to the shoreline in reach 1 via a permanent bypass system from updrift of the Michigan City Harbor. Under alternative D, placed material would erode over the course of approximately one year. Placement of the sediment would provide additional material available on land for aeolian (wind) transport, thus encouraging foredune development. Beach placement also would provide some buffering against storm events. The additional sediment on the beach would protect the current shoreline profile from increased erosion resulting from intense wave action, particularly during storm events.

Implementing alternative D would be moderate, long-term, beneficial impacts as the sediment placed on the beach, in conjunction with wind action, would provide additional sediment supply to create foredunes.

Cumulative Impacts. Cumulative impacts under alternative D would generally be as described for alternative A, with the exception that beach nourishment activities would include the amount of sediment needed to balance the annual sediment budget deficit. Additionally, there would be a reduction in areas of accretion which would be used as sources of sediment for beach nourishment operations. Cumulative impacts would be negligible to minor, long-term and adverse.

Conclusion. Placing the proposed quantity of sediment on the beach in reach 1 would account for the estimated sediment budget deficit, and thereby maintain the current shoreline profile. Additionally, dredging sediment from an updrift location would more closely mimic natural processes, as compared to using material from upland sources. Implementing alternative D would also provide additional sediment to encourage foredune development along the shoreline, resulting in moderate to major, long-term, beneficial impacts on coastal processes. Cumulative impacts on coastal process would be negligible to minor, long-term and adverse.

Actions under alternative D would provide incremental beneficial increases to the overall adverse cumulative impacts described under alternative A. Despite these actions, existing navigational and industrial structures along the lakeshore would continue to disrupt the natural littoral drift along the lakeshore.

Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency)

Sediment Transport Processes. Under alternative E, a submerged cobble berm along the shoreline of reach 1 would be constructed. The submerged cobble berm would be comprised of appropriate-sized aggregate material from local glacial deposits which would be re-distributed across the lake bottom by natural wave action. The distribution would move the smaller aggregate closer to the shoreline, while the larger material would generally stay within a few feet of the submerged cobble berm. Distribution would be variable, depending on the intensity of storm events. Prior to breakdown of the submerged cobble berm, wave energy within the nearshore would be dissipated, thus increasing the likelihood of sediment retention in the nearshore. After the submerged cobble berm has been spread along the lake substrate, lakebed down-cutting would decrease as the aggregate material would create a protective layer.

The submerged cobble berm would be used in conjunction with a beach nourishment program to restore reach 1. The potential exists for reduced nourishment quantities, as the submerged cobble berm would increase sediment retention. The placement of nourishment material would be conducted to mitigate erosion within reach 1, and to maintain the current shoreline profile.

A moderate, long-term, beneficial impact on sediment transport processes would result from implementing alternative E. Annual nourishment from a dredged source would be determined in coordination with IDNR and would more closely mimic natural processes. Material used for the submerged cobble berm would provide additional protection of the clay sill on the lake bottom and would be similar to material historically found in reach 1. The submerged cobble berm, and the eventual distribution of its aggregate material, would help protect the shoreline from erosion due to storm events, and maintain a more stable shoreline profile.

Dune Formation Processes. Under alternative E, the submerged cobble berm would be used in conjunction with a beach nourishment program to restore reach 1 of Indiana Dunes National Lakeshore. Placement of the sediment would provide additional material available on land for aeolian (wind) transport, thus encouraging foredune development. Beach placement also would provide some buffering against storm events. The submerged cobble berm would provide additional retention of sediment in the area of placement.

Implementing alternative E would result in moderate, long-term, beneficial impacts as the submerged cobble berm would provide longer retention of the sediment. The material placed on the beach in conjunction with the submerged cobble berm, would allow for additional sediment supply to create foredunes. Beach placement of nourishment materials also would provide some buffering against storm events.

Cumulative Impacts. Cumulative effects under alternative E would generally be similar to those described under alternative A. The combination of the effects of the submerged cobble berm along with beach nourishment activities would create and maintain a more natural and stable shoreline. Cumulative effects under alternative E would be negligible, long-term and adverse.

Conclusion. Constructing a submerged cobble berm in addition to placing nourishment material from an updrift source would account for the estimated sediment budget deficit, and thereby maintain the current shoreline profile. Placing cobble aggregate material from local glacial deposits in reach 1 would more closely replicate material historically found in this area of the shoreline. Additionally, dredging sediment from an updrift location would more closely mimic natural processes, as compared to using material from upland sources. Implementing alternative E would increase sediment retention in the area of placement, provide additional sediment to encourage foredune development along the shoreline, and would result in moderate, long-term, beneficial impacts on coastal processes. Cumulative impacts on coastal process would be negligible, long-term and adverse.

Actions under alternative E would provide incremental beneficial increases to the overall adverse cumulative impacts described under alternative A. Despite these actions, existing navigational and industrial structures along the lakeshore would continue to disrupt the natural littoral drift along the lakeshore.

Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline) – Preferred Alternative

Sediment Transport Processes. Under alternative F, a beach nourishment program to restore reach 1 would be implemented. Under this alternative an additional volume of small native stones native to the shoreline region would be added to the dredged materials at the shoreline. These small native stones would be consistent in size and volume with those presently found downdrift in dynamically stable beach zones. The combination of dredged and trucked in materials would be used as beach nourishment material to restore reach 1 of Indiana Dunes National Lakeshore. The objectives of adding the native stone to the nourishment material would be to stabilize the shoreline downdrift of the Michigan City Harbor by providing a more erosion resistant component, and to enhance aquatic habitat by diversifying the nearshore substrate consistent with dynamically stable reaches.

A moderate, long-term, beneficial impact on sediment transport processes would result from implementing alternative F. A quantity up to 136,500 cubic yards (the identified annual budget deficit for this reach) of lake-bottom sediment would be hydraulically placed annually on the beach in reach 1 to provide nourishment and protection of the shoreline. Additional stone materials would be added to beach nourishment materials until the desired shoreline condition was reached. The mixing of native stone material with sediment would reduce shoreline erosion by providing a mix of stone, consistent with dynamically stable shoreline reaches, that is more resistant to wave energy.

Dune Formation Process. Under alternative F, small native stones native to the shoreline would be used in conjunction with a beach nourishment program to restore reach 1 of Indiana Dunes National Lakeshore. Placement of the sediment would provide additional material available on land for aeolian (wind) transport, thus encouraging foredune development. Beach placement also would provide some buffering against storm events.

Implementing alternative F would result in moderate, long-term, beneficial impacts as the native stones would provide longer sediment retention along the beach. The material placed on the beach in conjunction with the native stones, would allow for additional sediment supply to create foredunes. Beach placement of nourishment materials also would provide some buffering against storm events.

Cumulative Impacts. Cumulative effects under alternative F would generally be similar to those described under alternative A. The combination of the effects of the beach nourishment activities with a mix of natural stone, dredged sediment, and coarse upland material at the shoreline would create and maintain a more natural and stable shoreline. Cumulative effects under alternative F would be negligible, long-term and adverse.

Conclusion. Placing nourishment material from an updrift source on an annual basis with a mix of natural stone, dredged sediment, and coarse upland material at the shoreline would account for the estimated sediment budget deficit, and thereby maintain the current shoreline position. The mixing of native stone material with sediment would reduce shoreline erosion by providing a mix of stone that is consistent with dynamically stable shoreline reaches and would be more resistant to wave energy. Additionally, dredging sediment from an updrift location would more closely mimic natural processes, as compared to using material from upland sources. Implementing alternative F would increase sediment retention in the area of placement, provide additional sediment to encourage foredune development along the shoreline, and would result in moderate, long-term, beneficial impacts on coastal processes. Cumulative impacts on coastal process would be negligible, long-term and adverse.

Actions under alternative F would provide incremental beneficial increases to the overall adverse cumulative impacts described under alternative A. Despite these actions, existing navigational and industrial structures along the lakeshore would continue to disrupt the natural littoral drift along the lakeshore.

SHORELINE AND BEACH COMPLEX, REACHES 3 AND 4

Alternative A (No-action Alternative)

Sediment Transport Processes. Under alternative A, sediment would continue to be dredged annually around the NIPSCO/Bailly intake. The dredged material would be placed in the nearshore at Portage Lakefront and Riverwalk, while sediment from Burns International Harbor would have an offshore, open-water placement. Despite intermittent nearshore placement activities associated with dredging, erosion of the shoreline would continue as the quantity of material being placed would not address the sediment budget deficit in the area. Additionally, nearshore placement would typically be less effective than beach nourishment as less sediment would be transported via wave action to the shoreline.

Although implementing the no-action alternative would propose continuing current dredging and placement of sediment in the nearshore, an annual sediment budget deficit in the erosion areas of the lakeshore would still result. The sediment being placed in the nearshore at Portage Lakefront and Riverwalk would continue to help reduce the sediment budget deficit; however, the area would still experience a net loss of sediment, impacting the natural sediment transport processes. Accordingly, impacts under the no-action alternative would be minor to moderate, long-term and adverse. As dredging of the intake area would be intermittent, the accretion areas would continue to grow, potentially achieving a stable profile and allowing sediment to bypass harbor structures. Sediment would accumulate in the navigational channel, and the sediment would adversely affect the intake as well as a warm-water industrial discharge point.

Dune Formation Processes. Current management practices by the COE include dredging material from around the NIPSCO/Bailly intake, and placing that sediment in the nearshore at Portage Lakefront and Riverwalk. Placement of sediment in this area is less effective relative to foredune creation than if it were placed on the beach, as much of the material would be transported downdrift or further lakeward to open waters rather than towards the shoreline. Subsequently, less is available to be transported via wind action onto the beach to form embryonic dunes. If the no-action alternative were implemented, beach erosion would continue, thus threatening park infrastructure along the shoreline. Taking no new actions in the park would result in minor to moderate, long-term, adverse impacts.

Cumulative Impacts. The primary past and present actions that have affected coastal processes are the construction of man-made structures, which have impacted the natural littoral drift along the lakeshore. The main structures in reaches 3 and 4 are associated with the Port of Indiana and Gary-U.S. Steel breakwater. The presence of these structures has resulted in areas of accretion (east of the structures) and areas of sediment budget deficit (west of the structures). Additionally, there are sections of shoreline that are armored with steel-sheet piling and stone revetments, which have also altered natural shoreline conditions. The Calumet Harbor and River project and its associated dredging activities affect littoral drift in the Great Lakes resulting in sediment accretion and sediment budget deficits along the shoreline. Present dredging activities in the accretion areas, and beach nourishment activities in the areas with severe erosion, have helped lessen the existing impacts, but are not adequate to account for the annual sediment budget deficit, and do not fully address issues of sediment accretion. No future modifications to the shoreline have been identified within reaches 3 and 4, as most federal and industrial harbors and other man-made shoreline structures have already been constructed. Cumulative impacts on coastal processes under alternative A would be moderate, long-term and adverse.

Conclusion. Despite the continuation of the current dredging program and nearshore placement of sediment by the COE, under the no-action alternative, erosion would continue to affect Indiana Dunes National Lakeshore's sandscapes and shorelines. This would result in an overall minor to moderate, long-term, adverse impact. As erosion continues, the integrity of cultural and natural resources along the shoreline, as well as nearby infrastructure would be threatened. Additionally, existing navigational and industrial structures along the lakeshore would continue to interrupt sediment transportation. Cumulative impacts on coastal processes under alternative A would be moderate, long-term and adverse. Actions under alternative A would provide no incremental increase to the overall cumulative impacts.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency) – Preferred Alternative

Sediment Transport Processes. Under alternative C-1, sediment would be dredged from an updrift location placed annually on the beach at Portage Lakefront and Riverwalk. This would initially increase beach size within the placement area. The additional nourishment material would be sufficient to maintain the current shoreline position for approximately one year, as natural wave action would continue to erode the sediment after placement. The shorelines downdrift of the placement area at Portage Lakefront and Riverwalk would receive a large infusion of sediment following the material placement, affecting reach 4.

Transporting sediment from an updrift to a downdrift location mimics the natural processes, as material used would remain within the Lake Michigan system.

Implementing alternative C-1 therefore, would result in moderate, long-term, beneficial impacts as the sediment would be provided from an updrift source, more closely mimicking natural processes.

Dune Formation Processes. Under alternative C-1, sediment would be dredged from an updrift location in Lake Michigan and placed annually on the beach at Portage Lakefront and Riverwalk. Placement of the sediment would provide additional material available on land for aeolian (wind) transport, thus encouraging foredune development. Beach placement also would provide some buffering against storm events. The additional sediment on the beach would protect the current shoreline profile from increased erosion resulting from intense wave action, particularly during storm events.

Implementing alternative C-1 would result in moderate, long-term, beneficial impacts as the sediment placed on the beach, in conjunction with wind action, would allow for additional sediment supply to create foredunes.

Cumulative Impacts. Cumulative impacts under alternative C-1 would generally be as described for alternative A, with the exception that beach nourishment activities would include the amount of sediment needed to balance the annual sediment budget deficit. Cumulative effects would be negligible to minor, long-term and adverse.

Conclusion. Placing the proposed quantity of sediment on the beach in reach 3 would mitigate the sediment budget deficit, and thereby protect the current shoreline profile. Additionally, dredging sediment from an updrift location would more closely mimic natural processes as compared to using material from upland sources. Actions associated with alternative C-1 would also provide additional sediment to encourage foredune development along the shoreline, resulting in moderate, long-term, beneficial impacts on coastal processes. Cumulative impacts on coastal process would be negligible to minor, long-term and adverse. Actions under alternative C-1 would provide incremental beneficial increases to the overall adverse cumulative impacts described under alternative A. Despite these actions, existing navigational and industrial structures along the lakeshore would continue to disrupt the natural littoral drift along the lakeshore.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

Sediment Transport Processes. Under alternative C-5, the five-year quantity of sediment to be placed on the beach in reach 3 would occur via dredging from an updrift location in Lake Michigan, such as near the NIPSCO/Bailly intake. The approximate 370,000 cubic yards (yd^3) of sediment would initially increase beach size along the length of reach 3, and would be sufficient to maintain the current shoreline position for approximately five years, as natural wave action would continue to erode the sediment after placement. The shoreline downdrift of reach 3 would receive a large infusion of sediment following the material placement, affecting reach 4. The large amount of sediment placed on the beach under alternative C-5 would increase the potential for there to be increased sedimentation at the Burns International Harbor, due to sediment transport along the lakeshore. If this occurred, it would create the need for increased dredging activities at the harbor. Additional studies and/or monitoring would be needed to evaluate the potential for this effect.

Transporting sediment from an updrift to a downdrift location would mimic the natural processes, as the material used would remain within the Lake Michigan system, resulting in moderate, long-term, beneficial impact. Potential issues with sedimentation at the Burns International Harbor would need to be evaluated, and would result in a minor to moderate, long-term, adverse impact.

Dune Formation Processes. Under alternative C-5, the five-year quantity of sediment to be placed on the beach in reach 3 would occur via dredging from an updrift location in Lake Michigan, such as near the NIPSCO/Bailly intake. This sediment would erode over the course of approximately five years. Placement of the sediment would provide additional material available on land for aeolian (wind) transport, thus encouraging foredune development. Placing the five-year quantity of sediment on the beach would result in additional protection against storm events. The additional sediment would protect the current shoreline profile from increased erosion resulting from intense wave action, particularly during winter weather. Implementing alternative C-5 would result in moderate to major, long-term, beneficial impacts, as the additional quantity of material on the beach, in conjunction with wind action, would encourage foredune development. The additional quantity of material would also provide buffering against intense weather events.

Cumulative Impacts. Cumulative impacts under alternative C-5 would generally be as described for alternative A, with the exception that beach nourishment activities would include the amount of sediment needed to balance the annual sediment budget deficit. The initial large amount of material placed on the beach would enhance conditions for dune formation, and provide greater protection to the beach complex from storm events. Cumulative effects would be negligible, long-term and adverse.

Conclusion. Placing the proposed quantity of sediment on the beach in reach 3 every five years would mitigate the sediment budget deficit and protect the current shoreline profile. Actions associated with alternative C-5 would also provide a large quantity of sediment on the beach from an updrift source to facilitate foredune development along the shoreline, resulting in moderate, long-term, beneficial impacts on coastal processes. Cumulative impacts on coastal process would be negligible, long-term and adverse. There would also be potential increased sedimentation at Burns International Harbor.

Actions under alternative C-5 would provide incremental beneficial increases to the overall adverse cumulative impacts described under alternative A. Despite these actions, existing navigational and industrial structures along the lakeshore would continue to disrupt the natural littoral drift along the lakeshore.

Alternative D (Beach Nourishment via Permanent Bypass System)

Sediment Transport Processes. Under alternative D, the amount of sediment material deposited in reach 3 would fulfill the estimated sediment budget deficit. A permanent bypass system would be constructed and operated to transport sediment from updrift of the NIPSCO/Baily complex to Portage Lakefront and Riverwalk. As with the previously described alternatives, implementing alternative D would place the additional sediment on the beach in reach 3. This would result in an initial increase in beach size within the placement area in front of Portage Lakefront and Riverwalk. The additional nourishment material would be sufficient to maintain the current shoreline position for approximately one year, as natural wave action would continue to erode the sediment after placement. The shoreline downdrift of Portage Lakefront and Riverwalk would receive an infusion of sediment following the material placement, affecting not only reach 3, but also reach 4.

Transporting sediment from an updrift to a downdrift location in this manner would mimic natural processes as material used in nourishment would remain within the Lake Michigan system, resulting in moderate, long-term, beneficial impacts.

Dune Formation Processes. Under alternative D, the amount of sediment material deposited in reach 1 would fulfill the estimated sediment budget deficit. A permanent bypass system would be constructed and operated to transport sediment from updrift of the NIPSCO/Baily complex to Portage Lakefront and Riverwalk under this alternative. This sediment deposit would erode over the course of approximately one year. Placement of sediment on the beach is more effective than nearshore placement as additional material is available for aeolian (wind) transport, thus encouraging foredune development. Beach placement would provide some buffering against storm events. The additional sediment on the beach would protect the current shoreline profile from increased erosion resulting from intense wave action, particularly during storm events.

Implementing alternative D would result in moderate, long-term, beneficial impacts, as the sediment placed on the beach, in conjunction with wind action, would provide additional sediment supply to create foredunes.

Cumulative Impacts. Cumulative impacts for alternative D would generally be as described for alternative A, with the exception that beach nourishment activities would include the amount of sediment needed to balance the annual sediment budget deficit. Cumulative impacts would be negligible to minor, long-term and adverse.

Conclusion. Placing the proposed quantity of sediment on the beach in reach 3 would mitigate the sediment budget deficit, and thereby maintain the current shoreline profile. Additionally, dredging sediment from an updrift location would more closely mimic natural processes as compared to using material from upland sources. The actions associated with alternative D would also provide additional sediment to encourage foredune development along the shoreline, resulting in moderate, long-term, beneficial impacts on coastal processes. Cumulative impacts on coastal process would be negligible to minor, long-term and adverse.

Actions under alternative D would provide incremental beneficial increases to the overall adverse cumulative impacts described under alternative A. Despite these actions, existing navigational and industrial structures along the lakeshore would continue to disrupt the natural littoral drift along the lakeshore.

FOREDUNE AND DUNE COMPLEX, REACHES 1 THROUGH 4

Current and Proposed Management Actions

Current and proposed management actions for the foredune and dune complex address the issues of sensitive habitat restoration, invasive vegetation management, and anthropogenic influences. These actions primarily affect terrestrial resources. Management actions that would result in dune stabilization, such as revegetation with native plants and protection from pedestrian overuse (e.g., the realignment of trails), would encourage the dune formation processes. Also, as sediment is transported between the nearshore, beach, and dune complexes, improved conditions in the foredune and dune complex would enhance the natural sediment transport processes between these complexes. These actions would result in minor, long-term, beneficial impacts on coastal processes.

Cumulative Impacts. Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under coastal processes as a result of proposed management actions would be negligible to minor, long-term, and beneficial from the enhanced natural sediment transport process that would result from the improved conditions in the foredune and dune complex.

Conclusion. Addressing sensitive habitat issues in the foredune and dune complex through site restoration, invasive vegetation management, and limiting and managing anthropogenic influences would result in dune stabilization from enhanced natural sediment transport processes, resulting in minor, long-term, beneficial impacts.

Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under coastal processes would be negligible to minor, long-term, and beneficial from the enhanced natural sediment transport process that would result from the improved conditions in the foredune and dune complex.

AQUATIC FAUNA

METHODOLOGY

This analysis incorporates the best available scientific literature applicable to the region, the setting, and the actions being considered in the alternatives. Available information describing native, invasive and nonnative aquatic communities and distribution, including published scientific papers, NPS research reports, planning documents, state program materials, national databases and mapping efforts, and consultation with park specialists, were gathered, reviewed, and summarized. Impacts on aquatic fauna were evaluated by comparing projected changes resulting from the action alternatives to the projected results of implementing the no-action alternative.

Intensity Level Definitions

Intensity thresholds for native aquatic fauna are defined as follows:

Negligible: The impact is barely detectable, and/or would result in no noticeable or perceptible changes in encouraging native aquatic fauna presence.

Minor: The impact is slight but detectable, and/or would result in small but noticeable changes in encouraging native aquatic fauna presence.

Moderate: The impact is readily apparent, and would result in easily detectable changes in encouraging native aquatic fauna presence.

Major: The impact is severely adverse, or exceptionally beneficial, and/or would result in appreciable changes in encouraging native aquatic fauna presence.

SHORELINE AND BEACH COMPLEX, REACHES 1 AND 2

Alternative A (No-action Alternative)

Storm waves, capable of reaching the base of coastal dunes, cause massive erosion and slumping of dune sands. This, in turn, introduces large volumes of sediment into the nearshore sediment transport system. Fine dune sediment is held in suspension much longer than beach sediment or fill sediment, and could therefore, be transported farther offshore. Suspended solids in the water could affect fish populations by delaying the hatching time of fish eggs, killing the fish by abrading their gills, and causing anoxia. Fish tolerance to suspended solids varies from species to species and by age; however, destruction of habitat rather than suspension of sediments appears to be the major hazard to beach and nearshore fish. Most of these aquatic species have the ability to migrate from an undesirable environment and return when deposition ceases. Benthic fish (those living on or near the bottom of the lake) move into an area within the first day after a disturbance ceases. The motile aquatic species, that have stringent environmental requirements, such as substrate preferences for spawning, foraging, or shelter, as well as species closely associated with the beach for part of their life cycle (e.g., longnose dace [*Rhinichthys cataractae*]), would be most likely affected by beach nourishment (COE 1989). Species that form lake-bottom or benthic communities on most high-energy coastal beaches are adapted to periodic changes related to the natural erosion and accretion cycles and storms. Organisms adapted to unstable nearshore bottom conditions tend to tolerate perturbations better than those in more stable offshore environments. Areas of continued erosion and accretion would disturb spawning and nursery habitats in the nearshore.

Potential effects of beach nourishment include: altered distribution during offshore nourishment; potential for gill clogging and abrasion; temporary smoldering of benthic prey; burial of areas that serve as foraging and shelter sites; and potential burial of benthic fish. Burial of offshore benthic animals by beach nourishment material has a greater potential for adverse effects because the offshore organisms are more sensitive to perturbation than those in the upper nearshore and swash zone. Direct burial of nonmotile aquatic species in the placement area would produce localized mortality but would not have an appreciable effect of population stability (COE 1989).

Under alternative A, the natural processes occurring in the lake, though exacerbated by the modifications along the shoreline, would continue to provide nearshore habitat for the most disturbance-tolerant species. It is assumed that beach nourishment activities would continue, averaging approximately 31,500 yd^3 of mined material placed annually along the shoreline around Crescent Dune near Mount Baldy.

Meiofauna and macroinvertebrates — A 2006 study conducted in association with the current beach nourishment activities indicated that the benthic community affected by material deposition near Mount Baldy showed evidence of a relatively high rate of recovery within eight to 12 months after beach nourishment activities. Densities and total number of benthic taxa increased with depth, suggesting lower impact of sediment drift and wave action in deeper waters (Przybryla-Kelly and Whitman 2006). Since the benthic community within the beach nourishment placement area would recover within a year, impacts on the benthic community under the no-action alternative would be minor, short-term and adverse.

Fish of Lake Michigan — Yellow perch (*Perca flavescens*), as well as other fish species, are frequently found in the nearshore area, where wave-induced sediment transport is naturally active. It is well-recognized that these fish would vacate this nearshore area whenever a temporary natural disturbance occurred (e.g., the passage of a storm resulting in high wave activity and suspension of large quantities of sediment) and would return when favorable conditions were again present. Under the no-action alternative, the yellow perch population in the nearshore would be subjected to environmental stress arising from erosion and suspension of fine dune sands. The current beach nourishment program conducted by the COE was designed to combat this erosion. The average 31,500 yd^3 of material placed annually would be less than the calculated sediment budget deficit of 136,500 yd^3. Annual beach nourishment results in temporary displacement of fish as turbidity in the water column in both the dredge location and placement area would render the nearshore temporarily inhospitable. Under the no-action alternative, the erosion along the shoreline would continue, and fish assemblages in the nearshore area would remain subjected to environmental stress. Impacts on native fish species under alternative A would be minor, short-term and adverse.

Invasive and nonnative species — The presence of invasive and nonnative species, including round gobies and dreissenid mussels, changes native species composition. Dreissenid mussels compete directly with zooplankton for food because they filter phytoplankton from the water column. The decrease in zooplankton densities indirectly results in reduced numbers of age-0 yellow perch. Under the no-action alternative, beach nourishment activities would disturb the placement site, which would encourage the establishment of nonnative and invasive species at that site. This is because the sandy substrate of the lakeshore provides for benthic species and fish assemblages intertwined in a delicate food web that is easily disrupted by external forces, such as beach nourishment and placement activities like those currently taking place in reach 1. The sediment material used for such beach nourishment could provide a pathway for the establishment and introduction of nonnative species. Sediment placement activities could also cause an unequal distribution of sediment supply to the lakeshore, resulting in a disturbed environment for aquatic fauna that encourages or invites nonnative and invasive species. The continued high rate of erosion taking place under the no-action alternative would result in loss of nearshore habitat, thus displacing native fish communities and encouraging a disturbed environment potentially more conducive to the presence of invasive and nonnative species. Effects on native species from the introduction and establishment of invasive and nonnative species would be negligible, long-term and adverse.

Cumulative Impacts. Several potential actions, independent of this plan, would affect the park's aquatic fauna. As described in the "Affected Environment" chapter, anthropogenic influences and alterations to the natural lake habitat have affected native aquatic species. The COE's electric barrier currently helps to block the passage of aquatic nuisance species between the Great Lakes and Mississippi River basins and beneficially discourages the presence of invasive and nonnative aquatic fauna. In the future, additional modifications to the nearby industrial and other properties may be made, which may affect the benthic community and fish assemblages along the Lake Michigan shoreline. Additionally, permitting requirements for industrial and federal discharges into the lake may change, becoming stricter or more lax. Ongoing river projects, like the Calumet Harbor and River project and its associated dredging activities and support of transit in the Great Lakes, may lead to future introductions of aquatic invasive species and continued disturbance to aquatic habitat. Additionally, ships' ballast water, which has accounted for 55% to 70% of reported aquatic invasive species introductions in to the Great Lakes since 1959, continues to provide a pathway for aquatic invasive species in to the Great Lakes. However, future introductions of aquatic invasive species may be effectively managed through ballast water exchange, saltwater flushing, or shipboard treatment, and through restricting access to the Great Lakes to vessels that have not taken protective measures to ensure they do not harbor aquatic invasive species.

Overall, these combined actions would have a moderate, long-term, adverse impact on the native aquatic species from disturbances to the natural lake habitat and from the pathways these activities introduce for aquatic invasive species. When combined with other past, present, and reasonably foreseeable future actions, implementing the no-action alternative would provide no incremental addition to the overall cumulative impacts on aquatic fauna.

Conclusion. Under the no-action alternative, nourishment activities would disturb the placement site, which would encourage the establishment of nonnative and invasive species at that site. In addition, the 31,500 yd^3 of nourishment material would not be sufficient to address the sediment deficit and beach erosion would continue. The actions proposed under the no-action alternative would result in negligible to minor, short- and long-term, adverse impacts on the native aquatic species. The overall cumulative impacts from invasive and nonnative aquatic fauna from past, present, and reasonably foreseeable future projects would be moderate, long-term and adverse. Under the no-action alternative, there would be no incremental addition to the overall cumulative impacts from disturbances to the nearshore lake habitat.

Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency)

Under alternative B-1, the general effects of nourishment activities would be similar to those described under the no-action alternative. Under alternative B-1, nourishment activities would consist of 136,500 yd^3 of mined nourishment material being placed at Crescent Dune.

Meiofauna and macroinvertebrates — Under alternative B-1, impacts on benthic communities would be similar to those described under the no-action alternative, except that onshore placement of 136,500 yd^3 of beach nourishment material would temporarily smother benthic fauna at the placement location, which would consist of a greater area. As beach nourishment material would be from upland sources, there would be no disturbance to the aquatic habitat from dredging activities. In addition, the nourishment volume would match the sediment budget deficit and alleviate the adverse effects from erosion, thereby enhancing the aquatic habitat of the benthic communities. There would be fewer adverse effects from erosion of the shoreline, but the footprint of burial of benthic communities would be larger. Overall effects on the benthic community would be minor, short- and long-term, adverse and beneficial.

Fish of Lake Michigan — Under alternative B-1, effects on fish species would be similar to those described under the no-action alternative, except that under alternative B-1 there would be less erosion and less associated environmental stress to spawning and nursery habitats. Overall effects on fish species would be minor, long-term and beneficial because there would be less environmental stress from erosion and no disturbance from dredging. Under alternative B-1, the volume of beach nourishment material placed on reach 1 would cover a larger area and require longer placement times (approximately four months every year) than under the no-action alternative, resulting in a longer duration of turbid waters and thus longer periods of environmental stress for aquatic fauna. This annual beach nourishment would temporarily displace fish and result in minor, short-term, adverse effects on fish species.

Invasive and nonnative species — Invasive and nonnative aquatic species located in the nearshore of Lake Michigan would be affected similar to the native fish species. A largely homogenous sandy substrate would make the nearshore environment desirable to not only the native species, but to the invasive and nonnative aquatic species as well. Disruption of the natural environment typically would allow for introduction and establishment of nonnative and invasive species. Under alternative B-1, beach nourishment activities would disturb the placement site, which would encourage the establishment of nonnative and invasive species at that site. This is because the sandy substrate of the lakeshore provides for benthic species and fish assemblages that are easily disrupted by external forces, such as the beach nourishment activities that would take place under alternative B-1. Sediment placement activities could cause an unequal distribution of sediment supply to the lakeshore, resulting in a disturbed environment for aquatic fauna that would encourage or invite nonnative and invasive species. Appropriate beach nourishment material would be used, which would help mitigate attracting nonnative species. Therefore, under alternative B-1, effects from encouraging the presence of invasive and nonnative aquatic fauna would be similar to those described under the no-action alternative, except that over 105,000 yd^3 of additional beach nourishment material would be distributed on the beach. Impacts from invasive and nonnative aquatic species under alternative B-1 would be negligible, long-term and adverse.

Cumulative Impacts. Past, present, and reasonably foreseeable future projects with the potential to affect aquatic fauna would be similar to those described under the no-action alternative; moderate, long-term and adverse. Under alternative B-1, nourishment activities would beneficially add to the cumulative, long-term impacts. When combined with other past, present, and reasonably foreseeable future actions, implementing alternative B-1 would incrementally provide a beneficial effect from reducing erosion in the area, and a slight addition to the adverse effects from smothering benthic communities, displacing fish species and potentially encouraging the presence of invasive and nonnative aquatic fauna.

Conclusion. The actions proposed under alternative B-1 would result in negligible to minor, short- and long-term, adverse and beneficial impacts on the native aquatic species. The fish assemblages in the nearshore would be temporarily displaced and benthic communities would be smothered during beach nourishment activities. Also, nourishment activities would disrupt the nearshore environment, which would allow for the introduction and establishment of invasive and nonnative species, but overall the decreased erosion in the area would benefit benthic communities. The overall cumulative effects on aquatic fauna from past, present, and reasonably foreseeable future projects would be moderate, long-term and adverse. Under alternative B-1, there would be a slight incremental addition to the overall short-term, adverse cumulative impacts from smothering benthic communities, displacing fish species and potentially encouraging the presence of invasive and nonnative aquatic fauna.

Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency)

Meiofauna and macroinvertebrates — Under alternative B-5, effects on the benthic community would be similar to those under alternative B-1. Placement of 682,500 yd^3 of sediment along the length of reach 1, would reduce erosion in the area, but would also smother benthic fauna within a greater footprint than under alternative B-1 and would last approximately 18 months every five years. The appropriate sediment placed during beach nourishment activities, in conjunction with effective timing, design and deposition rate, would reduce the adverse effects. Nonetheless, under alternative B-5, increasing the footprint of the placement area would result in burial of the benthic fauna along most of reach 1. The impacts under alternative B-5 would be moderate, long-term and adverse from smothering benthic communities, and minor, long-term and beneficial from reducing erosion.

Fish of Lake Michigan — Under alternative B-5, effects on fish species would be similar to those described under alternative B-1. Placement of 682,500 yd^3 of sediment along the length of reach 1 every five years would reduce erosion in the area, but would also displace fish and interrupt fish life cycles until turbidity in the water column subsided such that the area was once again inhabitable. Water turbidity would last for a longer period of time under alternative B-5 than under alternative B-1 because of the larger area of placement and the longer duration (approximately 18 months every five years) of placement activities. Therefore, under alternative B-5, impacts on fish species would be moderate, long-term and adverse from displacement due to water turbidity, and minor, long-term and beneficial from reducing erosion in the area and enhancing the fish habitat.

Invasive and nonnative species — Under alternative B-5, both native and nonnative/invasive benthic species would be temporarily affected by burial. Disruption of the natural environment would allow for introduction and establishment of nonnative and invasive species. Under alternative B-5, beach nourishment activities would disturb the placement site, which would encourage the establishment of nonnative and invasive species at that site. This is because the sandy substrate of the lakeshore provides for benthic species and fish assemblages that are easily disrupted by external forces, such as the beach nourishment activities that would take place under alternative B-5. Sediment placement activities could cause an unequal distribution of sediment supply to the lakeshore, resulting in a disturbed environment for aquatic fauna that would encourage or invite nonnative and invasive species. Risks from attracting nonnative species would be minimized because appropriate grain sized material would be used. Therefore, under alternative B-5, the effects from encouraging invasive and nonnative aquatic fauna would be negligible, long-term and adverse.

Cumulative Impacts. Past, present, and reasonably foreseeable future projects with the potential to affect aquatic fauna would be similar to those described under the no-action alternative: moderate, long-term and adverse. Under alternative B-5, beach nourishment activities would incrementally add to the cumulative long-term impacts. When combined with other past, present, and reasonably foreseeable future actions, implementing alternative B-5 would provide an incremental addition to the overall short-term, adverse cumulative impacts from smothering benthic communities, displacing fish species and potentially encouraging the presence of invasive and nonnative aquatic fauna.

Conclusion. The actions proposed under alternative B-5 would result in negligible to moderate, long-term, adverse and beneficial impacts on the native aquatic species. The fish assemblages in the nearshore would be temporarily displaced and benthic communities would be smothered during beach nourishment activities. Also, beach nourishment activities would disrupt the nearshore environment, which would allow for the introduction and establishment of invasive and nonnative species. Overall, the decreased erosion in the area would benefit benthic communities. The overall cumulative effects on aquatic fauna from past, present, and reasonably foreseeable future projects would be moderate, long-term and adverse. Under alternative B-5, there would be a slight incremental addition to the overall adverse cumulative impacts from smothering benthic communities, displacing fish species and potentially encouraging the presence of invasive and nonnative aquatic fauna.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency)

Meiofauna and macroinvertebrates — The effects on benthic communities under alternative C-1 would be similar to those described under alternative B-1 except that 136,500 yd^3 of beach nourishment material would be dredged from an updrift location and placed annually on the beach in reach 1.

Some research has shown that that the high-pressure (dredge) pipe kills most soft-bodied infaunal organisms, and animals that survive suspension only play a minor role in re-colonization. To enhance the chance of survival, sediment would closely match the native beach and would be applied slowly in a sheeting spray of sediment and water. This would allow organisms to keep up with the sediment overburdens as they were applied. As previously mentioned, literature reviews of beach nourishment impacts on beach biota indicate short-term declines in abundance, biomass, and taxa richness following beach nourishment. Recovery of the benthic community within the nearshore environment has been shown to occur within eight to 12 months after nourishment activities. Additionally, densities and total number of benthic taxa increased with depth, suggesting lower impact of sediment drift and wave action in deeper waters (Przybryla-Kelly and Whitman 2006).

Under alternative C-1, annual beach nourishment of the park shoreline with dredged material deposited onto the beach would have minor, short- and long-term, adverse and beneficial impacts on the benthic community in the placement area. There would be a long-term, beneficial effect from reducing erosion of the shoreline, but dredge activities would kill individual soft-bodied infaunal organisms. A high rate of recovery of the benthos would be expected in less than one year.

Fish of Lake Michigan — The effects on fish species under alternative C-1 would be similar to those described under alternative B-1 except that beach nourishment material would be dredged and pumped along reach 1. The turbidity in the water column would last longer because the volume of beach nourishment material placed on reach 1 under alternative C-1 would cover a larger area and require longer placement times (approximately two months every year) than under the no-action alternative. This annual beach nourishment activity would temporarily displace fish and result in minor, short-term, adverse effects. Overall effects on fish species would be minor, long-term and beneficial because there would be less environmental stress from erosion.

Invasive and nonnative species — Dredging activities under alternative C-1 would disturb the natural environment and allow invasive and nonnative aquatic fauna to become established. Under alternative C-1, beach nourishment activities would disturb the placement site, which would encourage the establishment of nonnative and invasive species at that site. This is because the sandy substrate of the lakeshore provides for benthic species and fish assemblages that are easily disrupted by external forces, such as beach nourishment, placement, and dredging activities like those that would take place under alternative C-1. Sediment placement activities could also cause an unequal distribution of sediment supply to the lakeshore, resulting in a disturbed environment for aquatic fauna that would encourage or invite nonnative and invasive species. The dredged material would be similar in grain size distributions to those of the native beach and the grain size would closely match that of the natural beach sediments. Under alternative C-1, effects from encouraging the presence of invasive and nonnative aquatic fauna would be similar to those described under alternative B-1: negligible, short-term and adverse.

Cumulative Impacts. Past, present, and reasonably foreseeable future projects with the potential to affect aquatic fauna would be similar to those described under the no-action alternative: moderate, long-term and adverse. Under alternative C-1, beach nourishment activities would beneficially add to the cumulative, long-term impacts. When combined with other past, present, and reasonably foreseeable future actions, implementing actions under alternative C-1 would provide a slight incremental addition to the overall short-term, adverse cumulative impacts from smothering benthic communities, displacing fish species and potentially encouraging the presence of invasive and nonnative aquatic fauna.

Conclusion. The actions proposed under alternative C-1 would result in negligible to minor, short- and long-term, adverse and beneficial impacts on the native aquatic species. The fish assemblages in the nearshore would be temporarily displaced and benthic communities would be smothered during beach nourishment activities. Also, nourishment and dredging activities would disrupt the nearshore environment, which would allow for the introduction and establishment of invasive and nonnative species, but overall the decreased erosion in the area would benefit benthic communities. The overall cumulative effects on aquatic fauna from past, present, and reasonably foreseeable future projects would be moderate, long-term and adverse. Under alternative C-1, there would be a slight incremental addition to the overall short-term, adverse cumulative impacts from smothering benthic communities, displacing fish species and potentially encouraging the presence of invasive and nonnative aquatic fauna.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

Meiofauna and macroinvertebrates — Under alternative C-5, effects on the benthic community would be similar to those under alternative C-1. Placement of 682,500 yd^3 of sediment on the beach in reach 1 every five years would reduce erosion in the area, but would also smother benthic fauna within a greater footprint than under alternative C-1 and there would be greater mortality to individual soft-bodied infaunal organisms. The impacts under alternative C-5 would be moderate to major, short- and long-term, and adverse from dredging activities and smothering benthic communities, and minor, long-term and beneficial from reducing the effects of erosion.

Fish of Lake Michigan — Under alternative C-5, effects on fish species would be similar to those under alternative C-1. Placement of 682,500 yd^3 of sediment along the length of reach 1 every five years would reduce erosion in the area, but would also displace fish and interrupt fish life cycles until turbidity in the water column subsided such that the area was once again inhabitable. Water turbidity would last for a longer period of time under alternative C-5 than under alternative C-1 because of the larger area of placement and the longer duration (approximately 10 months every five years) of dredging and placement activities. Therefore, under alternative C-5, impacts on fish species would be moderate to major, short- and long-term, and adverse from displacement due to water turbidity and dredging activities, and minor, long-term and beneficial from reducing erosion in the area and enhancing the fish habitat.

Invasive and nonnative species — Dredging activities under alternative C-5 would further disturb the natural environment, more so than under alternative C-1, and allow for the establishment of invasive and nonnative aquatic fauna. Therefore, under alternative C-5, effects from encouraging the presence of invasive and nonnative aquatic fauna would be negligible, short-term, and adverse.

Cumulative Impacts. Past, present, and reasonably foreseeable future projects with the potential to affect aquatic fauna would be similar to those described under the no-action alternative: moderate, long-term and adverse. Under alternative C-5, beach nourishment activities would beneficially add to the long-term, cumulative impacts. When combined with other past, present, and reasonably foreseeable future actions, implementing actions under alternative C-5 would provide a slight incremental addition to the overall short-term, adverse cumulative impacts from smothering benthic communities, displacing fish species and potentially encouraging the presence of invasive and nonnative aquatic fauna.

Conclusion. The actions proposed under alternative C-5 would result in negligible to major, short- and long-term, adverse and beneficial impacts on native aquatic species. The fish assemblages in the nearshore would be temporarily displaced and benthic communities would be smothered during beach nourishment activities. Also, beach nourishment and dredging activities would disrupt the nearshore environment, which would allow for the introduction and establishment of invasive and nonnative species, but overall the decreased erosion in the area would benefit benthic communities. The overall cumulative effects on aquatic fauna from past, present, and reasonably foreseeable future projects would be moderate, long-term and adverse. Under alternative C-5, there would be a slight incremental addition to the overall adverse, short-term, cumulative impacts from smothering benthic communities, displacing fish species and potentially encouraging the presence of invasive and nonnative aquatic fauna.

Alternative D (Beach Nourishment via Permanent Bypass System)

Meiofauna and macroinvertebrates — Under alternative D, on average, a total of 136,500 yd^3 of sediment would be transported via a permanent bypass system annually from updrift of the Michigan City Harbor to reach 1. The effects of implementing the high-pressure line associated with the permanent bypass system would be similar to those described under alternative C-1. There would be a minor, long-term, beneficial effect from reducing erosion of the shoreline, but the bypass system would kill individual soft-bodied infaunal organisms and cause minor, short-term impacts on benthic communities. Therefore, nourishment of the park shoreline with a sediment bypass system would have minor, short- and long-term, adverse and beneficial impacts on the benthic community in the placement area.

Fish of Lake Michigan — Under alternative D, the effects on fish species would be similar to those described under alternative C-1 except that beach nourishment material would be pumped via a permanent bypass system. Implementing this beach nourishment system would result in temporary displacement of fish and produce minor, short-term, adverse effects. Overall effects on fish species would be minor, long-term and beneficial because there would be less environmental stress from erosion.

Invasive and nonnative species — The construction of the permanent bypass system would temporarily disrupt the natural environment and allow for the introduction of invasive and nonnative species. Invasive species, particularly round gobies and zebra mussels, would be attracted to artificial structures within the nearshore environment. There would be a slight change in the attraction of invasive and nonnative aquatic fauna. Under alternative D, effects from encouraging the presence of invasive and nonnative aquatic fauna would be negligible, long-term and adverse.

Cumulative Impacts. Past, present, and reasonably foreseeable future projects with the potential to affect invasive and nonnative aquatic fauna would be similar to those described under the no-action alternative: moderate, long-term and adverse. Under alternative D, beach nourishment activities and the permanent bypass system would incrementally add to the long-term, cumulative impacts. When combined with other past, present, and reasonably foreseeable future actions, actions under alternative D would provide an incremental addition to the overall adverse cumulative impacts from smothering benthic communities, displacing fish species and potentially encouraging the presence of invasive and nonnative aquatic fauna.

Conclusion. The actions proposed under alternative D would result in negligible to minor, short- and long-term, adverse and beneficial impacts on native aquatic species. The fish assemblages in the nearshore would be temporarily displaced and benthic communities would be smothered during beach nourishment activities. Also, construction of a permanent bypass system would disrupt the nearshore environment and allow for the introduction and establishment of invasive and nonnative species. Overall, the decreased erosion in the area would benefit benthic communities. The overall cumulative effects on aquatic fauna from past, present, and reasonably foreseeable future projects would be moderate, long-term and adverse. Under alternative D, there would be a slight incremental addition to the overall adverse cumulative impacts from smothering benthic communities, displacing fish species and encouraging the presence of invasive and nonnative aquatic fauna with the installation of a permanent bypass system.

Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency)

Meiofauna and macroinvertebrates — The sandy substrate along the nearshore of the park shoreline supports a limited benthic community of low diversity. Increased densities have been noted in intermittent beds of cobble/gravel material. In the relatively high wave energy nearshore environment, at certain sediment-starved areas along the shoreline, particularly at the base of Mount Baldy, the clay substrate naturally found beneath the sediment has been exposed, and organic matter often found in calmer waters has been carried away from the shoreline (Garza and Whitman 2004). The kinetic nature of the nearshore environment has therefore created low density and diversity within the benthic community. One study, conducted from 1996 to 1998 in conjunction with a COE beach nourishment program, indicated that relatively few species were detected in the benthic community inhabiting sandy substrates in the nearshore area, as indicated by the Shannon-Wiener and Margalef's diversity indices (Horvath *et al.* 1999).

The use of a submerged cobble berm in reach 1 would result in a longer retention of sediment within the nearshore. As the submerged cobble berm would begin to dissipate after construction, the aggregate material would disperse along the lakebed, creating a substrate inhabitable for benthic organisms. The nearshore environment at the base of Mount Baldy is currently identified with a lower benthic diversity and density as compared to other areas along the park shoreline (Garza and Whitman 2004). The implementation of alternative E within reach 1 would result in effects similar to those described under alternative C-1 because the submerged cobble berm would be used in conjunction with a beach nourishment program to restore reach 1 of Indiana Dunes National Lakeshore. These effects would be minor, short-term and adverse as the benthic fauna would be smothered during placement of the sediment. Impacts would be localized to the placement and construction area. There would be moderate, long-term and beneficial effects on the benthic community as the cobble material would both create additional habitat for these aquatic species and reduce erosion in the area. Longer retention of sediment and some organic material would allow for those species historically present in this area to re-colonize the area.

Fish of Lake Michigan — Under alternative E, the nearshore environment would be disrupted not only during the beach nourishment activities, but also during construction and placement of the submerged cobble berm, and during subsequent nourishment activities. The reduced quantity of beach nourishment material deposited annually in reach 1 would make the nearshore environment desirable to native species and invasive and nonnative aquatic species alike. The effects of the annual placement of nourishment material would be similar to those described under alternative C-1.
As is the case with the benthic community in the nearshore, the presence of a submerged cobble berm in reach 1 would eventually provide a habitat for additional fish species not currently present in that area. In the initial years after construction during which the submerged cobble berm would be largely intact, wave energy would be dissipated, resulting in a calmer nearshore environment. Sediment retention time would increase, as would organic material and benthic organisms; both would be food sources for a variety of fish species. After the submerged cobble berm spread along the lake bottom, the aggregate material would potentially allow for more fish nurseries as the interstitial spaces would provide protection.

Ultimately, the implementation of alternative E would result in minor, short-term, adverse impacts as fish would be temporarily displaced during construction and beach nourishment activities. However, moderate, long-term, beneficial impacts would also result as the cobble material would enhance the aquatic fauna habitat.

Invasive and nonnative species — Invasive species, particularly round gobies and zebra mussels, would be attracted to artificial structures within the nearshore environment. Under alternative E, beach nourishment activities would disrupt the nearshore environment, which would allow for the introduction and establishment of invasive and nonnative species. Construction of the submerged cobble berm would also further attract invasive species. The cobble material and associated interstitial spaces in the submerged cobble berm would be an attractive habitat for invasive and nonnative species until the material dissipates and becomes covered by sediment. After the aggregate material dispersed along the lake bottom, zebra mussels' attraction to it would be minimized; however, additional invasive and nonnative aquatic species, such as the round goby, would continue to inhabit the area. Therefore, under alternative E, the introduction of the submerged cobble berm into the nearshore environment would result in minor, long-term, adverse effects from encouraging invasive and nonnative aquatic fauna.

Cumulative Impacts. Past, present, and reasonably foreseeable future projects with the potential to affect aquatic fauna would be similar to those described under the no-action alternative: moderate, long-term and adverse. Under alternative E, nourishment activities and the submerged cobble berm would incrementally add both minor, short-term, adverse and minor, long-term, beneficial effects on cumulative impacts. When combined with other past, present, and reasonably foreseeable future actions, actions under alternative E would provide an incremental addition to the overall cumulative impacts by enhancing the habitat for benthic communities. These effects would be slightly countered by the enhancement of habitat for invasive and nonnative aquatic fauna as well.

Conclusion. The actions proposed under alternative E would result in moderate, short- and long-term, adverse and beneficial impacts on the native aquatic species. The aquatic fauna in the nearshore would be temporarily disturbed or displaced during construction of the submerged cobble berm and during beach nourishment activities. Long term, the aquatic habitat would be enhanced by providing protection and food sources for a variety of fish. The habitat would also be enhanced for nonnative and invasive species. The overall cumulative impacts on aquatic fauna from past, present, and reasonably foreseeable future projects would be moderate, long-term and adverse. Under this alternative, there would be an incremental addition to the overall cumulative effects by enhancing the habitat for benthic communities. These effects would be slightly countered by the enhancement of habitat for invasive and nonnative aquatic fauna as well.

Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline) – Preferred Alternative

Meiofauna and macroinvertebrates — Under alternative F, the use of an annual beach nourishment with a mix of small natural stone, dredged sediment, and coarse upland material would result in a longer retention of sediment within the nearshore. The objectives of adding the native stone to the nourishment material would be to stabilize the shoreline downdrift of the Michigan City Harbor by providing a more erosion resistant component, and to enhance aquatic habitat by diversifying the nearshore substrate consistent with dynamically stable reaches. The nearshore environment at the base of Mount Baldy is currently identified with a lower benthic diversity and density as compared to other areas along the park shoreline (Garza and Whitman 2004). The implementation of alternative F within reach 1 would result in effects similar to those described under alternative C-1 because the beach nourishment program with a mix of small natural stone, dredged sediment, and coarse upland material would be utilized to restore reach 1 of Indiana Dunes National Lakeshore. These effects would be minor, short-term and adverse as the benthic fauna would be smothered during placement of the sediment. Impacts would be localized to the placement and construction area. There would be moderate, long-term and beneficial effects on the benthic community as the small natural stones would both create additional habitat for these aquatic species and reduce erosion in the area. Longer retention of sediment and some organic material would allow for those species historically present in this area to re-colonize the area

Fish of Lake Michigan — Under the preferred alternative, the nearshore environment would be disrupted during the beach nourishment activities. The effects of the annual placement of nourishment material would be similar to those described under alternative C-1.

As is the case with the benthic community in the nearshore, the presence of small natural stone mixed in the beach nourishment would provide a habitat for additional fish species not currently present in that area. Sediment retention time would increase, as would organic material and benthic organisms; both would be food sources for a variety of fish species.

Ultimately, the implementation of the preferred alternative would result in minor, short-term, adverse impacts as fish would be temporarily displaced during beach nourishment activities. However, moderate, long-term, beneficial impacts would also result as the nourishment material would enhance the aquatic fauna habitat.

Invasive and nonnative species — Under the preferred alternative, beach nourishment activities would temporarily disrupt the nearshore environment. Dispersion of small stones would provide habitats consistent with those of dynamically stable reaches. Existing populations of nonnative species such as the round goby will neither benefit nor be hindered. Population densities would be expected to be consistent with those already existing at dynamically stable reaches. Therefore under the preferred alternative the introduction of the native stone into the nearshore environment would result in minor long-term adverse effects from encouraging invasive and nonnative aquatic fauna.

Cumulative Impacts. Past, present, and reasonably foreseeable future projects with the potential to affect aquatic fauna would be similar to those described under the no-action alternative: moderate, long-term and adverse. Under the preferred alternative, beach nourishment activities with a mix of small natural stone, dredged sediment, and coarse upland material would incrementally add both minor, short-term, adverse and minor, long-term, beneficial effects on cumulative impacts. When combined with other past, present, and reasonably foreseeable future actions, actions under the preferred alternative would provide an incremental addition to the overall cumulative impacts by enhancing the habitat for benthic communities. These effects would be slightly countered by the enhancement of habitat for invasive and nonnative aquatic fauna as well.

Conclusion. The actions proposed under the preferred alternative would result in moderate, short- and long-term, adverse and beneficial impacts on the native aquatic species. The aquatic fauna in the nearshore would be temporarily disturbed or displaced during during beach nourishment activities. Long term, the aquatic habitat would be enhanced by providing protection and food sources for a variety of fish. The habitat would also be enhanced for nonnative and invasive species. The overall cumulative impacts on aquatic fauna from past, present, and reasonably foreseeable future projects would be moderate, long-term and adverse. Under the preferred alternative, there would be an incremental addition to the overall cumulative effects by enhancing the habitat for benthic communities. These effects would be slightly countered by the enhancement of habitat for invasive and nonnative aquatic fauna as well.

SHORELINE AND BEACH COMPLEX, REACHES 3 AND 4

Alternative A (No-action Alternative)

Storm waves, capable of reaching the base of coastal dunes, cause massive erosion and slumping of dune sands. This, in turn, causes large volumes of fine sand to be carried into the nearshore sediment transport system. Fine dune sand is held in suspension much longer than natural beach sediment or fill sediment and could, therefore, be transported farther offshore. Suspended solids in the water could affect fish populations by delaying the hatching time of fish eggs, killing the fish by abrading their gills, and causing anoxia. Fish tolerance to suspended solids varies from species to species and by age. Destruction of habitat rather than suspension of sediments appears to be the major hazard to beach and nearshore fishes. Most of these aquatic species have the ability to migrate from an undesirable environment and return when turbidity levels in the water column have decreased, and living conditions are once again present. Several long-term studies have shown that moderate to complete recovery of motile animal populations has occurred in less than a year. These studies have shown that motile aquatic species generally temporarily depart an area disturbed by beach nourishment, but return when the physical disturbance ceases. Benthic fish move into an area within the first day after a disturbance. The motile aquatic species that have stringent environmental requirements, such as substrate preferences for spawning, foraging, or shelter, are most likely to be affected (COE 1989). Therefore, species that are closely associated with the beach for part of their life cycle are most affected by beach nourishment (COE 1989). Species that form lake-bottom or benthic communities on most high-energy coastal beaches are adapted to periodic changes related to the natural erosion and accretion cycles and storms. Organisms adapted to unstable nearshore bottom conditions tend to tolerate perturbations better than those in more stable offshore environments.

Potential effects of beach nourishment include: altered distribution during offshore nourishment; potential for gill clogging and abrasion; temporary smoldering of benthic prey; burial of areas that serve as foraging and shelter sites; and potential burial of benthic (living on or near the bottom of the lake) fish. Burial of offshore benthic animals by beach nourishment material has a greater potential for adverse effects because the offshore organisms are more sensitive to perturbation than those in the upper nearshore and swash zone. Direct burial of nonmotile aquatic species in the placement area could be lethal to the individual. Effects of direct burial of aquatic fauna are not generally substantial at the population or community level, unless it is a sensitive resource (COE 1989).

Under alternative A, the natural processes occurring in the lake, though exacerbated by the modifications along the shoreline, would continue to provide nearshore habitat for the most disturbance-tolerant species. Beach nourishment activities would consist of 74,000 yd^3 of dredged material placed within open water between 12 and 18 feet of water depth near reach 3.

Meiofauna and macroinvertebrates — The lake substrate in reach 3 is largely homogenous and composed of sand; there is relatively little diversity and low density of benthic fauna. Under the no-action alternative, erosion would continue at an accelerated rate which would threaten the aquatic nearshore environment. As wave dynamics in this area are such that only the most disturbance-prone organisms could survive, the benthic community would remain affected by natural processes. The nearshore placement of dredged sediment would result in minor, short-term, adverse impacts on the benthic fauna in the nearshore as they would be smothered during placement of sediment. Impacts would be localized to the placement area.

Fish of Lake Michigan — Without nourishment material on the beach, the fish population in the nearshore would be subjected to an adverse environmental stress, arising from the erosion and suspension of fine dune sands. The current nearshore placement conducted by the COE was designed to combat the continued erosion of the shoreline along Portage Lakefront and Riverwalk. Erosion along the shoreline would continue, and fish assemblages in the nearshore would continue to be subjected to the environmental stress associated with erosion in the area. Nearshore nourishment placement would temporarily displace fish, as turbidity in the water column of the placement area would render the nearshore temporarily inhospitable. Impacts on native fish species under alternative A would therefore be minor, short-term and adverse.

Invasive and nonnative species — Under the no-action alternative, beach nourishment activities would disturb the placement site, which would encourage the establishment of nonnative and invasive species at that site. This is because the sandy substrate of the lakeshore provides for benthic species and fish assemblages intertwined in a delicate food web that is easily disrupted by external forces, such as beach nourishment and placement activities like those currently taking place in reach 3. The sediment material used for such beach nourishment could provide a pathway for the establishment and introduction of nonnative species. Sediment placement activities could also cause an unequal distribution of sediment supply to the lakeshore, resulting in a disturbed environment for aquatic fauna that encourages or invites nonnative and invasive species. Under the no-action alternative, the effects on native populations from encouraging the presence of invasive and nonnative species would be negligible, short-term and adverse.

Cumulative Impacts. Several potential actions, independent of this plan, would affect the park's aquatic fauna. As described in the "Affected Environment" chapter, anthropogenic influences and alterations to the natural lake habitat have affected native aquatic species. The COE's electric barrier currently helps to block the passage of aquatic nuisance species between the Great Lakes and Mississippi River basins and beneficially discourages the presence of invasive and nonnative aquatic fauna. In the future, additional modifications to nearby industrial and other properties may be made, which may affect the benthic community and fish assemblages along the Lake Michigan shoreline. Additionally, permitting requirements for industrial and federal discharges into the lake may change, becoming stricter or more lax. Ongoing river projects, like the Calumet Harbor and River project and its associated dredging activities and support of transit in the Great Lakes, may lead to future introductions of aquatic invasive species in the Great Lakes and continued disturbance to aquatic habitat. Additionally, ships' ballast water, continues to provide a pathway for aquatic invasive species in to the Great Lakes. However, future introductions of aquatic invasive species may be effectively managed through ballast water exchange, saltwater flushing, or shipboard treatment, and through restricting access to the Great Lakes to vessels that have not taken protective measures to ensure they do not harbor aquatic invasive species.

Overall, these combined actions would have a moderate, long-term, adverse impact on the native aquatic species from disturbances to the natural lake habitat and from the pathways these activities introduce for aquatic invasive species. When combined with other past, present, and reasonably foreseeable future actions, implementing the no-action alternative would provide no incremental addition to the overall cumulative impacts on aquatic fauna.

Conclusion. Under the no-action alternative, beach nourishment activities would disrupt the nearshore environment, which would allow for the introduction and establishment of invasive and nonnative species. In addition, the 74,000 yd^3 of beach nourishment material placed in open water would not alleviate beach erosion in the area. The actions proposed under the no-action alternative would result in negligible to minor, short-term, adverse impacts on native aquatic species. The overall cumulative impacts on aquatic fauna from past, present, and reasonably foreseeable future projects would be moderate, long-term and adverse. Under the no-action alternative, there would be no incremental addition to the overall existing cumulative impacts.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency) – Preferred Alternative

Under alternative C-1, the general effects of beach nourishment activities would be similar to those described under the no-action alternative. Under alternative C-1, nourishment activities would consist of 74,000 yd^3 of dredged beach nourishment material being placed annually on the beach at Portage Lakefront and Riverwalk.

Meiofauna and macroinvertebrates — Under the preferred alternative, impacts on benthic communities would be similar to those described under the no-action alternative, except that placement of 74,000 yd^3 of beach nourishment material would be hydraulically pumped onshore. Some research has shown that the high-pressure (dredge) pipe kills most soft-bodied infaunal organisms, and animals that survive suspension only play a minor role in re-colonization. To enhance the chance of survival, sediment would closely match the native beach and would be applied slowly in a sheeting spray of sediment and water. This would allow organisms to keep up with the sediment overburdens as they were applied. Literature reviews of beach nourishment impacts to beach biota indicate short-term declines in abundance, biomass, and taxa richness following beach nourishment. Recovery of the benthic community within the nearshore environment has been shown to occur within eight to 12 months after nourishment activities. Additionally, densities and total number of benthic taxa increased with depth, suggesting lower impact of sediment drift and wave action in deeper waters (Przybryla-Kelly and Whitman 2006). Therefore, under alternative C-1, annual nourishment of the park shoreline with dredged material deposited onto the beach would have minor, short- and long-term, adverse and beneficial impacts on the benthic community in the placement area. There would be a minor, long-term, beneficial effect from reducing erosion of the shoreline, but the dredge would kill individual soft-bodied infaunal organisms. A high rate of recovery of the benthos would be expected within less than one year.

Fish of Lake Michigan — Under alternative C-1, effects on fish species would be similar to those described under the no-action alternative, except under alternative C-1 there would be less erosion and less associated environmental stress to spawning and nursery habitats. Effects on fish species would be minor, long-term, and beneficial because there would be less environmental stress. Under alternative C-1, the volume of beach nourishment material placed on reach 3 would cover a larger area and require longer placement times (approximately two months every year) than under the no-action alternative, resulting in a longer duration of turbid waters and thus longer periods of environmental stress for aquatic fauna. This annual beach nourishment would temporarily displace fish and result in minor, short-term, adverse effects on fish species.

Invasive and nonnative species — Invasive and nonnative aquatic species located in the nearshore of Lake Michigan would be affected similar to the native fish species. A sandy substrate would make the nearshore environment desirable to not only the native species, but the invasive and nonnative aquatic species as well. Disruption of the natural environment typically allows for introduction and establishment of nonnative and invasive species. Under alternative C-1, beach nourishment activities would disturb the placement site, which would encourage the establishment of nonnative and invasive species at that site. This is because the sandy substrate of the lakeshore provides for benthic species and fish assemblages that are easily disrupted by external forces, such as beach nourishment, placement, and dredging activities like those that would take place under alternative C-1. Sediment placement activities could also cause an unequal distribution of sediment supply to the lakeshore, resulting in a disturbed environment for aquatic fauna that would encourage or invite nonnative and invasive species. Appropriate beach nourishment material would be used, which would help mitigate attracting nonnative species. Therefore, under alternative C-1, effects from encouraging the presence of invasive and nonnative aquatic fauna would be similar to those described under the no-action alternative and would be negligible, short-term and adverse.

Cumulative Impacts. Past, present, and reasonably foreseeable future projects with the potential to affect aquatic fauna would be similar to those described under the no-action alternative: moderate, long-term and adverse. Under the preferred alternative, beach nourishment activities would beneficially add to the long-term, cumulative impacts by reducing erosion in the area and enhancing the aquatic habitat. When combined with other past, present, and reasonably foreseeable future actions, actions under alternative C-1 would provide a slight incremental addition to the overall short-term, adverse cumulative impacts from smothering benthic communities, displacing fish species and potentially encouraging the presence of invasive and nonnative aquatic fauna.

Conclusion. The actions proposed under alternative C-1 would result in negligible to minor, short- and long-term, adverse and beneficial impacts on native aquatic species. The fish assemblages in the nearshore would be temporarily displaced and benthic communities would be smothered during beach nourishment activities. Also, nourishment and dredging activities would disrupt the nearshore environment, which would allow for the introduction and establishment of invasive and nonnative species, but overall the decreased erosion in the area would benefit benthic communities. The overall cumulative effects on aquatic fauna from past, present, and reasonably foreseeable future projects would be moderate, long-term and adverse. Under alternative C-1, there would be a slight incremental addition to the short-term, adverse cumulative impacts from smothering benthic communities, displacing fish species and potentially encouraging the presence of invasive and nonnative aquatic fauna.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

Under alternative C-5, the general effects of beach nourishment activities would be similar to those described under the no-action alternative. Under alternative C-5, beach nourishment activities would consist of 370,000 yd^3 of sediment being dredged from an updrift location in Lake Michigan, such as near the NIPSCO/Bailly intake, once every five years.

Meiofauna and macroinvertebrates — Under alternative C-5, effects on the benthic community would be similar to those under alternative C-1. Placement of 370,000 yd^3 of sediment along Portage Lakefront and Riverwalk at reach 3 once every five years would reduce erosion in the area, but would also smother benthic fauna within a greater footprint than that under alternative C-1. In addition, there would be greater mortality to individual soft-bodied infaunal organisms from the hydraulic pumping of beach nourishment material. Therefore, the impacts on benthic communities under alternative C-5 would be moderate to major, short- and long-term, and adverse due to the duration (i.e., approximately six months every five years) and extent of the beach nourishment placement, and effects from reducing erosion in the area would be minor, long-term and beneficial.

Fish of Lake Michigan — Under alternative C-5, effects on fish species would be similar to those under alternative C-1. Placement of 370,000 yd^3 of sediment every five years would reduce erosion in the area, but would also displace fish and interrupt fish life cycles until turbidity in the water column subsided such that the area was once again inhabitable. Water turbidity would last for a longer period of time under alternative C-5 than under alternative C-1 because of the larger area of placement and the longer duration (approximately six months every five years) of dredging and placement activities. Therefore, under alternative C-5, impacts on fish species would be moderate to major, short- and long-term, and adverse from displacement due to water turbidity and dredging activities, and minor, long-term, and beneficial from reducing erosion in the area and enhancing the fish habitat.

Invasive and nonnative species — Dredging/pumping activities under alternative C-5 would further disturb the natural environment, more so than under alternative C-1, and allow for the establishment of invasive and nonnative aquatic fauna. Under alternative C-5, beach nourishment activities would disturb the placement site, which would encourage the establishment of nonnative and invasive species at that site. Beach nourishment, placement, and dredging activities like those that would take place under alternative C-1 would disturb the aquatic fauna environment. Sediment placement activities could also cause an unequal distribution of sediment supply to the lakeshore, resulting in a disturbed environment for aquatic fauna that would encourage or invite nonnative and invasive species. Therefore, under alternative C-5, effects from encouraging the presence of invasive and nonnative aquatic fauna would be negligible, short-term, and adverse.

Cumulative Impacts. Past, present, and reasonably foreseeable future projects with the potential to affect invasive and nonnative aquatic fauna would be similar to those described under the no-action alternative: moderate, long-term and adverse. Under alternative C-5, nourishment activities would incrementally add to the long-term, beneficial, cumulative impacts by reducing the adverse effects of erosion in the area. When combined with other past, present, and reasonably foreseeable future actions, the actions under alternative C-5 would also provide an incremental addition to the overall short-term, adverse cumulative impacts from displacing or disturbing native fish species and encouraging the presence of invasive and nonnative aquatic fauna.

Conclusion. The actions proposed under alternative C-5 would result in negligible to major, short- and long-term, adverse and beneficial impacts on the native aquatic species. Fish assemblages would be displaced, and fish life cycles would be interrupted. Also, beach nourishment and dredging activities would disrupt the nearshore environment, which would allow for the introduction and establishment of invasive and nonnative aquatic fauna. The overall cumulative impacts on aquatic fauna from past, present, and reasonably foreseeable future projects would be moderate, long-term and adverse. Implementing the actions under alternative C-5 would provide an incremental addition to the overall short-term, adverse and beneficial, cumulative impacts, as effects from erosion in the area would be lessened, but there would be disturbances to the aquatic communities during beach nourishment activities.

Alternative D (Beach Nourishment via Permanent Bypass System)

Meiofauna and macroinvertebrates — Under alternative D, 74,000 yd^3 of sediment would be transported via a permanent bypass system from updrift of the NIPSCO/Bailly complex and be placed on the beach at Portage Lakefront and Riverwalk. The effects of the high-pressure line associated with the permanent bypass system would be similar to those described under alternative C-1. There would be a minor, long-term, beneficial effect from reducing erosion of the shoreline, but the bypass system would kill individual soft-bodied infaunal organisms and cause minor, short-term, adverse impacts on benthic communities. Therefore, nourishment of the park shoreline with a sediment bypass system would have minor, short- and long-term, adverse and beneficial impacts on the benthic community in the placement area.

Fish of Lake Michigan — The effects on fish species under alternative D would be similar to those described under alternative C-1, except that beach nourishment material would be pumped via a permanent bypass system. This nourishment system would temporarily displace fish, resulting in minor, short-term, adverse effects. Overall effects on fish species would be minor, long-term and beneficial because there would be less environmental stress from erosion.

Invasive and nonnative species — The construction of the permanent bypass system would temporarily disrupt the natural environment and allow for the introduction of invasive and nonnative species. Invasive species, particularly round gobies and zebra mussels, would be attracted to artificial structures within the nearshore environment. There would be an easily detectible change in the attraction of invasive and nonnative aquatic fauna. Under alternative D, effects from encouraging the presence of invasive and nonnative aquatic fauna would be negligible, long-term and adverse.

Cumulative Impacts. Past, present, and reasonably foreseeable future projects with the potential to affect invasive and nonnative aquatic fauna would be similar to those described under the no-action alternative: moderate, long-term and adverse. Under alternative D, beach nourishment activities and the permanent bypass system would incrementally add to the long-term, cumulative impacts. When combined with other past, present, and reasonably foreseeable future actions, actions implemented under alternative D would provide an incremental addition to the overall short-term, adverse cumulative impacts from smothering benthic communities, displacing fish species and potentially encouraging the presence of invasive and nonnative aquatic fauna.

Conclusion. The actions proposed under alternative D would result in negligible to minor, short- and long-term, adverse and beneficial impacts on native aquatic species. The fish assemblages in the nearshore would be temporarily displaced and benthic communities would be smothered during beach nourishment activities. Also, construction activities would disrupt the nearshore environment, which would allow for the introduction and establishment of invasive and nonnative species. Overall, the decreased erosion in the area would benefit benthic communities. The overall cumulative effects on aquatic fauna from past, present, and reasonably foreseeable future projects would be moderate, long-term and adverse. Under alternative D, there would be a slight incremental addition to the overall short-term, adverse cumulative impacts from smothering benthic communities, displacing fish species and encouraging the presence of invasive and nonnative aquatic fauna with the installation of a permanent bypass system.

FOREDUNE AND DUNE COMPLEX, REACHES 1 THROUGH 4

Current and Proposed Management Actions

Current and proposed management actions for the foredune and dune complex address issues with sensitive habitat restoration, invasive vegetation management, and anthropogenic influences. These are actions that primarily affect terrestrial resources. Management actions that would result in reduced erosion in the area, such as revegetation with native plants and protection from pedestrian overuse, would reduce the volume of fine sand that would carried into the nearshore sediment transport system and would thereby beneficially enhance the aquatic habitat. These actions would result in minor, long-term, beneficial impacts on aquatic fauna.

Cumulative Impacts. Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under aquatic fauna as a result of proposed management actions would be negligible to minor, long-term, and beneficial from the reduced erosion in the area and reduced volume of fine sediment that would be carried into the nearshore sediment transport system, beneficially enhancing the aquatic habitat.

Conclusion. Addressing sensitive habitat issues in the foredune and dune complex through site restoration, invasive vegetation management, and limiting and managing anthropogenic influences positively affect terrestrial resources and would result in minor, long-term, beneficial impacts on aquatic fauna. Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under aquatic fauna would be negligible to minor, long-term, and beneficial from the enhanced aquatic habitat.

TERRESTRIAL HABITAT

METHODOLOGY

Impacts on plant and animal terrestrial habitat were evaluated by comparing projected changes that would result from implementing the action alternatives to taking no action (i.e., the no-action alternative). Information about native terrestrial habitat in the park was compiled from site visits, publicly available research data, information from park staff, and studies of similar actions and effects. Impacts on terrestrial habitat were assessed qualitatively based on the project team's knowledge and best professional judgment.

A discussion of potential effects on wildlife necessarily involves discussion of wildlife habitat, which is primarily the vegetation communities within the park. Potential effects to terrestrial invertebrates, birds, amphibians and reptiles, and mammals are based on assessed effects to native plant communities because the park's wildlife species are directly affected by the natural abundance, biodiversity, and the ecological integrity of the vegetation that composes their habitat. Effects from noise on wildlife are addressed under the "Soundscape" section of the "Environmental Consequences" chapter.

Intensity Level Definitions

Intensity thresholds for terrestrial habitat are defined as follows:

Negligible: The impact is barely detectable and/or would result in no noticeable or perceptible changes in encouraging terrestrial habitat for plant and animal communities.

Minor: The impact is slight but detectable and/or would result in small but noticeable changes in encouraging terrestrial habitat for plant and animal communities.

Moderate: The impact is readily apparent and would result in easily detectable changes in encouraging terrestrial habitat for plant and animal communities.

Major: The impact is severely adverse or exceptionally beneficial, and/or would result in appreciable changes in encouraging terrestrial habitat for plant and animal communities.

SHORELINE AND BEACH COMPLEX, REACHES 1 AND 2

Alternative A (No-action Alternative)

Under the no-action alternative, there would be no new impacts on the terrestrial habitat of native plant and animal communities in the park, and the actions associated with this alternative would neither invite nor deter invasive species from inhabiting the shoreline and beach complex in reaches 1 and 2. Under this alternative, the current trend of destabilization of the foredunes would continue, increasing the risk to Mount Baldy. Such destabilization would lead to the localized loss of the natural ecosystems associated with the beach and the foredunes, including plant species endemic to the dunes, as well as insects, reptiles, birds and mammals dependent upon this habitat. These actions would have minor, short- and long-term, adverse impacts on terrestrial habitat. In addition, the western terminus of reach 1 would continue to be infested with nonnative trees. Continued erosion and degradation would invite colonization by these species and other nonnative invasive plants, having a minor, long-term, adverse impact on terrestrial habitat for native plant and animal communities.

Under the no-action alternative, current beach nourishment activities in reach 1 would forestall continued erosion and degradation around Mount Baldy. The amount of sediment added to the shoreline would be inadequate to offset the deficit under this alternative. Therefore, the erosion and degradation of the foredune would continue, thus jeopardizing plant species endemic to the foredune complex. The actions associated with the no-action alternative would have minor, short- and long-term, adverse impacts on native plant and animal communities, as some beach vegetation would be smothered by sediment placement during beach nourishment activities and loss of critical terrestrial habitat would continue. With no new actions being taken under alternative A, storm events would continue to cause substantial erosion in the park to the detriment of terrestrial habitat for plant and animal communities.

Cumulative Impacts. Several actions, independent of this plan, would affect the park's terrestrial habitat for plant and animal communities. As described in the "Affected Environment" chapter, much of the terrestrial habitat for native plant communities in the park, including species of conservation concern, has been altered by invasive vegetation and anthropogenic influences.

The Michigan City Harbor, Burns International Harbor, and the Gary-U.S. Steel man-made structures that were constructed in and around the project area continue to interrupt natural processes with minor, long-term, adverse effects on the terrestrial habitat for native plant and animal communities because of the changes to natural sediment accumulation that these cause. The designation of the appropriate route to and from Mount Baldy from the parking lot by the park resulted in minor, long-term, beneficial impacts on native plant and animal communities by reducing the social trails in reach 1, thus reducing the trampling of native plants in this area and the introduction of invasive plant species to this reach.

Development projects, past, present, and future, like those that occurred under Phase I of the Marquette Plan and those that are proposed under Phase II of that plan, would have minor to moderate, short- and long-term, adverse impacts on native plant vegetation. Construction work often results in the loss and modification of vegetation in construction areas, and potentially introduces invasive and nonnative plant species. The spread of nonnative and invasive plant species in the park has been a problem. Pathways that could introduce nonnative and invasive plant species in to the park include construction and visitor activities, as well as natural sources such as wind and bird migration. It is difficult to determine the impact of nonnative species on native vegetation due to the uncertainties about the type of species that could be introduced, as well as the locations and frequencies of the introductions. Despite monitoring and management efforts, the impact of the introduction and establishment of nonnative species in the park would range from minor to moderate, and would be long-term and adverse.

Ongoing clean sediment beach nourishment activities in reach 1 are performed on an intermittent basis. These activities impact sediment deposition, and have a minor, short-term, beneficial impact on native plant and animal communities from the reduced erosion that results. "Clean" beach nourishment also reduces the likelihood of introduction of invasive and nonnative plant species into the park.

Restoration work in the park, including invasive vegetation management through the early detection and rapid response program and Invasive Plant Management Plan and fencing off highly eroded and environmentally sensitive areas on Mount Baldy, stabilizes select areas of eroded areas in the park with native vegetation. This work would have minor, long-term, beneficial impacts on native plant and animal communities by preserving the natural physiography of the land and restoring lands to their natural states. Similarly, efforts to expand visitor outreach and education opportunities in the park would have minor, long-term, beneficial impacts on native plant and animal communities from the reduction in vegetation trampling and destruction of habitat. Future realignment of trails would result in minor, long-term, beneficial impacts on terrestrial habitat for native plant and animal communities from reducing social trails (leading to less trampling and the reduced likelihood of introduction of invasive nonnative plant species in the park); though this work would involve negligible to minor, short-term, adverse impacts during construction and re-alignment work due to the temporary disturbance to habitat.

Overall, when the actions described above are added to the existing environment for terrestrial habitat, there would be minor, short- and long-term, adverse and beneficial, cumulative impacts. The actions under alternative A would add a small increment to the overall cumulative impact.

Conclusion. Under alternative A, there would continue to be minor, short- and long-term, adverse impacts on the terrestrial habitat of native plant and animal communities from the erosion and destabilization that would result from taking no new actions in the park. Cumulatively, there would be minor to moderate, short- and long-term, adverse and beneficial, cumulative impacts on the terrestrial habitat of native plant and animal communities. Adverse impacts would result from continued degradation of habitat that would result from ongoing erosion; beneficial impacts would result from restoration efforts that preserve natural plant and animal habitat in the park. Implementing the actions under alternative A would result in a small increment being added to the overall cumulative impact.

Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency)

The actions associated with alternative B-1 would allow for increased beachfront, thereby providing the potential for a stabilized dune complex, particularly at Mount Baldy. Foredune development under this alternative would be feasible with sediment supply, wind, and an entrapment feature, such as vegetation. In conjunction with the restoration option selected, terrestrial management practices, such as revegetation in areas of beach erosion, would promote the formation of foredunes. These embryotic dunes would protect leeward dunes, pannes, and other ecological features; provide habitat connectivity and sustainability; and contribute sediment (via natural erosion) to the coastal system. These actions would result in minor, short-term, beneficial impacts on the terrestrial habitat for native plant and animal communities. Nourishment of the park shoreline, particularly in areas of accelerated erosion, would result in minor, short-term, beneficial impacts on the terrestrial community.

Under alternative B-1, continued erosion and degradation of the foredune complex would diminish and reduce continued colonization by invasive and nonnative plant species. Revegetation, along with colonization of native plant species would help to prevent nonnative invasive plant species from dominating the area, and have a minor, short-term, beneficial impact on terrestrial habitat. Implementing the actions associated with alternative B-1 would improve the ability of the beach to withstand storm events and preserve terrestrial habitat for plants and animals, thereby having a negligible to minor, short-term, beneficial effect.

Actions under alternative B-1 would forestall continued erosion and degradation and provide for a greater amount of sediment added to reach 1 than provided in the past. This beach nourishment, coupled with revegetation in nonsensitive areas, would benefit the terrestrial habitat of native plant and animal communities and have a minor, short-term, beneficial impact; however, a minor, short-term, adverse impact would also result from covering/smothering existing plant species during sediment placement. Plant species endemic to the beach plant community would re-emerge, and colonization and revegetation would provide the basis for a stable system in reach 1. In addition, some nonnative, invasive species would be present in the material from upland sources, but park management practices, like the early detection and rapid response program and Invasive Plant Management Plan, include early identification and eradication of such species. Implementing actions under alternative B-1 would result in minor, short-term, adverse impacts on the terrestrial habitat for native plant and animal communities.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative B-1. Compared to the cumulative impacts expected under the no-action alternative, under alternative B-1, these differences in relation to past, present, and reasonably foreseeable future projects would add a small increment. Cumulative impacts would be minor, short- and long-term and adverse and beneficial. Beneficial impacts would result from the decreased erosion and more stable habitat that would result under this alternative; adverse impacts would result from the temporary smothering of plants and plant and animal habitat during beach nourishment activities and from the temporary displacement of wildlife. Implementing the actions associated with alternative B-1 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative B-1, there would be minor, short-term, adverse impacts on terrestrial habitat for native plant and animal communities from the introduction of invasive nonnative plant species into the park during sediment placement activities. In addition, minor, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion, would occur under this alternative. Implementing the actions associated with alternative B-1 would improve the ability of the beach to withstand storm events, preserve terrestrial habitat for plants and animals, and result in a negligible to minor, short-term, beneficial effect. The actions under this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term and adverse and beneficial, cumulative effects.

Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency)

The actions and impacts associated with alternative B-5 would be similar to those described above for alternative B-1, with a few differences. That is, under alternative B-5, there would be minor, short-term, adverse impacts from the introduction of invasive nonnative plant species in the park during sediment placement activities; negligible to minor, long-term, adverse effects from activities associated with revegetation that would affect sensitive habitats; minor, long-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion; and minor, long-term, beneficial impacts as continued erosion and degradation of the foredune would reduce continued colonization by invasive and nonnative plant species. Implementing the actions associated with alternative B-5 would improve the ability of the beach to withstand storm events, preserve terrestrial habitat for plants, and have a negligible to minor, long-term, beneficial effect.

Impacts under alternative B-5 would be greater than those under the annual beach nourishment proposed under alternative B-1 because of the longer duration (approximately 18 months every five years) of nourishment activities and the larger footprint of sediment placed on the beach. These actions under alternative B-5 would have moderate, long-term, adverse impacts on terrestrial habitat for native plant and animal communities. The recovery period between placements would be greater than under alternative B-1, which would enhance colonization by native species, and benefit restoration of habitat for threatened and endangered species and species of concern and management of nonnative invasive plant species.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative B-5. Compared to the cumulative impacts expected under the no-action alternative, under alternative B-5, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large incremental addition to the cumulative environment. Cumulative impacts would be minor to moderate, short- and long-term and adverse and beneficial from the longer duration (approximately 18 months every five years) of sediment placement and from the larger footprint of placement. The actions associated with alternative B-5 would provide a large contribution to overall cumulative impacts.

Conclusion. Under alternative B-5, there would be minor, long-term, adverse impacts on terrestrial habitat for native plant and animal communities from the introduction of invasive nonnative plant species into the park during sediment placement activities; minor, long-term, beneficial impacts from nourishment of the park shoreline; moderate, long-term, adverse impacts from the longer duration (approximately 18 months every five years) of nourishment activities and the larger footprint of sediment placed on the beach; minor, long-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion; and minor, long-term, beneficial impacts as continued erosion and degradation of the foredune would reduce continued colonization by invasive and nonnative plant species. Additionally, the actions associated with alternative B-5 would improve the ability of the beach to withstand storm events, preserve terrestrial habitat for plants.

The actions under this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have moderate, short- and long-term, adverse and beneficial, cumulative effects.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency)

The actions and impacts associated with alternative C-1 would be similar to those described under alternative B-1. That is, under alternative C-1, there would be negligible to minor, short-term, adverse effects from revegetation that would affect sensitive habitats; and minor, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion. Given the importance of beach nourishment in reducing loss of terrestrial habitat and enhancing the ability to manage nonnative invasive species under this alternative, the impacts would be minor, short-term and beneficial as nourishment material placed would be dredged from an updrift location, such as the nearshore area east of the Michigan City Harbor, and not be likely to introduce weed seeds to the shoreline and beach complex. The actions associated with alternative C-1 would improve the ability of the beach to withstand storm events, preserve terrestrial habitat for plants, and have a negligible to minor, short-term, beneficial effect.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-1. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-1, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small increment being added to the cumulative environment. Cumulative impacts would be minor, short- and long-term and adverse and beneficial. Adverse impacts would result from the temporary disturbance to plant and animal terrestrial habitat during placement activities; beneficial impacts would result from the decreased erosion and improved natural habitat for plants and animals. The actions associated with alternative C-1 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-1, there would also be negligible to minor, short-term, adverse effects from revegetation that would affect sensitive habitats. Additionally, minor, short-term, beneficial impacts would result from nourishment of the park shoreline, particularly in areas of accelerated erosion. The actions associated with alternative C-1 would improve the ability of the beach to withstand storm events, preserve terrestrial habitat for plants, and have a negligible to minor, short-term, beneficial effect. Under this alternative, material would be dredged from an updrift location, and have no or limited viable nonnative invasive plant species seedbank, resulting in a negligible to minor, short-term, beneficial effect on terrestrial habitat. The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term and adverse and beneficial, cumulative effects.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

The actions and impacts associated with alternative C-5 would be similar to those described under alternative C-1 with a few differences. Impacts under alternative C-5 would be greater than those under the annual nourishment proposed under alternative C-1 because of the longer duration (approximately 10 months every five years) of nourishment activities and the larger footprint of sediment placed on the beach, resulting in moderate, long-term, adverse effects from the smothering of plants and plant and animal terrestrial habitat during placement activities. The recovery period between placements under alternative C-5 would be longer than under alternative C-1, which would enhance colonization by native species, and benefit restoration of habitat for threatened and endangered species and species of concern and manage nonnative invasive plant species. These actions under alternative C-5 would have moderate, short-term, beneficial impacts on terrestrial habitat for native plant and animal communities.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-5. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-5, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term and adverse and beneficial. Adverse impacts would result from the disturbance to plant and animal terrestrial habitat during placement activities; beneficial impacts would result from the decreased erosion and improved natural habitat for plants and animals following placement activities. The actions associated with alternative C-5 would provide a large contribution to overall cumulative impacts.

Conclusion. Under alternative C-5, there would be moderate, short-term, beneficial impacts from nourishment of the park shoreline; and moderate, long-term, adverse impacts from the longer duration (approximately 10 months every five years) of nourishment activities and the larger footprint of sediment placed on the beach. The actions associated with alternative C-5 would improve the ability of the beach to withstand storm events, preserve terrestrial habitat for plants, and introduce no or limited viable nonnative invasive plant species seedbank since material would be dredged from an updrift location, such as the nearshore area east of the Michigan City Harbor, having negligible to minor, long-term beneficial effects on terrestrial habitat for plants and animals. The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term and adverse and beneficial, cumulative effects.

Alternative D (Beach Nourishment via Permanent Bypass System)

The actions and impacts associated with alternative D would be similar to those described under alternative C-1. That is, there would be negligible to minor, short-term, adverse effects from revegetation that would affect sensitive habitats, such as those utilized by the piping plover (*Charadrius melodus*). And, there would be minor, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion. The continuation of sediment placement in reach 1 would have limited potential to introduce invasive and nonnative plant species under alternative D because of the clean sediment source for the beach nourishment material. Given the importance of beach nourishment in reducing loss of terrestrial habitat and enhancing the ability to manage nonnative invasive plant species, the impacts under alternative D would be minor, short-term and beneficial because the beach nourishment material would be transported to reach 1 via a permanent bypass system from updrift of the Michigan City Harbor and not be likely to introduce weed seeds to the shoreline and beach complex. The actions associated with alternative D would improve the ability of the beach to withstand storm events, preserve terrestrial habitat for plants, and have a negligible to minor, short-term, beneficial effect.

The actions associated with alternative D would involve increasing the amount of sediment placed in the project area through a permanent bypass system, thereby decreasing degradation of the beach and consequently the foredune plant communities. These actions would have minor, short-term, adverse impacts, as some beach vegetation would be smothered during placement. There would also be minor, short-term, beneficial impacts from the decreased erosion and improved natural ecological setting for native plants and animals to thrive on.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative D. Compared to the cumulative impacts expected under the no-action alternative, under alternative D, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small change. Cumulative impacts would be minor, short- and long-term and adverse and beneficial. Adverse impacts would result from the temporary disturbance to plant and animal terrestrial habitat during placement activities; beneficial impacts would result from the decreased erosion and improved natural habitat for plants and animals. The actions associated with alternative D would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative D, there would be negligible to minor, short-term, adverse effects from revegetation that would affect sensitive habitats, and there would be minor, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion. The actions associated with alternative D would involve increasing the amount of sediment placed in the project area through a permanent bypass system, thereby decreasing degradation of the beach and consequently the foredune plant communities. As some beach vegetation would be smothered during placement, actions under alternative D would have minor, short-term, adverse impacts, but also minor, short-term, beneficial impacts from the decreased erosion and improved natural ecological setting for native plants and animals. The actions associated with alternative D would improve the ability of the beach to withstand storm events and preserve terrestrial habitat. The actions of this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term and adverse and beneficial, cumulative effects.

Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency)

Like the other action alternatives, the actions associated with alternative E would allow for increased beachfront, thereby providing the potential for dune stabilization, particularly at Mount Baldy. Foredune development would be feasible under this alternative, too, with sediment supply, wind, and an entrapment feature, such as vegetation. In conjunction with the restoration alternative selected, terrestrial management practices, such as revegetation in areas of erosion, would promote the formation of foredunes. Foredune formation would provide habitat connectivity and sustainability and contribute sediment (via natural erosion) to the coastal system. These actions would have minor, long-term, beneficial impacts on terrestrial habitat for native plant and animal communities. Restoration of the park shoreline, particularly in areas of accelerated erosion, through the use of the submerged cobble berm proposed under alternative E, would result in minor, long-term, beneficial impacts on the terrestrial community. The actions associated with alternative E would improve the ability of the beach to withstand storm events, preserve terrestrial habitat for plants, and have a minor, long-term, beneficial effect.

Construction of a submerged cobble berm in reach 1 under alternative E would result in longer retention of sediment along the shoreline, thereby decreasing erosion of the beach and the foredune plant communities. While placement of sediment may cover existing vegetation and have minor, short-term, adverse effects, colonization and emergence of covered plants would occur, and have minor, short-term, beneficial impacts. In addition, terrestrial management, including revegetation and management of nonnative invasive plant species, would benefit the native plant community in areas of degradation. Management efforts would not be likely to introduce weed seeds to the shoreline and beach complex because under alternative E nourishment material placed would be obtained from a dredged source, located east, updrift of the Michigan City Harbor structure.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative E. Compared to the cumulative impacts expected under the no-action alternative, under alternative E, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small change. Cumulative impacts would be minor, short- and long-term and adverse and beneficial. Adverse impacts would result from the temporary disturbance to plant and animal terrestrial habitat during placement activities; however, these impacts would be reduced from current impact levels due to the decreased volume of dredged beach nourishment that would be required annually with the addition of a submerged cobble berm that would gradually dissipate. Beneficial impacts would result from the decreased erosion and improved natural habitat for plants and animals, and the reduction in annual beach nourishment volumes. The actions associated with alternative E would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative E, there would be minor, long-term, beneficial impacts on terrestrial habitat for native plant and animal communities from dune stabilization and foredune development; minor, long-term, adverse effects on sensitive habitats from interfering with an already stable area in reach 2; and minor to moderate, long-term, beneficial impacts from restoration of the park shoreline, particularly in areas of accelerated erosion. Impacts would be less than those from the previously described annual beach nourishment activities under alternatives B-1 and C-1. Impacts would be minor to moderate, long-term and beneficial from the reduced consumption of material for nourishment activities. The actions associated with alternative E would improve the ability of the beach to withstand storm events and preserve terrestrial habitat for plants and animals. The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term, adverse and beneficial, cumulative effects.

Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stones at the Shoreline) – Preferred Alternative

The actions associated with alternative F, the preferred alternative, would allow for increased beachfront, thereby providing the potential for dune stabilization, particularly at Mount Baldy. Foredune development would be feasible with sediment supply, wind, and an entrapment feature, such as vegetation. In conjunction with the restoration alternative selected, terrestrial management practices, such as revegetation in areas of erosion, would promote the formation of foredunes. Foredune formation would provide habitat connectivity and sustainability and contribute sediment (via natural erosion) to the coastal system. These actions would have minor, long-term, beneficial impacts on terrestrial habitat for native plant and animal communities. Restoration of the park shoreline, particularly in areas of accelerated erosion, through the implementation of beach nourishment with a mix of small natural stone, dredged sediment, and coarse upland material at the shoreline under alternative F, would result in minor, long-term, beneficial impacts on the terrestrial community. The actions associated with alternative F would improve the ability of the beach to withstand storm events, preserve terrestrial habitat for plants, and have a minor, long-term, beneficial effect.

Beach nourishment with a mix of small natural stone, dredged sediment, and coarse upland material along the shoreline on an annual frequency in reach 1 under alternative F would result in longer retention of sediment along the shoreline, thereby decreasing erosion of the beach and the foredune plant communities. While placement of sediment may cover existing vegetation and have minor, short-term, adverse effects, colonization and emergence of covered plants would occur and have minor, short-term, beneficial impacts. In addition, terrestrial management, including revegetation and management of nonnative invasive plant species, would benefit the native plant community in areas of degradation. Management efforts would not be likely to introduce weed seeds to the shoreline and beach complex because under alternative F nourishment material placed would be obtained from a dredged source, located updrift of the Michigan City Harbor structure.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under the preferred alternative. Compared to the cumulative impacts expected under the no-action alternative, under alternative F, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small change. Cumulative impacts would be minor, short- and long-term, and adverse and beneficial. Adverse impacts would result from the temporary disturbance to plant and animal terrestrial habitat during placement activities; however, these impacts would be reduced from current impact levels due to the decreased volume of dredged beach nourishment that would be required annually along with the mix of small natural stone, dredged sediment, and coarse upland material at the shoreline. Beneficial impacts would result from the decreased erosion and improved natural habitat for plants and animals, and the reduction in annual beach nourishment volumes. The actions associated with alternative F would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative F, there would be minor, long-term, beneficial impacts on terrestrial habitat for native plant and animal communities from dune stabilization and foredune development; minor, long-term, adverse effects on sensitive habitats from interfering with an already stable area in reach 2; and minor to moderate, long-term, beneficial impacts from restoration of the park shoreline, particularly in areas of accelerated erosion. Impacts would be less than those from the previously described annual beach nourishment activities under alternatives B-1 and C-1. Impacts would be minor to moderate, long-term, and beneficial from the reduced consumption of material for beach nourishment activities. The actions associated with the preferred alternative would improve the ability of the beach to withstand storm events and preserve terrestrial habitat for plants and animals. The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term, adverse and beneficial, cumulative effects.

SHORELINE AND BEACH COMPLEX, REACHES 3 AND 4

Alternative A (No-action Alternative)

Under the no-action alternative for reaches 3 and 4, there would be no new impacts on the terrestrial habitat of native plant and animal communities in the park, and the actions associated with this alternative would neither invite nor deter invasive species from inhabiting the shoreline and beach complex in reaches 3 and 4. Under alternative A, the current trend of destabilization of the foredunes would continue, especially at Portage Lakefront and Riverwalk. Such destabilization would lead to the localized loss of the natural ecosystems associated with the beach and the foredunes, including plant species endemic to the dunes, as well as insects, reptiles, birds, and mammals dependent upon this habitat. Implementation of the no-action alternative would have minor, short- and long-term, adverse impacts on the terrestrial habitat for native plant and animal communities.

Continued erosion in the vicinity of Portage Lakefront and Riverwalk would be likely under the no-action alternative despite the introduction of dredged material from ongoing beach nourishment activities and habitat loss would continue from the erosion. The possibility of establishing a natural ecosystem is unlikely under the no-action alternative. Taking no new actions in the park would lead to minor, short- and long-term, adverse impacts on the terrestrial habitat for native plant and animal communities. Under alternative A, the beach would continue to erode and would not be able to withstand storm events.

Cumulative Impacts. The cumulative impacts under alternative A in reaches 3 and 4 would be similar to those described above under the no-action alternative for reaches 1 and 2. That is, overall, when the actions described above are combined with the existing terrestrial habitat for native plant and animal communities, there would be minor to moderate, short- and long-term, adverse and beneficial, cumulative impacts. The actions under alternative A would add a small increment to the overall cumulative impact.

Conclusion. Under alternative A, there would be no new actions taken in the park, including any actions to invite or deter invasive and nonnative plants. If no new actions are taken in the park, there would continue to be minor, short- and long-term, adverse impacts on the terrestrial habitat of native plant and animal communities from the ongoing erosion and destabilization. Taking no new actions in the park would not improve the ability of the beach to withstand storm events. Cumulatively, there would be minor to moderate, short- and long-term, adverse and beneficial, cumulative impacts on the terrestrial habitat of native plant and animal communities. The actions under alternative A would result in a small increment being added to the overall cumulative impact.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency) – Preferred Alternative

The actions and impacts associated with the preferred alternative for reaches 3 and 4 would be similar to those described above under alternative C-1 for reaches 1 and 2 with a few differences. Under alternative C-1 in reaches 3 and 4, beach erosion in the vicinity of Portage Lakefront and Riverwalk would diminish as a result of dredged material being added to the beach near Ogden Dunes. Under alternative C-1, there would be negligible to minor, short-term, adverse effects from activities associated with revegetation that would interfere with stable reaches along the shoreline and affect sensitive habitats. In addition, minor, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion, would result under this alternative. The actions associated with alternative C-1 would have negligible to minor, short-term, adverse impacts as some beach vegetation would be smothered during placement activities; however, the potential for site restoration would be enhanced since the amount of beach nourishment would counteract erosion, and have a minor, short-term, beneficial impact. Given the importance of beach nourishment in reducing loss of terrestrial habitat and enhancing the ability to manage nonnative invasive species, impacts under alternative C-1 would be negligible to minor, short-term and beneficial since material dredged from an updrift location in Lake Michigan would have no or a limited viable nonnative invasive plant species seedbank. The actions associated with alternative C-1 would improve the ability of the beach to withstand storm events, preserve terrestrial habitat for plants, and have a negligible to minor, short-term, beneficial effect.

Additionally, bank swallows (*Riparia riparia*) nest in the foredune "cliff" area created as a result of shoreline erosion. As nourishment material placed on the beach under alternative C-1 would stabilize the shoreline and combat the high rates of erosion, these eroded cliff areas would be reduced, potentially removing the swallows of a suitable nesting habitat, particularly during the placement of the nourishment material. If the eroded cliff was reduced through beach nourishment activities associated with alternative C-1, the terrestrial habitat for the bank swallow would be reduced. There are a few suitable sites for this habitat along Burns International Harbor, which would provide an alternative site for the birds, unless the COE completes a restoration project along the waterway that would involve eliminating the steep, open banks. The ephemeral nature of the species' natural nesting venues of muddy banks, dunes, and lakeshores makes this species well-adapted to re-finding appropriate habitat year-after-year (FWS 2007b). Beach nourishment activities under alternative C-1 would reduce erosion and the subsequent maintenance of eroded cliff areas for the birds resulting in minor, short-term, adverse impacts to the bank swallow as they would lose immediate habitat. However, the birds would relocate to other suitable habitat in the near vicinity. Work would be conducted outside critical periods (such as nesting) for these specific species when possible.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-1. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-1, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small change. Cumulative impacts would be minor, short- and long-term and adverse and beneficial. Adverse impacts would result from the temporary disturbance to plant and animal terrestrial habitat during placement activities; beneficial impacts would result from the decreased erosion and improved natural habitat for plants and animals. The actions associated with alternative C-1 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under the preferred alternative, there would be negligible to minor, short-term, adverse effects from revegetation that would affect sensitive habitats, in addition to minor, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion. The actions associated with alternative C-1 would have negligible to minor, short-term, adverse impacts as some beach vegetation would be smothered during placement; however, the potential for site restoration would be enhanced since the amount of beach nourishment would counteract erosion, and have a minor, short-term, beneficial impact. Impacts under alternative C-1 would be negligible to minor, short-term and beneficial, since material dredged from an updrift location in Lake Michigan would have no or limited viable nonnative invasive plant species seedbank. The actions associated with alternative C-1 would improve the ability of the beach to withstand storm events and preserve terrestrial habitat for plants and animals. Beach nourishment activities under alternative C-1 would reduce erosion and the subsequent maintenance of eroded cliff areas for the bank swallows resulting in minor, short-term, adverse impacts to these birds as they would lose immediate habitat. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term and adverse and beneficial, cumulative effects.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

The actions and impacts associated with alternative C-5 for reaches 3 and 4 would be similar to those described above under alternative C-1, with a few differences. Impacts would be greater under alternative C-5 than under the annual beach nourishment proposed under alternative C-1 because of the longer duration (approximately six months every five years) of nourishment activities and the larger footprint of sediment placed on the beach. Under alternative C-5, there would be negligible to minor, short-term, adverse effects from revegetation that would affect sensitive habitats; moderate, short-term, beneficial impacts from nourishment of the park shoreline; and moderate, long-term, adverse impacts from the longer duration (approximately six months every five years) of nourishment activities and the larger footprint of sediment placed on the beach. The actions associated with alternative C-5 would improve the ability of the beach to withstand storm events and preserve terrestrial habitat for plants. Nourishment material dredged from an updrift location in Lake Michigan would have no or limited viable nonnative invasive plants species seedbank, having a negligible to minor, long-term, beneficial effect.

A minor, long-term, adverse impact would occur on bank swallows that nest along the eroded cliffs in reach 4 under alternative C-5, as beach nourishment would reduce erosion and cliff-forming processes, reducing the terrestrial habitat for the bank swallow. As indicated under alternative C-1 for reaches 3 and 4, the birds would relocate to other suitable habitat in the near vicinity. Work would be conducted outside critical periods (such as nesting) for these specific species when possible.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-5. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-5, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small change. Cumulative impacts would be minor to moderate, short- and long-term and adverse and beneficial. Adverse impacts would result from the disturbance to plant and animal terrestrial habitat during placement activities; beneficial impacts would result from the decreased erosion and improved natural habitat for plants and animals and the improved ability of the beach to withstand storm events. The actions associated with alternative C-5 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-5, there would also be negligible to minor, short-term, adverse effects from revegetation that would affect sensitive habitats, in addition to moderate, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion. The actions associated with alternative C-5 would also result in moderate, long-term, adverse effects on terrestrial habitat from the longer duration (approximately six month every five years) of placement activities and the larger placement footprint. The actions associated with alternative C-5 would improve the ability of the beach to withstand storm events and preserve terrestrial habitat for plants and animals, and would introduce no or limited viable nonnative invasive plant species seedbank since material would be dredged from an updrift location, having negligible to minor, long-term beneficial impacts on terrestrial habitat. A minor, long-term, adverse impact would occur on bank swallows that nest along the eroded cliffs in reach 4 under alternative C-5, as beach nourishment would reduce erosion and cliff-forming processes, reducing the terrestrial habitat for the bank swallow. The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term and adverse and beneficial, cumulative effects.

Alternative D (Beach Nourishment via Permanent Bypass System)

The actions and impacts associated with alternative D for reaches 3 and 4 would be similar to those above under alternative D for reaches 1 and 2, with a few differences. That is, negligible to minor, short-term, adverse impacts from revegetation that would affect sensitive habitats; and minor, short-term, beneficial impacts from nourishment of the park shoreline. The actions associated with alternative D would involve increasing the amount of sediment placed in the project area through a permanent bypass system, thereby decreasing degradation of the beach and consequently the foredune plant communities, and have minor, short-term, adverse impacts as some beach vegetation would be smothered during placement; and also minor, short-term, beneficial impacts from the decreased erosion and an improved natural terrestrial habitat for native plants to thrive.

Under alternative D, beach erosion in the vicinity of Ogden Dunes would diminish as a result of additional material being added to the beach via a permanent bypass system. The addition of beach material would lead to foredune development and habitat loss would diminish. The establishment of a natural ecosystem would be likely through site restoration. Under alternative D, there would be negligible to minor, short-term, adverse impacts as some beach vegetation could be smothered during placement; however, the potential for site restoration would be enhanced, since the amount of beach nourishment would counteract erosion. The actions associated with alternative D would improve the ability of the beach to withstand storm events, preserve terrestrial habitat for plants and animals, and introduce no or limited viable nonnative invasive plants species seedbank since material would be transported to reach 3 via a permanent bypass system from updrift of the NIPSCO/Bailly complex to Portage Lakefront and Riverwalk, and have a negligible to minor, short-term, beneficial effect.

A minor, short-term, adverse impact would occur on bank swallows that nest along the eroded cliffs in reach 4 under alternative D, as beach nourishment would reduce erosion and cliff-forming processes, reducing the terrestrial habitat for the bank swallow. As indicated under alternative C-1 for reaches 3 and 4, the birds would relocate to other suitable habitat in the near vicinity. Work would be conducted outside critical periods (such as nesting) for these specific species when possible.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative D. Compared to the cumulative impacts expected under the no-action alternative, under alternative D, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small change. Cumulative impacts would be minor, short- and long-term and adverse and beneficial. Adverse impacts would result from the temporary disturbance to plant and animal terrestrial habitat during placement activities; beneficial impacts would result from the decreased erosion and improved natural habitat for plants and animals, and improved ability of the beach to withstand storm events. Implementing the actions associated with alternative D would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative D, there would also be negligible to minor, short-term, adverse effects from revegetation that would affect sensitive habitats; and there would be minor, short-term, beneficial impacts from nourishment of the park shoreline, particularly in areas of accelerated erosion. The actions associated with alternative D would involve increasing the amount of sediment placed in the project area through a permanent bypass system, thereby decreasing degradation of the beach and consequently the foredune plant communities. The actions associated with alternative D would result in minor, short-term, adverse impacts as some beach vegetation would be smothered during placement, as well as minor, short-term, beneficial impacts from the decreased erosion and improved terrestrial habitat for native plants and animals to thrive on. The actions associated with alternative D would improve the ability of the beach to withstand storm events and preserve terrestrial habitat for plants, and would introduce no or limited viable nonnative invasive plant species seedbank since material would be transported to reach 3 via a permanent bypass system from updrift of the NIPSCO/Bailly complex. A minor, long-term, adverse impact would occur on bank swallows that nest along the eroded cliffs in reach 4 under alternative D, as beach nourishment would reduce erosion and cliff-forming processes, reducing the terrestrial habitat for the bank swallow. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term and adverse and beneficial, cumulative effects.

FOREDUNE AND DUNE COMPLEX, REACHES 1 THROUGH 4

Current Management Actions

As explained in "The Alternatives" chapter, there are various current management actions of Indiana Dunes National Lakeshore that impact terrestrial habitat for plant and animal species in reaches 1 through 4.

Designation of an approved route from the parking lot to and from Mount Baldy in reach 1 has reduced the anthropogenic influences in that reach, including the trampling of native vegetation and the spread of invasive nonnative plant species, having a negligible to minor, long-term, beneficial impact on the habitat for native plant and animal communities.

Ongoing beach nourishment activities in reaches 1 and 3 have a minor, long-term, adverse impact from the smothering of native vegetation that occurs during sediment placement activities (and the subsequent period it typically takes native species to colonize and re-emerge as a stable population); however, these same activities result in minor, long-term, beneficial impacts from reduced erosion and improved ability of the shoreline to withstand storm events.

Restoration efforts (including installing fencing to protect environmentally sensitive areas and revegetating eroded areas with native vegetation) in the park have minor, long-term, beneficial impacts on terrestrial habitat for native plant communities by preserving and restoring the natural habitat and ecological processes that are critical to this vegetation's survival and reproduction in the park, and by improving the ability of the terrestrial habitat to withstand storm events. Similarly, visitor outreach and education efforts have minor, long-term, beneficial impacts on terrestrial habitat by increasing the knowledge base of visitors in the park and limiting the anthropogenic influences introduced and witnessed in the park.

Invasive vegetation management is performed in all the reaches of the park and includes an early detection and rapid response program and Invasive Plant Management Plan. This work manages the spread of invasive nonnative plants in the park and encourages early detection and eradication of such species, preserving the native habitat. These actions result in minor, long-term, beneficial impacts on the terrestrial habitat of native plant and animal communities.

Proposed Management Actions

Various proposed management actions at the park would impact terrestrial habitat for native plant and animal species in reaches 1 through 4.

The park would continue with the current management actions discussed above, having a minor, long-term, beneficial impact on terrestrial habitat for native plant and animal species by preserving and restoring critical habitat of native plant communities and preserving the ability of the habitat to withstand storm events. By continuing to manage nonnative invasive plant species, the National Park Service would provide a negligible to minor, long-term, beneficial effect on natural processes, including terrestrial habitat for plant communities in the park.

The proposed realigning of trails in the beach reaches would have minor, long-term, beneficial impacts on the terrestrial habitat for native plant and animal communities by limiting the anthropogenic influences witnessed in the park and by reducing the number of social trails (thereby reducing the trampling of native plant species).

Additionally, the park proposes to restore the foredune and dune complex in reach 4 by stabilizing eroded dunes with native vegetation and fencing off highly eroded and environmentally sensitive areas on the foredune to allow for ecological recovery of natural communities. Such work would have a minor, long-term, beneficial impact on the terrestrial habitat for native plant and animal communities by preserving and restoring the natural environment in which the species thrive and improving the ability of such habitat to better withstand storm events.

Cumulative Impacts. Proposed developments, including that proposed in Phase II of the Marquette Plan (IDNR *et al.* 2005), in and around the park would have a minor, short- and long-term, adverse effect on the terrestrial habitat of native plants as construction areas provide pathways for the introduction of invasive nonnative plant species. In addition, construction work would result in the trampling of native vegetation and destruction of critical habitat for native plant and animal species. Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under terrestrial habitat as a result of proposed management actions would be negligible to minor, long-term, and beneficial from the actions proposed to preserve terrestrial plant and animal critical habitat and to protect environmentally sensitive areas to allow for ecological recovery of natural communities.

Conclusion. Impacts on the foredune and dune complex in reaches 1 through 4 under terrestrial habitat as a result of proposed management actions would be negligible to minor, long-term, and beneficial from continuing with current management actions to protect and preserve terrestrial plant and animal critical habitat and to fence off highly eroded and environmentally sensitive areas to allow for ecological recovery of natural communities, and from the proposed realigning of trails in the beach reaches to limit anthropogenic influences and social trails experienced in the park, reducing the trampling of native plant species. Proposed developments in and around the park would have a minor, short-term, adverse effect on the terrestrial habitat of native plants as construction areas provide pathways for the introduction of invasive nonnative plant species and because construction work would result in the trampling of native vegetation and destruction of critical habitat for native plant and animal species. Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under terrestrial habitat as a result of proposed management actions would be negligible to minor, long-term, and beneficial.

THREATENED AND ENDANGERED SPECIES AND SPECIES OF CONCERN

METHODOLOGY

The "Affected Environment" chapter provides a description of the federal endangered, threatened, and candidate species found at Indiana Dunes National Lakeshore, including the Karner blue butterfly (*Lycaeides melissa samuelis*), Indiana bat (*Myotis sodalis*), piping plover, Pitcher's thistle, and eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*). Disturbance to these species and their habitat was evaluated by comparing projected changes resulting from implementing the action alternatives to taking no action (i.e., the no-action alternative). Impacts to piping plover and Pitcher's thistle are discussed under each of the alternative discussions below. Impacts to the Karner blue butterfly, Indiana bats, and eastern massasauga rattlesnake are summarized here.

Populations of the Karner blue butterfly do not occur within reaches 1, 2, and 3. Within Indiana Dunes National Lakeshore, there are populations that occur in reach 4 (at West Beach and in the adjacent Miller Woods), but other populations are located further inland. There would be no effect on the Karner blue butterfly under any of the alternatives for any of the reaches because the Karner blue butterfly does not occur in reaches 1, 2, and 3, and because nourishment activities in reach 3 would not affect the populations located within and adjacent to reach 4.

Indiana bats have been found within the inland Heron Rookery Unit of the park but not within reaches 1, 2, 3, and 4 where suitable habitat is unlikely to be present. There would be no effect on the Indiana bat under any of the alternatives for any of the reaches because suitable habitat for the Indiana bat does not occur in reaches 1, 2, 3, and 4.

Although sightings are rare, individual eastern massasauga rattlesnakes have been observed within suitable habitat inland. There would be no effect on the eastern massasauga rattlesnake under any of the alternatives for any of the reaches because actions implemented within the shoreline and beach complex would not affect these habitats and the eastern massasauga rattlesnake is unlikely to inhabit beach areas where nourishment would occur.

Information about the federal endangered, threatened and candidate species was compiled from site visits, research data that is publicly available, information from park staff, and studies of similar actions and effects. Impacts on the species are assessed qualitatively based on the project team's knowledge and best professional judgment.

Intensity Level Definitions

Intensity thresholds for threatened and endangered species and species of concern are defined as follows:

Negligible: The impact is barely detectable and/or would result in no noticeable or perceptible changes in the protection of threatened and endangered species and species of concern.

Minor: The impact is slight but detectable and/or would result in small but noticeable changes in the protection of threatened and endangered species and species of concern.

Moderate: The impact is readily apparent and would result in easily detectable changes in the protection of threatened and endangered species and species of concern.

Major: The impact is severely adverse or exceptionally beneficial, and/or would result in appreciable changes in the protection of threatened and endangered species and species of concern.

SHORELINE AND BEACH COMPLEX, REACHES 1 AND 2

Alternative A (No-action Alternative)

Under the no-action alternative, no new actions would be taken in the park in regards to threatened and endangered species and species of concern and their habitat. Under this alternative, reaches 1 and 2 would continue to experience erosion, beach loss, and degradation of the foredune and dune complex. Moderate, short-term, adverse impacts would result under alternative A from continued erosion, loss of habitat for piping plover and Pitcher's thistle, and the continued sediment budget deficit that would impact habitat for threatened and endangered species. Restoration of habitat for the Pitcher's thistle, and possibly the piping plover, which do not currently occur in reaches 1 and 2, would be unlikely under the no-action alternative. Therefore, under the no-action alternative these species may be affected, and are likely to be adversely affected, because development of future habitat is not addressed and substantial erosion would be likely to continue.

Cumulative Impacts. Several actions, independent of this plan, would affect the park's threatened and endangered species and species of concern. As described in the "Affected Environment" chapter, the unique environment at Indiana Dunes National Lakeshore provides a mosaic of habitats for terrestrial plants and wildlife in a relatively small area.

Independent of this plan, park staff would continue to monitor and protect threatened and endangered species and species of concern in the park to the greatest extent possible. Education and outreach activities, and other actions such as the realignment of some trails in the park, would have negligible to minor, long-term, beneficial effects on these species due to reduced anthropogenic influences. Habitat critical for the preservation of threatened and endangered species and species of concern would thus be maintained.

Additionally, restoration efforts by the park to preserve the foredune and dune complex (such as fencing off highly eroded areas and revegetating eroded areas with native plants) and to stabilize highly eroded areas would have negligible to minor, long-term, beneficial impacts on threatened and endangered species and species of concern by restoring the natural environment/habitat for such plants and animals.

Current and proposed development in and around the park, like that which occurred under Phase I of the Marquette Plan and that which is proposed under Phase II of that plan, would have minor, long-term, adverse impacts on threatened and endangered species and species of concern from the removal of habitat for these species, and minor, short-term, adverse impacts from the destruction of habitat during construction and the time it takes for species to colonize and re-emerge.

Activities or projects that would introduce new sound sources into the park, like construction and special events, such as the annual Super Boat Grand Prix boat race, would have negligible to minor, short-term, adverse effects on threatened and endangered species and species of concern. These effects, however, would be temporary, lasting only as long as construction or the duration of the special event.

Overall, when the actions described above are added to the existing threatened and endangered species and species of concern scenario, there would be negligible to minor, short- and long-term, adverse and beneficial cumulative impacts. The actions under alternative A would add a small increment to the overall cumulative impact.

Conclusion. Under the no-action alternative, the Pitcher's thistle and piping plover (which are threatened and endangered species may be affected, and are likely to be adversely affected, because loss of historical habitat is not addressed adequately and substantial erosion would likely continue under this alternative. Moderate, short-term, adverse impacts would result under alternative A from continued erosion, loss of habitat for piping plover and Pitcher's thistle, and the continued sediment budget deficit that would impact habitat for threatened and endangered species and species of concern. Cumulatively, there would be negligible to minor, short- and long-term, adverse and beneficial impacts. The actions under alternative A would result in a small increment being added to the overall cumulative impact.

Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency)

Currently, there is no habitat within reach 1 for Pitcher's thistle and piping plover; however, there would be the potential for such habitat to be restored as a result of the beach nourishment proposed under alternative B-1. Therefore, under alternative B-1, there would be moderate to major, short- and long-term, beneficial impacts on these species from habitat restoration, and minor, short-term, adverse impacts as the placement of nourishment material would temporarily disturb the ability of piping plover to nest and Pitcher's thistle to establish. The actions associated with alternative B-1 would affect, but are not likely to adversely affect, the Pitcher's thistle and piping plover (threatened and endangered species.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative B-1. Compared to the cumulative impacts expected under the no-action alternative, under alternative B-1, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor to moderate, short- and long-term, and adverse and beneficial. Adverse impacts would result from the temporary disturbance to habitat for threatened and endangered species and species of concern during placement activities, affecting the ability of some species to nest and establish. Beneficial impacts would result from the restoration of habitat for threatened and endangered species and species of concern. The actions associated with alternative B-1 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative B-1, there would be moderate to major, short-term, beneficial impacts on Pitcher's thistle and piping plover (threatened and endangered species, from the habitat restoration that would result from the expanded beach nourishment activities. The implementation of alternative B-1 would also result in minor, short-term, adverse impacts on threatened and endangered species and species of concern as placement of nourishment material from upland sources would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. With respect to the Pitcher's thistle and piping plover, this alternative may affect, but is not likely to adversely affect these species. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term, and adverse and beneficial cumulative effects.

Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency)

Similar to alternative B-1, there would be the potential for habitat to be restored under alternative B-5 for Pitcher's thistle and piping plover because of the additional beach nourishment that would occur under this alternative. Therefore, under alternative B-5, there would be moderate to major, long-term, beneficial impacts on these species from habitat restoration. Due to the longer placement period (approximately 18 months every five years), there would also be minor to moderate, long-term, adverse impacts from the placement of nourishment material that would disturb the ability of piping plover to nest and Pitcher's thistle to establish. The actions associated with alternative B-5 would affect, but are not likely to adversely affect, Pitcher's thistle and piping plover (threatened and endangered species.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative B-5. Compared to the cumulative impacts expected under the no-action alternative, under alternative B-5, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term, and adverse and beneficial. Beneficial impacts would result from the restoration of habitat for threatened and endangered species and species of concern. Adverse impacts would result from the temporary disturbance to habitat for threatened and endangered species and species of concern during placement activities, affecting the ability of some species to nest and establish. The actions associated with alternative B-5 would provide a large incremental contribution to overall cumulative impacts.

Conclusion. Under alternative B-5, there would be moderate to major, long-term, beneficial impacts on Pitcher's thistle and piping plover from the habitat restoration that would result from the expanded beach nourishment activities. The implementation of alternative B-5 would also result in minor to moderate, long-term, adverse impacts on these species as placement of nourishment material from upland sources would disturb the ability of piping plover to nest and for Pitcher's thistle to establish. With respect to the Pitcher's thistle and piping plover, this alternative may affect, but is not likely to adversely affect these species. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term, and adverse and beneficial cumulative effects.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency)

Like the other action alternatives in reaches 1 and 2, under alternative C-1 there would be the potential for Pitcher's thistle and piping plover habitat to be restored because of the additional beach nourishment that would occur via dredging. Therefore, under alternative C-1, there would be moderate to major, short- and long-term, beneficial impacts on these species from habitat restoration, and minor, short-term, adverse impacts from the placement of nourishment material that would temporarily disturb the ability of piping plover to nest and Pitcher's thistle to establish. The actions associated with alternative C-1 would affect, but are not likely to adversely affect, threatened and endangered species and species of concern.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-1. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-1, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor to moderate, short- and long-term, and adverse and beneficial. Adverse impacts would result from the temporary disturbance to habitat for threatened and endangered species and species of concern during placement activities, affecting the ability of some species to nest and establish. Beneficial impacts would result from the restoration of habitat for threatened and endangered species and species of concern. The actions associated with alternative C-1 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-1, there would be moderate to major, short-term, beneficial impacts on threatened and endangered species and species of concern from the habitat restoration that would result from the expanded beach nourishment activities. The implementation of alternative C-1 would also result in minor, short-term, adverse impacts on threatened and endangered species and species of concern as placement of nourishment material would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. With respect to the Pitcher's thistle and piping plover, this alternative may affect, but is not likely to adversely affect these species. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term, and adverse and beneficial cumulative effects.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

Similar to alternative C-1, there would be the potential for habitat to be restored under alternative C-5 for Pitcher's thistle and piping plover because of the additional beach nourishment that would occur via dredging. Therefore, under alternative C-5, there would be moderate to major, long-term, beneficial impacts on these species from habitat restoration. Due to the longer placement period (approximately 10 months every five years), there would also be minor to moderate, short-term, adverse impacts from the placement of nourishment material that would disturb the ability of piping plover to nest and Pitcher's thistle to establish. The actions associated with alternative C-5 would affect, but are not likely to adversely affect, threatened and endangered species and species of concern.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-5. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-5, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term, and adverse and beneficial. Adverse impacts would result from the temporary disturbance to habitat for threatened and endangered species and species of concern during placement activities, affecting the ability of some species to nest and establish. Beneficial impacts would result from the restoration of habitat for threatened and endangered species and species of concern. The actions associated with alternative C-5 would provide a large incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-5, there would be moderate to major, long-term, beneficial impacts on Pitcher's thistle and piping plover from the habitat restoration that would result from the expanded beach nourishment activities. The implementation of alternative C-5 would also result in minor to moderate, short-term, adverse impacts on these species as placement of nourishment material would disturb the ability of piping plover to nest and for Pitcher's thistle to establish. With respect to the Pitcher's thistle and piping plover, this alternative may affect, but is not likely to adversely affect these species. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term, and adverse and beneficial cumulative effects.

Alternative D (Beach Nourishment via Permanent Bypass System)

Like the other action alternatives in reaches 1 and 2, under alternative D, there is the potential for Pitcher's thistle and piping plover habitat to be restored because of the additional beach nourishment that would occur via a permanent bypass system. Therefore, under alternative D, there would be moderate to major, short-term, beneficial impacts on these species from habitat restoration, and minor, short-term, adverse impacts from the placement of nourishment material that would temporarily disturb the ability of piping plover to nest and Pitcher's thistle to establish. The actions associated with alternative D would affect, but are not likely to adversely affect, Pitcher's thistle and piping plover (threatened and endangered species. Coupled with site restoration, the Pitcher's thistle and piping plover would be likely to benefit as a result of habitat improvements under alternative D.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative D. Compared to the cumulative impacts expected under the no-action alternative, under alternative D, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor to moderate, short- and long-term, and adverse and beneficial. Beneficial impacts would result from the restoration of habitat for threatened and endangered species and species of concern. Adverse impacts would result from the temporary disturbance to habitat for threatened and endangered species and species of concern during placement activities, affecting the ability of some species to nest and establish. The actions associated with alternative D would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative D, there would be moderate to major, short-term, beneficial impacts on threatened and endangered species and species of concern from the habitat restoration that would result from the expanded beach nourishment activities via the permanent bypass system that would be constructed. The implementation of alternative D would also result in minor, short-term, adverse impacts on threatened and endangered species and species of concern as placement of nourishment material would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. With respect to the Pitcher's thistle and piping plover, this alternative may affect, but is not likely to adversely affect these species. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have negligible to minor, short- and long-term, and adverse and beneficial cumulative effects.

Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency)

Under alternative E, there is the potential for Pitcher's thistle and piping plover habitat to be restored because of the additional beach nourishment and greater sediment retention that would occur with the use of a submerged cobble berm in conjunction with a beach nourishment program. Therefore, under alternative E, there would be major, long-term, beneficial impacts on these species from habitat restoration, and minor, short-term, adverse impacts from the placement of the submerged cobble berm that would temporarily disturb the ability of piping plover to nest and Pitcher's thistle to establish. The actions associated with alternative E would affect, but are not likely to adversely affect, threatened and endangered species and species of concern. Coupled with site restoration, the Pitcher's thistle and piping plover would benefit as a result of habitat improvements under alternative E.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative E. Compared to the cumulative impacts expected under the no-action alternative, under alternative E, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term, and adverse and beneficial. Beneficial impacts would result from the restoration of habitat for threatened and endangered species and species of concern. Adverse impacts would result from the temporary disturbance to habitat for threatened and endangered species and species of concern during placement activities, affecting the ability of some species to nest and establish. The actions associated with alternative E would provide a large incremental contribution to overall cumulative impacts.

Conclusion. Under alternative E, there would be major, long-term, beneficial impacts on Pitcher's thistle and piping plover from the habitat restoration that would result from the placement of the submerged cobble berm. The implementation of alternative E would also result in minor, short-term, adverse impacts on threatened and endangered species and species of concern as placement of nourishment material would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. With respect to the Pitcher's thistle and piping plover, this alternative may affect, but is not likely to adversely affect these species. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term, and adverse and beneficial cumulative effects.

Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline) – Preferred Alternative

Under alternative F, Pitcher's thistle and piping plover habitat would be restored because of the beach nourishment program that would include a mix of coarse upland material and small natural stone. Therefore, under alternative F, there would be major, long-term, beneficial impacts on these species from habitat restoration, and minor, short-term, adverse impacts from the placement of the sediment and native stone mix that would temporarily disturb the ability of piping plover to nest and Pitcher's thistle to establish. The actions associated with alternative F would affect, but are not likely to adversely affect, threatened and endangered species and species of concern. Coupled with site restoration, the Pitcher's thistle and piping plover would benefit as a result of habitat improvements under the preferred alternative.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative F. Compared to the cumulative impacts expected under the no-action alternative, under the preferred alternative, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term, and adverse and beneficial. Beneficial impacts would result from the restoration of habitat for threatened and endangered species and species of concern. Adverse impacts would result from the temporary disturbance to habitat for threatened and endangered species and species of concern during placement activities, affecting the ability of some species to nest and establish. The actions associated with alternative F would provide a large incremental contribution to overall cumulative impacts.

Conclusion. Under the preferred alternative, there would be major, long-term, beneficial impacts on Pitcher's thistle and piping plover from the habitat restoration that would result from the additional beach nourishment and greater sediment retention. The implementation of alternative F would also result in minor, short-term, adverse impacts on threatened and endangered species and species of concern as placement of the beach nourishment mix would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. With respect to the Pitcher's thistle and piping plover, this alternative may affect, but is not likely to adversely affect, these species. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short-and long-term, and adverse and beneficial cumulative effects.

SHORELINE AND BEACH COMPLEX, REACHES 3 AND 4

Alternative A (No-action Alternative)

Like the no-action alternative in reaches 1 and 2, no new actions would be taken in the park in regards to threatened and endangered species and species of concern and their habitat under alternative A in reaches 3 and 4. Under this alternative, reaches 3 and 4 would continue to experience erosion, beach loss, and degradation of the foredune and dune complex. Moderate, short-term, adverse impacts would result under alternative A from continued erosion, loss of habitat for piping plover and Pitcher's thistle, and the continued sediment budget deficit that would impact habitat for threatened and endangered species and species of concern. Restoration of habitat for the Pitcher's thistle, and possibly the piping plover, would be unlikely under the no-action alternative. Therefore, under the no-action alternative these species may be affected, and are likely to be adversely affected, because loss of historical habitat would not be addressed adequately and substantial erosion would continue.

Cumulative Impacts. Several actions, independent of this plan, would affect the park's threatened and endangered species and species of concern. Independent of this plan, park staff would continue to monitor and protect threatened and endangered species and species of concern in the park to the greatest extent possible. Education and outreach activities, and other actions, such as the realignment of some trails in the park, would have negligible to minor, long-term, beneficial effects on these species due to reduced anthropogenic influences. Habitat critical for the preservation of threatened and endangered species and species of concern would thus be maintained.

Additionally, restoration efforts by the park to preserve the foredune and dune complex (such as fencing off highly eroded areas and revegetating eroded areas with native plants) and to stabilize highly eroded areas would have negligible to minor, long-term, beneficial impacts on threatened and endangered species and species of concern by restoring the natural environment/habitat for such plants and animals.

Current and proposed development in and around the park, like that which occurred under Phase I of the Marquette Plan and that which is proposed under Phase II of that plan, would have minor, long-term, adverse impacts on threatened and endangered species and species of concern from the removal of habitat for these species, and minor, short-term, adverse impacts from the destruction of habitat during construction and the time it takes for species to colonize and re-emerge. Activities or projects that would introduce new sound sources into the park, like construction and special events, such as the annual Super Boat Grand Prix boat race, would have negligible to minor, short-term, adverse effects on threatened and endangered species and species of concern. These effects, however, would be temporary, lasting only as long as construction or the duration of the special event.

Overall, when the actions described above are added to the existing threatened and endangered species and species of concern scenario, there would be negligible to minor, short- and long-term, adverse and beneficial cumulative impacts. The actions under alternative A would add a small increment to the overall cumulative impact.

Conclusion. Under the no-action alternative, the threatened and endangered species, Pitcher's thistle and piping plover, may be affected, and are likely to be adversely affected, because loss of historical habitat is not addressed adequately and substantial erosion would continue under this alternative. Moderate, short-term, adverse impacts would result under alternative A from continued erosion, loss of habitat for piping plover and Pitcher's thistle, and the continued sediment budget deficit that would impact habitat for threatened and endangered species and species of concern. Cumulatively, there would be negligible to minor, short- and long-term, adverse and beneficial impacts. The actions under alternative A would result in a small increment being added to the overall cumulative impact.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency) – Preferred Alternative

Under alternative C-1, the preferred alternative in reaches 3 and 4, there would be the potential for Pitcher's thistle and piping plover habitat to be restored because of the additional beach nourishment that would occur via dredging. Under alternative C-1, there would be moderate to major, short-term, beneficial impacts on the threatened and endangered species, Pitcher's thistle and piping plover, from the habitat restoration that would result from the expanded beach nourishment activities. There would also be minor, short-term, adverse impacts as placement of nourishment material would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. Critical habitat for the piping plover is located within the eastern terminus of reach 3, as well as near the water intake operated by NIPSCO. Mining of sediment to be placed on the beach in reach 3 would occur via dredging around the NIPSCO intake, lakeward of the piping plover habitat. The annual dredging operations would not directly disturb the piping plover habitat, though the sound generated from this process would have an indirect effect if conducted during the migration and nesting season (though work would be conducted outside critical periods [such as nesting] for the specific species when possible, and work in areas in or near suitable threatened and endangered bird habitat would occur as late as possible in the summer/fall). With respect to the Pitcher's thistle and piping plover, this alternative may affect, but is not likely to adversely affect these species. No adverse modification of the piping plover critical habitat would occur under this alternative. Overall, the actions associated with alternative C-1 would affect, but are not likely to adversely affect, Pitcher's thistle and piping plover (threatened and endangered species).

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-1 in reaches 3 and 4. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-1, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor to moderate, short- and long-term, and adverse and beneficial. Beneficial impacts would result from the restoration of habitat for threatened and endangered species and species of concern. Adverse impacts would result from the temporary disturbance to habitat for threatened and endangered species and species of concern during placement activities, affecting the ability of some species to nest and establish. The actions associated with alternative C-1 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-1, there would be moderate to major, short-term, beneficial impacts on threatened and endangered species and species of concern from the habitat restoration that would result from the expanded beach nourishment activities. There would also be minor, short-term, adverse impacts to threatened and endangered species and species of concern as placement of nourishment material would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. Coupled with beach nourishment, dredging would not be an adverse modification to the piping plover habitat under alternative C-1. No adverse modification of the piping plover critical habitat would occur under this alternative. The actions associated with alternative C-1 would affect, but are not likely to adversely affect, Pitcher's thistle and piping plover (threatened and endangered species). This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term, and adverse and beneficial cumulative effects.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

The actions and impacts under alternative C-5 would be similar to those described under alternative C-1 for reaches 3 and 4, except that the nourishment activities would take longer (approximately six months every five years). Under alternative C-5 there would be the potential for Pitcher's thistle and piping plover habitat to be restored because of the additional beach nourishment that would occur via dredging, and there would be moderate to major, long-term, beneficial impacts on threatened and endangered species and species of concern from this. There would also be minor, short-term, adverse impacts as placement of nourishment material would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish.

Under alternative C-5, sediment would be dredged from an updrift location in Lake Michigan, such as near the NIPSCO/Bailly intake, lakeward of the piping plover habitat. The annual dredging operations would not directly disturb the piping plover habitat, though the sound generated from this process would have an indirect effect if conducted during the migration and nesting season (though work would be conducted outside critical periods [such as nesting] for the specific species when possible, and work in areas in or near suitable threatened and endangered bird habitat would occur as late as possible in the summer/fall). With respect to the Pitcher's thistle and piping plover, this alternative may affect, but is not likely to adversely affect these species. No adverse modification of the piping plover critical habitat would occur under this alternative.

The actions associated with alternative C-1 would affect, but are not likely to adversely affect, Pitcher's thistle and piping plover (threatened and endangered species).

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-5. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-5, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term, and adverse and beneficial. Beneficial impacts would result from the restoration of habitat for threatened and endangered species and species of concern. Adverse impacts would result from the temporary disturbance to habitat for threatened and endangered species and species of concern during placement activities, affecting the ability of some species to nest and establish. The actions associated with alternative C-5 would provide a large incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-5, there would be moderate to major, long-term, beneficial impacts on threatened and endangered species and species of concern from the habitat restoration that would result from the expanded beach nourishment activities. There would also be minor, short-term, adverse impacts as placement of nourishment material would temporarily disturb the ability of piping plover to nest and for Pitcher's thistle to establish. Coupled with beach nourishment, dredging would not be an adverse modification to the piping plover habitat under alternative C-5. No adverse modification of the piping plover critical habitat would occur under this alternative, and the actions associated with alternative C-5 would affect, but are not likely to adversely affect, these threatened and endangered species. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term, and adverse and beneficial cumulative effects.

Alternative D (Beach Nourishment via Permanent Bypass System)

The actions and impacts under alternative D would be similar to those described under alternative C-1 for reaches 3 and 4, except that nourishment would be conducted via a permanent bypass system for sediment transport. Like the other action alternatives proposed for reaches 3 and 4, there is the potential for Pitcher's thistle and piping plover habitat to be restored because of the additional beach nourishment that would occur, resulting in moderate to major, short-term beneficial impacts on these threatened and endangered species from the habitat restoration that would result. The continuation of sediment placement in this reach would be of benefit to the Pitcher's thistle and piping plover. Habitat restoration at an increased level of beach nourishment would occur. The actions associated with alternative D would result in minor, short-term, adverse impacts from placement activities, and may affect, but are not likely to adversely affect these species as placement of the nourishment material may temporarily disturb the ability for piping plover to nest and for Pitcher's thistle to establish. Work would be conducted outside critical periods (such as nesting) for the specific species when possible. In addition, work in areas in or near suitable threatened and endangered bird habitat would occur as late as possible in the summer/fall.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative D. Compared to the cumulative impacts expected under the no-action alternative, under alternative D, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor to moderate, short- and long-term, and adverse and beneficial. Adverse impacts would result from the temporary disturbance to habitat for threatened and endangered species and species of concern during placement activities, affecting the ability of some species to nest and establish. Beneficial impacts would result from the restoration of habitat for threatened and endangered species and species of concern. The actions associated with alternative D would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative D, habitat loss would diminish and the possibility of the establishment of a natural ecosystem would be likely, resulting in moderate to major, short-term, beneficial impacts. The continuation of sediment placement in this reach would be of benefit to the Pitcher's thistle and piping plover. Habitat restoration at an increased level of beach nourishment would occur. The actions associated with alternative D would result in minor, short-term, adverse impacts during placement activities, and may affect, but are not likely to adversely affect these species. Coupled with beach nourishment, a permanent bypass system would not be an adverse modification to the piping plover habitat. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term, and adverse and beneficial cumulative effects.

FOREDUNE AND DUNE COMPLEX, REACHES 1 THROUGH 4

Current Management Actions

The current management actions described in "The Alternatives" chapter for the foredune and dune complex have multiple impacts on threatened and endangered species and species of concern. Ongoing beach nourishment activities in reaches 1 and 3 provide a minor, short-term, beneficial impact on threatened and endangered species and species of concern by preventing erosion, thus protecting critical habitat for these species. Placement activities also result in negligible to minor, short-term, adverse effects from the temporary disruption of habitat to these species during these activities.

Current management efforts to maintain, protect, and restore eroding areas (such as fencing off highly eroded areas and revegetating with native plants) in the park have minor, long-term, beneficial impacts on threatened and endangered species and species of concern from the preservation and restoration of critical habitat for these species. Activities related to these efforts have negligible to minor, short-term, adverse effects that last only as long as construction/maintenance work from the temporary disruption to critical habitat.

Invasive vegetation management in the park has minor, long-term, beneficial impacts on threatened and endangered species and species of concern from the restoration of critical habitat for these species, although there are negligible to minor, short-term, adverse effects during activities related to revegetation and management efforts that result from the temporary disruption of habitat for these species.

Education and outreach activities that help limit anthropogenic influences in the park have negligible to minor, long-term, beneficial impacts on threatened and endangered species and species of concern by preserving their habitat and reducing their exposure to outside influences.

By preserving existing ecological conditions through sustaining natural coastal processes, the National Park Service is providing a negligible to minor, long-term, beneficial effect on the threatened and endangered species and species of concern within the park, particularly piping plover and existing populations of Pitcher's thistle.

Proposed Management Actions

The proposed management actions are described in "The Alternatives" chapter. The park proposes to continue with the current management actions described above, having a negligible to minor, long-term, beneficial impact on threatened and endangered species and species of concern by increasing the potential for these species to find suitable habitat in the park and to inhabit the park.

Cumulative Impacts. Ongoing planned facility upgrades and proposed new developments in the park (such as those proposed under Phase II of the Marquette Plan) would have minor to moderate, short-term, adverse impacts on threatened and endangered species and species of concern from the sound that construction-related activities would bring in to the park that could temporarily displace threatened and endangered species and species of concern during construction and from the temporary disturbance to habitat during these activities. Special events near the park, like the Super Boat Grand Prix, would have negligible to minor, short-term, adverse impacts on threatened and endangered species and species of concern from the increase in sound in the park during such activities, and from the increase in anthropogenic influences (e.g., native vegetation trampling and increased numbers of social trails) that typically result during and after increased visitorship periods.

Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under threatened and endangered species and species of concern as a result of proposed management actions would be negligible, long-term, and beneficial as a result of increasing the potential for these species to find suitable habitat in the park and to inhabit the park over the long term.

Conclusion. Impacts on the foredune and dune complex in reaches 1 through 4 under threatened and endangered species and species of concern as a result of proposed management actions would be negligible to minor, long-term, and beneficial from actions being taken to increase the potential for these species to find suitable habitat in the park and to inhabit the park. Ongoing planned facility upgrades and proposed new developments in the park would have minor to moderate, short-term, adverse impacts on threatened and endangered species and species of concern from the sound that construction-related activities would bring in to the park that could temporarily displace threatened and endangered species and species of concern during construction and from the temporary disturbance to habitat during these activities. Special events near the park, like the Super Boat Grand Prix, would have negligible to minor, short-term, adverse impacts on threatened and endangered species and species of concern from the increase in sound in the park during such activities, and from the increase in anthropogenic influences that typically result during and after increased visitorship periods. Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under threatened and endangered species and species of concern as a result of proposed management actions would be negligible, long-term, and beneficial.

WETLANDS AND PANNES

METHODOLOGY

As explained in the "Affected Environment" chapter, there are two wetland features specific to Indiana Dunes National Lakeshore, the aquatic and panne communities. Impacts on wetlands and pannes were evaluated by comparing projected changes resulting from implementing the action alternatives to taking no action (i.e., the no-action alternative).

Information about the park's wetlands and pannes was compiled from site visits, research data that is publicly available, information from park staff, and studies of similar actions and effects. Impacts on wetlands and pannes were assessed qualitatively based on the project team's knowledge and best professional judgment.

Intensity Level Definitions

Intensity thresholds for wetlands and pannes are defined as follows:

Negligible: The impact is barely detectable and/or would result in no noticeable or perceptible changes to wetlands and pannes in the park.

Minor: The impact is slight but detectable and/or would result in small but noticeable changes to wetlands and pannes in the park.

Moderate: The impact is readily apparent and would result in detectable changes to wetlands and pannes in the park.

Major: The impact is severely adverse or exceptionally beneficial, and/or would result in appreciable changes to wetlands and pannes in the park.

SHORELINE AND BEACH COMPLEX, REACHES 1 THROUGH 4

The entire shoreline at Indiana Dunes National Lakeshore is classified as a wetland. Under the no-action alternatives and action alternatives for all reaches, the shoreline would remain un-vegetated beach wetland communities. Under the current nourishment activities taking place under the no-action alternative, as well as under the actions that would take place under the action alternatives for all reaches, temporary impacts to the beach wetlands would result from the placement of nourishment material directly on the beach. However, there would be a benefit to the wetland habitat as a result of the nourishment activities, including continued maintenance of the sediment required to sustain the un-vegetated beach wetland habitat. Natural ecological processes would function as they did prior to disturbance, to the extent practicable. No wetlands outside of the project area would be adversely impacted, resulting in no-net-loss of wetlands. This meets the NPS "no-net-loss of wetlands" policy as stated in NPS Director's Order 77-1: *Wetland Protection* and *Procedural Manual #77-1*. Under the action alternatives, the resulting shoreline (post-restoration) would be the same acreage of the same wetland type as currently exists, either maintained in its present position or shifted northward because a comparable shoreline profile would develop. As such, the project would be considered under the Restoration Exception in Section 4.2.1(h) of NPS Director's Order 77-1 and would be an excepted action. A Wetland Statement of Findings would not need to be prepared. There would be no incremental or cumulative effects on wetlands because the project would not affect the overall acreage or type of wetlands either within or outside of the project area.

FOREDUNE AND DUNE COMPLEX, REACHES 1 THROUGH 4

Current Management Actions

As explained in "The Alternatives" chapter, there are various current management actions taking place in the reaches of Indiana Dunes National Lakeshore that impact wetlands and pannes in reaches 1, 3, and 4 (reach 2 has no wetlands or pannes). These include the ongoing beach nourishment activities that take place on an intermittent basis in reaches 1 and 3. Such beach nourishment activities help prevent erosion and protect the existence of wetlands and pannes, having a negligible to minor, short-term, beneficial impact on these resources.

At blowout locations in the park, invasive plant management is performed to help protect Pitcher's thistle populations, having a negligible to minor, long-term, beneficial effect on these populations and the wetlands and pannes in areas that surround them. In addition, invasive nonnative plant species management, which include the early detection and rapid response program and Invasive Plant Management Plan, in other areas of the park (such as West Beach and Miller), help preserve the pannes (the foredune complex at Miller is interrupted by leeward pannes and aquatic plant communities and West Beach has the largest concentration of high quality pannes in the project area). These activities have negligible to minor, long-term, beneficial effects on wetlands and pannes, as do measures that are taken by the park to manage anthropogenic influences in the reaches, such as fencing and visitor outreach and education (West Beach is one of the most popular and highly visited entry points in the park with numerous social trails extending from the parking lots to the beach that traverse through sensitive habitat within the foredune and dune complex). Outreach and education create visitor awareness of the impacts of invasive nonnative plant species and anthropogenic influences in the park.

Current restoration and resource protection projects in the park, such as the early detection and rapid response program and Invasive Plant Management Plan and revegetation with native seeds, have minor, long-term, beneficial impacts on wetlands and pannes from the early detection and eradication of such species.

Proposed Management Actions

As explained in "The Alternatives" chapter, there are multiple proposed management actions for Indiana Dunes National Lakeshore that would impact wetlands and pannes in reaches 1, 3, and 4. If the park proceeds with expanding their education and outreach efforts, there would be negligible to minor, long-term, beneficial impacts on wetlands and pannes from the increased visitor awareness of these sensitive areas. In addition, should the park proceed with realigning some trails in the park, there would be negligible to minor, long-term, beneficial impacts on wetlands and pannes from the reduction in anthropogenic influences in these resource areas. Similarly, future actions by the park to restore the foredune and dune complex by stabilizing eroded dunes with native vegetation and fencing off highly eroded and environmentally sensitive areas on the foredune to allow for ecological recovery of natural communities would have minor, long-term, beneficial impacts on wetlands and pannes by preserving their natural environment.

Cumulative Impacts. Proposed development projects, like those included in Phase II of the Marquette Plan (IDNR *et al.* 2005), would have negligible, short-term, adverse impacts on wetlands and pannes from disruption to these sensitive landforms during construction activities. Development in the park would also have minor, long-term, adverse impacts from the take of some of these lands that would be required to build the proposed developments.

Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under wetlands and pannes as a result of proposed management actions would be negligible to minor, long-term, and beneficial from the actions proposed to educate visitors on anthropogenic influences on wetlands and pannes and from protection and restoration measures that would be taken for these environmentally sensitive areas.

Conclusion. Impacts on the foredune and dune complex in reaches 1 through 4 under wetlands and pannes as a result of proposed management actions would be negligible to minor, long-term, and beneficial from the park expanding its education and outreach efforts, increasing visitor awareness of these sensitive areas. In addition, realigning some trails in the park would have negligible to minor, long-term, beneficial impacts on wetlands and pannes from the reduction in anthropogenic influences in these resource areas. Actions to restore the foredune and dune complex by stabilizing eroded dunes with native vegetation and fencing off highly eroded and environmentally sensitive areas on the foredune to allow for ecological recovery of natural communities would have minor, long-term, beneficial impacts on wetlands and pannes by preserving their natural environment. Proposed development projects would have negligible, short-term, adverse impacts on wetlands and pannes from disruption to these sensitive landforms during construction activities; such development would also have minor, long-term adverse impacts from the take of some of these lands that would be required to build the proposed developments. Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under terrestrial habitat as a result of proposed management actions would be negligible to minor, long-term, and beneficial.

SOUNDSCAPE

METHODOLOGY

As explained in the "Affected Environment" chapter, the soundscape of Indiana Dunes National Lakeshore includes both the human and natural environment. The sound environment of the park changes seasonally. Visitors perceive the soundscape subjectively and typically seek out areas of the park where they can either experience the natural quiet or areas where human-generated sounds dominate, depending on their personal preference. Impacts to the soundscape under each alternative were analyzed to assess how the actions associated with each would help identify a series of management actions that could be implemented by park staff, as needed, to provide a balance between protection of the shoreline ecosystem and appropriate visitor enjoyment of the park. The National Park Service's Director's Order 47: *Preservation and Noise Management* defines noise as "an unwanted or undesired sound, often unpleasant in quality, intensity or repetition. This makes noise a subjective term and pushes society to address which sounds or aspects of sound constitute unwanted interruptions in specific situations. Noise is often a byproduct of desirable activities or machines. In a national park setting, noise is a subset of human-made noise." For purposes of this plan / final EIS, soundscape and natural sounds apply to the environment; noise is only referred to in discussions of impacts. Information about the soundscape at Indiana Dunes National Lakeshore was compiled from data from park staff and studies of similar actions and effects. Soundscape impacts were assessed quantitatively and qualitatively for this resource, based on the project team's knowledge and best professional judgment.

Intensity Level Definitions

Intensity thresholds of visitor experience are defined as follows:

Negligible: The impact is barely detectable and/or would result in no noticeable or perceptible changes in the soundscape of the park.

Minor: The impact is slight but detectable and/or would result in small but noticeable changes in the soundscape of the park.

Moderate: The impact is readily apparent and would result in easily detectable changes in the soundscape of the park.

Major: The impact is severely adverse or exceptionally beneficial, and/or would result in appreciable changes in the soundscape of the park.

SHORELINE AND BEACH COMPLEX, REACHES 1 AND 2

Alternative A (No-action Alternative)

Under the no-action alternative, there would be no changes to the park's soundscape. The current beach nourishment program at the park includes sediment being placed along the shoreline at Crescent Dune from a permitted upland borrow site. This sediment is deposited on an intermittent basis and is graded along the beach with minimal equipment, having a minor, short-term, adverse impact from the noise that's generated during placement and grading activities. Under the no-action alternative, there would be no new impacts on the soundscape.

Cumulative Impacts. Current human and natural sound from inside and outside the park has affected the natural soundscape of Indiana Dunes National Lakeshore in the past, and would continue to do so in the future. The park experiences sound intrusions from various transportation corridors, including the roads that run through and around the park; such sound intrusions have negligible, long-term, adverse effects on the soundscape since the park is surrounded by substantial development and industry. The park also experiences sound intrusions from existing industry development; for example, NIPSCO operations produce rhythmic mechanical industrial sounds that have negligible, long-term, adverse impacts on the sound environment at the park from ongoing, routine operations.

Just as the soundscape at the park varies by season and high-use times (i.e., holidays and weekends), the soundscape also varies with events. The Super Boat Grand Prix, a Michigan City sponsored event that has taken place the past three years, adds to the existing soundscape setting under the no-action alternative with minor, short-term, adverse impacts that are temporary, lasting as long as event set up, event run, and event take down. These impacts result from the increased number of boats operating in the lake, the increased number of visitors in the park during the event, and the addition of event sponsors and staff commuting to and from and being in the park to run the event.

The Northern Indiana Commuter Transportation District (the South Shore Railroad), which currently traverses the park, incrementally adds minor, long-term, adverse effects to the natural soundscape in the park from the sounds generated during daily operation of the train.

Should any of the proposed development or construction in or around the park take place (see the "Cumulative Impacts Scenario" section for a listing of the development projects proposed under the Marquette Plan) (IDNR *et al.* 2005), there would be an incremental addition of minor, short-term, adverse effects on the soundscape from the sound that would be generated from the related construction activities, including the operation of construction equipment.

Ongoing restoration, preservation, and invasive vegetation management work in the park incrementally add only negligible to minor, short-term, adverse effects on the existing soundscape, since this work is routine and cyclic, and already part of the existing soundscape at the park.

It is possible in the future that those events outside the boundaries of the park, such as recreational boating, would generate substantial sounds that would be heard in the park. New developments adjacent to the park would also result in sound generation during and after construction in these areas. These actions would incrementally add to the existing soundscape with negligible to minor, short- and long-term, adverse impacts during construction and associated daily living/operational activities.

Overall, if the actions described above were added to the existing soundscape, there would be negligible to minor, short- and long-term, adverse cumulative impacts on the soundscape. The actions under alternative A would add a small increment to the overall cumulative impact.

Conclusion. Under alternative A, there would be minor, short-term, adverse impacts from beach nourishment activities related to sound generated from the trucks hauling the sediment and the sediment being graded along the shoreline. No new impacts on the existing soundscape in reaches 1 and 2 would result under this alternative since no new actions would be taken. Cumulatively, there would be negligible to minor, short- and long-term, adverse impacts on the natural soundscape from the sounds associated with special events, construction/development projects, and restoration and preservation work. The actions under alternative A would result in a very small increment being added to the overall cumulative impact.

Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency)

Under alternative B-1, beach nourishment material would be mined and placed on the beach each year at Crescent Dune from a permitted upland source by trucks traveling along an existing access road. As many as five bulldozers would be employed to distribute the sediment along the beach. The beach nourishment activities would occur over approximately four months every year in off-peak months, if possible. The beach construction area would be closed to visitors during this time. These actions associated with alternative B-1 would result in negligible to minor, short-term, adverse impacts on the soundscape in the park.

Ambient daytime noise levels within reach 1 may range from 30 A-weighted decibels (dB[A]) in areas away from human activities to 60 dBA near areas of greater human activity, such as the Michigan City Marina to the east and Lakefront Drive to the west. Under alternative B-1, up to 80 trucks per eight-hour day, five days per week, would deliver sediment to reach 1, and as many as five bulldozers would be actively moving sediment toward the western portion of the reach. Depending on the age and condition of the construction equipment, noise levels from a large diesel truck would range up to near 90 dBA at a distance of 50 feet, while the bulldozer sound level would range up to 95 dBA at a distance of 50 feet (EPA 1971). Sound intensity attenuates with distance as it propagates over a larger area, generally in a spherical spreading pattern, away from a stationary noise source, or "point source" where the sound waves were generated. Generally speaking, noise generated by a point source decreases by approximately 6 dBA over hard surfaces (e.g., reflective surfaces such as parking lots or smooth bodies of water), and 7.5 dBA over soft surfaces (e.g., absorptive surfaces such as soft dirt, grass, or scattered bushes and trees) for each doubling of distance. Visitors would experience near ambient daytime noise levels within the nearby open beach areas because visitors would be excluded from the beach areas where nourishment activities would take place. Visitors would continue to experience the natural sound environment in the park that exists under the no-action alternative.

Therefore, truck and equipment operation under alternative B-1 would have a negligible to minor, short-term, adverse impact on the soundscape.

There would be fewer park visitors impacted, although terrestrial fauna would be affected by impacts on the soundscape, because activities under alternative B-1 would take place during the off-season as much as possible. If beach nourishment under alternative B-1 occurred in the fall months, the food gathering and other winter preparation activities of small mammals would be impacted by the sounds and vibrations from the trucks and construction equipment. Additionally, fall migratory birds that find rest, refuge, and forage in the park after their Lake Michigan overflight, would be disturbed and stressed by these activities. Impacts under alternative B-1 would be negligible to minor, short-term and adverse because of these effects on terrestrial fauna.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative B-1. If those impacts were added to the impacts under alternative B-1, there would be negligible to minor, short- and long-term, adverse cumulative impacts on the soundscape from the addition of sound in the park to execute the actions associated with this alternative. Impacts under alternative B-1 would occur on week days during the off-peak months; therefore, actions associated with alternative B-1 would add a very small increment to the overall cumulative impact.

Conclusion. Under alternative B-1 there would be negligible to minor, short-term, adverse impacts on the soundscape from beach nourishment activities. These impacts would be primarily due to sound generated from the trucks hauling the sediment and construction equipment grading the nourishment material along the beach. There would be negligible to minor, short- and long-term, adverse cumulative impacts on the natural soundscape if sounds from the actions associated with alternative B-1 were added to the existing soundscape environment; however, the actions from this alternative would result in a very small increment being added to the overall cumulative impact since work would be performed during off-peak months and during the week.

Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency)

Under alternative B-5, beach nourishment would take place similar as described above under alternative B-1, with a few differences. Under alternative B-5, beach nourishment would take place on a five-year frequency instead of an annual frequency. In addition, the implementation of this alternative would effectively close the reach 1 beach for approximately 18 months every five years. Under alternative B-5, there would be minor to moderate, long-term, adverse effects on the soundscape from these beach nourishment activities and the associated sound generated from hauling and grading activities.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative B-5. If those impacts were added to the impacts under alternative B-5, there would be negligible to moderate, short- and long-term, adverse cumulative impacts on the soundscape from the addition of sound in the park to execute the actions associated with this alternative. These cumulative impacts would occur during high-use times (e.g., summer), and on weekdays over the course of approximately 18 months every five years. The actions associated with alternative B-5 would therefore add a large effect to the overall cumulative impact.

Conclusion. Under alternative B-5 there would be minor to moderate, long-term, adverse impacts on the soundscape. These impacts would be primarily due to sound generated from trucks hauling sediment and construction equipment grading the nourishment material along the beach. There would be negligible to moderate, short- and long-term, adverse cumulative impacts on the soundscape. The actions associated with alternative B-5 would therefore add a large effect to the overall cumulative impact since work would be performed during the peak and off-peak seasons.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency)

Under alternative C-1, beach nourishment material would be dredged from an updrift location and placed annually on the beach in reach 1. As many as five bulldozers would be employed to distribute the sediment along the beach. The beach nourishment activities would occur over approximately two months every year during the off-peak season. The beach construction area would be closed to visitors during this time. These actions associated with alternative C-1 would result in negligible to minor, short-term, adverse impacts on the soundscape in the park from the sound they would generate.

Under alternative C-1, dredging equipment would operate 8 to 10 hours per day at a location offshore. Standing at the water's edge, a receptor (i.e., person or animal) would hear the sound of a small- to moderate-sized dredge at a level of approximately 60 dBA on a calm day (Borough of Poole Commissioners 2004). The bulldozers needed to move sediment along the beach would each generate noise levels as high as 95 dBA. Sound intensity attenuates with distance as it propagates over a larger area, generally in a spherical spreading pattern, away from a point source where the sound waves were generated. Generally speaking, noise generated by a point source decreases by approximately 6 dBA over hard surfaces (e.g., reflective surfaces such as parking lots or smooth bodies of water), and 7.5 dBA over soft surfaces (e.g., absorptive surfaces such as soft dirt, grass, or scattered bushes and trees) for each doubling of distance. Visitors would experience near ambient daytime noise levels within the nearby open beach areas because visitors would be excluded from the beach areas where nourishment activities would take place. Visitors would continue to experience the natural sound environment in the park that exists under the no-action alternative. Therefore, truck and equipment operation under alternative C -1 would have a negligible to minor, short-term, adverse impact on the soundscape.

Under alternative C-1, work would be performed during the park's off-season so there would be fewer park visitors impacted by these activities, although the work would impact terrestrial fauna. If beach nourishment occurred in October and November, the food gathering and other winter preparation activities of small mammals would be impacted by the sound and vibrations from the equipment. Further, fall migratory birds that find rest, refuge, and forage in the park after their Lake Michigan overflight, would be disturbed and stressed by these activities. Under alternative C-1, there would be negligible to minor, short-term, adverse impacts on the natural soundscape of Indiana Dunes National Lakeshore during fall performance of the activities associated with this alternative.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-1. If those impacts were added to the impacts under alternative C-1, there would be negligible to minor, short- and long-term, adverse cumulative impacts to the soundscape from the addition of sounds in the park to execute the actions associated with this alternative. These cumulative impacts would occur on weekdays under alternative C-1. Therefore, the actions associated with alternative C-1 would add a very small increment to the overall cumulative impact due to the timing of the actions.

Conclusion. The actions associated with alternative C-1 would result in negligible to minor, short-term, adverse impacts. These impacts would be primarily due to sound generated from barges and construction equipment grading the nourishment material along the beach. There would be negligible to minor, short- and long-term, adverse cumulative impacts on the soundscape if noise impacts under alternative C-1 were added to the existing soundscape; however, the actions from this alternative would result in a very small increment being added to the cumulative impact due to the time of the actions.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

Under alternative C-5, beach nourishment material would be placed on the beach as described above for alternative C-1, with a few differences. Beach nourishment activities under alternative C-5 would take place every five years rather than annually. In addition, the nourishment material would be placed on the beach on weekdays over approximately 10 months every five years. The actions associated with alternative C-5 would result in minor to moderate, short-term, adverse impacts on the soundscape in the park due to the dredging and spreading of sediment along the shoreline over an approximate 10-month period every five years.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-5. If those impacts were added to the impacts under alternative C-5, there would be negligible to moderate, short- and long-term, adverse cumulative impacts on the soundscape from the addition of sound in the park to execute the actions associated with this alternative. These cumulative impacts would occur on weekdays over approximately 10 months every five years. The actions associated with alternative C-5 would therefore add a large increment to the overall cumulative impact.

Conclusion. Under alternative C-5 there would be minor to moderate, short-term, adverse impacts on the soundscape. These impacts would be primarily due to sound generated from construction equipment grading the nourishment material along the beach and from dredging operations. Cumulative impacts would be negligible to moderate, short- and long-term and adverse as sound would occur during peak and off-peak times over approximately 10 months every five years. The actions associated with alternative C-5 would therefore add a large effect to the overall cumulative impact.

Alternative D (Beach Nourishment via Permanent Bypass System)

Under alternative D, a permanent bypass system would be constructed. Construction activities would have a negligible, short-term, adverse impact on the soundscape, lasting only as long as construction. Under this alternative, a permanent bypass system would transport sediment from updrift of the Michigan City Harbor to reach 1. As many as five bulldozers would be employed to distribute the sediment along the beach. The beach construction area would be closed to visitors during this time. These actions associated with alternative D would have negligible, short-term, adverse impacts on the park soundscape.

Under alternative D, the permanent bypass system would operate 8 to 10 hours a day. The exact location of the dredging barges, lift station, and pumps would be determined at a later stage, under a planning effort focused on implementation; however, when standing approximately 300 feet from the equipment, a receptor would be able to hear the sound of a small- to moderate-sized dredge at a level of approximately 60 dBA on a calm day. Bulldozers needed to move sediment along the beach would each generate noise levels at high as 95 dBA. Sound intensity attenuates with distance as it propagates over a larger area, generally in a spherical spreading pattern, away from a point source where the sound waves were generated. Generally speaking, noise generated by a point source decreases by approximately 6 dBA over hard surfaces (e.g., reflective surfaces such as parking lots or smooth bodies of water), and 7.5 dBA over soft surfaces (e.g., absorptive surfaces such as soft dirt, grass, or scattered bushes and trees) for each doubling of distance. Visitors would experience near ambient daytime noise levels within the nearby open beach areas because visitors would be excluded from the beach areas where nourishment activities would take place. Visitors would continue to experience the natural sound environment in the park that exists under the no-action alternative. Therefore, truck and equipment operation under alternative D would have a negligible to minor, short-term, adverse impact on the soundscape during dredging and spreading operations.

Due to the work being performed under alternative D during the park's off-season, there would be fewer park visitors impacted by these activities, although the work would impact terrestrial fauna, as described under alternative C-1 above, impact food gathering and other winter preparation activities. These actions associated with alternative D would result in negligible to minor, short-term, adverse impacts.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative D. If the impacts under alternative D were added to the existing soundscape, there would be negligible to minor, short- and long-term, adverse cumulative impacts on the soundscape from the addition of sound in the park to execute the actions associated with this alternative. Impacts under alternative D would occur on weekdays during the off-peak months; therefore, the actions associated with alternative D would add a very small increment to the overall cumulative impact.

Conclusion. Under alternative D, there would be negligible to minor, short-term, adverse impacts from the sound that would be generated from construction and associated operations of the permanent bypass system. There would be negligible to minor, short- and long-term, adverse cumulative impacts on the natural soundscape if sound generated from the actions associated with alternative D were added to the existing soundscape; however, the actions from this alternative would result in a very small increment being added to the cumulative impact due to the timing of the work.

Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency)

Under alternative E, the placement of a submerged cobble berm would be accomplished by employing a barge and crane. The crane would place the submerged cobble berm offshore approximately 10 feet below the water surface and parallel to the shoreline. The total length and design of the submerged cobble berm would be determined at a later stage, under a planning effort focused on implementation. In conjunction with the submerged cobble berm, a beach nourishment program would be used to restore reach 1 of Indiana Dunes National Lakeshore, although a reduced quantity would be needed as the submerged cobble berm would lessen beach erosion. Sediment placed on the beach would be distributed with as many as five bulldozers. The beach nourishment activities would occur during the off-peak season. The beach construction area would be closed to visitors during this time. These actions associated with alternative E would have negligible, short-term, adverse impacts on the park soundscape.

Under alternative E, the dredge equipment would operate 8 to 10 hours per day at a location offshore. Standing at the water's edge, a receptor would hear the sound of a small- to moderate-sized dredge at a level of approximately 60 dBA on a calm day (Borough of Poole Commissioners 2004). Bulldozers needed to move sediment along the beach would each generate noise levels as high as 95 dBA. Sound intensity attenuates with distance as it propagates over a larger area, generally in a spherical spreading pattern, away from a point source where the sound waves were generated. Generally speaking, noise generated by a point source decreases by approximately 6 dBA over hard surfaces (e.g., reflective surfaces such as parking lots or smooth bodies of water), and 7.5 dBA over soft surfaces (e.g., absorptive surfaces such as soft dirt, grass, or scattered bushes and trees) for each doubling of the distance. Visitors would experience near ambient daytime noise levels within the nearby open beach areas because visitors would be excluded from the beach areas where nourishment activities would take place. They would continue to experience the natural sound environment in the park that exists under the no-action alternative. Therefore, truck and equipment operation under alternative E would have a negligible to minor, short-term, adverse impact on the soundscape during dredging and spreading operations.

There would be fewer park visitors impacted by the actions associated with alternative E since activities would take place during the off-season; therefore, there would be negligible, short-term, adverse impacts to the soundscape from these actions.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative E. If the impacts under alternative E were added to the existing soundscape, negligible to minor, short- and long-term, adverse cumulative impacts on the soundscape would result from the addition of sound in the park to execute the actions associated with this alternative. Under alternative E, impacts would occur on weekdays during the off-peak months; therefore, the actions associated with alternative E would add a very small increment to the overall cumulative impact.

Conclusion. Under alternative E, there would be negligible, short-term, adverse impacts on the soundscape from the beach nourishment activities. These impacts would be primarily due to sound generated from construction activities as well as barges and construction equipment grading the nourishment material along the beach. There would be negligible to minor, short- and long-term, adverse cumulative impacts on the natural soundscape if sound generated from the actions associated with alternative E were added to the existing soundscape; however, the actions associated with this alternative would result in a very small increment being added to the overall cumulative impact.

Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stones at the Shoreline) – Preferred Alternative

Under alternative F, the preferred alternative, a beach nourishment program with a mix of small natural stone, dredged sediment, and coarse upland material at the shoreline would be used to restore reach 1 of Indiana Dunes National Lakeshore. Sediment placed on the beach would be distributed with as many as five bulldozers. The beach nourishment activities would occur during the off-peak season. The beach construction area would be closed to visitors during this time. These actions associated with alternative F would have negligible, short-term, adverse impacts on the park soundscape.

Under alternative F, the dredge equipment would operate 8 to 10 hours per day at a location offshore. Standing at the water's edge, a receptor would hear the sound of a small- to moderate-sized dredge at a level of approximately 60 dBA on a calm day (Borough of Poole Commissioners 2004). Bulldozers needed to move sediment along the beach would each generate noise levels as high as 95 dBA. Trucks would deliver coarse material and small native stones to reach 1, and bulldozers would be actively mixing the sediment and rocks. Depending on the age and condition of the construction equipment, noise levels from a large diesel truck would range up to near 90 dBA at a distance of 50 feet, while the bulldozer sound level would range up to 95 dBA at a distance of 50 feet (EPA 1971). Sound intensity attenuates with distance as it propagates over a larger area, generally in a spherical spreading pattern, away from a point source where the sound waves were generated. Generally speaking, noise generated by a point source decreases by approximately 6 dBA over hard surfaces (e.g., reflective surfaces such as parking lots or smooth bodies of water), and 7.5 dBA over soft surfaces (e.g., absorptive surfaces such as soft dirt, grass, or scattered bushes and trees) for each doubling of the distance. Visitors would experience near ambient daytime noise levels within the nearby open beach areas because visitors would be excluded from the beach areas where nourishment activities would take place. They would continue to experience the natural sound environment in the park that exists under the no-action alternative. Therefore, truck and equipment operation under alternative F would have a negligible to minor, short-term, adverse impact on the soundscape during dredging and spreading operations.

There would be fewer park visitors impacted by the actions associated with alternative F since visitors would be excluded from areas while beach nourishment activities are taking place; therefore, there would be negligible, short-term, adverse impacts to the soundscape from these actions.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under the preferred alternative. If the impacts under alternative F were added to the existing soundscape, negligible to minor, short- and long-term, adverse cumulative impacts on the soundscape would result from the addition of sound in the park to execute the actions associated with this alternative. Under the preferred alternative, impacts would occur on weekdays during the off-peak months; therefore, the actions associated with alternative F would add a very small increment to the overall cumulative impact.

Conclusion. Under alternative F, there would be negligible, short-term, adverse impacts on the soundscape from the beach nourishment activities. These impacts would be primarily due to sound generated from barges, and from trucks and bulldozers mixing and grading the nourishment material along the beach. There would be negligible to minor, short- and long-term, adverse cumulative impacts on the natural soundscape if sound generated from the actions associated with alternative F were added to the existing soundscape; however, the actions associated with this alternative would result in a very small increment being added to the overall cumulative impact.

SHORELINE AND BEACH COMPLEX, REACHES 3 AND 4

Alternative A (No-action Alternative)

Under the no-action alternative in reaches 3 and 4, there would be no changes to the park's soundscape. The current beach nourishment program includes the dredging of sediment annually around the NIPSCO/Bailly intake and placing it in the nearshore at Portage Lakefront and Riverwalk. The sediment is then graded along the beach with minimal equipment, having minor, short-term, adverse impacts from the sound that is generated during placement and grading activities. As described in the "Affected Environment" chapter, there are numerous human and natural components of sound in and around the park. Under the no-action alternative, there would be no new impacts on the soundscape from these existing actions.

Cumulative Impacts. The cumulative impacts under alternative A for reaches 3 and 4 would be similar to those described above for the no-action alternative for reaches 1 and 2. Overall, there would be negligible to minor, short- and long-term, adverse cumulative impacts on the soundscape if the impacts under the no-action alternative were added to the existing soundscape. The actions under alternative A would add a small increment to the overall cumulative impact.

Conclusion. Under alternative A, there would be minor, short-term, adverse impacts from beach nourishment activities related to sound generated from the sediment being graded along the shoreline. There would be no new impacts on the existing soundscape in reaches 3 and 4 since no new actions would be taken under alternative A. Cumulatively, there would be negligible to minor, short- and long-term, adverse impacts on the natural soundscape. The actions under alternative A would result in a very small increment being added to the overall cumulative impact.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency) – Preferred Alternative

Under alternative C-1, sediment would be dredged from an updrift location in Lake Michigan and placed annually on the beach at Portage Lakefront and Riverwalk. As many as five bulldozers would be employed to distribute the sediment along the beach. The beach nourishment activities would occur over an approximate two-month period every year during the off-peak season. The beach construction area would be closed to visitors during this time. These actions would result in negligible, short-term, adverse impacts on the soundscape in the park from the associated sound generation.

Ambient daytime noise levels within reach 3 may range from 30 dBA in areas away from human activities to higher than 60 dBA near areas of greater human activity such as Burns International Harbor to the east and the residential community of Ogden Dunes to the west. Under alternative C-1 in reaches 3 and 4, dredging equipment would operate 8 to 10 hours per day offshore. Standing at the water's edge, a receptor would hear the sound of small- to moderate-sized dredging equipment at a level of approximately 60 dBA on a calm day. Bulldozers needed to move sediment along the beach would each generate noise levels as high as 95 dBA. Sound intensity attenuates with distance as it propagates over a larger area, generally in a spherical spreading pattern, away from a point source where the sound waves were generated. Generally speaking, noise generated by a point source decreases by approximately 6 dBA over hard surfaces (e.g., reflective surfaces such as parking lots or smooth bodies of water), and 7.5 dBA over soft surfaces (e.g., absorptive surfaces such as soft dirt, grass, or scattered bushes and trees) for each doubling of distance. Visitors would experience near ambient daytime noise levels within the nearby open beach areas because visitors would be excluded from the beach areas where nourishment activities would take place. Visitors would continue to experience the natural sound environment in the park that exists under the no-action alternative. Therefore, construction equipment operation under alternative C-1 would have a negligible to minor, short-term, adverse impact on the soundscape during dredging and spreading operations.

Due to the work being performed under alternative C-1 during the park's off-season, there would be fewer park visitors impacted by these activities, although the work would impact terrestrial fauna, as described under alternative C-1 for reaches 1 and 2. Under alternative C-1, there would be negligible to minor, short-term, adverse impacts on the natural soundscape of Indiana Dunes National Lakeshore.

Additionally, due to the location of reaches 3 and 4 in the park, construction-related traffic would have to commute through surrounding neighborhoods to access this area, increasing the daily traffic and related traffic sounds generated for residents and park visitors. Such increases in traffic (and thus, traffic-related sounds) would have a negligible to minor, short-term, adverse impact on the soundscape.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under the preferred alternative. If the impacts under alternative C-1 were added to the existing soundscape, there would be negligible to minor, short- and long-term, adverse cumulative impacts on the soundscape from the addition of sound in the park to execute the actions associated with this alternative. Under alternative C-1, impacts would occur on weekdays during the off-peak months; therefore, the actions associated with alternative C-1 would add a very small increment to the overall cumulative impact.

Conclusion. Under alternative C-1, there would be negligible to minor, short-term, adverse impacts. These impacts would be primarily due to sound generated from barges and construction equipment grading the nourishment material along the beach. There would be negligible to minor, short- and long-term, adverse cumulative impacts on the soundscape if sound generated from the activities associated with alternative C-1 were added to the existing soundscape; however, these actions would result in a very small increment being added to the overall cumulative impact due to the timing of the actions.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

The beach nourishment activities that would take place under alternative C-5 would be similar to those described above for alternative C-1, with a few differences. Under alternative C-5, beach nourishment activities would take place every five years rather than annually, and these activities would occur over approximately six months every five years. Such actions would have minor to moderate, short-term. adverse impacts on the soundscape from the sounds that would be generated.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-5. If the impacts under alternative C-5 were added to the existing soundscape, there would be negligible to moderate, short- and long-term, adverse cumulative impacts on the natural soundscape from the addition of sound in the park to execute the actions associated with this alternative. Impacts under alternative C-5 would occur on weekdays for approximately six months every five years. The actions associated with alternative C-5 would therefore add a large effect to the overall cumulative impact.

Conclusion. Under alternative C-5, there would be minor to moderate, short-term, adverse impacts primarily due to sound generated from construction equipment grading the nourishment material along the beach. There would be negligible to moderate, short- and long-term, adverse cumulative impacts on the soundscape as sounds would be generated and occur during high-use times and on weekdays over approximately six months every five years. The actions associated with alternative C-5 would therefore add a large effect to the overall cumulative impact from the sound that would be generated.

Alternative D (Beach Nourishment via Permanent Bypass System)

Impacts under alternative D in reaches 3 and 4 would be similar to those described above for alternative D in reaches 1 and 2. That is, negligible to minor, short-term, adverse impacts from the sound that would be generated from construction of the permanent bypass system.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative D. If the impacts under alternative D were added to the existing soundscape, there would be negligible to minor, short- and long-term, adverse cumulative impacts on the soundscape from the addition of sound in the park to execute the actions associated with this alternative. Impacts under alternative D would occur on weekdays during the off-peak months; therefore, the actions associated with alternative D would add a very small increment to the overall cumulative impact.

Conclusion. Under alternative D, there would be negligible to minor, short-term, adverse impacts from the sound that would be generated from construction and associated operations of the permanent bypass system. There would be negligible to minor, short- and long-term, adverse cumulative impacts on the natural soundscape if sound generated from the actions associated with alternative D were added to the existing soundscape; however, the actions from this alternative would result in a very small increment being added to the cumulative impact due to the timing of the work.

FOREDUNE AND DUNE COMPLEX, REACHES 1 THROUGH 4

Current Management Actions

The continuation of current management actions described in "The Alternatives" chapter for the foredune and dune complex in reaches 1 through 4 would have no new effect on the *existing* soundscape since no new actions would be introduced into any of the reaches.

Proposed Management Actions

The proposed management actions described in "The Alternatives" chapter for the foredune and dune complex for reaches 1 through 4 would add negligible, short-term, adverse impacts on the natural soundscape in the park related to the sound generated from the proposed realignment of trails, and development of picnic areas, parking lots, access points, etc. These impacts would be temporary, lasting only as long as construction.

Cumulative Impacts. Sound from development that results from Phase II of the Marquette Plan (IDNR *et al.* 2005) would add negligible, short-term, adverse impacts on the natural soundscape. The Northern Indiana Commuter Transportation District (the South Shore Railroad), which currently traverses the park, incrementally adds minor, long-term, adverse effects to the natural soundscape in the park from the sounds generated during daily operation of the train. Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under soundscape as a result of proposed management actions would be negligible to minor, short- and long-term, and adverse from the incremental addition of sounds in the park during construction (short-term) and operation (long-term) of proposed upgrades and developments.

Conclusion. Impacts on the foredune and dune complex in reaches 1 through 4 under the soundscape as a result of proposed management actions would be negligible, short-term, and adverse from the sound that would be generated during the proposed realignment of trails, and development of picnic areas, parking lots, access points, etc. These impacts would be temporary, lasting only as long as construction. Likewise, sound from development that results from Phase II of the Marquette Plan (IDNR *et al.* 2005) would add negligible, short-term, adverse impacts on the natural soundscape. The Northern Indiana Commuter Transportation District (the South Shore Railroad), which currently traverses the park, adds minor, long-term, adverse effects to the natural soundscape in the park from the sounds generated during daily operation of the train. Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under terrestrial habitat as a result of proposed management actions would be negligible to minor, short- and long-term, and adverse.

VISITOR EXPERIENCE

METHODOLOGY

Information about visitor use and experience at Indiana Dunes National Lakeshore was compiled from data from park records and studies of similar actions and effects. Impacts were assessed qualitatively for this resource, based on the project team's knowledge and best professional judgment regarding how the proposed actions for each alternative would impact visitor use and experience in the park.

Intensity Level Definitions

Intensity thresholds for visitor experience are defined as follows:

Negligible: The impact is barely detectable and/or would result in no noticeable or perceptible changes in visitors' experience at the park.

Minor: The impact is slight but detectable and/or would result in small but noticeable changes in visitors' experience at the park.

Moderate: The impact is readily apparent and would result in easily detectable changes in visitors' experience at the park.

Major: The impact is severely adverse or exceptionally beneficial, and/or would result in appreciable changes in visitors' experience at the park.

SHORELINE AND BEACH COMPLEX, REACHES 1 AND 2

Alternative A (No-action Alternative)

Under the no-action alternative, visitor opportunities would remain essentially unchanged as the existing management protocol for the shoreline would be continued. Impacts on visitor experience under the no-action alternative would be minor, short-term, and adverse from temporary beach closings during intermittent beach nourishment and grading activities in reach 1. Under the no-action alternative, moderate, long-term, adverse impacts would result from degradation of popular visitor amenities within reaches 1 and 2, as a result of continued shoreline erosion and no new actions being taken.

Cumulative Impacts. Under the no-action alternative, restoration and preventative work in the park would incrementally add minor, short-term, adverse impacts on visitor experience from the resulting trail and beach closings. This work would also have a minor, long-term, beneficial impact on visitor experience from decreased future trail and beach closings and improved scenic views (from restoring natural views), ultimately improving the overall visitor experience at the park. Any action in the park resulting in trail closings and/or pedestrian detours would be readily apparent to visitors, who could express an opinion about them.

Ongoing and planned facility upgrades would incrementally add a negligible to minor, short-term, adverse impact on visitor experience during construction and renovation activities; however, following construction, there would be minor, long-term, beneficial impacts on visitor experience from the availability of improved facilities in the park and from a reduction in future closings of facilities for maintenance and upkeep.

Overall, there would be negligible to minor, short- and long-term, adverse and beneficial, cumulative impacts on visitor experience if the impacts under the no-action alternative were added to the existing visitor environment. Adverse impacts would result from the temporary beach, trail, and facility closings for maintenance work and upgrades, and beneficial impacts would result from the reduction in future closings, improved access to better facilities, and restoration of scenic views to more natural views. The actions under alternative A would add a small increment to the overall cumulative impact.

Conclusion. Under alternative A, the impact of taking no new actions in the park would be a minor to moderate, short- and long-term, adverse impact on visitor experience from temporary beach closings and ongoing degradation of popular visitor amenities from continued shoreline erosion. Impacts would continue under alternative A, even though the no-action alternative would have no new impacts on visitor experience. Cumulatively, there would be negligible to minor, short- and long-term, adverse and beneficial impacts on visitor experience. The actions associated with alternative A would result in a small increment being added to the overall cumulative impact.

Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency)

Under alternative B-1, the quantity of beach nourishment material that would be mined and delivered to the lakeshore would be increased compared to alternative A. The sediment would be placed at Crescent Dune on an annual basis over an approximate four-month period each year. To the extent possible, efforts would be made to minimize impacts on visitor experience by conducting beach nourishment activities during off-peak months (i.e., fall and winter months). The actions associated with alternative B-1 would have minor, short-term, adverse impacts on visitor experience from the additional trucks and grading equipment that would appear along the shoreline on an annual basis, disrupting the natural viewsheds of the park for visitors.

Under alternative B-1, the placement area would be temporarily closed to visitors during placement activities for safety purposes, resulting in minor, short-term, adverse impacts on visitor experience from access removal. The actions associated with alternative B-1 would also result in minor, short-term, beneficial impacts on visitor experience as there would be a temporary increase in beach size in the placement area near Mount Baldy, expanding the area available for visitor use and enjoyment.

The actions associated with alternative B-1 would fulfill the sediment budget deficit calculated for reach 1, preventing additional erosion, resulting in minor, short-term, beneficial impacts on visitor experience from decreased trail and beach closings and pedestrian detours for maintenance and restoration efforts. The shorelines downdrift of Mount Baldy would receive an infusion of sediment from the beach nourishment activities under alternative B-1, impacting not only reach 1, but reach 2 and a portion of reach 3, as well, similarly reducing cyclic maintenance and restoration demands in those areas, having a minor, short-term, beneficial impact on visitor experience.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative B-1. If the impacts under alternative B-1 were added to the existing environment for visitor experience, there would be minor, short-term, adverse impacts from beach and trail closings for beach nourishment activities, as well as minor, short-term, beneficial, cumulative impacts from decreased future closings and expanded area available for visitor use during the temporary increase in beach size near Mount Baldy. The actions associated with alternative B-1 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative B-1, there would be minor, short-term and adverse impacts during temporary beach and trail closings for nourishment activities in reach 1. There would also be minor, short-term, beneficial impacts on visitor experience due to the temporary increase in beach size and reduction in future trail closings. The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short-term, adverse and beneficial, cumulative effects.

Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency)

Under alternative B-5, the beach nourishment activities described above for alternative B-1 would be similar, with a few differences. The amount of beach nourishment material mined and delivered to the lakeshore from a permitted upland source via trucks would be increased relative to the no-action alternative, and would be placed along the lakeshore for approximately 18 months every five years. Such actions would result in moderate, long-term, adverse impacts on visitor experience from the beach and trail closings for safety reasons. Additionally, under alternative B-5, beach nourishment activities would require additional trucks and grading equipment along the shoreline for approximately 18 months every five years, resulting in additional visual intrusions to the viewshed for visitors, resulting in minor, long-term, adverse impacts.

The actions associated with alternative B-5 would cause a temporary increase in beach size in reach 1, having a minor, short-term, beneficial impact on visitor experience from the expanded area available for visitor use and enjoyment. The actions associated with alternative B-5 would fulfill the sediment budget deficit calculated for reach 1, preventing additional erosion, and would result in minor, long-term, beneficial impacts on visitor experience from fewer future beach closings for cyclic maintenance and restoration work.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative B-5. Compared to the cumulative impacts expected under the no-action alternative, under alternative B-5, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term and adverse and beneficial from the beach and trail closings during placement activities (adverse) and from fewer future closings for cyclic maintenance and restoration work (beneficial). The actions associated with alternative B-5 would provide a substantial incremental contribution to overall cumulative impacts.

Conclusion. Under alternative B-5, there would be minor to moderate, long-term, adverse impacts on visitor experience from the visual intrusions being introduced into the park during beach nourishment activities and the beach and trail closings during placement work. In addition, under this alternative there would be minor, short- and long-term, beneficial impacts from the temporary increase in beach size and future reduction in beach closings for nourishment activities due to the decrease in erosion. The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term, adverse and beneficial impacts.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency)

Under alternative C-1, beach nourishment material would be dredged from an updrift location and placed on the beach in reach 1 on an annual basis. The amount of sediment would fulfill the calculated sediment budget deficit for reach 1, and this placement would occur during an approximate two-month period each year when impacts on visitor use would be minimized to the extent possible (i.e., during fall or winter months). Overall, minor, short-term, adverse impacts on visitor experience would result under alternative C-1 as nourishment would require barges and additional grading equipment along the shoreline on an annual basis, impacting the natural viewshed of visitors in the park. Placement activities associated with alternative C-1 would have minor, short-term, adverse impacts on visitor experience from the associated beach and trail closings. A minor, short-term, beneficial impact would also result as there would be a temporary increase in beach size in the beach area near Crescent Dune and Mount Baldy, expanding the area of beach available for visitor use and enjoyment.

The actions associated with alternative C-1 would fulfill the sediment budget deficit calculated for reach 1 and prevent additional erosion. This would result in minor, short-term, beneficial impacts on visitor experience from decreased beach and trail closings that result from cyclic maintenance and restoration work (which would be reduced). The shorelines downdrift of Mount Baldy would receive an infusion of sediment from the beach nourishment activities under alternative C-1, impacting not only reach 1, but reach 2 and a portion of reach 3, as well, similarly reducing cyclic maintenance demands in those areas. This would result in fewer beach closings for work in those areas, again having a minor, short-term, beneficial impact on visitor experience.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-1. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-1, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor, short- and long-term and adverse and beneficial from the temporary beach and trail closings required during placement activities, the additional visual intrusions that would be introduced into the park, and the decrease in beach and trail closings for annual maintenance and restoration work. The actions associated with alternative C-1 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-1, there would be minor, short-term, adverse impacts that would result from the temporary beach closings and visual intrusions being introduced into the park during placement activities. There would also be minor, short-term, beneficial impacts on visitor experience from the temporary increase in beach size and the decrease in future beach closings that would result from less restoration work having to be performed (from reduced erosion). The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term, adverse and beneficial, cumulative impacts.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

Under alternative C-5, the beach nourishment activities and impacts described above for alternative C-1 would be similar with a few differences. Under alternative C-5, the beach nourishment material would be dredged every five years rather than annually and dredging activities would take approximately 10 months to complete every five years (longer than the approximate two-month period under alternative C-1 due to the greater volume of sediment being placed and distributed). Under alternative C-5, there would be moderate, short-term, adverse impacts on visitor experience from implementation of this alternative, as beach nourishment would require additional grading equipment along the shoreline for approximately 10 months on a five-year frequency, interrupting the natural viewshed experienced by visitors. Dredging and placement operations would have moderate, short-term, adverse impacts on visitor experience from the associated beach and trail closings that would take place for safety reasons.

The actions associated with alternative C-5 would have a minor, short-term, beneficial impact on visitor experience as the beach would experience a temporary increase in size near Crescent Dune and Mount Baldy, resulting in a greater area of beach being available for visitor use and enjoyment. The actions associated with alternative C-5 would fulfill the sediment budget deficit calculated for reach 1, preventing additional erosion, resulting in minor, long-term, beneficial impacts on visitor experience from fewer future beach and trail closings that would take place for cyclic maintenance and restoration work (which would be reduced).

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-5. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-5, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term and adverse and beneficial from the temporary beach and trail closings during dredging and placement activities and the visual intrusions that would be added, and from the resultant decrease in future work related to maintenance and restoration of the shoreline (as erosion would decrease). The actions associated with alternative C-5 would provide a large incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-5, there would be moderate, short-term, adverse impacts during dredging and placement activities from temporary beach and trail closings and the visual intrusions such activities and construction equipment would introduce into the visitor's viewshed. There would also be minor, short- and long-term, beneficial impacts on visitor experience from the temporary increase in beach size and the decrease in future beach closings that would result from reduced erosion (and thus reduced maintenance and restoration activities that require beach closings). The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term and adverse and beneficial, cumulative effects.

Alternative D (Beach Nourishment via Permanent Bypass System)

Under alternative D, a permanent bypass system would transport sediment to reach 1. The actions associated with alternative D would not result in major changes to visitor experience; however, there would be minor, short-term, adverse impacts from distributing the sediment placed, due to the visual intrusion additional construction equipment would introduce into the park to construct the permanent bypass system, and from the temporary beach and trail closings that would result for safety reasons. Under alternative D, the beach size would temporarily increase and result in minor, short-term, beneficial impacts on visitor experience from the expanded area that would be available for visitor use and enjoyment.

Under alternative D, the permanent small lift stations that would be constructed would be visible near the shoreline, introducing a visual intrusion in the park and interrupting the natural viewshed experienced by visitors. Such actions would have a minor, long-term, adverse impact on visitor experience. The visible lift stations proposed under alternative D would pose a safety hazard to nonconfident swimmers in the park, having a negligible to minor, long-term, adverse effect on visitor experience.

The actions associated with alternative D would fulfill the sediment budget deficit calculated for reach 1, preventing additional erosion, and would result in minor, short-term, beneficial impacts on visitor experience from reduced beach and trail closings that result from cyclic maintenance and restoration work (which would be reduced). The shorelines downdrift of Mount Baldy would receive an infusion of sediment from these beach nourishment activities, impacting not only reach 1, but reach 2 and a portion of reach 3, as well, similarly reducing cyclic maintenance and restoration work in those areas, resulting in minor, short-term, beneficial impacts on visitor experience from fewer beach and trail closings.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative D. Compared to the cumulative impacts expected under the no-action alternative, under alternative D, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor, short- and long-term and adverse and beneficial. The actions associated with alternative D would provide a small incremental contribution to overall cumulative impacts in those areas.

Conclusion. Under alternative D, there would be minor, short- and long-term, adverse impacts on visitor experience from temporary beach closings, the visual intrusions construction of the permanent bypass system would introduce in to the park during construction (i.e., construction equipment), and hazards posed to nonconfident swimmers by the lift and pump stations. There would also be minor, short-term, beneficial impacts from the reduction in future beach closings that would result from less cyclic maintenance and restoration work needing to be performed from reduced erosion, as well as the temporary increase in beach size. Implementation of alternative D would also result in minor, long-term, adverse impacts to visitor experience from the visual intrusion the small lift stations would introduce to the park. The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term, adverse and beneficial, cumulative effects.

Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency)

Under alternative E, a submerged cobble berm would be used in conjunction with a beach nourishment program to restore reach 1 of Indiana Dunes National Lakeshore. This alternative would stabilize the shoreline through the area, reduce the amount of sediment required to continually replenish the supply of beach sediment, and lessen the interruptions in visitor use of the beach from trucks, grading equipment, and nourishment-related activities. Such actions would have moderate, long-term, beneficial impacts on visitor experience from reduced beach closings for nourishment activities and a reduction in the presence of construction and grading equipment on the beach (improving the visitor's viewshed).

During construction of the submerged cobble berm and beach nourishment activities, there would be minor, short-term, adverse impacts on visitor experience from temporary beach closings and installation activities. Such closings would last only as long as construction and placement of the submerged cobble berm. As described in "The Alternatives" chapter, the submerged cobble berm would be placed in approximately 10 feet of water (at low water datum), with a top elevation of approximately 4 feet below low water datum. The presence of the submerged cobble berm would result in negligible to minor, short-term, adverse impacts as it would pose a safety concern to boaters, particularly deep draft vehicles, before it would disperse across the lakebed. As the submerged cobble berm dissipates, the individual cobble material would be carried towards the beach via wave action to approximately 5 to 6.5 feet below water. The area between this water depth and the shoreline would remain largely free of cobbles. Additionally, after the berm has been re-shaped, nourishment material placed in subsequent years would cover the berm material, leaving a largely sandy substrate. The submerged cobble berm would have negligible to minor, short-term, adverse impacts on visitor experience, as swimmers would come into contact (though minimal) with the cobbles until they were covered with the additional nourishment material. Mitigation measures would be considered to offset the safety concerns posed to visitors under this alternative.

The actions associated with alternative E would temporarily increase the beach size in reach 1, resulting in minor, short-term, beneficial impacts on visitor experience from the expanded area available for visitor use and enjoyment.

Under alternative E, the submerged cobble berm that would be constructed would result in minor, long-term, adverse impacts on visitor experience from the visual intrusion it would create. The submerged cobble berm would potentially be seen from elevated heights in the park before dispersing along the lake bottom. Minor, short-term, adverse impacts would also result, as the barges used in the dredging operations and the grading equipment for current nourishment activities would interrupt the aesthetics of the shoreline during nourishment on an annual basis. The actions associated with alternative E would fulfill the sediment budget deficit calculated for reach 1, preventing additional erosion, and result in minor, long-term, beneficial impacts on visitor experience from fewer beach and trail closings as a result of less cyclic maintenance and restoration work needing to be performed in the park.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative E. Compared to the cumulative impacts expected under the no-action alternative, under alternative E, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term and adverse and beneficial. Adverse impacts would result from the temporary beach and trail closings during construction and installation of the submerged cobble berm, from the visual intrusions that the submerged cobble berm would introduce into the park, and from the safety concerns the submerged cobble berm would pose to boaters until it had dissipated. Beneficial impacts would result from the decreased erosion that would result, reducing the frequency of beach and trail closings for cyclic maintenance and restoration work. The actions associated with alternative E would provide a large incremental contribution to overall cumulative impacts.

Conclusion. Under alternative E, there would be would minor, short- and long-term, adverse impacts on visitor experience during construction of the submerged cobble berm due to the temporary beach closings and visual intrusion the submerged cobble berm would introduce into the park and the safety concerns it would pose to boaters before dissipation. The submerged cobble berm, until it had dispersed along the lakebed, would result in negligible to minor, long-term, adverse impacts on visitors from the safety concerns it would pose. The park would consider implementing mitigation measures to offset these concerns. Under alternative E, there would also be minor, short- and long-term, beneficial impacts from the reduced maintenance demands and reduced restoration demands that would result in fewer beach and trail closings. The actions of this alternative, when combined with other past, present, and reasonably foreseeable actions would result in minor to moderate, short- and long-term, adverse and beneficial, cumulative effects.

Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline) – Preferred Alternative

Under alternative F, beach nourishment material would be dredged from an updrift location and trucked from an upland source and placed on the beach in reach 1 on an annual basis. The amount of sediment would fulfill the calculated sediment budget deficit for reach 1, and this placement would occur during an approximate two-month period each year when impacts on visitor use would be minimized to the extent possible (i.e., during fall or winter months). Overall, minor, short-term, adverse impacts on visitor experience would result under alternative F as beach nourishment activities would require barges, trucks, and additional mixing and grading equipment along the shoreline on an annual basis, impacting the natural viewshed of visitors in the park. Placement activities associated with alternative F would have minor, short-term, adverse impacts on visitor experience from the associated beach and trail closings. A minor, short-term, beneficial impact would also result as there would be a temporary increase in beach size in the beach area near Crescent Dune and Mount Baldy, expanding the area of beach available for visitor use and enjoyment.

The actions associated with alternative F would fulfill the sediment budget deficit calculated for reach 1 and prevent additional erosion. This would result in minor, short-term, beneficial impacts on visitor experience from decreased beach and trail closings that result from cyclic maintenance and restoration work (which would be reduced). The shorelines downdrift of Mount Baldy would receive an infusion of sediment from the beach nourishment activities under alternative F, impacting not only reach 1, but reach 2 and a portion of reach 3, as well, similarly reducing cyclic maintenance demands in those areas. This would result in fewer beach closings for work in those areas, again having a minor, short-term, beneficial impact on visitor experience.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative F. Compared to the cumulative impacts expected under the no-action alternative, under alternative F, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor, short- and long-term and adverse and beneficial from the temporary beach and trail closings required during placement activities, the additional visual intrusions that would be introduced into the park, and the decrease in beach and trail closings for annual maintenance and restoration work. The actions associated with alternative F would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative F, there would be minor, short-term, adverse impacts that would result from the temporary beach closings and visual intrusions being introduced into the park during placement activities. There would also be minor, short-term, beneficial impacts on visitor experience from the temporary increase in beach size and the decrease in future beach closings that would result from less restoration work having to be performed (from reduced erosion). The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term, adverse and beneficial, cumulative impacts.

SHORELINE AND BEACH COMPLEX, REACHES 3 AND 4

Alternative A (No-action Alternative)

Under the no-action alternative for reaches 3 and 4, visitor opportunities would remain essentially unchanged and the existing management protocol for the shoreline would be continued, including the continuation of the dredging of sediment annually around the NIPSCO/Bailly intake. Impacts on visitor experience under the no-action alternative would be similar to those described above for alternative A under reaches 1 and 2. That is, visitor opportunities would remain essentially unchanged as the existing management protocol for the shoreline would be continued. Impacts on visitor experience under the no-action alternative would be minor, short-term, and adverse from temporary beach closings during current clean sediment beach nourishment and grading activities in reach 3. Under the no-action alternative, moderate, long-term, adverse impacts would result from degradation of popular visitor amenities within reaches 3 and 4, as a result of continued shoreline erosion and no new actions being taken.

Cumulative Impacts. The cumulative impacts under alternative A in reaches 3 and 4 would be similar to those described above for the no-action alternative under reaches 1 and 2. That is, the proposed plan would incrementally add negligible to minor, short- and long-term, adverse and beneficial effects on visitor experience. Adverse impacts would result from the temporary beach, trail, and facility closings for maintenance work and upgrades, and beneficial impacts would result from the reduction in future closings, improved access to better facilities, and restoration of scenic views to more natural views. The actions under alternative A would add a small increment to the overall cumulative impact.

Conclusion. Under alternative A, the impact of taking no new actions in the park would be a minor to moderate, short- and long-term, adverse impact on visitor experience from temporary beach closings and ongoing degradation of popular visitor amenities from continued shoreline erosion. Impacts would continue under alternative A, even though the no-action alternative would have no new impacts on visitor experience. Cumulatively, there would be negligible to minor, short- and long-term, adverse and beneficial impacts on visitor experience. The actions associated with alternative A would result in a small increment being added to the overall cumulative impact.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency) – Preferred Alternative

The actions and impacts under alternative C-1 in reaches 3 and 4 would be similar to those described earlier for alternative C-1 under reaches 1 and 2. That is, minor, short-term and adverse from the visual intrusions the barges and additional grading equipment along the shoreline would introduce into the park on an annual basis for an approximate two-month period each year; minor, short-term and adverse from beach and trail closings and minor, short-term and beneficial as there would be a temporary increase in beach size in reach 3, expanding the area of beach available for visitor use and enjoyment.

The actions associated with alternative C-1 would fulfill the sediment budget deficit for reach 3, preventing additional erosion, resulting in minor, short-term, beneficial impacts on visitor experience from reduced beach and trail closings that would result from cyclic maintenance and restoration work (which would be reduced). reach 4 would receive an infusion of sediment from the beach nourishment activities under alternative C-1, similarly reducing cyclic maintenance and restoration demands in that area. This would result in fewer beach closings for that work, again having a minor, short-term, beneficial impact on visitor experience.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would apply under alternative C-1. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-1, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor, short- and long-term and adverse and beneficial. The actions associated with alternative C-1 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-1, there would be minor, short-term, adverse impacts on visitor experience from the visual intrusions introduced into the park and the annual beach and trail closings that would be required during nourishment activities for safety reasons. There would also be minor, short-term, beneficial impacts under this alternative from the temporary increase in beach size in reach 3 (resulting in an expanded area for visitor use and enjoyment), and from reductions in the amount of maintenance and restoration work required from decreased erosion (resulting in fewer beach closings). This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term and adverse and beneficial, cumulative effects. The actions of alternative C-1 would add a small increment to the overall cumulative impacts.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

Under alternative C-5 in reaches 3 and 4, the impacts would be similar to those described above for alternative C-5 under reaches 1 and 2. That is, minor to moderate, short-term, adverse impacts would result from implementation of this alternative, as beach nourishment would require additional grading equipment along the shoreline for approximately six months every five years. This would disrupt the viewshed experienced by visitors. Minor to moderate, short-term, adverse impacts would result under alternative C-5 from beach and trail closings during placement activities for safety reasons. Minor, short-term, beneficial impacts would result from the temporary increase in beach size that would make a greater area of beach available for visitor use and enjoyment.

The actions associated with alternative C-5 would fulfill the sediment budget deficit for reach 3 and prevent additional erosion. This would result in minor, long-term, beneficial impacts on visitor experience due to fewer future beach and trail closings that would take place during cyclic maintenance and restoration work (which would be reduced). Reach 4 would receive an infusion of sediment from the beach nourishment activities under alternative C-5. This would reduce cyclic maintenance and restoration demands in that area, and would result in fewer beach closings for that work, again having a minor, long-term, beneficial impact on visitor experience.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would apply under alternative C-5 for reaches 3 and 4. Under alternative C-5, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term and adverse and beneficial from the temporary beach and trail closings during dredging and placement activities and the visual intrusions that would be added to the park, and from the resultant decrease in future work related to maintenance and restoration of the shoreline (as erosion would decrease. The actions associated with alternative C-5 would provide a substantial incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-5, there would be minor to moderate, short-term, adverse impacts on visitor experience from the six-month period of beach closings that would take place every five years and the visual intrusions that would be introduced into the visitors' viewshed. There would also be minor, short- and long-term, beneficial impacts under this alternative from the temporary increase in beach size, providing visitors with an expanded area to use and enjoy, and from the reduction in future maintenance and restoration work in the park (which would reduce the number of beach and trail closings). The actions of this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short-and long-term and adverse and beneficial, cumulative effects.

Alternative D (Beach Nourishment via Permanent Bypass System)

The actions and impacts that would result under alternative D in reaches 3 and 4 would be similar to those described earlier for alternative D in reaches 1 and 2. That is, minor, short-term, adverse impacts would result on an annual basis from distributing the sediment placed, due to the visual obtrusion additional construction equipment would introduce into the park, and from the temporary beach and trail closings that would result for safety reasons. Under alternative D, the beach size would temporarily increase and result in minor, short-term, beneficial impacts on visitor experience from the expanded area that would be available for visitor use and enjoyment.

Under alternative D, the small lift stations that would be constructed would be visible near the shoreline, introducing a visual intrusion in the park and interrupting the natural viewshed experienced by visitors. Such actions would have a minor, long-term, adverse impact on visitor experience.

The actions associated with alternative D would fulfill the sediment budget deficit for reach 3, preventing additional erosion, and would result in minor, short-term, beneficial impacts on visitor experience from reduced beach and trail closings that result from cyclic maintenance and restoration work (which would be reduced). The shorelines downdrift of reach 3 would receive an infusion of sediment from these beach nourishment activities, impacting reach 4, similarly reducing cyclic maintenance and restoration work in that area, resulting in minor, short-term, beneficial impacts on visitor experience from fewer beach and trail closings.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative D. Compared to the cumulative impacts expected under the no-action alternative, under alternative D, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor, short- and long-term, and adverse and beneficial. The actions associated with alternative D would provide a small incremental contribution to overall cumulative impacts in those areas.

Conclusion. Under alternative D, there would be minor, short- term, adverse impacts on visitor experience from temporary beach closings and visual intrusions being introduced into the park. There would also be minor, short-term, beneficial impacts from the reduction in future beach closings that would result from less cyclic maintenance and restoration work needing to be performed from reduced erosion, as well as the temporary increase in beach size. Implementation of alternative D would also result in minor, long-term, adverse impacts to visitor experience from the visual intrusion the small lift stations would introduce to the park. The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term, adverse and beneficial, cumulative effects.

FOREDUNE AND DUNE COMPLEX, REACHES 1 THROUGH 4

Current Management Actions

The current management actions described in "The Alternatives" chapter for the foredune and dune complex have multiple impacts on visitor experience. Ongoing facility upgrades in the park have negligible to minor, short-term, adverse impacts on visitor experience from the temporary loss of access to these facilities and the visual intrusions that are introduced into the park during construction/renovation. Such upgrades also have negligible to minor, long-term, beneficial impacts on visitor experience from access to improved facilities and a reduction in future closings of these facilities for cyclic maintenance.

Current beach nourishment activities in the park have minor, short-term, adverse effects on visitor experience from the resulting beach closings during nourishment activities for safety reasons. Similarly, existing restoration and invasive vegetation management work in the park and work to limit anthropogenic influences has minor, short-term, adverse effects on visitor experience from beach, trail, and dune closings while the park performs this work; however, minor, long-term, beneficial impacts on visitor experience result from an improved viewshed and a reduction in future closings for cyclic maintenance work.

Education and public outreach efforts to visitors by the park have a negligible, long-term, beneficial impact on visitor experience by helping visitors understand the importance of limiting social trails and other anthropogenic influences in the park. This results in fewer trail closings for maintenance and restoration work.

Proposed Management Actions

The proposed management actions described in "The Alternatives" chapter for the foredune and dune complex would have multiple impacts on visitor experience.

The park proposes to expand its education and outreach efforts about nonnative invasive plant species to visitors. Such efforts would result in negligible, long-term, beneficial impacts on visitor experience from the resultant reduction in anthropogenic influences in the park.

To address the apparent anthropogenic influences in the park, the park is considering realigning some trails and is developing a mitigation plan for new/proposed access points. Such actions would result in minor, short-term, adverse impacts on visitor experience during trail closings related to the construction activities associated with such work. These actions would also result in minor, long-term, beneficial impacts on visitor experience from new approved access points, which would result in less trampling of park vegetation by visitors (and thus reduced restoration work, which would equate to fewer trail closings for visitors.

Cumulative Impacts. Proposed construction by the park and surrounding areas and property owners, like the development projects proposed under Phase II of the Marquette Plan (IDNR *et al.* 2005), would have negligible to minor, short- and long-term, adverse impacts due to areas of the park being closed during construction, and from the visual intrusions that construction and construction equipment would introduce into the park, and the visual intrusion that new development would introduce to the natural viewshed of visitors in the park and surrounding areas. The Northern Indiana Commuter Transportation District (the South Shore Railroad), which currently traverses the park, introduces a visual intrusion of track and rail cars into the park, having a minor, long-term, adverse effect on visitor experience.

Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under visitor experience as a result of proposed management actions would be minor, short- and long-term, and adverse and beneficial. Minor, short-term, and adverse cumulative impacts would result from trail closings during construction and restoration efforts, and from the visual intrusions (e.g., construction equipment) that would be introduced in to the park during such work. Minor, long-term, beneficial impacts would result from reductions in future trail closings from reduced erosion and increased preservation and from increased visitor awareness and knowledge about park resources.

Conclusion. Impacts on the foredune and dune complex in reaches 1 through 4 under visitor experience as a result of proposed management actions would be negligible, long-term, and beneficial from expanded education and outreach efforts about nonnative invasive plant species and the resultant reduction in anthropogenic influences. Realigning trails and developing a mitigation plan for new/proposed access points would result in minor, short-term, adverse impacts on visitor experience during trail closings related to the construction activities associated with such work. Such actions would also result in minor, long-term, beneficial impacts on visitor experience from new improved access points, which would result in less trampling of park vegetation by visitors (thus reduced restoration work, which would equate to fewer future trail closings for visitors). Construction in the park would have negligible to minor, short- and long-term, adverse impacts due to areas of the park being closed temporarily during construction, and from the visual intrusions that construction and construction equipment would introduce into the park, and the visual intrusion that new development would introduce to the natural viewshed of visitors in the park and surrounding areas. The Northern Indiana Commuter Transportation District (the South Shore Railroad), which currently traverses the park, introduces a visual intrusion of track and rail cars into the park, having a minor, long-term, adverse effect on visitor experience. Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under visitor experience as a result of proposed management actions would be minor, short- and long-term, and adverse and beneficial.

PARK OPERATIONS

METHODOLOGY

"Park operations" refers to the ability of NPS staff to protect and preserve the resources of Indiana Dunes National Lakeshore and to provide opportunities for enjoyable visitor experiences. Park operations also relates to the effectiveness and efficiency with which NPS staff is able to perform such tasks. National Park Service operational data were compiled from various sources, including park staff, and included data on park staffing, maintenance, budgets, visitor use, funding, and park resource needs to assess the impacts of each of the alternatives being analyzed in this plan.

Intensity Level Definitions

Intensity thresholds of park operations are defined as follows:

Negligible: The impact is barely detectable and/or would result in no noticeable or perceptible changes in current park operations, staffing, and/or funding requirements.

Minor: The impact is slight but detectable and/or would result in small but noticeable changes in current park operations, staffing, and/or funding requirements.

Moderate: The impact is readily apparent and would result in easily detectable changes in current park operations, staffing, and/or funding requirements.

Major: The impact is severely adverse or exceptionally beneficial, and/or would result in appreciable changes in current park operations, staffing, and/or funding requirements.

SHORELINE AND BEACH COMPLEX, REACHES 1 AND 2

Alternative A (No-action Alternative)

Under the no-action alternative, park operations would continue as described in the "Affected Environment" chapter. The park is considering realigning some trails, as well as developing a mitigation plan for new/proposed access points to limit the anthropogenic influences witnessed in the park. Such efforts would have a minor, short-term, adverse impact on park operations due to the staff hours required for developing, planning, and implementing such plans and construction; however, there would also be minor, long-term, beneficial impacts from improved natural conditions in the park and less vegetation trampling, subsequently resulting in fewer routine maintenance and upkeep demands on park staff.

Assuming current funding trends continue and staffing levels remain similar to present levels, the park would be unable to fully achieve desired conditions in program areas such as resource protection and visitor services. Actions associated with the no-action alternative would have minor, long-term, adverse impacts on park operations, but there would be no new impacts.

Cumulative Impacts. Under the no-action alternative, ongoing and planned facility upgrades would have negligible, short-term, adverse impacts on park operations due to the increased demands placed on park staff and operating budgets during planning and construction; however, these upgrades would result in negligible, long-term, beneficial impacts from the increased operating efficiencies that typically come with such upgrades. Similar impacts would result from proposed new development, like the picnic area near the Porter access point that the park is considering.

Resource protection and restoration projects, like the early detection and rapid response program and Invasive Plant Management Plan, would result in minor, long-term, beneficial impacts from increased resource protection and stability that would decrease demands on park operations for maintenance and restoration efforts. Such projects would also pose a minor, short-term, adverse impact on park operations due to the increased demands placed on park staff during planning, development, and implementation of such programs and plans. Monitoring the long-term effects and successfulness of such programs would pose a minor, long-term, adverse impact on park staff due to ongoing monitoring and documentation of each plan's success, adding to the park staff's existing workloads. Cyclic maintenance needs would decrease through restoring the park's native vegetation mix by decreasing the presence of nonnative species in the park, thus having a minor, long-term, beneficial impact on park operations due to the decreased maintenance workload.

Minor, long-term, adverse impacts would occur from the current beach nourishment program that includes sediment being accepted in reach 1 from upland sources. This places demands on park maintenance staff and operating budgets.

Special events, like the annual Super Boat Grand Prix, have minor, short-term, adverse impacts on park operations due to the event planning and execution that is required of park staff for such events.

Under the no-action alternative, the proposed plan would incrementally add negligible to minor short- and long-term, adverse and beneficial effects on park operations. When combined with other past, present, and reasonably foreseeable future actions, park operations would experience overall minor, short- and long-term, adverse and beneficial impacts.

Conclusion. The impact of taking no new actions in the park and continuing with the existing beach nourishment program that includes sediment being accepted in reach 1 from upland sources would be minor, long-term and adverse. Ongoing impacts would continue, even though the no-action alternative would have no new impacts on park operations. When considered with other past, present, and reasonably foreseeable future actions, the proposed plan would incrementally add to cumulative impacts on park operations, having an overall negligible, minor, short- and long-term, adverse and beneficial impact.

Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency)

Beach nourishment via upland sources with an annual frequency would require additional staff time to monitor and oversee this action, placing additional demands on park staff and budgets from added responsibilities related to planning, communication, and monitoring over approximately four months each year, resulting in minor, short-term, adverse effects on park operations. The actions associated with alternative B-1 would fulfill the sediment budget deficit calculated for reach 1, preventing additional erosion, and result in minor, short-term, beneficial impacts on park operations from reduced cyclic maintenance and restoration demands for up to a year. The shorelines downdrift of Mount Baldy would receive an infusion of sediment from these beach nourishment activities, impacting not only reach 1, but reach 2 and a portion of reach 3, as well, similarly reducing cyclic maintenance and restoration demands in those areas, resulting in minor, short-term, beneficial impacts on park operations from reduced maintenance workloads.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative B-1. Compared to the cumulative impacts expected under the no-action alternative, under alternative B-1, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor, long-term and beneficial under alternative B-1 due to the long-term reductions in workloads from reduced maintenance requirements. Cumulative impacts would also be minor, short-term, and adverse from short-term increases in staff workloads during the annual four-month period of nourishment activities. The actions associated with alternative B-1 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative B-1, there would be minor, short-term, adverse impacts on park operations from the increased demands that would be placed on park staff and budgets annually. There would also be minor, short-term, beneficial impacts from the resulting reductions in annual cyclic maintenance and restoration work that the park performs. The actions of this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term and adverse and beneficial, cumulative effects.

Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency)

Beach nourishment activities and impacts under alternative B-5 would be similar to those described above under alternative B-1, with a few differences. Under alternative B-5, beach nourishment would take place once every five years with nourishment activities taking approximately 18 months to complete. Moderate, long-term, adverse impacts would result from the additional demands that would be placed on park staff and budgets from increased responsibilities over an approximate 18-month period related to planning, communication, and monitoring; and minor, long-term, beneficial impacts would also result from reduced cyclic maintenance and restoration as a result of decreased erosion.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative B-5. Compared to the cumulative impacts expected under the no-action alternative, under alternative B-5, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term and adverse and beneficial from the increases in park staff workloads to implement the actions associated with alternative B-5 and from the reduced cyclic maintenance demands that would result over the five-year. The actions associated with alternative B-5 would provide a substantial incremental contribution to overall cumulative impacts.

Conclusion. Under alternative B-5, there would be moderate, long-term, adverse impacts from the additional planning, execution, and monitoring tasks that would tax employees and operating budgets for approximately 18 months every five years during beach nourishment activities; however, there would also be minor, long-term, beneficial impacts from reduced cyclic maintenance and restoration demands on park staff and park dollars over each five-year period. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term and adverse and beneficial, cumulative effects.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency)

Under alternative C-1, sediment would be dredged from an updrift location and placed on the beach in reach 1 over an approximate two-month period every year. These activities would place additional demands on park staff from added responsibilities related to planning, communication, and monitoring. This would result in minor, short-term, adverse effects on park operations. The actions associated with alternative C-1 would fulfill the sediment budget deficit calculated for reach 1, preventing additional erosion, and would result in minor, short-term, beneficial impacts on park operations from reduced cyclic maintenance and reduced restoration demands. The shorelines downdrift of Mount Baldy would receive an infusion of sediment from these beach nourishment activities, impacting not only reach 1, but reach 2 and a portion of reach 3, as well, similarly reducing cyclic maintenance and restoration demands in those areas, and having a minor, short-term, beneficial impact on park operations.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-1. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-1, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor, short- and long-term and adverse and beneficial from the decrease in annual maintenance demands to restore the park shoreline and from the increase in park staff workloads during the approximate two-month nourishment period each year. The actions associated with alternative C-1 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-1, there would be minor, short-term, adverse impacts on park operations from the increased demands that would be placed on staff and budgets each year during the approximate two-month period for beach nourishment activities each year. Under this alternative, there would also be minor, short-term, beneficial impacts park operations from the annual decrease in maintenance and restoration work required by park staff and of park budgets. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term and adverse and beneficial, cumulative effects.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

Beach nourishment activities and impacts on park operations under alternative C-5 would be similar to those described above under alternative C-1, with a few differences. Under alternative C-5, beach nourishment activities would take place every five years versus annually, and dredging activities would take approximately 10 months to complete every five years. Impacts under this alternative would be moderate, short-term and adverse from the additional demands that would be placed on park staff for planning, communication, and monitoring for an approximate 10-month period every five year; and minor, long-term and beneficial from the reduced cyclic maintenance and reduced restoration demands that would result from decreased erosion.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-5. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-5, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term and adverse and beneficial from the decrease in park staff workloads to address shoreline beach erosion every five years, and from the short-term increase in staff workloads and additional demands on park operating budgets for the nourishment that would occur over approximately 10 months every five years. The actions associated with alternative C-5 would provide a large incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-5, there would be moderate, short-term, adverse impacts on park operations from the demands the associated activities would place on park staff and budgets. There would also be minor, long-term, beneficial impacts from the resulting decrease in cyclic maintenance and restoration work performed in the park from the decrease in erosion. The actions of this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term, adverse and beneficial, cumulative effects.

Alternative D (Beach Nourishment via Permanent Bypass System)

Under alternative D, sediment would be transported via a permanent bypass system from updrift of the Michigan City Harbor to reach 1. This beach nourishment activity would place additional demands on park staff from added responsibilities related to planning, communication, construction, and monitoring. This would result in minor to moderate, short-term, adverse effects on park operations from the increase in staff workloads and the burden that would be placed on operating budgets. In addition, following construction, the permanent bypass system would require monitoring and routine maintenance, adding to existing park staff workloads, resulting in minor to moderate, long-term, adverse impacts on park operations. The actions associated with alternative D would fulfill the sediment budget deficit calculated for reach 1, preventing additional erosion, resulting in minor, short-term, beneficial impacts on park operations from reduced cyclic maintenance and reduced restoration demands. The shorelines downdrift of Mount Baldy would receive an infusion of sediment from the beach nourishment activities associated with alternative D, impacting not only reach 1, but reach 2 and a portion of reach 3, as well, similarly reducing cyclic maintenance and restoration demands in those areas.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative D. Compared to the cumulative impacts expected under the no-action alternative, under alternative D, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor, short- and long-term and adverse and beneficial from the reduction in annual maintenance demands of the shoreline related to erosion, and from the short-term increase in workloads and operating budget demands related to the nourishment activities. The actions associated with alternative D would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative D, there would be minor to moderate, short- and long-term, adverse impacts on park operations from the increase in park staff responsibilities and the increased demand placed on the park's operating budget to carry out the actions associated with alternative D beach nourishment, especially the routine monitoring and maintenance of the permanent bypass system for the life of this plan. There would also be minor, short-term, beneficial impacts under this alternative from the decrease in maintenance and restoration work that would result from the decrease in erosion that would occur from the annual beach nourishment activities. The actions of this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term and adverse and beneficial, cumulative effects.

Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency)

Under alternative E, the one-time construction of the submerged cobble berm would place additional workload demands on park staff during planning and construction, resulting in minor, short-term, adverse effects on park operations that would last only as long as construction. Over time, the submerged cobble berm would facilitate stabilization of the shoreline and reduce the quantity of sediment needed for beach nourishment along this reach, resulting in moderate, long-term, beneficial impacts on park operations from reduced operating budgets over the proposed plan's lifespan and beyond (from fewer nourishment activities being performed, improved erosion barriers, and fewer maintenance and restoration demands). The actions associated with alternative E would fulfill the sediment budget deficit calculated for reach 1, preventing additional erosion, resulting in moderate, long-term, beneficial impacts on park operations from reduced cyclic maintenance and restoration demands.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative E. Compared to the cumulative impacts expected under the no-action alternative, under alternative E, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be moderate, short- and long-term and adverse and beneficial from the reduced maintenance demands related to shoreline erosion over the life of the plan and from the temporary increase in park staff workloads during construction and placement of the submerged cobble berm. The actions associated with alternative E would provide a large incremental contribution to overall cumulative impacts, adverse in the short-term during construction, but beneficial over the long-term.

Conclusion. Under alternative E, there would be minor, short-term, adverse impacts on park operations during construction of the submerged cobble berm; and moderate, long-term, beneficial impacts on park operations from the reduced maintenance demands, reduced restoration demands, and lower operating budgets over the life of the plan. The actions associated with this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have moderate, short- and long-term and adverse and beneficial, cumulative effects.

Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline) – Preferred Alternative

Under alternative F, sediment would be dredged from an updrift location and coarse material and small native stones would be trucked from an upland source and placed on the beach in reach 1. These activities would place additional demands on park staff from added responsibilities related to planning, communication, and monitoring. This would result in minor, short-term, adverse effects on park operations. The actions associated with alternative F would fulfill the sediment budget deficit calculated for reach 1, preventing additional erosion, and would result in minor, short-term, beneficial impacts on park operations from reduced cyclic maintenance and reduced restoration demands. The shorelines downdrift of Mount Baldy would receive an infusion of sediment from these beach nourishment activities, impacting not only reach 1, but reach 2 and a portion of reach 3, as well, similarly reducing cyclic maintenance and restoration demands in those areas, and having a minor, short-term, beneficial impact on park operations.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative F. Compared to the cumulative impacts expected under the no-action alternative, under alternative F, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor, short- and long-term and adverse and beneficial from the decrease in annual maintenance demands to restore the park shoreline and from the increase in park staff workloads during the approximate two-month beach nourishment period each year. The actions associated with alternative F would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative F, there would be minor, short-term, adverse impacts on park operations from the increased demands that would be placed on staff and budgets each year during the approximate two-month period for beach nourishment activities each year. Under this alternative, there would also be minor, short-term, beneficial impacts park operations from the annual decrease in maintenance and restoration work required by park staff and of park budgets. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term and adverse and beneficial, cumulative effects.

SHORELINE AND BEACH COMPLEX, REACHES 3 AND 4

Alternative A (No-action Alternative)

Under the no-action alternative for reaches 3 and 4, park operations would continue to be characterized and impacted as explained under the no-action alternative above for reaches 1 and 2 and no new actions would be taken. Assuming current funding trends continue and staffing levels remained similar to present levels, the park would continue to be unable to fully achieve desired conditions in program areas such as resource protection, visitor services, and cyclic maintenance. The existing beach nourishment program would continue to impact the industrial warm-water discharge location, extending it east towards the park shoreline, impacting aquatic and terrestrial habitats, requiring increased dredging of the federal channel. Such actions would continue to add to the workloads of park staff and increase the operating budget requirements, resulting in minor, long-term, adverse effects on park operations.

In addition, excessive sedimentation around the intake would inhibit the use of the cold-water intake structure, resulting in potential emergency plant shutdowns, imposing additional workloads on park staff and increasing cyclic maintenance demands, resulting in minor, long-term, adverse effects on park operations. Actions associated with the no-action alternative would have minor, long-term, adverse impacts on park operations, but there would be no *new* impacts.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative for reaches 1 and 2 would also apply under alternative A in reaches 3 and 4. Under the no-action alternative, the proposed plan would incrementally add a negligible to minor, short- and long-term, beneficial and adverse effect on park operations. When combined with other past, present, and reasonably foreseeable future actions, park operations would experience overall minor, short- and long-term, adverse and beneficial impacts, but there would be no new impacts.

Conclusion. The impacts associated with taking no new actions in the park and continuing with the existing dredging that is performed for beach nourishment in reach 3 would be minor, long-term and adverse from the growing workload demands and maintenance operations that would be required. Ongoing impacts would continue, even though the no-action alternative would have no *new* impacts on park operations. When considered with other past, present, and reasonably foreseeable future actions, the proposed plan would incrementally add to cumulative impacts on park operations, having an overall negligible to minor, short- and long-term, adverse and beneficial impact.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency) – Preferred Alternative

Beach nourishment activities and impacts under the preferred alternative in reaches 3 and 4 would be similar to those described above under alternative C-1 for reaches 1 and 2. That is, moderate, short-term, adverse impacts from the added responsibilities that would be placed on park staff for planning, communication, and monitoring of the beach nourishment activities that would take place each year over an approximate two-month period; and minor, short-term, beneficial impacts from reduced cyclic maintenance and reduced restoration demands. The actions associated with alternative C-1 would fulfill the sediment budget deficit estimated for reach 3, preventing additional erosion, resulting in minor, short-term, beneficial impacts on park operations from reduced cyclic maintenance and restoration demands. The shoreline downdrift of Portage Lakefront and Riverwalk would receive an infusion of sediment from these beach nourishment activities, impacting reach 4, similarly reducing cyclic maintenance and restoration demands in that reach.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-1. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-1, these differences in relation to past, present, and reasonably foreseeable future projects would result in a small difference. Cumulative impacts would be minor, short- and long-term and adverse and beneficial from the short-term demands placed on park staff and park operating budgets during beach nourishment activities, and from the short-term, annual reduction in maintenance/restoration work. The actions associated with alternative C-1 would provide a small incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-1, there would be minor, short-term, adverse impacts on park operations from the additional demands that would be placed on park staff and park operating budgets to plan and carry out the required actions annually over an approximate two-month period. There would also be minor, short-term, beneficial impacts from the savings and decreased workloads that would result from the reduced maintenance and restoration demands that would result with less shoreline erosion. This alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor, short- and long-term and adverse and beneficial, cumulative effects.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency)

Beach nourishment activities and impacts on park operations under alternative C-5 would be similar to those described above under alternative C-1, with a few differences. Impacts under this alternative would be minor to moderate, short-term and adverse from the additional demands that would be placed on park staff for planning, communication, and monitoring; and minor, long-term and beneficial from the reduced cyclic maintenance and reduced restoration demands that would result from decreased shoreline erosion. Under alternative C-5, the dredging of sediment would take place every five years rather than annually, and dredging every five years would take approximately six months to complete, resulting in minor to moderate, short-term, adverse effects on park operations from the additional coordination and planning efforts park staff would need to perform to carry out the actions associated with this alternative.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative C-5. Compared to the cumulative impacts expected under the no-action alternative, under alternative C-5, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term and adverse and beneficial from the short-term demands on park staff and park operating budgets to carry out this work and the benefits that would be realized through decreased erosion and related maintenance/restoration work. The actions associated with alternative C-5 would provide a substantial incremental contribution to overall cumulative impacts.

Conclusion. Under alternative C-5, there would be minor to moderate, short-term, adverse impacts on park operations from the additional demands that would be placed on park staff and park budgets (for approximately six months every five years) to carry out the actions associated with this alternative. There would also be minor, long-term, beneficial impacts from the reductions in maintenance and restoration work as the actions associated with this alternative would decrease erosion in the park. The actions of this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term and adverse and beneficial, cumulative effects.

Alternative D (Beach Nourishment via Permanent Bypass System)

Under alternative D in reaches 3 and 4, the actions and impacts would be similar to those described above under alternative D for reaches 1 and 2. That is, minor, short-term, adverse effects on park operations from the increase in staff workloads and the burden that would be placed on operating budgets related to planning, communication, construction, and monitoring; and minor to moderate, long-term, adverse impacts from the monitoring and routine maintenance demands that would be placed on park staff to maintain the permanent bypass system. The actions associated with alternative D would fulfill the sediment budget deficit estimated for reach 3, preventing additional erosion, resulting in minor, short-term, beneficial impacts on park operations from reduced cyclic maintenance and reduced restoration demands. The shorelines downdrift of reach 3 would receive an infusion of sediment from the beach nourishment activities associated with this alternative, impacting reach 4, reducing cyclic maintenance and restoration demands in that area as well.

Cumulative Impacts. The same scenario of past, present, and reasonably foreseeable future actions described under the no-action alternative would also apply under alternative D. Compared to the cumulative impacts expected under the no-action alternative, under alternative D, these differences in relation to past, present, and reasonably foreseeable future projects would result in a large difference. Cumulative impacts would be minor to moderate, short- and long-term and adverse and beneficial from the short-term impacts on park staff workloads and operating budgets during the construction of the permanent bypass system and the long-term monitoring and maintenance of the permanent bypass system for the life of this plan. The actions associated with alternative D would provide a large incremental contribution to overall cumulative impacts.

Conclusion. Under alternative D, there would be minor to moderate, short- and long-term, adverse impacts on park operations from the additional staff time and operating dollars the associated beach nourishment actions would require, especially the routine monitoring and maintenance of the permanent bypass system for the life of this plan. There would also be a minor, short-term, beneficial impact from the associated erosion decrease and resultant decrease in required maintenance and restoration work by park staff (reducing operating budget drains). The actions of this alternative, when combined with other past, present, and reasonably foreseeable future actions, would have minor to moderate, short- and long-term and adverse and beneficial, cumulative effects.

FOREDUNE AND DUNE COMPLEX, REACHES 1 THROUGH 4

Current Management Actions

The current management actions described in "The Alternatives" chapter for the foredune and dune complex have multiple impacts on park operations.

Current actions to maintain/preserve/restore areas of the park from invasive vegetation and anthropogenic influences, like fencing off highly eroded areas, revegetating eroded areas with native seeds, and conducting visitor education and outreach efforts, have a negligible, short-term, adverse effect on park operations from the workloads these actions require of staff and from the drain on operating budgets. These actions also have a minor, long-term, beneficial impact on park operations from reduced future work requirements related to preserving the foredune and dune complex and reducing anthropogenic influences in the park.

Existing beach nourishment activities in reaches 1 and 3 have a minor, long-term, adverse effect on park operations from the ongoing commitment of park staff and dollars to these efforts.

Education and outreach activities have negligible, short-term, adverse impacts on park operations due to the resource commitments they require; however, such activities also have a negligible to minor, long-term, beneficial impact from reduced cyclic maintenance and invasive vegetation management work as anthropogenic influences are reduced.

Proposed Management Actions

The proposed management actions described in "The Alternatives" chapter for the foredune and dune complex would have multiple impacts on park operations.

The park proposes to expand its education and outreach efforts about the impacts of invasive nonnative plant species and anthropogenic influences in the park. This would have negligible, short-term, adverse impacts on park operations from the additional park resources this would require; however, there would also be negligible to minor, long-term, beneficial impacts from a better educated visitor population and a resultant decrease in anthropogenic influences in the park.

To address the apparent anthropogenic influences in the park, the park is considering realigning some trails and is developing a mitigation plan for new/proposed access points and trails to Crescent Dune. Such actions would result in minor, short-term, adverse impacts on park operations due to increased workloads and additional operating budget drains to plan, design, and construct/implement trail realignments. In addition, there would be minor, long-term, beneficial impacts on park operations from decreased demands on park staff for cyclic maintenance and restoration after trails were realigned. Development of a mitigation plan for new/proposed access points in reach 1 would have negligible, short- and long-term, adverse impacts on park operations from increased workloads to develop, implement, and monitor the success of such a plan; however, there would also be minor, long-term, beneficial impacts on park operations from reduced cyclic maintenance demands and reduced restoration requirements in this area over the long-term.

Cumulative Impacts. Proceeding with proposed developments, like a picnic area near the Porter access point or other development projects proposed in Phase II of the Marquette Plan (IDNR *et al.* 2005), would have minor, short-term, adverse impacts on park operations because of the additional work demands that would be placed on park staff to plan, develop, and construct such facilities. Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under park operations as a result of proposed management actions would be minor, short- and long-term, and adverse and beneficial from the short-term impacts on park staff workloads and operating budgets during planning, coordinating, and construction efforts related to the proposed management actions, and the long-term benefits of reduced future maintenance and restoration work.

Conclusion. Impacts on the foredune and dune complex in reaches 1 through 4 under park operations as a result of proposed management actions would be negligible, short-term, and adverse from expanding education and outreach efforts about the impacts of invasive nonnative plant species and anthropogenic influences in the park because such activities would require park staff time; however, there would also be negligible to minor, long-term, beneficial impacts from a better educated visitor population and a resultant decrease in anthropogenic influences in the park. Realigning some trails and developing a mitigation plan for new/proposed access points and trails to Crescent Dune would result in minor, short-term, adverse impacts on park operations due to increased workloads and additional operating budget drains to plan, design, and construct/ implement trail realignments. In addition, there would be minor, long-term, beneficial impacts on park operations from decreased demands on park staff for maintenance and restoration work after trails were realigned. Development of a mitigation plan for new/proposed access points in reach 1 would have negligible, short- and long-term, adverse impacts on park operations from increased workloads to develop, implement, and monitor the success of such a plan; however, there would also be minor, long-term, beneficial impacts on park operations from reduced cyclic maintenance demands and reduced restoration requirements over the long-term. Proceeding with proposed developments would have minor, short-term, adverse impacts on park operations because of the additional work demands that would be placed on park staff to plan, develop, and construct such facilities. Cumulative impacts on the foredune and dune complex in reaches 1 through 4 under park operations as a result of proposed management actions would be minor, short- and long-term, and adverse and beneficial.

SUMMARY OF IMPACT ANALYSIS

UNAVOIDABLE ADVERSE IMPACTS

The National Park Service is required to consider if the alternative actions of a proposed action would result in adverse impacts that would not be fully mitigated or avoided. A summary of unavoidable adverse impacts is presented below by reach and alternative.

Reaches 1 and 2

Alternative A (No-action Alternative). Under the no-action alternative, erosion of the shoreline would continue to occur in reach 1, threatening aquatic and terrestrial habitats and the sediment budget deficit would also continue, resulting in a deficit of material for foredune and dune formation. Taking no new actions in the park would result in continued erosion and destabilization of terrestrial habitat for plants and animals (thus adversely affecting threatened and endangered species and species of concern, as well) and would not improve the ability of the beach to withstand storm events. Short-term, adverse impacts on the natural soundscape would continue during current beach nourishment activities and during high-use times (e.g., summer weekends and holidays) under the no-action alternative. Visitors would continue to be adversely impacted by ongoing beach nourishment activities under the no-action alternative from the continued temporary beach closings and ongoing degradation of popular visitor amenities from shoreline erosion. Aquatic fauna would continue to be adversely affected under the no-action alternative from temporary displacement due to turbidity and the benthic fauna that would be smothered during placement of sediment; additionally, current nourishment activities would result in a disrupted environment which would continue to allow for the introduction/establishment of invasive and nonnative aquatic species. Under the no-action alternative, park operations would continue to be adversely impacted as a result of the ongoing workload demands and maintenance costs associated with existing beach nourishment activities and shoreline erosion.

Alternative B-1 (Beach Nourishment via Upland Sources, Annual Frequency). Under alternative B-1, adverse impacts on terrestrial habitat for plants and animals and on threatened and endangered species and species of concern would result from the introduction of invasive and nonnative plant species. The natural soundscape of the park would be adversely impacted on a temporary basis from the beach nourishment activities related to this alternative, including the trucks hauling sediment and the construction equipment grading the nourishment material along the beach. Native aquatic fauna would be adversely impacted by the actions associated with alternative B-1 as fish would be temporarily displaced due to turbidity and benthic fauna would be temporarily smothered during placement of sediment. Nourishment activities would result in a disrupted environment which would allow for the introduction and/or establishment of invasive and nonnative aquatic fauna species. Visitor experience would be affected adversely on a short-term basis from temporary beach and trail closings for nourishment activities in reach 1 and the visual intrusions that would be introduced in to the park (e.g., construction and grading equipment). The actions associated with alternative B-1 would have an adverse impact on park operations from the increased demands that would be placed on park staff and park budgets annually.

Alternative B-5 (Beach Nourishment via Upland Sources, Five-Year Frequency). The actions associated with alternative B-5 would be similar to those under alternative B-1 except actions would result in long-term, adverse impacts on aquatic and terrestrial habitat for plants and animals, threatened and endangered species and species of concern, the natural soundscape, visitor experience, and park operations as beach nourishment activities would last for approximately 18 months every five years. In addition, the placement area would have a larger footprint than under alternative B-1 due to the larger volume of material that would be placed. Under alternative B-5, fish life-cycles would be interrupted due to the longer duration (approximately 18 months every five years) for nourishment placement.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency). Under Alternative C-1, short-term, adverse impacts on the natural aquatic and terrestrial habitats for plants and animals, threatened and endangered species and species of concern, the park soundscape, visitor experience, and park operations would occur during the beach nourishment activities.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five-Year Frequency). Under Alternative C-5, there would be short-term, adverse impacts on terrestrial habitat for plants and animals, threatened and endangered species and species of concern, the natural soundscape of the park, aquatic fauna, visitor experience, and park operations. There would also be long-term adverse impacts on native aquatic fauna from the duration (approximately 10 months every five years) of placement activities (i.e., fish would be displaced for under a year but fish life cycles would be interrupted).

Alternative D (Beach Nourishment via Permanent Bypass System). Under alternative D, short-term, adverse impacts on the natural aquatic and terrestrial habitats for plants and animals, as well as the park soundscape, threatened and endangered species and species of concern, visitor experience, and park operations would occur during ongoing beach nourishment activities and during construction of the permanent bypass system. Long-term adverse impacts would also result from the actions associated with this alternative from the visual intrusion the small lift stations would introduce in to the park, and from the additional staff time and operating dollars the routine monitoring and maintenance of the permanent bypass system would require.

Alternative E (Submerged Cobble Berm and Beach Nourishment, Annual Frequency). Under alternative E, there would be short-term, adverse impacts on the natural aquatic and terrestrial habitats for plants and animals, the park soundscape, threatened and endangered species and species of concern, visitor experience, and park operations during the construction of the submerged cobble berm, as well as during beach nourishment activities. There would also be long-term adverse impacts from the visual intrusion the submerged cobble berm would introduce into the park and the safety concerns it would pose to boaters before dissipation (though the park would consider implementing mitigation measures to offset these safety concerns).

For the impacts mentioned above for reaches 1 and 2, the mitigation measures described in "The Alternatives" chapter, would help minimize, but not eliminate, these impacts.

Alternative F (Beach Nourishment, Annual Frequency with a Mix of Small Natural Stone at the Shoreline) – Preferred Alternative. Under the preferred alternative, there would be short-term, adverse impacts on the natural aquatic and terrestrial habitats for plants and animals, the park soundscape, threatened and endangered species and species of concern, visitor experience, and park operations during beach nourishment activities.

For the impacts mentioned above for reaches 1 and 2, the mitigation measures described in "The Alternatives" chapter, would help minimize, but not eliminate, these impacts.

Reaches 3 and 4

Alternative A (No-action Alternative). Under the no-action alternative, erosion of the shoreline would continue to occur in reach 3, threatening aquatic and terrestrial habitats and the sediment budget deficit would also continue, resulting in a deficit of material for foredune and dune formation. Taking no new actions in the park would result in continued erosion and destabilization of terrestrial habitat for plants and animals (thus adversely affecting threatened and endangered species and species of concern, as well) and would not improve the ability of the beach to withstand storm events. Short-term, adverse impacts on the natural soundscape would continue during current beach nourishment activities and during high-use times (e.g., summer weekends and holidays) under the no-action alternative. Visitors would continue to be adversely impacted by ongoing beach nourishment activities from the temporary beach closings and ongoing degradation of popular visitor amenities that result from shoreline erosion. Aquatic fauna would continue to be adversely affected under the no-action alternative from temporary displacement due to turbidity and the benthic fauna that would be smothered during placement of sediment; additionally, current nourishment activities would result in a disrupted environment which would continue to allow for the introduction and/or establishment of invasive and nonnative aquatic species. Park operations would continue to be adversely impacted from the ongoing workload demands and maintenance costs associated with existing beach nourishment activities and shoreline erosion.

Alternative C-1 (Beach Nourishment via Dredged Sources, Annual Frequency) – Preferred Alternative. Under alternative C-1, short-term, adverse impacts on the natural aquatic and terrestrial habitats for plants and animals, threatened and endangered species and species of concern, park soundscape, visitor experience, and park operations would occur during the beach nourishment activities.

Alternative C-5 (Beach Nourishment via Dredged Sources, Five Year Frequency). Under alternative C-5, there would be short-term, adverse impacts on terrestrial habitat for plants and animals, threatened and endangered species and species of concern, the natural soundscape of the park, aquatic fauna, visitor experience, and park operations. There would also be long-term adverse impacts on native aquatic fauna from the duration (approximately six months every five years) of placement activities (i.e., fish would be displaced for under a year but fish life cycles would be interrupted).

Alternative D (Beach Nourishment via Permanent Bypass System). Under alternative D, short-term, adverse impacts on the natural aquatic and terrestrial habitats for plants and animals, as well as the park soundscape, threatened and endangered species and species of concern, visitor experience, and park operations would occur during ongoing beach nourishment activities and during construction of the permanent bypass system. Long-term adverse impacts would also result from the actions associated with this alternative from the visual intrusion the small lift stations would introduce in to the park, from the additional staff time and operating dollars the routine monitoring and maintenance of the permanent bypass system would require.

For the impacts mentioned above for reaches 3 and 4, the mitigation measures listed in "The Alternatives" chapter would help minimize, but not eliminate, these impacts.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The National Park Service is required to consider if its actions involve an irreversible or irretrievable commitment of resources. A resource commitment is irreversible if it results in loss of resources that cannot be reversed, except perhaps in the extreme long term. Irreversible impacts involve use of and impacts on a non-renewable resource (or a resource renewable only over a long period of time) such that future options for use of that resource are limited. Irretrievable commitments of resources are actions that result in the loss of resources or the consumption of resources that are not renewable or recoverable for future use.

Reaches 1 through 4

For all alternatives presented in this plan / final EIS there would be an irreversible and irretrievable commitment of resources associated with shoreline restoration activities.

Energy Resources. Energy resources utilized for the proposed action alternatives would be irreversibly lost. These include petroleum-based products (such as gasoline and diesel) and electricity. During shoreline restoration activities, gasoline and diesel would be used for the operation of heavy equipment, barges, haul trucks, and maintenance vehicles. During terrestrial habitat restoration activities, gasoline would be used for the operation of private and government-owned vehicles. Consumption of these energy resources would not place a substantial demand on these resources or on the availability of them in the region. Therefore, no major impacts would occur.

Human Resources. The use of human resources for shoreline and terrestrial restoration activities would be an irretrievable loss, only in that it would preclude such personnel from engaging in other work activities. The use of human resources for the proposed action would also represent employment opportunities, and would be considered beneficial.

Soil Resources. The loss of soils and sediment due to erosion would be an irreversible commitment of resources under each of the action alternatives presented because it takes so long for soils to form. The proposed action alternatives would also lessen the erosive loss of soils compared to the loss that would occur under the no-action alternatives, and would be considered beneficial in the long-term.

RELATIONSHIP OF SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

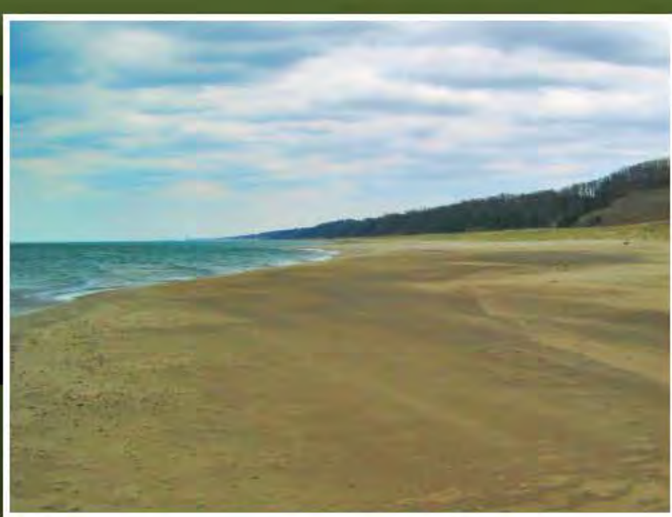
The National Park Service is required to consider the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. In doing so, the National Park Service considers the long-term impacts of its actions, and whether its actions involve tradeoffs between immediate use of resources and long-term productivity and sustainability of resources. This analysis examines whether the productivity of park resources would be traded for the immediate use of land.

Reaches 1 through 4

Under any of the action alternatives, the National Park Service would continue to manage the park and its shoreline to maintain ecological processes and native biological communities and to provide appropriate recreational and visitor use opportunities consistent with preservation of natural resources. The park's resources would continue to be protected in their current, relatively natural state to the greatest extent possible, and would maintain their long-term productivity. The primary short-term uses of the shoreline would continue to be recreational/visitor uses.

Under the no-action alternative, continuing adverse impacts on the shoreline and beach and aquatic and terrestrial habitats due to erosion would reduce the productivity of natural resources and processes in localized areas over time, resulting in a large effect on the park's long-term productivity as the erosion of the shoreline would threaten the integrity of natural resources.

Under the action alternatives presented in this plan / final EIS, these management actions would be implemented to restore coastal and natural processes and terrestrial habitat. Although there would be short- and long-term, adverse impacts that would result from the localized loss of aquatic fauna and terrestrial habitat, overall, no noticeable effect on the park's long-term productivity would result. Conversely, the actions proposed would restore the shoreline and would increase long-term productivity of the shoreline environment through natural processes.



CHAPTER 5
Consultation and Coordination

PUBLIC INVOLVEMENT, INCLUDING SCOPING

The National Park Service actively engaged the public, stakeholders, and government officials at the federal, state, and local levels throughout the planning process. Scoping is an early and open process for determining the scope of a proposed action or project and for identifying issues related to the project. During scoping, NPS staff provides an overview of the project, including the purpose and need, in addition to preliminary issues. The public is then asked to submit comments, concerns, and suggestions relating to the project and preliminary issues. The public had three primary avenues for participating during the development of this *Shoreline Restoration and Management Plan / Draft Environmental Impact Statement* (EIS): 1) attending a public meeting and providing comment verbally or by submitting a comment form; 2) responding to the information contained in park newsletters that contained information and updates about the project; and 3) providing comments via mail, and by electronic submission through the NPS planning website.

The public was notified of this Indiana Dunes National Lakeshore planning effort via: (1) a *Federal Register* notice of intent (volume 75, number 137) to prepare an EIS, dated July 19, 2010; (2) distribution of two newsletters for this effort in December 2010 and May 2011; and (3) a press release announcing a public comment opportunity, including public scoping meetings for the plan / draft EIS.

PUBLIC SCOPING MEETINGS

To kick off this plan / draft EIS, four public scoping meetings were held on December 8, 9, 15, and 16, 2010 in open house format. The meetings were announced by postcard, email, and a press release. The *Post-Tribune* published an article about the meetings on December 1, 2010. In total, 65 members of the public and three reporters attended the meetings. The meetings were held at the Northwest Indiana Regional Planning Commission in Portage, the Lubeznik Center for The Arts in Michigan City and at the Indiana Dunes National Lakeshore Visitor Center in Porter, Indiana. The purpose of the public scoping meetings was to:

- present basic information and data about the park
- identify the purpose and need of the project and its objectives
- describe the guidelines for restoration endpoints within the park
- discuss potential management strategies for approaching the proposed project
- outline the planning / National Environmental Policy Act of 1969, as amended (NEPA) process

The preliminary project area boundary and an array of shoreline restoration tools were also presented to the public by park staff during the public scoping meetings. After a brief introduction about the project, participants were invited to visit/tour informational stations set up around the meeting rooms and discuss the plan / draft EIS with NPS project team members. During the December meetings participants were offered comment cards and *Newsletter #1*.

During the meetings many members of the public expressed support for soft or natural shoreline restoration tools. The public's main concerns were protecting habitat, maintaining a natural viewshed, and not causing additional disruptions to sediment movement in the area. Other meeting attendees expressed support for hard or man-made shoreline restoration tools, citing the need for a long-term solution that would protect homes and public infrastructure along the shoreline. Shoreline restoration tools that were mentioned/ recommended by the public included sediment bypass systems and various approaches to dredging.

Several meeting participants discussed their understanding of sediment movement and their personal experiences related to sediment movement with members of the NPS project team. The unknown effects of climate change were also mentioned in relationship to extreme storm weather events, lake levels, and coastal processes.

Comment Cards, Offered During the December 2010 Public Scoping Meetings

Comment cards offered to the public at the public scoping meetings asked participants to respond to the following questions:

- What are the most important shoreline restoration and management issues?
- What are the most important ecological issues along the shoreline and foredunes?
- Which shoreline restoration and management tools should the National Park Service consider?
- Which shoreline restoration and management tools should the National Park service not consider?
- Do you have any other comments or concerns about the plan / draft EIS the National Park service should consider?

See the "Public Scoping Meetings" section of the "Consultation and Coordination" chapter for a summary of the comments received.

Newsletter #1, Issued During December 2010 Public Scoping Meetings

Newsletter #1 was issued during the public scoping meetings in December 2010 and invited readers to comment in person, via mail, or online using the NPS website. *Newsletter #1* provided the following information:

- the purpose and need for the plan / draft EIS
- the special characteristics of Indiana Dunes National Lakeshore
- a description of the ecological issues along the Indiana Dunes National Lakeshore shoreline
- a description of the process of shoreline restoration and management planning
- an update on the planning process

The public comment period for the proposed project was from December 8, 2010, through February 7, 2011. A total of 24 public comments were submitted during the comment period either in comment form, letter, electronic mail, or website format (http://parkplanning.nps.gov/indu).

After summarizing the discussions at the public meetings and reviewing the comments submitted the NPS project team developed a list of issues of concern presented by the public. Recreational use of the park was important to many commenters. The ecological issues receiving the most comment included general habitat, water quality, threatened and endangered species and species of concern, and the impacts of visitors on the environment. Most commenters indicated valuing the preservation and restoration of the shoreline not only for recreational uses but also for the ecological and biological diversity of the area.

Newsletter #2, Issued during Summer 2011

Newsletter #2 was issued in May 2011 and recapped the information presented at the public scoping meetings held in December 2010. This newsletter summarized the comments received during the previous public scoping efforts, and also:

- described shoreline sediment movement and shoreline restoration tools
- updated readers on the planning process and the planning considerations that had been identified to date
- invited readers to participate in the planning efforts

Using input received from the public and considering the probable environmental consequences and costs of the alternatives, the NPS project team developed a list of alternatives, including a preliminary preferred alternative, and analyzed the affected environment and impacts associated with each. The results of this analysis were published in the plan / draft EIS, which was distributed for public review. The mailing list for the plan / draft EIS included over 300 individuals and groups.

COOPERATING AGENCIES

In accordance with NEPA (42 *United States Code* [USC] 4321-4370h) and the CEQ regulations (sections 1501.5 and 1501.6),the National Park Service invited the U.S. Army Corps of Engineers (COE), Chicago District, and the State of Indiana to be cooperating agencies for the EIS process. Both agencies were requested to provide information in their areas of technical expertise and to review and comment on the plan / draft EIS. The State of Indiana declined to participate as a cooperating agency.

The COE replied to the park's invitation and indicated they would participate as a cooperating agency with the National Park Service in the development of the plan / draft EIS. A memorandum of understanding between the National Park Service and the COE was executed on August 17, 2010. This agreement defined the roles and responsibilities of each agency relative to the plan / draft EIS.

CONSULTATION AND COORDINATION TO DATE WITH OTHER AGENCIES, OFFICES, AND TRIBES

Appendix B: Initial Agency Consultation contains a copy of correspondence related to this plan / draft EIS.

FEDERAL AGENCIES

U.S. Fish and Wildlife Service, Section 7 Consultation

The Endangered Species Act of 1973, as amended, requires in section 7(a)(2) that each federal agency, in consultation with the Secretary of the Interior, ensure that any action the agency authorizes, funds, or carries out will not jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat.

The National Park Service contacted the U.S. Fish and Wildlife Service (FWS) in a letter dated July 2011. The letter advised the U.S. Fish and Wildlife Service of the NPS planning process for this plan / draft EIS and requested concurrence with a determination that the proposed project may affect, but is not likely to adversely affect endangered, threatened, and candidate species nor adversely modify piping plover critical habitat.

The U.S. Fish and Wildlife Service responded to the park's request in a letter dated August 8, 2011, and concurred with the NPS determination for special status species and critical habitat found within the proposed project area (which encompasses the shoreline of Lake Michigan between Michigan City in LaPorte County on the east, and the U.S. Steel breakwater in Gary in Lake County on the west). The entire Porter County shoreline of Lake Michigan is also included in the project area.

STATE AGENCIES

Section 106 Consultation

Agencies that have direct or indirect oversight of historic properties are required under Section 106 of the National Historic Preservation Act, as amended (NHPA) (16 USC 470, *et seq.*), to take into account the effect of any undertaking on properties listed in or eligible for listing in the National Register of Historic Places.

In a letter dated April 28, 2011, the National Park Service contacted the Indiana state historic preservation officer (SHPO). The letter advised the Indiana SHPO about the start of the NPS planning process for this plan / draft EIS and requested SHPO's involvement in the planning process, soliciting input on the issues and concerns to be addressed in the plan / draft EIS. A letter dated May 23, 2011, from James A. Glass, Deputy SHPO, stated that the Indiana SHPO had no specific comments at that time, but looked forward to receiving additional information about the project as it became available. The Indiana SHPO will have an opportunity to review and comment on this plan / draft EIS. This document provides the basis for NPS' determination of "no adverse effect" on historic properties. Assuming the state of Indiana concurs with the NPS' determination of "no adverse effect," it will transmit its formal concurrence in writing and that letter will be published in the plan / final EIS.

Coastal Zone Consistency Determination

Federal agency activities in or affecting Indiana's coastal zone must comply with Section 307 of the Coastal Zone Management Act (CZMA) and implementing regulations, which require that such federal activities be conducted in a manner consistent, to the extent practicable, with Indiana's Coastal Management Program. The park is included in Indiana's coastal zone. The National Park Service has determined that the preferred alternative is consistent with Indiana's coastal management program, including the state's goals and policies for this area.

This plan / draft EIS provides the substantive basis for NPS' consistency determination. The National Park Service has submitted this document to the Indiana Department of Natural Resources (IDNR) for its concurrence.

Such a consistency determination and the agency's concurrence comply with the requirements of the CZMA. Assuming the state of Indiana concurs with the NPS' consistency determination it will transmit its formal concurrence in writing and that letter will be published in the plan / final EIS.

AMERICAN INDIAN TRIBES

The National Park Service recognizes that indigenous peoples may have traditional interests and rights in lands now under NPS management. Native American concerns about park projects are sought through Native American consultation. The need for government-to-government Native American consultations stems from the historic power of Congress to make treaties with American Indian tribes as sovereign nations. Consultation with American Indians and other Native Americans, such as Native Hawaiians and Alaska Natives, is required by various federal laws, executive orders, regulations, and policies. They are needed, for example, to comply with Section 106 of the NHPA. Implementing regulations of the CEQ also call for Native American consultation.

The National Park Service contacted eight federally recognized tribes and one tribe not federally recognized through letters dated February 24, 2011. The NPS letter provided the tribes a brief background and description of the project area and invited the tribes to participate in the development of the plan / draft EIS. To date, no tribes have responded. The tribes contacted are listed below.

- Citizen Potawatomi Nation
- Forest County Potawatomi
- Hannahville Indian Community of Wisconsin Potawatomi Indians of Michigan
- Match-e-be-nash-she-wish Band of Potawatomi Indians
- Miami Tribe of Oklahoma
- Nottawaseppi Huron Band of Potawatomi Indians
- Pokagon Band of Potawatomi Indians
- Prairie Band of Potawatomi Nation
- Miami Nation of Indians of the State of Indiana (not federally recognized)

LIST OF RECIPIENTS OF PLAN / SHORELINE RESTORATION AND MANAGEMENT PLAN / FINAL ENVIRONMENTAL IMPACT STATEMENT

The National Park Service made the plan / final EIS available to the agencies and organizations listed below in either electronic format or hard copy. Copies of the document are available for review at Indiana Dunes National Lakeshore and at http://parkplanning.nps.gov/indu. A limited number of hardcopies of the document are also available upon request by interested individuals.

FEDERAL DEPARTMENTS AND AGENCIES

COE, Chicago District
U.S. Fish and Wildlife Service
U.S. House of Representatives
Office of Senator Richard Lugar
U.S. Environmental Protection Agency, Great Lakes National Program Office
U.S. Geological Survey Lake Michigan Ecological Research Station

STATE AGENCIES

Indiana Department of Environmental Management
Indiana Department of Natural Resources
Indiana Geological Survey
Indiana Dunes State Park
Lake Michigan Coastal Program
State of Indiana (Governor)

COUNTY AND LOCAL AGENCIES

Beverly Shores Town Council
Burns Harbor Town Council
Chesterton Town Council
City of Chicago (Mayor)
City of Gary (Mayor)
City of Gary (Department of Environmental Affairs)
City of Gary (Park Department)
City of Lake Station (Mayor)
City of Michigan City (Mayor)
City of Portage (Mayor)
Dune Acres Town Council
Lake County Commission
Lake County Council
53 Lake County Parks and Recreation Department
LaPorte County Board of Commissioners
LaPorte County Council
LaPorte County Parks and Recreation
Michigan City Parks and Recreation Department
Michigan City Port Authority
Northwest Indiana Forum
Northwest Indiana Regional Development Authority
Northwest Indiana Regional Planning Commission
Ogden Dunes Town Council
Pines Town Council
Port of Indiana, Burns International Harbor
Porter County Board of Commissioners
Porter County Commission
Porter County Council
Ports of Indiana
Town of Beverly Shores
Town of Chesterton
Town of Ogden Dunes

ORGANIZATIONS AND BUSINESSES

Association of Beverly Shores Residents
Arcelor Mittal
Chicago Wilderness
Coastal and Hydraulics Lab
Eppley Institute for Parks and Public Lands
Friends of the Indiana Dunes
Indiana-American Water Company, Inc.
Dunes Learning Center
Indiana Landmarks
Indiana University
Izaak Walton League
Little Calumet River Basin Development Commission

National Parks and Conservation Association
NiSource Corporate Services Company
Purdue University Calumet
Save the Dunes Conservation Fund
Save the Dunes Council
Shirley Heinze Land Trust
The Nature Conservancy
The Trust for Public Land
U.S. Steel, Midwest Division
U.S. Steel, Gary Works
Gary Chamber of Commerce
Greater Portage Chamber of Commerce
Greater Valparaiso Chamber of Commerce
Indiana Dunes Tourism
Porter County Convention and Visitor Commission
South Shore Convention and Visitors Authority
Lakeshore Chamber of Commerce
Chesterton Duneland Chamber of Commerce
LaPorte County Convention and Visitors Bureau
Michigan City Area Chamber of Commerce

AMERICAN INDIAN TRIBES AND AGENCIES

Citizen Potawatomi Nation
Forest County Potawatomi
Hannahville Indian Community of Wisconsin Potawatomi Indians of Michigan
Match-e-be-nash-she-wish Band of Potawatomi Indians
Miami Tribe of Oklahoma
Nottawaseppi Huron Band of Potawatomi Indians
Pokagon Band of Potawatomi Indians
Prairie Band of Potawatomi Nation
Miami Nation of Indians of the State of Indiana (not Federally recognized)

PUBLIC REVIEW OF PLAN / DRAFT EIS

Availability of the plan / draft EIS was announced through local newspapers, postings on the park website, and on the Planning Environment and Public Comment (PEPC) website, and announcements in the Federal Register.

During the 60-day comment period hardcopies of the plan / draft EIS were available for review at the headquarters of the Indiana Dunes National Lakeshore located at 1100 North Mineral Springs Road, Porter, Indiana, 46304; at the Park's Visitor Center located at 1215 North State Road 49, Porter, Indiana 46304; at the Beverly Shores Town Hall; the Michigan City Public Library; and on the internet as indicated below. Copies of the plan / draft EIS were also sent to applicable federal, state, and local agencies for review and comment.

An electronic copy of the document could be found on the NPS PEPC website at http://parkplanning.nps.gov. This site provides access to current plans, environmental analyses, and related documents available for public review. The document was posted on PEPC under the Midwest Region, Indiana Dunes National Lakeshore. The plan / draft EIS could also be accessed through the park's home page at: http://www.nps.gov/indu. The public was encouraged to submit comments on the plan / draft EIS during the 60-day comment period.

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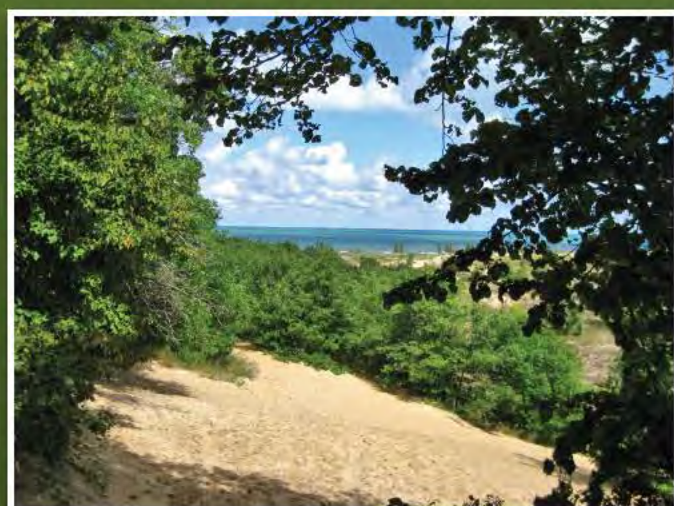

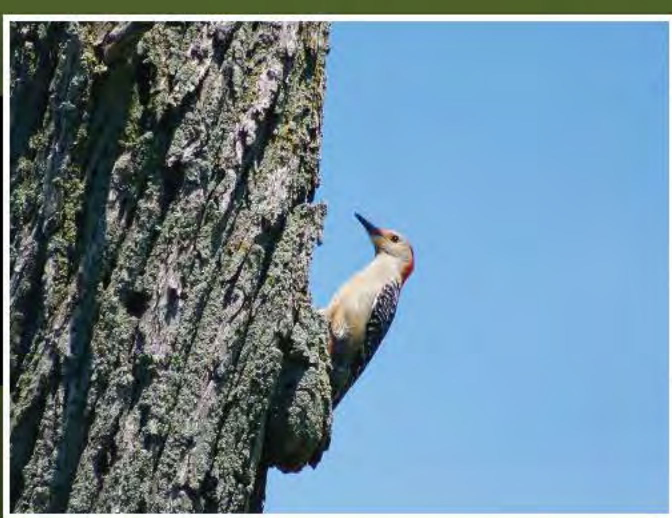

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INDEX

GLOSSARY

A–weighted decibels(dBA) – An expression of the relative loudness of sounds in air as perceived by the human ear.

accretion – The process of growth or enlargement by a gradual buildup of sediment.

accretion area – A portion of the shoreline at which coastal sediments return to the visible portion of the beach, gradually increasing its size.

adaptive management – A systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. Its most effective form, "active" adaptive management employs management programs that are designed to experimentally compare selected policies or practices, by implementing management actions explicitly designed to generate information useful for evaluating alternative hypotheses about the system being managed.

aeolian transport – Movement and weathering of sand particles behind and parallel to the shoreline caused by wind. It is the first process of coastal dune formation.

anadromous – Migratory fishes which spend most of their lives in the sea and migrate upstream to fresh water to breed.

anoxia – A total decrease in oxygen levels.

anthropogenic effects – Effects which are caused by or attributed to humans. As used within this document, they are factors that cause stress in natural systems.

attributes – Any living or nonliving feature or process of the environment that can be measured or estimated and that provide insights into the state of the ecosystem. The term indicator is reserved for a subset of attributes that is particularly information–rich in the sense that their values are somehow indicative of the quality, health, or integrity of the larger ecological system to which they belong.

benthic – Living at, in, or associated with structures on the bottom of a body of water.

berm – A mound of earth or sand formed into a narrow shelf, path, or ledge which is typically located at the top or bottom of a slope.

biomass – Represents the entire community of living biological organisms in a given area or ecosystem at a certain point in time.

biome – A complex biotic community extending over a large geographic area and characterized by distinctive plant and animal species and the prevailing climate.

blowout – A sandy depression in a sand dune ecosystem caused by the removal of sediment by wind. This usually occurs when a patch of protective vegetation is lost.

boreal relic – A group of plants with characteristics similar to those found in northern Boreal forests that are remnants of historical ecological conditions and are unlike the current surrounding vegetation.

calcareous – Mostly or partly composed of calcium carbonate, or containing lime and being chalky.

clay sill – A tabular igneous intrusion that parallels the bedding of the surrounding sedimentary or metamorphic rock.

chart datum –The lowest astronomically predictable tide level, this level is used as a reference level on nautical charts; the maps of the lake and lakebed.

demersal – Living near, deposited on, or sinking to the bottom of a body of water.

dreissenid – A small, aquatic bivalve mollusk which attaches to stones or any other hard surface in freshwater.

dune succession – The process of a dune changing from inorganic and unpopulated, to a dune that has organic components and is highly populated. It is the evolution of a dune beginning with its development as a foredune close to the beach with little established vegetation, to the final stage as a wooded dune farther back from the beach.

dynamically stable – A dynamic equilibrium where the shoreline shape is relatively constant over a period of months or years. Although the shoreline shape is constant, in response to varying winds, waves and currents, the position of the shoreline at any particular time will vary about the average.

ecological restoration – Highlights the recovery of pre–disturbance biotic communities and native species composition. It attempts to return an ecosystem or natural community to historic, pre–disturbance conditions. In its broadest sense, ecological restoration is the process of assisting the recovery of a degraded, damaged, or severely altered ecosystem. Example: Remove invasive species from an otherwise intact habitat, such as a panne.

ecological preservation – The act or process of applying the measures necessary to sustain the existing form, function, and integrity of an ecosystem or natural area. Preservation focuses on protection and avoids degradation altogether. Example: Early Detection and Rapid Response.

ecological indicator – Measurable attributes of the environment that provide insights regarding (1) the functional status of one or more key ecosystem processes, (2) the status of ecosystem properties that are clearly related to these ecosystem processes, and/or (3) the capacity of ecosystem processes or properties to resist or recover from natural disturbances and/or anthropogenic stressors. In the context of ecosystem health, key ecosystem processes and properties are those that are most closely associated with the capacity of the ecosystem to maintain its characteristic structural and functional attributes over time (including natural variability).

embayment – A bay or a formation resembling a bay or the formation of a bay.

embryonic dunes – Dry beach features resembling miniature dunes, formed by wind–deposited sand on and leeward of objects that decrease wind velocity, such as driftwood and vegetation.

endemic – Flora, fauna, or other distinctive characteristics that are exclusively found in a defined geographic location.

entrainment – The process by which sediment from the surface is incorporated into a fluid flow, such as air or water, as part of the process of erosion.

eroded parabolic dune – A U–shaped dune with elongated arms formed as a result of a blowout area.

fen – A type of wetland characterized by neutral or alkaline water chemistry with high dissolved mineral levels but few other plant nutrients and fed by mineral–rich surface water or groundwater.

fillet beach – A beach formed by accretion processes, or retained by a coastal protection structure.

foraging – The act of searching for and exploiting food resources.

foredune – Low, very active dunes that run parallel to the shoreline of a large lake or ocean and are stabilized by vegetation. They are often the smallest and youngest dunes along a coast and are located just shorewards of embryonic dunes.

hardened structures – Navigational and industrial structures as well as other materials installed to armor the shoreline, including revetment walls and sheet piling.

high floristic quality – A quantitative indicator of good ecosystem health based on the Floristic Quality Assessment. Individual, native species are ranked with a Coefficient of Conservatism based on their likelihood to occur in a landscape relatively unaltered from those of pre–settlement times. A higher ranking indicates a lower likelihood of that species appearing in a given setting due to its high ecological requirements, so if many species of high floristic quality are present, the ecosystem is more likely to be healthy and meet those ecological requirements.

homogenous – Having the same composition throughout; of uniform make up.

infaunal – Aquatic animals that live in the substrate of a body of water, especially in a soft sea bottom.

interstitial space – An empty space or gap between spaces full of structure or matter.

lacustrine – Of or relating to lakes.

lake substrate – The earthy material that exists at the bottom of a lake, such as dirt, rocks, sand, or gravel.

lakebed down–cutting – The gradual erosion of cohesive soil, such as clay or glacial till, from a shoreline due to wave interaction.

lee side – The side of something that is sheltered from the wind.

leeward – On or toward the side sheltered from the wind; downwind.

littoral – Of or pertaining to the shore of a large body of water.

longshore transport – The sediment movement with a direction parallel to the shoreline; alongshore.

low water datum –The base elevation for Lake Michigan, used as a reference level for measurement of water depth.

macroinvertebrate – An invertebrate that is large enough to be seen without a microscope.

maintenance dredging – The routine removal of accumulated sediment from the bottom of a waterway to ensure continued ease of navigation or the holding capacity of reservoirs or lakes.

marl – Lake sediments which have been hardened over time to create a calcium carbonate or lime–rich mud or mudstone which contains variable amounts of clays and aragonite, or crystalized calcium carbonate.

meiofauna – Small, aquatic invertebrates that live on or within the substrate on the bottom of a large body of water.

mesic – A type of habitat with a moderate or well–balanced supply of moisture.

mesophytic – Grown in or adapted to a moderately moist environment.

mitigation measures – Steps taken to moderate, or reduce the severity of, a quality or condition in force or intensity.

net transport rate – The net amount of sediment movement in the predominant direction; expressed in cubic yards per year.

oligotrophic – A lake with low primary biological productivity as a result of low nutrient content. These lakes have very clear water, high drinking–water quality, ample oxygen, and support a wide variety of fish species due relatively low levels of algae.

open–water placement – Placing of dredged sediment in an open–water section of the lake, away from the dredging location. This sediment must be clean and meet set federal guidelines to qualify for open–water placement.

overflight – An air flight over a specific area, country or territory.

pannes – A series of shallow ponds located among sand dunes.

pelagic – Occurring in or over open water and away from the bottom.

phytoplankton – Photosynthesizing microscopic organisms which inhabit the upper sunlit layer of most water bodies. If they are present in a large quantity, they can make the water body appear green.

piscivorous – Fish–eating.

pseudofeces – Wastes released by filter–feeding bivalve mollusks that are comprised of suspended particles which have been rejected as unsuitable for food.

recolonization – The reestablishment of flora and fauna in an ecologically disturbed area. Vegetative recolonization begins with hardy species such as grasses and progresses with more sensitive species as the area recovers environmentally.

refugia – Any local environments that have escaped regional ecological change and therefore provide habitats for threatened or endangered species.

revetment – Sloping structures placed on banks or cliffs in such a way as to absorb the energy of incoming water

sandscape – A landscape dominated by sand.

sediment budget – A costal management tool used to balance the sediment volumes entering or exiting a particular section of coast. This can be used to predict changes to the form and structure of a coastline over time.

sediment deficit – A net loss of sediment from a coastline, based on the sediment budget. This can be remedied by physically adding sediment to a coastline to combat widespread erosion.

seedbank – A stockpile of seeds which acts as a source for planting in case seed reserves elsewhere are destroyed.

sheet piling – A cylindrical or flat member of wood, steel, concrete, etc., often tapered or pointed at the lower end, hammered vertically into soil to form part of a foundation or retaining wall. They are driven side by side to retain earth, etc., or to prevent seepage into an excavation.

social trails – A path developed by erosion caused by footfall. The path usually represents the shortest or most easily navigated route between an origin and destination. The width and amount of erosion of the line represents the amount of demand.

soundscapes – An atmosphere or environment created by or with sound.

spawning – To deposit eggs or sperm directly into the water, as fishes.

swash zone – A turbulent layer of water that washes up on the beach after an incoming wave has broken. The swash action can move beach material up and down on the beach, which results in the cross–shore sediment exchange.

taxa – Taxonomic categories, as a species or genus.

tectonic activity – Movement associated with the earth's structural features.

terrestrial fauna – The aggregate of animals that inhabit dry land.

thermoregulatory – Tending to maintain a body at a particular temperature whatever its environmental temperature.

trophic level – The position an organism occupies on the food chain.

viewshed – An area of land, water, or other environmental element that is visible to the human eye from a fixed vantage point.

zooplankton – Heterotrophic (sometimes detritivorous) plankton. Plankton are organisms drifting in oceans, seas, and bodies of fresh water.

APPENDIX A: ENABLING LEGISLATION

PUBLIC LAW 89-761

PUBLIC LAW 94-549

PUBLIC LAW 96-612

PUBLIC LAW 99-583

PUBLIC LAW 102-430

COMPILATION OF LEGISLATION

Public Law 89-761

November 5, 1966
[S. 360]

AN ACT

To provide for the establishment of the Indiana Dunes National Lakeshore, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to preserve for the educational, inspirational, and recreational use of the public certain portions of the Indiana dunes and other areas of scenic, scientific, and historic interest and recreational value in the State of Indiana, the Secretary of the Interior is authorized to establish and administer the Indiana Dunes National Lakeshore (hereinafter referred to as the "lakeshore") in accordance with the provisions of this Act. The lakeshore shall comprise the area within the boundaries delineated on a map identified as "A Proposed Indiana Dunes National Lakeshore", dated September 1966, and bearing the number "LNPNE–1008–ID", which map is on file and available for public inspection in the office of the Director of the National Park Service, Department of the Interior.

Indiana Dunes National Seashore. Establishment.

Sec. 2. (a) Within the boundaries of the lakeshore the Secretary of the Interior (hereinafter referred to as the "Secretary") is authorized to acquire lands, waters, and other property, or any interest therein, by donation, purchase with donated or appropriated funds, exchange, or otherwise. The Indiana Dunes State Park may be acquired only by donation of the State of Indiana, and the Secretary is hereby directed to negotiate with the State for the acquisition of said park. In exercising his authority to acquire property by exchange for the purposes of this Act, the Secretary may accept title to non-Federal property located within the area described in section 1 of this Act and convey to the grantor of such property any federally owned property under the jurisdiction of the Secretary which he classifies as suitable for exchange or other disposal within the State of Indiana or Illinois. Properties so exchanged shall be approximately equal in fair market value, as determined by the Secretary who may, in his discretion, base his determination on an independent appraisal obtained by him: *Provided*, That the Secretary may accept cash from or pay cash to the grantor in such an exchange in order to equalize the values of the properties exchanged.

Acquisition of lands, authorization.

(b) In exercising his authority to acquire property under subsection (a) of this section, the Secretary may enter into contracts requiring the expenditure, when appropriated, of funds authorized to be appropriated by section 10 of this Act, but the liability of the United States under any such contract shall be contingent on the appropriation of funds sufficient to fulfill the obligations thereby incurred.

Contracts.

Sec. 3. As soon as practicable after the effective date of this Act and following the acquisition by the Secretary of an acreage within the boundaries of the area described in section 1 of this Act which in his opinion is efficiently administrable for the purposes of this Act, he shall establish the Indiana Dunes National Lakeshore by publication of notice thereof in the Federal Register. Following such establishment and subject to the limitations and conditions prescribed in section 1 hereof, the Secretary may continue to acquire lands and interests in lands for the lakeshore.

Boundaries. Publication in Federal Register.

Sec. 4. (a) The Secretary's authority to acquire property by condemnation shall be suspended with respect to all improved property located within the boundaries of the lakeshore during all times when an appropriate zoning agency shall have in force and applicable to such property a duly adopted, valid zoning ordinance approved by the Secretary in accordance with the provisions of section 5 of this Act.

Condemned property.

"Improved property."

(b) The term "improved property", whenever used in this Act, shall mean a detached, one-family dwelling, construction of which was begun before January 4, 1965, together with so much of the land on which the dwelling is situated, the said land being in the same ownership as the dwelling, as the Secretary shall designate to be reasonably necessary for the enjoyment of the dwelling for the sole purpose of noncommercial residential use, together with any structures accessory to the dwelling which are situated on the lands so designated. The amount of land so designated shall in every case be not more than three acres in area, and in making such designation the Secretary shall take into account the manner of noncommercial residential use in which the dwelling and land have customarily been enjoyed: *Provided*, That the Secretary may exclude from the land so designated any beach or waters, together with so much of the land adjoining such beach or waters, as he may deem necessary for public access thereto or public use thereof.

Standards.

SEC. 5. (a) As soon as practicable after enactment of this Act, the Secretary shall issue regulations specifying standards for approval by him of zoning ordinances for the purposes of sections 4 and 6 of this Act. The Secretary may issue amended regulations specifying standards for approval by him of zoning ordinances whenever he shall consider such amended regulations to be desirable due to changed or unforeseen conditions. The Secretary shall approve any zoning ordinance and any amendment to any approved zoning ordinance submitted to him which conforms to the standards contained in the regulations in effect at the time of adoption of such ordinance or amendment by the zoning agency. Such approval shall not be withdrawn or revoked, by issuance of any amended regulations after the date of such approval, for so long as such ordinance or amendment remains in effect as approved.

(b) The standards specified in such regulations and amended regulations for approval of any zoning ordinance or zoning ordinance amendment shall contribute to the effect of (1) prohibiting the commercial and industrial use, other than any commercial or industrial use which is permitted by the Secretary, of all property covered by the ordinance within the boundaries of the lakeshore; and (2) promoting the preservation and development, in accordance with the purposes of this Act, of the area covered by the ordinance within the lakeshore by means of acreage, frontage, and setback requirements and other provisions which may be required by such regulations to be included in a zoning ordinance consistent with the laws of the State of Indiana.

(c) No zoning ordinance or amendment thereof shall be approved by the Secretary which (1) contains any provision which he may consider adverse to the preservation and development, in accordance with the purposes of this Act, of the area comprising the lakeshore; or (2) fails to have the effect of providing that the Secretary shall receive notice of any variance granted under and any exception made to the application of such ordinance or amendment.

(d) If any improved property, with respect to which the Secretary's authority to acquire by condemnation has been suspended according to the provisions of this Act, is made the subject of a variance under or exception to such zoning ordinance, or is subjected to any use, which variance, exception, or use fails to conform to or is inconsistent with any applicable standard contained in regulations issued pursuant to this section and in effect at the time of passage of such ordinance, the Secretary may, in his discretion, terminate the suspension of his authority to acquire such improved property by condemnation.

(e) The Secretary shall furnish to any party in interest requesting the same a certificate indicating, with respect to any property located within the lakeshore as to which the Secretary's authority to acquire such property by condemnation has been suspended in accordance with provisions of this Act, that such authority has been so suspended and the reasons therefor.

Owners of improved property, retention rights.

SEC. 6. (a) Any owner or owners of improved property on the date of its acquisition by the Secretary may, as a condition to such acquisition, retain the right of use and occupancy of the improved property for noncommercial residential purposes for a term of twenty-five years, or for such lesser time as the said owner or owners may elect at the time of acquisition by the Secretary. Where any such owner retains a right of use and occupancy as herein provided, such right during its existence may be conveyed or leased for noncommercial residential purposes. The Secretary shall pay to the owner the fair market value of the property on the date of such acquisition, less the fair market value on such date of the right retained by the owner.

Termination right of Secretary.

(b) The Secretary shall have authority to terminate any right of use and occupancy retained as provided in subsection (a) of this section at any time after the date upon which any use occurs with respect to such property which fails to conform or is in any manner opposed to or inconsistent with the applicable standards contained in regulations issued pursuant to section 5 of this Act and which is in effect on said date: *Provided*, That no use which is in conformity with the provisions of a zoning ordinance approved in accordance with said section 5 and applicable to such property shall be held to fail to conform or be opposed to or inconsistent with any such standard. In the event the Secretary terminates a right of use and occupancy under this subsection, he shall pay to the owner of the right so terminated an amount equal to the fair market value of the portion of said right which remained unexpired on the date of termination.

Administration.

SEC. 7. (a) In the administration of the lakeshore the Secretary may utilize such statutory authorities relating to areas of the national park system and such statutory authority otherwise available to him for the conservation and management of natural resources as he deems appropriate to carry out the purposes of this Act.

(b) In order that the lakeshore shall be permanently preserved in its present state, no development or plan for the convenience of visitors shall be undertaken therein which would be incompatible with the preservation of the unique flora and fauna or the physiographic conditions now prevailing or with the preservation of such historic sites and structures as the Secretary may designate: *Provided*, That the Secretary may provide for the public enjoyment and understanding of the unique natural, historic, and scientific features within the lakeshore by establishing such trails, observation points, and exhibits and providing such services as he may deem desirable for such public enjoyment and understanding: *Provided further*, That the Secretary may develop for appropriate public uses such portions of the lakeshore as he deems especially adaptable for such uses.

Indiana Dunes National Lakeshore Advisory Commission.

SEC. 8. (a) There is hereby established an Indiana Dunes National Lakeshore Advisory Commission. Said Commission shall terminate ten years after the date of establishment of the national lakeshore pursuant to this Act.

Membership.

(b) The Commission shall be composed of seven members, each appointed for a term of two years by the Secretary, as follows: (1) one member who is a year-round resident of Porter County to be appointed from recommendations made by the commissioners of such county; (2) one member who is a year-round resident of the town of Beverly Shores to be appointed from the recommendations made by the board of trustees of such town; (3) one member who is a year-round resident of the towns of Porter, Dune Acres, Portage, Pines, Chesterton, Ogden Dunes, or the village of Tremont, such member to be appointed from recommendations made by the boards of trustees or the trustee of the affected town or township; (4) one member who is a year-round resident of the city of Michigan City to be appointed from recommendations made by such city; (5) two members to be appointed from recommendations made by the Governor of the State of Indiana; and (6) one member to be designated by the Secretary.

(c) The Secretary shall designate one member to be Chairman. Any vacancy in the Commission shall be filled in the same manner in which the original appointment was made.

(d) A member of the Commission shall serve without compensation as such. The Secretary is authorized to pay the expense reasonably incurred by the Commission in carrying out its responsibilities under this Act on vouchers signed by the Chairman.

(e) The Secretary or his designee shall, from time to time, consult with the Commission with respect to matters relating to the development of the Indiana Dunes National Lakeshore and with respect to the provisions of sections 4, 5, and 6 of this Act.

Crimes and offenses, jurisdiction.

SEC. 9. Nothing in this Act shall deprive the State of Indiana or any political subdivision thereof of its civil and criminal jurisdiction over persons found, acts performed, and offenses committed within the boundaries of the Indiana Dunes National Lakeshore or of its right to tax persons, corporations, franchises, or other non-Federal property on lands included therein.

Appropriation.

SEC. 10. There are hereby authorized to be appropriated not more than $27,900,000 for the acquisition of land and interests in land pursuant to this Act.

Approved November 5, 1966.

Public Law 89-762

November 5, 1966
[S. 1496]

AN ACT

To repeal section 3342 of title 5, United States Code, relating to the prohibition of employee details from the field service to the departmental service, and for other purposes.

Federal employee details.
Ante, p. 425.
Repeal.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That (a) section 3342 of title 5, United States Code, relating to the prohibition of details of employees from the field service to the departmental service, is hereby repealed.

(b) The table of contents of subchapter III of chapter 33 of title 5, United States Code, is amended by striking out—

"3342. Details; field to departmental service prohibited."

SEC. 2. Section 525 of the Act of June 17, 1930 (46 Stat. 741; 19 U.S.C. 1525), which provides exception to the Department of the Treasury from the restrictions imposed by section 3342 of title 5, United States Code, is hereby repealed.

Approved November 5, 1966.

Public Law 94-549
94th Congress

An Act

To amend the Act establishing the Indiana Dunes National Lakeshore to provide for the expansion of the lakeshore, and for other purposes.

Oct. 18, 1976
[H.R. 11455]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act entitled "An Act to provide for the establishment of the Indiana Dunes National Lakeshore, and for other purposes", approved November 5, 1966 (80 Stat. 1309), as amended (16 U.S.C. 460u), is further amended as follows:

Indiana Dunes National Lakeshore. Expansion.

(1) The last sentence of the first section of such Act is amended by striking out "'A Proposed Indiana Dunes National Lakeshore', dated September 1966, and bearing the number 'LNPNE-1008-ID'" and inserting in lieu thereof "'Boundary Map, Indiana Dunes National Lakeshore', dated September 1976 and bearing the number '626-91007'".

(2) Section 3 of such Act is amended by inserting the following at the end of the first sentence: "By no later than October 1, 1977, the Secretary shall publish in the Federal Register a detailed description of the boundaries of the lakeshore and shall from time to time so publish any additional boundary changes as may occur.".

16 USC 460u-2. Publication in Federal Register.

(3)(a) Subsection 4(a) of such Act is repealed, subsection 4(b) is redesignated as section 4, and the following sentence is added to new section 4: "All rights of use and occupancy shall be subject to such terms and conditions as the Secretary deems appropriate to assure the use of such property in accordance with the purposes of this Act.".

Repeal. 16 USC 460u-3.

(b) The first sentence of section 4 of such Act is amended by inserting immediately after "was begun before" the following: "February 1, 1973, or, in the case of improved property located within the boundaries delineated on a map identified as 'A Proposed Indiana Dunes National Lakeshore', dated September 1966, and bearing the number 'LNPNE-1008-ID', which map is on file and available for public inspection in the Office of the Director of the National Park Service, Department of the Interior, before".

(4)(a) Section 6(a) of such Act is amended by revising the first sentence thereof to read as follows: "Except for owners of property within the area on the map referred to in the first section of this Act as area II-B, any owner or owners, having attained the age of majority, of improved property on the date of its acquisition by the Secretary may, as a condition to such acquisition, retain the rights of use and occupancy of the improved property for noncommercial residential purposes for a term of twenty years, or for such lesser term as the owner or owners may elect at the time of acquisition by the Secretary".

16 USC 460u-5. Right of use and occupancy.

(b) Section 6(b) of such Act is amended to read as follows:

"(b) Upon his determination that the property, or any portion thereof, has ceased to be used in accordance with the applicable terms and conditions, the Secretary may terminate a right of use and occupancy. Nonpayment of property taxes, validly assessed, on any retained right of use and occupancy shall also be grounds for termination of such right by the Secretary. In the event the Secretary terminates a right of use and occupancy under this subsection he shall

Termination.

pay to the owners of the retained right so terminated an amount equal to the fair market value of the portion of said right which remained unexpired on the date of termination. With respect to any right of use and occupancy in existence on the effective date of this sentence, standards for retention of such rights in effect at the time such rights were reserved shall constitute the terms and conditions referred to in section 4.".

16 USC 460u-3. Indiana Dunes National Lakeshore Advisory Commission, membership. 16 USC 460u-7.

(5) Section 8(b) of such Act is amended (a) by striking out "seven members" and inserting in lieu thereof "eleven members", and (b) by striking out "and" immediately after "State of Indiana;", and (c) by striking out "Portage," immediately after "Dune Acres.", and (d) by inserting immediately after "designated by the Secretary" the following: "; (7) one member who is a year-round resident of the city of Gary to be appointed from recommendations made by the mayor of such city; (8) one member to be appointed from recommendations made by a regional planning agency established under the authority of the laws of the State of Indiana and composed of representatives of local and county governments in northwestern Indiana; (9) one member who is a year-round resident of the city of Portage to be appointed from recommendations made by the mayor of such city; and (10) one member who holds a reservation of use and occupancy and is a year-round resident within the lakeshore to be designated by the Secretary.".

(6) Section 8 of such Act is further amended by inserting the following new subsection (f):

Coal-fired powerplant, Porter County, Ind.

"(f) The Advisory Commission is authorized to assist with the identification of economically and environmentally acceptable areas, outside of the boundaries of the lakeshore, for the handling and disposal of industrial solid wastes produced by the coal-fired powerplant in Porter County, Indiana, section 21, township 37 north, range 6 west.".

Appropriation authorization. 16 USC 460u-9.
General management plan, submittal to congressional committees.

(7) Section 10 of such Act is amended to read as follows: "The Secretary may not expend more than $60,812,100 from the Land and Water Conservation Fund for the acquisition of lands and interests in lands nor more than $8,500,000 for development. By October 1, 1979, the Secretary shall develop and transmit to the Committees on Interior and Insular Affairs of the United States Congress a general management plan detailing the development of the national lakeshore consistent with the preservation objectives of this Act, indicating:

"(1) the facilities needed to accommodate the health, safety, and recreation needs of the visiting public;

"(2) the location and estimated costs of all facilities, together with a review of the consistency of the master plan with State, areawide, and local governmental development plans;

"(3) the projected need for any additional facilities within the national lakeshore; and

"(4) specific opportunities for citizen participation in the planning and development of proposed facilities and in the implementation of the general management plan generally.".

(8) Such Act is amended by adding at the end thereof the following:

Rights-of-way or easements. 16 USC 460u-10.

"SEC. 11. Nothing in this Act shall diminish any existing (as of March 1, 1975) rights-of-way or easements which are necessary for high voltage electrical transmission, pipelines, water mains, or line-haul railroad operations and maintenance.

"SEC. 12. (a) Nothing in the Act shall be construed as prohibiting any otherwise legal cooling, process, or surface drainage into the part of the Little Calumet River located within the lakeshore: *Provided*, That this subsection shall not affect nor in any way limit the Secretary's authority and responsibility to protect park resources. Little Calumet River. 16 USC 460u-11.

"(b) The authorization of lands to be added to the lakeshore by the Ninety-fourth Congress and the administration of such lands as part of the lakeshore shall in and of itself in no way operate to render more restrictive the application of Federal, State, or local air and water pollution standards to the uses of property outside the boundaries of the lakeshore, nor shall it be construed to augment the control of water and air pollution sources in the State of Indiana beyond that required pursuant to applicable Federal, State, or local law.

"SEC. 13. The Secretary shall acquire the area on the map referred to in the first section of this Act as area III-B within two years from the effective date of this section only if such area can be acquired for not more than $800,000, exclusive of administrative costs of acquisition, as adjusted by the Consumer Price Index: *Provided*, That the Secretary may not acquire such area by any means after two years from the effective date of this section. Land acquisition. 16 USC 460u-12.

"SEC. 14. The Secretary may acquire that portion of area I-C which is shaded on the map referred to in the first section of this Act only with the consent of the owner unless the present owner attempts to sell or otherwise dispose of such area. 16 USC 460u-13.

"SEC. 15. Within one year after the date of the enactment of this section, the Secretary shall submit, in writing, to the Committees on Interior and Insular Affairs and to the Committees on Appropriations of the United States Congress a detailed plan which shall indicate— Plan, submittal to congressional committees. 16 USC 460u-14.

"(1) the lands which he has previously acquired by purchase, donation, exchange, or transfer for administration for the purpose of the lakeshore; and

"(2) the annual acquisition program (including the level of funding) which he recommends for the ensuing five fiscal years.

"SEC. 16. The Secretary may acquire only such interest in the right-of-way designated 'Crossing A' on map numbered 626-91007 as he determines to be necessary to assure public access to the banks of the Little Calumet River within fifty feet north and south of the centerline of said river. "Crossing A" right-of-way. 16 USC 460u-15.

"SEC. 17. The Secretary shall enter into a cooperative agreement with the landowner of those lands north of the Little Calumet River between the Penn Central Railroad bridge within area II-E and 'Crossing A' within area IV-C. Such agreement shall provide that any roadway constructed by the landowner south of United States Route 12 within such vicinity shall include grading, landscaping, and plantings of vegetation designed to prevent soil erosion and to minimize the aural and visual impacts of said construction, and of traffic on such roadway, as perceived from the Little Calumet River. 16 USC 460u-16.

"SEC. 18. (a) The Secretary may not acquire such lands within the western section of area I-E, as designated on map numbered 626-91007, which have been used for solid waste disposal until he has received a commitment, in accordance with a plan acceptable to him, to reclaim such lands at no expense to the Federal Government. 16 USC 460u-17.

"(b) With respect to the property identified as area I-E on map numbered 626-91007, the Secretary may enter into a cooperative agreement whereby the State of Indiana or any political subdivision thereof may undertake to develop, manage, and interpret such area in a manner consistent with the purposes of this Act.

Study, transmittal to congressional committees. 16 USC 460u-18.

"SEC. 19. By July 1, 1977, the Secretary shall prepare and transmit to the Committees on Interior and Insular Affairs of the United States Congress a study of areas III-A, III-C, and II-A, as designated on map numbered 626-91007. The Secretary shall make reasonable provision for the timely participation of the State of Indiana, local public officials, affected property owners, and the general public in the formulation of said study, including, but not limited to, the opportunity to testify at a public hearing. The record of such hearing shall accompany said study. With respect to areas III-A and III-C, the study shall (a) address the desirability of acquisition of any or all of the area from the standpoint of resource management, protection, and public access; (b) develop alternatives for the control of beach erosion if desirable, including recommendations, if control is necessary, of assessing the costs of such control against those agencies responsible for such erosion; (c) consider and propose options to guarantee public access to and use of the beach area, including the location of necessary facilities for transportation, health, and safety; (d) detail the recreational potential of the area and all available alternatives for achieving such potential; (e) review the environmental impact upon the lakeshore resulting from the potential development and improvement of said areas; and (f) assess the cost to the United States from both the acquisition of said areas together with the potential savings from the retention of rights of use and occupancy and from the retention of the boundaries of the lakeshore, as designated on map numbered 626-91007, including the costs of additional administrative responsibilities necessary for the management of the lakeshore, including the maintenance of public services in the town of Beverly Shores, Indiana. With respect to area II-A, the Secretary shall study and report concerning the following objectives: (a) preservation of the remaining dunes, wetlands, native vegetation, and animal life within the area; (b) preservation and restoration of the watersheds of Cowles Bog and its associated wetlands; (c) appropriate public access to and use of lands within the area; (d) protection of the area and the adjacent lakeshore from degradation caused by all forms of construction, pollution, or other adverse impacts including, but not limited to, the discharge of wastes and any excessive subsurface migration of water; and (e) the economic consequences to the utility and its customers of acquisition of such area.

Land acquisition, notice to congressional committees; publication in Federal Register. 16 USC 460u-19.

"SEC. 20. After notifying the Committees on Interior and Insular Affairs of the United States Congress, in writing, of his intentions to do so and of the reasons therefor, the Secretary may, if he finds that such lands would make a significant contribution to the purposes for which the lakeshore was established, accept title to any lands, or interests in lands, located outside the present boundaries of the lakeshore but contiguous thereto or to lands acquired under this section, such lands the State of Indiana or its political subdivisions may acquire and offer to donate to the United States or which any private person, organization, or public or private corporation may offer to donate to the United States and he shall administer such lands as a part of the lakeshore after publishing notice to that effect in the Federal Register.".

(9) Section 5 of such Act is hereby repealed, and the succeeding sections are redesignated accordingly. Repeal. 16 USC 460u-4.

Approved October 18, 1976.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 94-818 (Comm. on Interior and Insular Affairs).
SENATE REPORT No. 94-1189 (Comm. on Interior and Insular Affairs).
CONGRESSIONAL RECORD, Vol. 122 (1976):
Feb. 17, considered and passed House.
Sept. 24, considered and passed Senate, amended.
Sept. 29, House agreed to Senate amendment.
WEEKLY COMPILATION OF PRESIDENTIAL DOCUMENTS, Vol. 12, No. 43:
Oct. 19, Presidential statement.

Public Law 96-612
96th Congress

An Act

To provide for the establishment of the Indiana Dunes National Lakeshore, and for other purposes.

Dec. 28, 1980
[S. 2261]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act entitled "An Act to provide for the establishment of the Indiana Dunes National Lakeshore, and for other purposes", approved November 5, 1966 (80 Stat. 1309), as amended (16 U.S.C. 460u), is further amended as follows:

Indiana Dunes National Lakeshore, amendment.

(1) A new section is added at the end thereof to read as follows:

"Sec. 20. (a) The Indiana Dunes National Lakeshore is hereby dedicated to the memory of Paul H. Douglas in grateful recognition of his leadership in the effort to protect, preserve, and enhance the natural, scientific, historic, and recreational value of the lakeshore for the use, enjoyment, and edification of present and future generations.

Paul H. Douglas, dedication. 16 USC 460u-20.

"(b) To further accomplish the purposes of subsection (a) of this section, the Secretary of the Interior shall designate the west unit of the lakeshore as the 'Paul H. Douglas Ecological and Recreational Unit' and shall, subject to appropriations being granted, design and construct a suitable structure or designate an existing structure within the lakeshore to be known as the 'Paul H. Douglas Center for Environmental Education' which shall provide facilities designed primarily to familiarize students and other visitors with, among other things: (1) the natural history of the lakeshore and its association with the natural history of the Great Lakes region; (2) the evolution of human activities in the area; and (3) the historical features which led to the establishment of the lakeshore by the Congress of the United States.

"(c) To inform the public of the contributions of Paul H. Douglas to the creation of the lakeshore, the Secretary of the Interior shall provide such signs, markers, maps, interpretive materials, literature, and programs as he deems appropriate.".

(2) Section 1 of the Act is amended by changing "September 1976 and bearing the number 626-91007" to "December 1980, and bearing the number 626-91014".

16 USC 460u.

(3) Section 2(a) of the Act is amended by adding the following new sentence at the end thereof: "The Secretary is expressly authorized to acquire by donation, purchase with donated or appropriated funds, or exchange, lands or interests therein which are owned for school or educational purposes by a State or a political subdivision thereof.".

Land acquisition. 16 USC 460u-1.

(4) Section 2(b) of the Act is amended by changing the phrase "section 10" to "section 9".

(5) In the first sentence of section 4 of the Act, preceding the word "February" insert: "January 1, 1981 or, in the case of improved property located within the boundaries delineated on a map identified as 'Boundary Map, Indiana Dunes National

16 USC 460u-3.

Lakeshore', dated September 1976 and bearing the number 626-91007, before".

Use and occupancy rights. 16 USC 460u-5.

(6) The first sentence of section 5(a) of the Act is amended to read as follows: "Except for owners of improved property within the area on the map referred to in the first section of this Act as area II-B, any owner or owners of record of improved property may retain a right of use and occupancy of said improved property for noncommercial residential purposes for a term (1) ending on his or her death or the death of his or her spouse, whichever occurs last, or (2) for a fixed term not to extend beyond September 30, 2010, or such lesser term as the owner or owners may elect at the time of acquisition by the Secretary: *Provided,* That the retention of a retained right under clause numbered (1) shall only be available to homeowners of record as of October 1, 1980, who have attained the age of majority as of that date and make a bona fide written offer not later than October 1, 1985, to sell to the Secretary.".

(7) Section 5 of the Act is amended by adding a new subsection (c) as follows:

Use and occupancy rights, extension.

"(c) With respect to improved properties acquired prior to the enactment of this subsection and upon which a valid existing right of use and occupancy has been reserved for a term of not more than twenty years, the Secretary may, in his discretion, extend the term of such retained right for a period of not more than nine years upon receipt of payment prior to September 30, 1983, from the holder of the retained right. The amount of such payment shall be equivalent to the amount discounted from the purchase price paid by the Secretary for the identical period of time under the terms of the original sale adjusted by a general index adopted by the Secretary reflecting overall value trends within Indiana Dunes National Lakeshore between the time of the original sale and the time of the retained right of extension offered by this subsection.".

16 USC 460u-7.

(8) Section 7(a) of the Act is amended by changing "ten years after the date of establishment of the national lakeshore pursuant to this Act" to "on September 30, 1985".

(9) Section 7(b) of the Act is amended as follows:

(A) by striking out "eleven members" and inserting in lieu thereof "thirteen members";

(B) by striking out "one member who is a year-round resident" in clause (4) and inserting in lieu thereof "two members who are year-round residents"; and

(C) by striking out "one member who is a year-round resident" in clause (7) and inserting in lieu thereof "two members who are year-round residents".

Appropriation authorization. 16 USC 460u-9.

(10) Section 9 of the Act is amended as follows:

(A) in the first sentence, change "$9,440,000 for development" to "$11,000,000 for development: *Provided,* That not more than $500,000 of said amount may be appropriated for the development of the Paul H. Douglas Environmental Education Center authorized pursuant to section 20 of this Act."; and

Ante, p. 3575.

(B) at the end thereof, add a new paragraph as follows: "In addition to any sums heretofore authorized for the acquisition of lands and interests in lands pursuant to the provisions of this Act, there are further authorized to be appropriated an additional $3,120,000.".

(11) A new section 21 is added to the Act as follows:

"SEC. 21. (a) The Secretary in consultation with the Secretary of Transportation, shall conduct a study of various modes of public access into and within the lakeshore which are consistent with the preservation of the lakeshore and conservation of energy by encouraging the use of transportation modes other than personal motor vehicles.

Public access, study. 16 USC 460u-21.

"(b) In carrying out the study, the Secretary shall utilize to the greatest extent practicable the resources and facilities of the organizations designated as clearinghouses under title IV of the Intergovernmental Cooperation Act of 1968 as implemented by Office of Management and Budget Circular A-95, and which have comprehensive planning responsibilities in the regions where the lakeshore is located, as well as any other agencies or organizations which the Secretary may designate. The Secretary shall make provision for timely and substantive consultations with the appropriate agencies of the States of Indiana and Illinois, local elected officials, and the general public in the formulation and implementation of the study.

Clearinghouse resources and facilities. 42 USC 4231.

"(c) The study shall address the adequacy of access facilities for members of the public who desire to visit and enjoy the lakeshore. Consideration shall be given to alternatives for alleviating the dependence on automobile transportation. The study of public transportation facilities shall cover the distance from cities of thirty-five thousand population or more within fifty miles of the lakeshore.

"(d) The study shall include proposals deemed necessary to assure equitable visitor access and public enjoyment by all segments of the population, including those who are physically or economically disadvantaged. It shall provide for retention of the natural, scenic, and historic values for which the lakeshore was established, and shall propose plans and alternatives for the protection and maintenance of these values as they relate to transportation improvements.

"(e) The study shall examine proposals for the renovation and preservation of a portion of the existing South Shore Railroad passenger car fleet. The study shall consider the historic value of the existing rolling stock and its role in transporting visitors into and within the lakeshore.

"(f) The study shall present alternative plans to improve, construct, and extend access roads, public transportation, and bicycle and pedestrian trails. It shall include cost estimates of all plans considered in this study, and shall discuss existing and proposed sources of funding for the implementation of the recommended plan alternatives.

"(g) The study shall be completed and presented to the Congress within two complete fiscal years from the effective date of this provision.

Submittal to Congress.

"(h) Effective October 1, 1981, there is hereby authorized to be appropriated not to exceed $200,000 for this study.".

Appropriation authorization.

(12) A new section 22 is added to the Act as follows:

"SEC. 22. In exercising his authority to acquire property under this Act, the Secretary shall give prompt and careful consideration to any offer made by an individual owning property within the lakeshore to sell such property, if such individual notifies the Secretary in writing that the continued ownership of such property is causing, or would result in, undue hardship.".

Land acquisition, owner's hardship. 16 USC 460u-22.

(13) A new section 23 is added to the Act as follows:

"SEC. 23. (a) The Secretary may acquire only such interest in that portion of area VII-A which is described in subsection (b) as the Secretary determines is necessary to assure public access over said portion of area VII-A.

Public access. 16 USC 460u-23.

"(b) The portion of area VII-A, as designated on the map referred to in section 1, to which subsection (a) applies is a parcel of land bounded—

"(1) on the east by a line three hundred feet east of the electrical transmission line crossing area VII-A on January 1, 1979;

"(2) on the west by a line fifty feet west of such electrical transmission line; and

"(3) on the north and south by the northern and southern boundaries, respectively, of area VII-A.

"(c) Area VII-A includes the bed of the railroad tracks forming the northern and northwestern boundaries of this area and extends to the northern edge of the bed of the railroad tracks forming the southern boundaries of this area.

"(d) Area I-D includes the bed of the railroad tracks along the northern boundary of this area.

"(e) The area designated as area VII-C on the map referred to in section 1 does not include approximately 1.3 acres of land on which the Linde Air Products plant is situated, nor does it include approximately 1 acre of land on which the Old Union Station building and the adjacent REA building are situated. Except as provided in the foregoing sentence, area VII-C extends to, but does not include, the beds of the railroad tracks forming the northern and southern boundaries of such area."

Effective date. 16 USC 460u note.

SEC. 2. Authorizations of moneys to be appropriated under this Act shall be effective on October 1, 1981. Notwithstanding any other provision of this Act, authority to enter into contracts, to incur obligations, or to make payments under this Act shall be effective only to the extent, and in such amounts, as are provided in advance in appropriation Acts.

Approved December 28, 1980.

LEGISLATIVE HISTORY:

SENATE REPORT No. 96-1005 (Comm. on Energy and Natural Resources).
CONGRESSIONAL RECORD, Vol. 126 (1980):
Sept. 30, considered and passed Senate.
Dec. 11, considered and passed House, amended.
Dec. 12, Senate agreed to House amendments.

Public Law 99-583
99th Congress

An Act

Oct. 29, 1986
[H.R. 4037]

Relating to the Indiana Dunes National Lakeshore, and for other purposes.

National parks, monuments, etc.
Housing.
Real property.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. INDIANA DUNES NATIONAL LAKESHORE.

(a) Boundary Changes.—The first section of the Act entitled "An Act to provide for the establishment of the Indiana Dunes National Lakeshore, and for other purposes", approved November 5, 1966 (16 U.S.C. 460u), is amended by striking out "December 1980, and bearing the number 626-91014" and inserting in lieu thereof "October 1986, and numbered 626-80,033-B".

16 USC 460u-3.

(b) Definition of Improved Property.—Section 4 of such Act is amended by striking out the first sentence and substituting "As used in this Act, the term 'improved property' means a detached, one-family dwelling which meets each of the following criteria:

"(1) The construction of the dwelling began before the date (shown in the table contained in this section) corresponding to the appropriate map.

"(2) The property is located within the boundaries delineated on the map described in such table which corresponds to such date.

"(3) The property is not located within the boundaries of any other map referred to in such table which bears an earlier date.

The term 'appropriate map', means a map identified as 'Boundary Map—Indiana Dunes National Lakeshore' (or 'A Proposed Indiana Dunes National Lakeshore' in the case of a dwelling the construction of which was begun before January 4, 1965) which is dated and numbered as provided in the following table.

Property Within Boundaries of Map	Construction Began Before
Dated October 1986, #626-80,033-B	February 1, 1986
Dated December 1980, #626-91014	January 1, 1981
Dated September 1976, #626-91007	February 1, 1973
Dated September 1966, #LNPNE-1008-ID	January 4, 1965

The term 'improved property' also includes the lands on which the dwelling is situated which meets both of the following criteria:

"(A) The land is in the same ownership as the dwelling.

"(B) The Secretary has designated the lands as reasonably necessary for the enjoyment of the dwelling for the sole purpose of noncommercial residential use.

Such term also includes any structures accessory to the dwelling which are situated on the lands so designated. The maps referred to in this section shall be on file and available for public inspection in the Office of the Director of the National Park Service, Department

Public information.

of the Interior. The Secretary shall designate the land referred to in subparagraph (B).".

(c) RETAINED RIGHTS.—Section 5(a) of such Act (16 U.S.C. 460u-5a) is amended as follows: 16 USC 460u-5.

(1) Strike out "the first section" and insert in lieu thereof "section 4, dated December 1980, and numbered 626-91014." *Ante*, p. 3318.

(2) Strike out ": *Provided,* That" and substitute a period followed by "In the case of improved property within the boundaries of the map dated December 1980 and numbered 626-91014".

(3) After "(a)" strike "Except for" and insert "(1) Except for owners described in paragraph (2) and".

(4) Strike "(1)" in each place it appears and substitute "(A)" and strike "(2)" and substitute "(B)".

(5) Add the following at the end thereof:

"(2)(A) In the case of property included within the boundaries of the lakeshore after 1980, any owner or owners of record of improved property may retain a right of use and occupancy for noncommercial residential purposes for a term ending at either of the following:

"(i) A fixed term not to extend beyond September 30, 2010, or such lesser fixed term as the owner or owners may elect at the time of acquisition.

"(ii) A term ending at the death of any owner or of a spouse of any owner, whichever occurs last.

The owner shall elect the term to be reserved.

"(B) The retention of rights under subparagraph (A) shall be available only to individuals who are homeowners of record as of July 1, 1986, who have attained the age of majority as of that date and who make a bona fide written offer not later than July 1, 1991, to sell to the Secretary.".

(d) AUTHORIZATION.—Section 9 of such Act (16 U.S.C. 460u-9) is amended as follows:

(1) In the first sentence strike "$11,000,000" and insert in lieu thereof "$20,000,000".

(2) Add after the last paragraph "In addition to any other sums authorized for the acquisition of lands and interests in lands pursuant to the provisions of this Act there are authorized to be appropriated an additional $3,500,000 to be used for such purposes. The Secretary shall conduct a feasibility study of establishing United States Highway 12 as the 'Indiana Dunes Parkway' under the jurisdiction of the National Park Service. The Secretary shall submit the results of such study to the Committee on Interior and Insular Affairs of the United States House of Representatives and the Committee on Energy and Natural Resources of the United States Senate within two years after the enactment of this sentence. Effective October 1, 1986, there is authorized to be appropriated such sums as may be necessary for the purposes of conducting the feasibility study.". Highways.

(e) EXISTING PROPERTY RIGHTS.—Section 10 of such Act (16 U.S.C. 460u-16) is amended by inserting at the end thereof: "Nothing in this Act shall be construed to diminish the existing property rights of Northern Indiana Public Service Company (as of October 1, 1986) with respect to— Energy. 16 USC 460u-10.

"(1) a parcel of land owned in fee by the Northern Indiana Public Service Company and used for high voltage electrical transmission lines, pipelines, and utility purposes, beginning at said Company's Dune Acres substation and extending east to said Company's Michigan City Generating Station, which parcel by this Act is included within the boundaries of the Indiana Dunes National Lakeshore and herein designated as area II-I on National Park Service Boundary Map No. 626-80,033-B, dated October 1986, excluding that certain parcel of approximately 6.0 acres adjacent Mineral Springs Road in areas II-I, and

(2) land owned in fee by the Northern Indiana Public Service Company and used for high voltage electrical transmission lines, pipelines, and utility purposes as has by this Act been included within the boundaries of the Indiana Dunes National Lakeshore and herein designated as area II-H on said National Park Service Boundary Map No. 626-80,033-B."

(f) OWNER CONSENT REQUIRED.—Section 13 of such Act (16 U.S.C. 460u-13) is amended by changing "SEC. 13." to "SEC. 13. (a)", by striking out "the first section" and inserting in lieu thereof "section 4, dated December 1980 and numbered 626-91014", and by adding a new subsection (b) as follows:

Ante, p. 3318.

"(b) The Secretary may acquire that portion of area IV-B in private ownership on the map referred to in section 1 of this Act only with the consent of the owner: *Provided*, That the Secretary may acquire an agricultural easement should the owner change the use in existence as of September 19, 1986, through eminent domain.".

Ante, p. 3318.

(g) MAP REFERENCE.—Section 16 of such Act (16 U.S.C. 460u-16) is amended by inserting at the end of the first sentence "on the map referred to in section 4, dated October 1976, and numbered 626-9100".

16 USC 460u-15.

(h) RIGHTS-OF-WAY.—Section 15 of such Act is amended by adding the following at the end thereof: "The Secretary may acquire only such interest in the rights-of-way designated 'Crossing B' and 'Crossing C' on the map dated October 1986 and numbered 626-80,033-B as he determines to be necessary to assure public access to the banks of the Little Calumet River and the banks of Salt Creek within fifty feet on either side of the centerline of said river and creek.".

(i) COOPERATIVE AGREEMENT AND STUDY.—Add the following new section at the end of such Act:

16 USC 460u-24. Contracts.

"SEC. 24. LITTLE CALUMET RIVER AND BURNS/PORTAGE WATERWAY.

"(a) COOPERATIVE AGREEMENT.—The Secretary may enter into a cooperative agreement with the Little Calumet River Basin Development Commission, the State of Indiana or any political subdivision thereof for the planning, management, and interpretation of recreational facilities on the tract within the boundaries of Indiana Dunes National Lakeshore identified as tract numbered 09-177 or on lands under the jurisdiction of the State of Indiana or political subdivision thereof along the Little Calumet River and Burns Waterway. The cooperative agreement may include provision for the planning of public facilities for boating, canoeing, fishing, hiking, bicycling, and other compatible recreational activities. Any recreational developments on lands under the jurisdiction of the National Park Service planned pursuant to this cooperative agreement shall be in a manner consistent with the purposes of this Act, including section 6(b).

Boating. Canoeing. Fish and fishing. Hiking. Bicycling.

16 USC 460u-6.

"(b) STUDY.—The Secretary shall conduct a study regarding the options available for linking the portions of the lakeshore which are divided by the Little Calumet River and Burns/Portage Waterway

so as to coordinate the management and recreational use of the lakeshore. The Secretary shall submit the results of the study to the Committee on Interior and Insular Affairs of the United States House of Representatives and the Committee on Energy and Natural Resources of the United States Senate within two years after the enactment of this section. Effective October 1, 1986, there is authorized to be appropriated such sums as may be necessary for the purposes of conducting the study.".

Effective date. Appropriation authorization.

Approved October 29, 1986.

LEGISLATIVE HISTORY—H.R. 4037:

HOUSE REPORTS: No. 99-762 (Comm. on Interior and Insular Affairs).
CONGRESSIONAL RECORD, Vol. 132 (1986):
Aug. 11, considered and passed House.
Oct. 16, considered and passed Senate, amended.
Oct. 17, House concurred in Senate amendment.

Public Law 102-430
102d Congress

An Act

Oct. 23, 1992
[H.R. 1216]

To modify the boundaries of the Indiana Dunes National Lakeshore, and for other purposes.

Indiana Dunes National Lakeshore Access and Enhancement Act.
Conservation.
16 USC 460u note.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "Indiana Dunes National Lakeshore Access and Enhancement Act".

SEC. 2. DEFINITION.

For the purposes of this Act, the term "the Act" means the Act entitled "An Act to provide for the establishment of the Indiana Dunes National Lakeshore, and for other purposes", approved November 5, 1966, as amended (16 U.S.C. 460u et seq.).

SEC. 3. BOUNDARIES.

(a) IN GENERAL.—The first section of the Act (16 U.S.C. 460u) is amended by striking "October 1986, and numbered 62680033-B" and inserting "October 1992, and numbered 626-80,039-C".

(b) CRESCENT DUNE.—Section 12 of the Act (16 U.S.C. 460u-12) is repealed.

SEC. 4. IMPROVED PROPERTY; RETENTION OF RIGHTS.

(a) ADDITIONAL AREAS.—The table in section 4 of the Act (16 U.S.C. 460u-3) is amended to read as follows:

"Property within boundaries of map	Construction began before
Dated October 1992, No. 626-80,039-C	October 1, 1991
Dated October 1986, No. 626-80,033-B	February 1, 1986
Dated December 1980, No. 626-91014	January 1, 1981
Dated September 1976, No. 626-91007	February 1, 1973
Dated September 1966, No. LNPNE-1008-ID	January 4, 1965".

(b) RETENTION OF RIGHTS.—Section 5(a) of the Act (16 U.S.C. 460u-5(a)) is amended by adding at the end thereof the following new paragraph:

"(3)(A) In the case of improved property included within the boundaries of the lakeshore after October 1, 1991, that was not included within such boundaries on or before that date, an individual who is an owner of record of such property as of that date may retain a right of use and occupancy of such improved property for noncommercial residential purposes for a term ending at either of the following:

"(i) A fixed term not to extend beyond October 1, 2020, or such lesser fixed term as the owner may elect at the time of acquisition.

"(ii) A term ending at the death of the owner or the owner's spouse, whichever occurs later. The owner or owners shall elect the term to be reserved.

"(B) Subparagraph (A) shall apply only to improved property owned by an individual who—

"(i) was an owner of record of the property as of October 1, 1991;

"(ii) had attained the age of majority as of that date; and

"(iii) made a bona fide written offer not later than October 1, 1997, to sell the property to the Secretary.".

(c) TECHNICAL AMENDMENT.—Section 5(a)(1) of the Act (16 U.S.C. 460u–5(a)(1)) is amended by striking the period after "626–91014" the first place it appears and inserting a comma.

SEC. 5. GREENBELT.

Section 18 of the Act (16 U.S.C. 460–18) is amended— 16 USC 460u–18.

(1) by inserting "(a)" after "SEC. 18."; and

(2) by adding at the end the following new subsection:

"(b)(1) The Secretary shall enter into a memorandum of agreement with the Northern Indiana Public Service Company (referred to as 'NIPSCO') that shall provide for the following with respect to the area referred to as Unit II–A on the map described in the first section of this Act (referred to as the 'Greenbelt'):

Contracts. Northern Indiana Public Service Company.

"(A) NIPSCO shall provide the National Park Service with access for resource management and interpretation through the Greenbelt and across the dike for purposes of a public hiking trail.

"(B) The National Park Service shall have rights of access for resource management and interpretation of the Greenbelt area.

"(C) NIPSCO shall preserve the Greenbelt in its natural state. If NIPSCO utilizes the Greenbelt temporarily for a project involving pollution mitigation or construction on its adjacent facilities, it shall restore the project area to its natural state.

"(D) If NIPSCO proposes a different use for the Greenbelt, NIPSCO shall notify the National Park Service, the Committee on Energy and Natural Resources of the Senate and the Committee on Interior and Insular Affairs of the House of Representatives and make no change in the use of the property until three years after the date notice is given.

"(2) If a memorandum of agreement is entered into pursuant to paragraph (1), so long as the memorandum of agreement is in effect and is being performed, the Secretary may not acquire lands or interests in land in the Greenbelt belonging to NIPSCO.".

SEC. 6. COOPERATIVE AGREEMENT.

The Act is amended by adding at the end the following new section:

"SEC. 25. In furtherance of the purposes of this Act, the Secretary may enter into a cooperative agreement with the city of Gary, Indiana, pursuant to which the Secretary may provide technical assistance in interpretation, planning, and resource management for programs and developments in the city of Gary's Marquette Park and Lake Street Beach.". 16 USC 460u–25.

SEC. 7. UNIT VII–D AND I–M.

The Act, as amended by section 5, is further amended by adding at the end the following new section:

"SEC. 26(a). Before acquiring lands or interests in lands in Unit VII–D (as designated on the map described in the first section of this Act) the Secretary shall consult with the Commissioner of the Indiana Department of Transportation to determine what 16 USC 460u–26.

lands or interests in lands are required by the State of Indiana for improvements to 15th Avenue (including the extension known as Old Hobart Road) and reconstruction and relocation of the intersection of 15th Avenue and State Road 51 so that the acquisition by the Secretary of lands or interests in lands in Unit VII–D will not interfere with planned improvements to the interchange and 15th Avenue in the area.

"(b) Before acquiring lands or interests in lands in Unit I–M (as designated on the map referred to in the first section of this Act) the Secretary shall consult with the Commissioner of the Indiana Department of Transportation to determine what lands or interests in lands are required by the State of Indiana for improvements to State Road 49 and reconstruction and relocation of the interchange with State Road 49 and U.S. 20 so that the acquisition by the Secretary of lands or interests in lands in Unit I–M will not interfere with planned improvements to such interchange and State Road 49 in the area.".

SEC. 8. VISITOR CENTER.

Dorothy Buell.

In order to commemorate the vision, dedication, and work of Dorothy Buell in saving the Indiana Dunes, the National Park Service visitor center at the Indiana Dunes National Lakeshore is designated as the "Dorothy Buell Memorial Visitor Center".

SEC. 9. AUTHORIZATION OF APPROPRIATIONS.

Section 9 of the Act (16 U.S.C. 460u–9) is amended—

(1) in the first sentence by striking the words "The Secretary may not expend more than $60,812,100 from the Land and Water Conservation Fund for the acquisition of lands and interests in lands nor more than $20,000,000 for development:" and inserting in lieu thereof: "The Secretary may expend such sums as may be necessary from the Land and Water Conservation Fund for acquisition of lands and interests in lands, and not to exceed $27,500,000 for development:";

(2) by striking the second paragraph in its entirety; and

(3) by striking the first sentence of the third paragraph.

Approved October 23, 1992.

LEGISLATIVE HISTORY—H.R. 1216:

HOUSE REPORTS: No. 102-151 (Comm. on Interior and Insular Affairs).
SENATE REPORTS: No. 102-340 (Comm. on Energy and Natural Resources).
CONGRESSIONAL RECORD:
Vol. 137 (1991): July 15, considered and passed House.
Vol. 138 (1992): July 29, considered and passed Senate, amended.
Oct. 5, House concurred in Senate amendment with amendments.
Oct. 8, Senate concurred in House amendments.

Compilation of Legislation

An Act

To provide for the establishment of the Indiana Dunes National Lakeshore, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to preserve for the educational, inspirational, and recreational use of the public certain portions of the Indiana dunes and other areas of scenic, scientific, and historic interest and recreational value in the State of Indiana, the Secretary of the Interior is authorized to establish and administer the Indiana Dunes National Lakeshore (hereinafter referred to as the "lakeshore") in accordance with the provisions of this Act. The lakeshore shall comprise the area within the boundaries delineated on a map identified as "'Boundary Map, Indiana Dunes National Lakeshore', dated October 1992, and numbered 626-80,039-C" which map is on file and available for public inspection in the Office of the Director of the National Park Service, Department of the Interior.

Sec. 2. (a) Within the boundaries of the lakeshore the Secretary of the Interior (hereinafter referred to as the "Secretary") is authorized to acquire lands, waters, and other property, or any interest therein, by donation, purchase with donated or appropriated funds, exchange, or otherwise. The Indiana Dunes State Park may be acquired only by donation of the State of Indiana, and the Secretary is hereby directed to negotiate with the State for the acquisition of said park. In exercising his authority to acquire property by exchange for the purposes of this Act, the Secretary may accept title to non-Federal property located within the area described in section 1 of this Act and convey to the grantor of such property any federally owned property under the jurisdiction of the Secretary which he classifies as suitable for exchange or other disposal within the State of Indiana or Illinois. Properties so exchanged shall be approximately equal in fair market value, as determined by the Secretary who may, in his discretion, base his determination on an independent appraisal obtained by him: Provided, That the Secretary may accept cash from or pay cash to the grantor in such an exchange in order to equalize the values of the properties exchanged. The Secretary is expressly authorized to acquire by donation, purchase with donated or appropriated funds, or exchange, lands or interests therein which are owned for school or educational purposes by a State or a political subdivision thereof.

(b) In exercising his authority to acquire property under subsection (a) of this section, the Secretary may enter into contracts requiring the expenditure, when appropriated, of funds authorized to be appropriated by section 9 of this Act, but the liability of the United States under any such contract shall be contingent on the appropriation of funds sufficient to fulfill the obligations thereby incurred.

Sec. 3. As soon as practicable after the effective date of this Act and following the acquisition by the Secretary of an acreage within the boundaries of the area described in section 1 of this Act which in his opinion is efficiently administrable for the purposes of this Act, he shall establish the Indiana Dunes National Lakeshore by publication of notice thereof in the Federal Register. By no later than October 1, 1977, the Secretary shall publish in the Federal Register a detailed description of the boundaries of the lakeshore and shall from time to time so publish any additional boundary changes as may occur. Following such establishment and subject to the limitations and conditions prescribed in section 1 hereof, the Secretary may continue to acquire lands and interests in lands for the lakeshore.

Sec. 4. As used in this Act, the term 'improved property' means detached, one-family dwelling which meets each of the following and construction criteria:

(1) The construction of the dwelling began before the date (shown in the table contained in this section) corresponding to the appropriate map.
(2) The property is located within the boundaries delineated on the map described in such table which corresponds to such date.
(3) The property is not located within the boundaries of any other map referred to in such table which bears an earlier date.

The term 'appropriate map', means a map identified as 'Boundary Map--Indiana Dunes National Lakeshore' (or 'A Proposed Indiana Dunes National Lakeshore' in the case of a dwelling the construction of which was begun before January 4, 1965) which is dated and numbered as provided in the following table.

Property Within Boundaries of Map	Construction Began Before
Dated October 1992, No. 626-80,039-C	October 1, 1991
Dated October 1986, No. 626-80,033-B	February 1, 1986
Dated December 1980, No. 626-91014	January 1, 1981
Dated September 1976, No. 626-91007	February 1, 1973
Dated September 1966, No. LNPNE-1008-ID	January 4, 1965

The term 'improved property' also includes the lands on which the dwelling is situated which meets both of the following criteria:
(A) The land is in the same ownership as the dwelling.
(B) The Secretary has designated the lands as reasonably necessary for the enjoyment of the dwelling for the sole purpose of noncommercial residential use.

Such term also includes any structures accessory to the dwelling which are situated on the lands so designated. The maps referred to in this section shall be on file and available for public inspection in the Office of the Director of the National Park Service, Department of the Interior. The Secretary shall designate the land referred to in subparagraph (B). The amount of land so designated shall in every case be not more than three acres in area, and in making such designation the Secretary shall take into account the manner of noncommercial residential use in which the dwelling and land have customarily been enjoyed: Provided, That the Secretary may exclude from the land so designated any beach or waters, together with so much of the land adjoining such beach or waters, as he may deem necessary for public access thereto or public use thereof. All rights of use and occupancy shall be subject to such terms and conditions as the Secretary deems appropriate to assure the use of such property in accordance with the purposes of this Act.

Sec. 5. (a) (1) Except for owners described in paragraph (2) and owners of improved property within the area on the map referred to in section 4, dated December 1980, and numbered 626-91014, of this act as area II-B, any owner or owners of record of improved property may retain a right of use and occupancy of said improved property for noncommercial residential purposes for a term (A) ending on his or her death or the death of his or her spouse, whichever occurs last, or (B) for a fixed term not to extend beyond September 30, 2010, or such lesser term as the owner or owners may elect at the time of acquisition by the Secretary.

In the case of improved property within the boundaries of the map dated December 1980 and numbered 626-91014 the retention of a retained right under clause numbered (A) shall only be available to homeowners of record as of October 1, 1980, who have attained the age of majority as of that date and make a bona fide written offer not later than October 1, 1985, to sell to the Secretary. Where any such owner retains a right of use and occupancy as herein provided, such right during its existence may be conveyed or leased for noncommercial residential purposes. The Secretary shall pay to the owner the fair market value of the property on the date of such acquisition, less the fair market value on such date of the right retained by the owner.

(2)(A) In the case of property included within the boundaries of the lakeshore after 1980, any owner or owners of record of improved property may retain a right of use and occupancy for noncommercial residential purposes for a term ending at either of the following:

(i) A fixed term not to extend beyond September 30, 2010, or such lesser fixed term as the owner or owners may elect at the time of acquisition.

(ii) A term ending at the death of any owner or of a spouse of any owner, whichever occurs last.

The owner shall elect the term to be reserved.

(B) The retention of rights under subparagraph (A) shall be available only to individuals who are homeowners of record as of July 1, 1986, who have attained the age of majority as of that date and who make a bona fide written offer not later than July 1, 1991, to sell to the Secretary.

(3)(A) In the case of improved property included within the boundaries of the lakeshore after October 1, 1991, that was not included within such boundaries on or before that date, an individual who is an owner of record of such property as of that date may retain a right of use and occupancy of such improved property for noncommercial residential purposes for a term ending at either of the following:

(i) A fixed term not to extend beyond October 1, 2020, or such lesser fixed term as the owner may elect at the time of acquisition.

(ii) A term ending at the death of the owner or the owner's spouse, whichever occurs later.

The owner or owners shall elect the term to be reserved.

(B) Subparagraph (A) shall apply only to improved property owner by an individual who:

(i) was an owner of record of the property as of October 1, 1991;

(ii) had attained the age of majority as of that date; and

(iii) made a bona fide written offer not later than October 1, 1997, to sell the property to the Secretary.

(b) Upon his determination that the property, or any portion thereof, has ceased to be used in accordance with the applicable terms and conditions, the Secretary may terminate a right of use and occupancy. Nonpayment of property taxes, validly assessed, on any retained right of use and occupancy shall also be grounds for termination of such right by the Secretary. In the event the Secretary terminates a right of use and occupancy under this subsection he shall pay to the owners of the retained right so terminated an amount equal to the fair market value of the portion of said right which remained unexpired on the date of termination. With respect to any right of use and occupancy in existence on the effective date of this sentence, standards for retention of such rights in effect at the time such rights were reserved shall constitute the terms and conditions referred to in section 4.

(c) With respect to improved properties acquired prior to the enactment of this subsection and upon which a valid existing right of use and occupancy has been reserved for a term of not more than twenty years, the Secretary may, in his discretion, extend the term of such retained right for a period of not more than nine years upon receipt of payment prior to September 30, 1983, from the holder of the retained right. The amount of such payment shall be equivalent to the amount discounted from the purchase price paid by the Secretary for the identical period of time under the terms of the original sale adjusted by a general index adopted by the Secretary reflecting overall value trends within Indiana Dunes National Lakeshore between the time of the original sale and the time of the retained right of extension offered by this subsection.

Sec. 6. (a) In the administration of the lakeshore the Secretary may utilize such statutory authorities relating to areas of the national park system and such statutory authority otherwise available to him for the conservation and management of natural resources as he deems appropriate to carry out the purposes of this Act.

(b) In order that the lakeshore shall be permanently preserved in its present state, no development or plan for the convenience of visitors shall be undertaken therein which would be incompatible with the preservation of the unique flora and fauna or the physiographic conditions now prevailing or with the preservation of such historic sites and structures as the Secretary may designate: Provided, That the Secretary may provide for the public enjoyment and understanding of the unique natural, historic, and scientific features within the lakeshore by establishing such trails, observation points, and exhibits and providing such services as he may deem desirable for such public enjoyment and understanding: Provided further, That the Secretary may develop for appropriate public uses such portions of the lakeshore as he deems especially adaptable for such uses.

Sec. 7. (a) There is hereby established an Indiana Dunes National Lakeshore Advisory Commission. Said Commission shall terminate on September 30, 1985.

(b) The Commission shall be composed of thirteen members each appointed for a term of two years by the Secretary, as follows:
(1) one member who is a year-round resident of Porter County to be appointed from recommendations made by the commissioners of such county; (2) one member who is a year-round resident of the town of Beverly Shores to be appointed from the recommendations made by the board of such town; (3) one member who is a year-round resident of the towns of Porter, Dune Acres, Pines, Chesterton, Ogden Dunes, or the village of Tremont, such member to be appointed from recommendations made by the boards of trustees or the trustee of the affected town or township; (4) two members who are year-round residents of the city of Michigan City to be appointed from recommendations made by such city; (5) two members to be appointed from recommendations made by the Governor of the State of Indiana;
(6) one member to be designated by the Secretary; (7) two members who are year-round residents of the city of Gary to be appointed from recommendations made by the mayor of such city; (8) one member to be appointed from recommendations made by a regional planning agency established under the authority of the laws of the State of Indiana and composed of representatives of local and county governments in northwestern Indiana; (9) one member who is a year-round resident of the city of Portage to be appointed from recommendations made by the mayor of such city; and (10) one member who holds a reservation of use and occupancy and is a year-round resident within the lakeshore to be designated by the Secretary.

(c) The Secretary shall designate one member to be Chairman. Any vacancy in the Commission shall be filled in the same manner in which the original appointment was made.

(d) A member of the Commission shall serve without compensation as such. The Secretary is authorized to pay the expense reasonably incurred by the Commission in carrying out its responsibilities under this Act on vouchers signed by the Chairman.

(e) The Secretary or his designee shall, from time to time, consult with the Commission with respect to matters relating to the development of the Indiana Dunes National Lakeshore and with respect to the provisions of sections 4, 5, and 6 of this Act.

(f) The Advisory Commission is authorized to assist with the identification of economically and environmentally acceptable areas, outside of the boundaries of the lakeshore, for the handling and disposal of industrial solid wastes produced by the coal-fired powerplant in Porter County, Indiana, section 21, township 37 north, range 6 west.

Sec. 8. Nothing in this Act shall deprive the State of Indiana or any political subdivision thereof of its civil and criminal jurisdiction over persons found, acts performed, and offenses committed within the boundaries of the Indiana Dunes National Lakeshore or of its right to tax persons, corporations, franchises, or other non-Federal property on lands included therein.

Sec. 9. The Secretary may expend such sums as may be necessary from the Land and Water Conservation Funds for acquisition of lands and interests in lands, and not to exceed $27,500,000 for development: Provided, That not more than $500,000 of said amount may be appropriated for the development of the Paul H. Douglas Environmental Education Center authorized pursuant to section 20 of this Act; and By October 1, 1979, the Secretary shall develop and transmit to the Committees on Interior and Insular Affairs of the United States Congress a general management plan detailing the development of the national lakeshore consistent with the preservation objectives of this Act, indicating: (1) the facilities needed to accommodate the health, safety, and recreation needs of the visiting public; (2) the location and estimated costs of all facilities, together with a review of the consistency of the master plan with State, areawide, and local governmental development plans; (3) the projected need for any additional facilities within the national lakeshore; and (4) specific opportunities for citizen participation in the planning and development of proposed facilities and in the implementation of the general management plan generally.

The Secretary shall conduct a feasibility study of establishing United States Highway 12 as the 'Indiana Dunes Parkway' under the jurisdiction of the National Park Service. The Secretary shall submit the results of such study to the Committee on Interior and Insular Affairs of the United States House of Representatives and the Committee on Energy and Natural Resources of the United States Senate within two years after the enactment of this sentence. Effective October 1, 1986, there is authorized to be appropriated such sums as may be necessary for the purposes of conducting the feasibility study.

Sec. 10. Nothing in this Act shall diminish any existing (as of March 1, 1975) rights-of-way or easements which are necessary for high voltage electrical transmission, pipelines, water mains, or line-haul railroad operations and maintenance. Nothing in this Act shall be construed to diminish the existing property rights of Northern Indiana Public Service Company (as of October 1, 1986) with respect to--

(1) a parcel of land owned in fee by the Northern Indiana Public Service Company and used for high voltage electrical transmission lines, pipelines, and utility purposes, beginning at said Company's Dune Acres substation and extending east to said Company's Michigan City Generating Station, which parcel by this Act is included within the boundaries of the Indiana Dunes National Lakeshore and herein designated as area II-I on National Park Service Boundary Map No. 626-80,033-B, dated October 1986, excluding that certain parcel of approximately 6.0 acres adjacent to Mineral Springs Road in area II-I, and

(2) land owned in fee by the Northern Indiana Public Service Company and used for high voltage electrical transmission lines, pipelines, and utility purposes as has by this Act been included within the boundaries of the Indiana Dunes National Lakeshore and herein designated as area II-H on said National Park Service Boundary Map No. 626-80,033-B.

Sec. 11. (a) Nothing in the Act shall be construed as prohibiting any otherwise legal cooling, process, or surface drainage into the part of the Little Calumet River located within the lakeshore: Provided, That this subsection shall not affect nor in any way limit the Secretary's authority and responsibility to protect park resources.

(b) The authorization of lands to be added to the lakeshore by the Ninety-fourth Congress and the administration of such lands as part of the lakeshore shall in and of itself in no way operate to render more restrictive the application of Federal, State, or local air and water pollution standards to the uses of property outside the boundaries of the lakeshore, nor shall it be construed to augment the control of water and air pollution sources in the State of Indiana beyond that required pursuant to applicable Federal, State, or local law.

Sec. 12. DELETED

Sec. 13. (a) The Secretary may acquire that portion of area I-C Area which is shaded on the map referred to in section 4, dated December 1980 and numbered 626-91014 of this Act only with the consent of the owner unless the present owner attempts to sell or otherwise dispose of such area.

(b) The Secretary may acquire that portion of area IV-B in private ownership on the map referred to in section 1 of this Act only with the consent of the owner: Provided, That the Secretary may acquire an agricultural easement should the owner change the use in existence as of September 19, 1986, through eminent domain.

Sec. 14. Within one year after the date of the enactment of this section, the Secretary shall submit, in writing, to the Committees on Interior and Insular Affairs and to the Committees on Appropriations of the United States Congress a detailed plan which shall indicate: (1) the lands which he has previously acquired by purchase, donation, exchange, or transfer for administration for the purpose of the lakeshore; and (2) the annual acquisition program (including the level of funding) which he recommends for the ensuing five fiscal years.

Sec. 15. The Secretary may acquire only such interest in the right-of-way designated 'Crossing A' on map numbered 626-91007 as he determines to be necessary to assure public access to the banks of the Little Calumet River within fifty feet north and south of the centerline of said river. The Secretary may acquire only such interest in the rights-of-way designated 'Crossing B' and 'Crossing C' on the map dated October 1986 and numbered 626-80,033-B as he determines to be necessary to assure public access to the banks of the Little Calumet River and the banks of Salt Creek within fifty feet on either side of the centerline of said river and creek.

Sec. 16. The Secretary shall enter into a cooperative agreement with the landowner of those lands north of the Little Calumet River between the Penn Central Railroad bridge within area II-E and 'Crossing A' within area IV-C on the map referred to in section 4, dated October 1976, and numbered 626-91007. Such agreement shall provide that any roadway constructed by the landowner south of United States Route 12 within such vicinity shall include grading, landscaping, and plantings of vegetation designed to prevent soil erosion and to minimize the aural and visual impacts of said construction, and of traffic on such roadway, as perceived from the Little Calumet River.

Sec. 17. (a) The Secretary may not acquire such lands within Area I-E. the western section of area I-E, as designated on map numbered 626-91007, which have been used for solid waste disposal until he has received a commitment in accordance with a plan acceptable to him, to reclaim such lands at no expense to the Federal Government.

(b) With respect to the property identified as area I-E on map numbered 626-91007, the Secretary may enter into a cooperative agreement whereby the State of Indiana or any political subdivision thereof may undertake to develop, manage and interpret such area in a manner consistent with the purposes of this Act.

Sec. 18. (a) By July 1, 1977, the Secretary shall prepare and transmit to the Committees on Interior and Insular Affairs of the United States Congress a study of areas III-A, III-C, and II-A, as designated on map numbered 626-91007. The Secretary shall make reasonable provision for the timely participation of the State of Indiana, local public officials, affected property owners, and the general public in the formulation of said study, including, but not limited to, the opportunity to testify at a public hearing. The record of such hearing shall accompany said study. With respect to areas III-A and III-C, the study shall (a) address the desirability of acquisition of any or all of the area from the standpoint of resource management, protection, and public access; (b) develop alternatives for the control of beach erosion if desirable, including recommendations, if control is necessary, of assessing the costs of such control against those agencies responsible for such erosion; (c) consider and propose options to guarantee public access to and use of the beach area, including the location of necessary facilities for transportation, health, and safety; (d) detail the recreational potential of the area and all available alternatives for achieving such potential; (e) review the environmental impact upon the lakeshore resulting from the potential development and improvement of said areas; and (f) assess the cost to the United States from both the acquisition of said areas together with the potential savings from the retention of rights of use and occupancy and from the retention of the boundaries of the lakeshore, as designated on map numbered 626-91007, including the costs of additional administrative responsibilities necessary for the management of the lakeshore, including the maintenance of public services in the town of Beverly Shores, Indiana. With respect to area II-A, the Secretary shall study and report concerning the following objectives: (a) preservation of the remaining dunes, wetlands, native vegetation, and animal life within the area; (b) preservation and restoration of the watersheds of Cowles Bog and its associated wetlands; (c) appropriate public access to and use of lands within the area; (d) protection of the area and the adjacent lakeshore from degradation caused by all forms of construction, pollution, or other adverse impacts including, but not limited to, the discharge of wastes and any excessive subsurface migration of water; and (e) the economic consequences to the utility and its customers of acquisition of such area.

(b)(1) The Secretary shall enter into a memorandum of agreement with the Northern Indiana Public Service Company (referred to as 'NIPSCO') that shall provide for the following with respect to the area referred to as Unit II-A on the map described in the first section of this Act (referred to as the "Greenbelt"):

(A) NIPSCO shall provide the National Park Service with access for resource management and interpretation through the Greenbelt and across the dike for purposes of a public hiking trail.

(B) The National Park Service shall have rights of access for resource management and interpretation of the Greenbelt area.

(C) NIPSCO shall preserve the Greenbelt in its natural state. If NIPSCO utilizes the Greenbelt temporarily for a project involving pollution mitigation or construction on its adjacent facilities, it shall restore the project area to its natural state.

(D) If NIPSCO proposes a different use for the Greenbelt, NIPSCO shall notify the National Park Service, the Committee on Energy and Natural Resources of the Senate and the Committee on Interior and Insular Affairs of the House of Representatives and make no change in the use of the property until 3 years after the date notice is given.

(2) If a memorandum of agreement is entered into pursuant to paragraph (1), so long as the memorandum of agreement is in effect and is being performed, the Secretary may not acquire lands or interests in land in the Greenbelt belonging to NIPSCO.

Sec. 19. After notifying the Committees on Interior and Insular Affairs of the United States Congress, in writing, of his intentions to do so and of the reasons therefore, the Secretary may, if he finds that such lands would make a significant contribution to the purposes for which the lakeshore was established, accept title to any lands, or interests in lands, located outside the present boundaries of the lakeshore but contiguous thereto or to lands acquired under this section, such lands the State of Indiana or its political subdivisions may acquire and offer to donate to the United States or which any private person, organization, or public or private corporation may offer to donate to the United States and he shall administer such lands as a part of the lakeshore after publishing notice to that effect in the Federal Register.

Sec. 20 (a) The Indiana Dunes National Lakeshore is hereby dedicated to the memory of Paul H. Douglas in grateful recognition of his leadership in the effort to protect, preserve, and enhance the natural, scientific, historic, and recreational value of the lakeshore for the use, enjoyment, and edification of present and future generations.

(b) To further accomplish the purposes of subsection (a) of this section, the Secretary of the Interior shall designate the west unit of the lakeshore as the "Paul H. Douglas Ecological and Recreational Unit" and shall, subject to appropriations being granted, design and construct a suitable structure or designate an existing structure within the lakeshore to be known as the "Paul H. Douglas Center for Environmental Education" which shall provide facilities designed primarily to familiarize students and other visitors with, among other things: (1) the natural history of the lakeshore and its association with the natural history of the Great Lakes region; (2) the evolution of human activities in the area; and (3) the historical features which led to the establishment of the lakeshore by the Congress of the United States.

(c) To inform the public of the contributions of Paul H. Douglas to the creation of the lakeshore, the Secretary of the Interior shall provide such signs, markers, maps, interpretive materials, literature, and programs as he deems appropriate.

Sec. 21. (a) The Secretary in consultation with the Secretary of Transportation, shall conduct a study of various modes of public access into and within the lakeshore which are consistent with the preservation of the lakeshore and conservation of energy by encouraging the use of transportation modes other than personal motor vehicles.

(b) In carrying out the study, the Secretary shall utilize to the greatest extent practicable the resources and facilities of the organizations designated as clearinghouses under title IV of the Intergovernmental Cooperation Act of 1968 as implemented by Office of Management and Budget Circular A-95, and which have comprehensive planning responsibilities in the regions where the lakeshore is located, as well as any other agencies or organizations which the Secretary may designate. The Secretary shall make provision for timely and substantive consultations with the appropriate agencies of the States of Indiana and Illinois, local elected officials, and the general public in the formulation and implementation of the study.

(c) The study shall address the adequacy of access facilities for members of the public who desire to visit and enjoy the lakeshore. Consideration shall be given to alternatives for alleviating the dependence on automobile transportation. The study of public transportation facilities shall cover the distance from cities of thirty-five thousand population or more within fifty miles of the lakeshore.

(d) The study shall include proposals deemed necessary to assure equitable visitor access and public enjoyment by all segments of the population, including those who are physically or economically disadvantaged. It shall provide for retention of the natural, scenic, and historic values for which the lakeshore was established, and shall propose plans and alternatives for the protection and maintenance of these values as they relate to transportation improvements.

(e) The study shall examine proposals for the renovation and preservation of a portion of the existing South Shore Railroad passenger car fleet. The study shall consider the historic value of the existing rolling stock and its role in transporting visitors into and within the lakeshore.

(f) The study shall present alternative plans to improve, construct, and extend access roads, public transportation, and bicycle and pedestrian trails. It shall include cost estimates of all plans considered in this study, and shall discuss existing and proposed sources of funding for the implementation of the recommended plan alternatives.

(g) The study shall be completed and presented to the Congress within two complete fiscal years from the effective date of this provision.

(h) Effective October 1, 1981, there is hereby authorized to be appropriated not to exceed

$200,000 for this study.

Sec. 22. In exercising his authority to acquire property under this act, the Secretary shall give prompt and careful consideration to any offer made by an individual owning property within the lakeshore to sell such property, if such individual notifies the Secretary in writing that the continued ownership of such property is causing, or would result in, undue hardship.

Sec. 23. (a) The Secretary may acquire only such interest in that portion of area VII-A which is described in subsection (b) as the Secretary determines is necessary to assure public access over said portion of area VII-A.

(b) The portion of area VII-A, as designated on the map referred to in section 1, to which subsection (a) applies is a parcel of land bounded; (1) on the east by a line three hundred feet east of the electrical transmission line crossing area VII-A on January 1, 1979; (2) on the west by a line fifty feet west of such electrical transmission line; and (3) on the north and south by the northern and southern boundaries, respectively, of area VII-A.

(c) Area VII-A includes the bed of the railroad tracks forming the northern and northwestern boundaries of this area and extends to the northern edge of the bed of the railroad tracks forming the southern boundaries of this area. (d) Area I-D includes the bed of the railroad tracks along the northern boundary of this area.

(e) The area designated as area VII-C on the map referred to in section 1 does not include approximately 1.3 acres of land on which the Linde Air Products plant is situated, nor does it include approximately 1 acre of land on which the Old Union Station building and the adjacent REA building are situated. Except as provided in the foregoing sentence, area VII-C extends to, but does not include, the beds of the railroad tracks forming the northern and southern boundaries of such area.

Sec. 24. (a) The Secretary may enter into a cooperative agreement with the Little Calumet River Basin Development Commission, State of Indiana or any political subdivision thereof for the planning, management, and interpretation of recreational facilities on the tract within the boundaries of Indiana Dunes National Lakeshore identified as tract numbered 09-117 or on lands under the jurisdiction of the State of Indiana or political subdivision thereof along the Little Calumet River and Burns Waterway. The cooperative agreement may include provision for the planning of public facilities for boating, canoeing, fishing, hiking, bicycling, and other compatible recreational activities. Any recreational developments on lands under the jurisdiction of the National Park Service planned pursuant to this cooperative agreement shall be in a manner consistent with the purposes of this Act, including section 6(b).

(b) The Secretary shall conduct a study regarding the options available for linking the portions of the lakeshore which are divided by the Little Calumet River and Burns/Portage Waterway so as to coordinate the management and recreational use of the lakeshore. The Secretary shall submit the results of the study to the Committee on Interior and Insular Affairs of the United States House of Representatives and the Committee on Energy and Natural Resources of the United States Senate within two years after the enactment of this section. Effective October 1, 1986, there is authorized to be appropriated such sums as may be necessary for the purposes of conducting this study.

Sec. 25. In furtherance of the purposes of this Act, the Secretary may enter into a cooperative agreement with the city of Gary, Indiana, pursuant to which the Secretary may provide technical assistance in interpretation, planning, and resource management for programs and developments in the city of Gary's Marquette Park and Lake Street Beach.

Sec. 26. (a) Before acquiring lands or interests in lands in Unit VII-D (as designated on the map described in the first section of this Act) the Secretary shall consult with the Commissioner of the Indiana Department of Transportation to determine what lands or interests in lands are required by the State of Indiana for improvements to 15th Avenue (including the extension known as Old Hobart Road) and reconstruction and relocation of the intersection of 15th Avenue and State Road 51 so that the acquisition by the Secretary of lands or interests in lands in Unit VII-D will not interfere with planned improvements to the interchange and 15th Avenue in the area.

(b) Before acquiring lands or interests in lands in Unit I-M (as designated on the map referred to in the first section of this Act) the Secretary shall consult with the Commissioner of the Indiana Department of Transportation to determine what lands or interests in lands are required by the State of Indiana for improvements to State Road 49 and reconstruction and relocation of the interchange with State Road 49 and U.S. 20 so that the acquisition by the Secretary of lands or interests in lands in Unit I-M will not interfere with planned improvements to such interchange and State Road 49 in the area.

Sec. 27. In order to commemorate the vision, dedication, and work of Dorothy Buell in saving the Indiana Dunes, the National Park Service visitor center at the Indiana Dunes National Lakeshore is designated as the "Dorothy Buell Memorial Visitor Center".

NOTE

This is a compilation of the act establishing Indiana Dunes National Lakeshore and four subsequent acts amending that original legislation.

P.L. 89-761, 89th Congress (11/05/66) (80 Stat 1309)
P.L. 94-549, 94th Congress (10/18/76) (90 Stat 2529)
P.L. 96-612, 96th Congress (12/28/80) (94 Stat 3575)
P.L. 99-583, 99th Congress (10/29/86) (100 Stat 3318)
P.L. 102-430, 102st Congress (10/23/92) (106 Stat 2208)

Appendix B: Agency Coordination

National Park Service to Indiana State Historic Preservation Officer (SHPO).
Request for comments on development of the Shoreline Restoration Management Plan.
dated April 25, 2011

Indiana SHPO response to request for comments.
dated May 23, 2011

National Park Service to Native American Tribes.
Request to participate in consultation on the development of
the Shoreline Restoration Management Plan.
dated February 24, 2011

Fish and Wildlife Service to National Park Service.
Comments provided on possible impacts of federally listed and candidate species
and designated critical habitats within the proposed project area.
Dated August 8, 2011

Memorandum of Understanding between the National Park Service and
the US Army Corps of Engineers.
Dated August 9, 2010

Request for the State of Indiana to be cooperating agency and
Response from the State of Indiana.
Dated April 21, 2011 and May 24, 2011

Request and Response for Indiana Department of Natural Resources
to be Cooperating Agency.
Dated June 3, 2011

United States Department of the Interior

NATIONAL PARK SERVICE
Indiana Dunes National Lakeshore
1100 N. Mineral Springs Road
Porter, Indiana 46304-1299

IN REPLY REFER TO:

April 25, 2011

H4217(INDU)

Mr. Robert E. Carter, Jr.
State Historic Preservation Officer
Indiana Department of Natural Resources
Division of Historic Preservation & Archeology
402 West Washington Street, W274
Indianapolis, Indiana 46204

Dear Mr. Carter:

The National Park Service (NPS) would like to initiate consultation with your office on the development of the Shoreline Restoration and Management Plan for Indiana Dunes National Lakeshore at this time. Please note, Mr. Steve Davis, Indiana Department of Natural Resources (DNR) Division of Water, and Mr. Mike Molnar, with the DNR's Coastal Zone Management Program, are participating in the development of this plan.

The development and installation of navigational harbors and shoreline stabilization structures (jetties, breakwaters, revetments, and bulkheads) has altered southern Lake Michigan's natural east to west littoral drift. This has resulted in the significant accretion of sands to the east (up drift) of the Michigan City and Burns International harbors, and the subsequent sand starvation to the west (down drift) of these harbors. The lack of continued sand replenishment from natural littoral drift has further resulted in extensive beach and dune erosion threatening both public and private resources. The project area includes areas off-shore, the shoreline, and within the foredunes.

The public scoping information, including handout and presentation, is available on the NPS Planning, Environmental and Public Comment (PEPC) website at http://parkplanning.nps.gov for your review, and we have enclosed a copy of the public scoping brochure. We are in the process of developing project alternatives, and a newsletter of our progress will be distributed to all interested parties within the next few months. We hope to have the draft EA developed by late fall.

If you have any questions, please feel free to call Ms. Brenda Waters, Assistant Chief, Natural Resource Management, at 219-395-1552 or email her at brenda_waters@nps.gov, or you may contact Ms. Judith Collins, Historical Architect, at 219-395-1986 or email her at judith_collins@nps.gov.

Mitchell E. Daniels, Jr., Governor
Robert E. Carter, Jr., Director

DNR Indiana Department of Natural Resources

Division of Historic Preservation & Archaeology•402 W. Washington Street, W274 · Indianapolis, IN 46204-2739
Phone 317-232-1646•Fax 317-232-0693 · dhpa@dnr.IN.gov

May 23, 2011

Constantine J. Dillon
Superintendent
Indiana Dunes National Lakeshore
1100 N. Mineral Springs Road
Porter, Indiana 46304-1299

Federal Agency: National Park Service

Re: Request for comments regarding the development of the Shoreline Restoration and Management Plan for Indiana Dunes National Lakeshore (DHPA #11613)

Dear Mr. Dillon:

Pursuant to Section 106 of the National Historic Preservation Act (16 U.S.C. § 470f) and 36 C.F.R. Part 800, the staff of the Indiana State Historic Preservation Officer ("Indiana SHPO") has conducted an analysis of the materials dated April 25, 2011 and received on April 28, 2011 for the above indicated project in Indiana Dunes National Lakeshore; Lake, LaPorte, and Porter counties, Indiana.

Thank you for your recent notice regarding the development of the Shoreline Restoration and Management Plan for Indiana Dunes National Lakeshore. We have no specific comments at this time, but we look forward to receiving additional information about the project as it becomes available.

A copy of the revised 36 C.F.R. Part 800 that went into effect on August 5, 2004 may be found on the Internet at www.achp.gov for your reference. If you have questions about archaeological issues please contact Amy Johnson at (317) 232-6982 or ajohnson@dnr.IN.gov. If you have questions about buildings or structures please contact Chad Slider at (317) 234-5366 or cslider@dnr.IN.gov. Additionally, in all future correspondence regarding the above indicated project, please refer to DHPA #11613.

Very truly yours,

James A. Glass, Ph.D.
Deputy State Historic Preservation Officer

JAG:CWS:cws

emc: Brenda Waters, Assistant Chief, Natural Resource Management, Indiana Dunes National Lakeshore
Judith Collins, Historical Architect, Indiana Dunes National Lakeshore

United States Department of the Interior

NATIONAL PARK SERVICE
Indiana Dunes National Lakeshore
1100 N. Mineral Springs Road
Porter, Indiana 46304-1299

IN REPLY REFER TO:

February 24, 2011

H4217(INDU)

Miami Nation of Indians of the State of Indiana
Mr. Brian J. Buchanan, Chief
P.O. Box 41
80 W. 6th Street
Peru, Indiana 46970

Dear Mr. Buchanan:

The National Park Service (NPS) would like to invite you, as a stakeholder, to participate in consultation on the development of the Shoreline Restoration and Management Plan for Indiana Dunes National Lakeshore.

The development and installation of navigational harbors and shoreline stabilization structures (jetties, breakwaters, revetments, and bulkheads) has altered southern Lake Michigan's natural east to west littoral drift. This has resulted in the significant accretion of sands to the east (up drift) of the Michigan City and Burns International harbors, and the subsequent sand starvation to the west (down drift) of these harbors. The lack of continued sand replenishment from natural littoral drift has further resulted in extensive beach and dune erosion threatening both public and private resources. The project area includes areas off-shore, the shoreline, and within the foredunes.

The public scoping information, including handout and presentation, is available on the NPS Planning, Environmental and Public Comment (PEPC) website at http://parkplanning.nps.gov for your review, and we have enclosed a copy of the public scoping brochure. If you have any questions, please feel free to call Ms. Brenda Waters at 219-395-1552 or email her at brenda_waters@nps.gov. Any comments you have should be mailed to:

Constantine J. Dillon, Superintendent
Attention: Brenda Waters, Assistant Chief, Natural Resource Management
Indiana Dunes National Lakeshore
1100 North Mineral Springs Road
Porter, Indiana 46304-1299

Thank you for your participation in the development of the Shoreline Restoration and Management Plan.

Sincerely,

Constantine J. Dillon
Superintendent

Miami Tribe of Oklahoma
Mr. Thomas E. Gamble, Chief
Post Office Box 1326
Miami, OK 74355

Citizen Potawatomi Nation
Mr. John A. Barrett, Chairman of Citizen Potawatomi Nation
1601 South Gordon Cooper Drive
Shawnee, Oklahoma 74801

Forest County Potawatomi
Mr. Harold Frank, Chairman
P.O. Box 340
5416 Everybody's Road
Crandon, Wisconsin 54520

Match-e-be-nash-she-wish Band of Potawatomi Indians
Mr. David Sprague, Chairperson
Box 218
Dorr, Michigan 49323

Nottawaseppi Huron Band of Potawatomi Indians
Mr. Homer A. Mandoka, Tribal Council Chairperson
2221-1 1/2 mile Road
Fulton, Michigan 49052

Pokagon Band of Potawatomi Indians
Mr. Matthew Wesaw, Tribal Chairman
P.O. Box 180
58620 Sink Road
Dowagiac, Michigan 49047

Prairie Band of Potawatomi Nation
Mr. Steve Ortiz, Chairman
16281 Q Road
Mayetta, Kansas 66509

Hannahville Indian Community of Wisconsin Potawatomi Indians of Michigan
Hannahville Indian Community Council
Mr. Kenneth Meshigaud, Tribal Chairperson
N14911 Hannahville B-1 Road
Wilson, Michigan 49896-9728

Not Federally Recognized
Miami Nation of Indians of the State of Indiana
Mr. Brian J. Buchanan, Chief and Mr. John Dunnagan, Vice Chief
P.O. Box 41
80 W. 6^{th} Street
Peru, Indiana 46970

United States Department of the Interior
Fish and Wildlife Service

Bloomington Field Office (ES)
620 South Walker Street
Bloomington, IN 47403-2121
Phone: (812) 334-4261 Fax: (812) 334-4273

August 8, 2011

Mr. Constantine J. Dillon
Superintendent
Indiana Dunes National Lakeshore
1100 North Mineral Springs Road
Porter, Indiana 46304

Dear Mr. Dillon:

The U.S. Fish and Wildlife Service has reviewed the Indiana Dunes National Lakeshore's (INDU) Preliminary Draft Shoreline Restoration and Management Plan and Environmental Impact Statement, dated July 2011. We have been asked to provide comments on the possible impacts of this Plan on Federally listed and candidate species and designated critical habitats within the proposed project area, which encompasses the southern shoreline of Lake Michigan between Michigan City, LaPorte County, on the east and the US Steel breakwater in Gary, Lake County, on the west. The entire Porter County shoreline of Lake Michigan is included.

The proposed project is within the range of the following Federally endangered, threatened, and candidate species:

Species	Location	Habitat
Indiana bat (Myotis sodalis) Endangered	All 3 counties	summer: forested areas typically associated with water resources; roost in trees with exfoliating bark
Karner blue butterfly (Lycaeides melissa samuelis) Endangered	Lake and Porter Counties	pine barrens and oak savanna with sandy soils and containing wild lupine
Mitchell's satyr	LaPorte County	prairie fens
Pitcher's (dune) thistle (Cirsium pitcheri) Threatened	Lake and Porter Counties	Great Lakes shoreline – stabilized dunes and blowout areas

Mead's milkweed (Asclepias medii) Threatened	Lake County	prairies
Eastern massasauga rattlesnake (Sistrurus catenatus catenatus) Candidate	LaPorte and Porter Counties	wetlands and adjacent uplands

The project study area also includes 9.7 kilometers (32,000 feet) of designated critical habitat for the endangered piping plover (Charadrius melodus) between the INDU/NIPSCO property line within the Dune Acres/Cowles Bog Unit and Kemil Road/East State Park Boundary Road at Beverly Shores, all in Porter County.

Neither the Mitchell's satyr nor the Mead's milkweed are found at INDU and therefore are not considered in the document. The eastern massasauga is found within suitable habitats at INDU inland from the project study area and is not present within the areas which will be affected by the proposed project.

The Indiana bat has been found at the Heron Rookery Unit of INDU but not within any of the habitats which will be affected by the shoreline project. Karner blue butterflies are present within several savanna complexes west of Burns Waterway and within Howes Prairie east of Burns Waterway. The project study area includes the former sand mines at West Beach where this species is found, but their habitat would not be affected by any of the activities proposed by this project.

Pitcher's thistle is present within dunes and blowouts landward of the beach within the Miller Woods, West Beach, Burns Ditch/Portage Lakefront Park, Dunes Acres/Howes Prairie, and Dune Ridge units of INDU, and within Big Blowout and nearby foredunes at Indiana Dunes State Park. The species was once present at Mt. Baldy but has not been observed since 1978, according to the Indiana Heritage Database. It is anticipated that the beach nourishment projects recommended by the project study will ultimately benefit this species through the increase of available sand and the restoration of dune formation processes, including the re-formation of foredunes where they have been eroded away. At some time in the future it may be possible to re-establish populations of Pitcher's thistle on various foredunes and at Mt. Baldy.

Piping plover currently do not nest within their designated critical habitat or elsewhere in Indiana but they are regularly observed during both spring and fall migration, often at Miller Beach in Gary but also at Washington Park Beach in Michigan City; in 2010 several migrating piping plover were observed along the beach within the Indiana Dunes State Park, which is part of the critical habitat. The sand accretion area east of the Port of Indiana Industrial Complex breakwalls, which is both the current and the proposed site of dredged sand for beach nourishment at the Portage Lakefront Park, is affecting the critical habitat by expanding the width of the beach. Based upon information currently available to us, we do not believe that the preferred alternative for removal of sand from this site, which is to dredge 370,000 cubic yards of material every five years and move it to the Portage Lakefront Park, would adversely modify this critical habitat. However, it may be necessary to further study the possible impacts of this dredging as project plans are finalized and the exact dredging location is determined.

Therefore, we concur with your determination that the proposed project may affect but is not likely to adversely affect these endangered, threatened, and candidate species or adversely modify piping plover critical habitat.

This precludes the need for further consultation on this project as required under Section 7 of the Endangered Species Act of 1973, as amended. If, however, new information on endangered species at the site becomes available or if project plans are changed significantly, please contact our office for further consultation.

Thank you for this opportunity to provide comments on this proposed project. If you have any questions, please contact Elizabeth McCloskey at (219) 983-9753 or elizabeth_mccloskey@fws.gov.

Sincerely yours,

Elizabeth S. McCloskey acting

for Scott E. Pruitt
Supervisor

DEPARTMENT OF THE ARMY
CHICAGO DISTRICT, U.S. ARMY CORPS OF ENGINEERS
111 NORTH CANAL STREET
CHICAGO IL 60606-7206

REPLY TO
ATTENTION OF

August 9, 2010

Office of Counsel

Brenda Waters
Assistant Chief of Natural Resources
Indiana Dunes National Lakeshore
1100 N. Mineral Springs Road
Porter, IN 46304

RE: Memorandum of Understanding (MOU) between the National Park Service and the U.S. Army Corps of Engineers

Dear Ms. Waters:

Please find enclosed for your further action an MOU for the Indiana Dunes National Lakeshore Shoreline Restoration and Management Plan Environmental Impact Statement, including two signature sheets partially executed by the U.S. Army Corps of Engineers.

If you have any questions, please contact me at (312) 846-5353 or by email at michaele.j.mandulak@usace.army.mil.

Sincerely,

Michaele Mandulak

Michaele Mandulak
Assistant District Counsel
Chicago District, U.S. Army Corps of Engineers

Enclosure

**MEMORANDUM OF UNDERSTANDING
BETWEEN
THE NATIONAL PARK SERVICE
AND
THE U.S. ARMY CORPS OF ENGINEERS
FOR INDIANA DUNES NATIONAL LAKESHORE
SHORELINE RESTORATION AND MANAGEMENT PLAN
ENVIRONMENTAL IMPACT STATEMENT**

This Memorandum of Understanding (MOU) is entered into by the National Park Service (NPS) and the U.S. Army Corps of Engineers, Chicago District (USACE).

I. PURPOSE

The purpose of this MOU is to effectuate the commitment of the USACE and the NPS to work together cooperatively in the preparation of the Environmental Impact Statement for the Indiana Dunes National Lakeshore Shoreline Restoration and Management Plan, as envisioned by the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321 et seq., and Council on Environmental Quality (CEQ) regulations implementing NEPA, 40 C.F.R. Parts 1500-1508.

II. BACKGROUND

The NPS is initiating the development of a Shoreline Restoration and Management Plan (Plan) and Environmental Impact Statement (EIS) for Indiana Dunes National Lakeshore. This Plan and EIS are funded by the Great Lakes Restoration Initiative (GLRI), an Environmental Protection Agency-led, interagency Great Lakes restoration initiative which will target the most significant problems in the Great Lakes region, including invasive aquatic species, non-point source pollution, and contaminated sediment, in order to protect, maintain, and restore the chemical, biological, and physical integrity of the Great Lakes.

The Plan and EIS are needed to restore and effectively manage approximately thirteen miles of the southern Lake Michigan shoreline at Indiana Dunes National Lakeshore. These documents will evaluate and select options for: 1) restoring or replicating natural sediment processes updrift of and within the park; 2) restoring and managing foredunes, controlling and preventing invasive nonnative plants, and protecting federally-listed threatened and endangered species in the park; 3) reducing potential nonnative invasive threats to the lakeshore such as Cladophora, round goby, and salmonella; 4) improving water quality; 5) ensuring appropriate visitor access and use; and 6) coordinating beach management and access with landowners and partners including a state park, three counties, five cities, ten townships, non-government organizations, private industry and landowners, and concerned citizens.

The Plan and EIS will: (1) examine the impacts of structures and activities along the Lake Michigan shoreline near and within the park, (2) determine the responsibility for mitigating such impacts, (3) develop a reasonable range of alternatives that would mitigate such impacts consistent with park resource management objectives, and (4) select one or several such alternative(s).

The involvement of the USACE in this effort will be critical to ensure that the EIS is technically adequate and legally defensible. USACE has regulatory jurisdiction over "waters of the United States" and possesses relevant analysis, data, and other technical information which the NPS will utilize for comparison of alternatives in the EIS and for decision-making. In addition, since it is likely that one or more of the alternatives in the EIS will involve USACE action, USACE involvement is important to ensure that the description and analysis of such alternatives is not inconsistent with USACE mandates.

Following the completion of the Plan and EIS, the NPS intends to implement the selected alternative(s) or work with other Federal and state agencies and other stakeholders to encourage and facilitate their implementation of the selected alternative(s).

III. STATUTORY AND REGULATORY AUTHORITIES

This MOU is entered into under the authority of NEPA, 42 U.S.C. § 4321 et seq.; CEQ regulations implementing NEPA, 40 C.F.R. Parts 1500-1508; Department of the Interior NEPA regulations at 43 C.F.R. Part 46; and USACE NEPA regulations at 33 C.F.R. Part 230. Pursuant to NEPA, the Federal government shall use all practicable means to improve and coordinate Federal plans, functions, programs, and resources to enhance the quality of the environment.

CEQ regulations at 40 C.F.R. § 1501.6 emphasize interagency cooperation early in the environmental review process; and at 40 C.F.R. § 1501.5 provide for the designation in writing of a lead agency that will supervise the preparation of an environmental impact statement and for the identification of cooperating agencies which have jurisdiction by law and/or special environmental expertise, if more than one Federal agency is involved in the same action, such as actions affecting the shoreline at Indiana Dunes National Lakeshore.

The NPS is authorized by the NPS Organic Act, 16 U.S.C. § 1 et seq., and its implementing regulations to conserve the resources of all units of the National Park System, including Indiana Dunes National Lakeshore, unimpaired for the enjoyment of current and future generations, and is further authorized by the Indiana Dunes National Lakeshore enabling statute, 16 U.S.C. § 460u through § 460u-13, to specifically preserve for the educational, inspirational, and recreational use of the public certain portions of the Indiana dunes and other areas of scenic, scientific, and historic interest and recreational value in the State of Indiana.

The Indiana Dunes National Lakeshore includes approximately 542 acres of submerged land and water area extending 300 feet into Lake Michigan from the south shore of the lake. The USACE is responsible for issuing Department of the Army Permits under Section 10 of the Rivers and Harbors Act approved March 3, 1899 (33 U.S.C. §403) and its implementing regulations for work in navigable waters affecting the course, location, condition, or capacity of such waters; and under Section 404 of the Clean Water Act (33 U.S.C. §1344) and its implementing regulations for the discharge of dredged or fill material into waters of the United States.

USACE has an authorized project—Indiana Shoreline Erosion, IN—for shoreline erosion protection at Indiana Dunes National Lakeshore that is authorized by Section 501(a) of the Water Resources Development Act of 1986 (P.L. 99-662), as amended by Section 4(g) of the Water Resources Development Act of 1988 (P.L. 100-676). USACE is further authorized by Section 204 of the Water Resources Development Act of 1992, as amended (33 U.S.C. 2326) to develop and implement regional sediment management plans.

IV. COMMITMENT OF THE PARTIES

A. In the spirit of cooperation and collaboration, and with the mutual understanding that this is a flexible working agreement among the signatory agencies, the NPS and USACE hereby commit to the following responsibilities:

1. The NPS will serve as the lead agency for the EIS for Indiana Dunes National Lakeshore Shoreline Restoration and Management Plan;

2. The USACE will serve as a cooperating agency for the EIS for Indiana Dunes National Lakeshore Shoreline Restoration and Management Plan.

B. As lead agency, the NPS agrees to:

1. Provide USACE with project information in a timely and thorough manner;

2. Seek input from USACE on the preferred and environmentally preferred alternatives in the EIS;

3. Invite USACE to project meetings;

4. Provide USACE an opportunity to comment on draft documents;

5. Provide USACE with an opportunity to participate in the NPS consultations with other agencies and organizations, including the U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service, the Indiana Department of Environmental Management, Indiana Department of Natural Resources, local cities, towns and county governments and other non-government groups such as the Northwestern Indiana Regional Planning Commission, and The Nature Conservancy;

6. Provide USACE with an opportunity to participate in the public involvement in this project from initial scoping through the entire process, including the preparation of

project newsletters at appropriate stages of the project, the establishment of a planning website for the project, and the implementation of public meetings; and

7. Provide USACE with an opportunity to participate in the consultation with tribal nations on a separate nation-to-nation track.

C. As cooperating agency, USACE agrees to:

1. Participate in the scoping process, meetings, consultation, and document review and editing process;

2. Provide the NPS, in a timely manner, with all reasonably available USACE data and analysis relevant to the EIS;

3. Provide assistance to the NPS in areas of USACE special technical expertise and legal jurisdiction, in a timely manner, with regard to the analysis, alternatives, and conclusions in the EIS;

4. Provide input to the NPS on the preferred and environmentally preferred alternatives in the EIS; and

5. Provide the NPS, in a timely manner, with comments on draft documents and otherwise fulfill the role of a cooperating agency as set forth at 40 C.F.R. Part 1501.6.

D. Both NPS and USACE agree to:

1. Consider both agencies' legal authorities, obligations, and constraints, including their jurisdictional and regulatory mandates, in the evaluation of the proposed alternatives;

2. Recognize that, pursuant to GLRI deadlines, the Plan and EIS must be completed by September 30, 2011, and accordingly expedite evaluation of the effects of the proposed alternatives in the EIS;

3. Identify opportunities for efficiency and collaboration in the development of the EIS;

4. Designate a point of contact for the development, review, and completion of the EIS; and

5. Make staff available, subject to available resources, to perform the responsibilities set forth in paragraphs IV.B and IV.C. and ensure that the EIS is completed by the GLRI deadline.

V. MISCELLANEOUS PROVISIONS

A. NPS and USACE will, as needed, enter into specific reimbursable agreements pursuant to the Economy Act, 31 U.S.C. § 1535, and in accordance with 40 C.F.R. 1501.6 (b)(5) when one party is to furnish materials or perform work or provide a service on behalf of another party.

B. NPS and USACE shall retain all applicable legal responsibility for their respective personnel working pursuant to this MOU. The MOU is not intended to change in any way the individual employee status or the liability or responsibility of any party under Federal law.

C. Nothing in this MOU is intended to conflict with current law, regulation, directive, or other governing authority of any party to this MOU. If any term of this MOU is inconsistent with such authority, then that term shall not apply, but the remaining terms and conditions of the MOU shall remain in full force and effect.

D. This document is an intra-governmental agreement between NPS and USACE intended to facilitate cooperation between NPS and USACE in the preparation of an EIS and does not create or confer any rights, privileges, or benefits upon any person or entity not a signatory hereto. This MOU is not and shall not be construed as a rule or regulation.

E. All provisions of this document are subject to the availability of funds.

VI. MODIFICATION, TERMINATION, AND TERM OF AGREEMENT

A. This MOU becomes effective upon the date of signature by the last signatory.

B. This MOU may be modified or amended in writing upon the mutual consent of the NPS and USACE, and other affected Federal or State agencies may seek to become a party to this MOU.

C. Either party to this MOU may terminate its participation in this MOU upon written notice to the other party.

D. This MOU shall terminate upon the completion of NPS's Record of Decision for the EIS, unless prior thereto it is relinquished, abandoned, or otherwise terminated pursuant to the provisions of this MOU.

VII. KEY OFFICIALS

The U.S. Army Engineer, Chicago District and Superintendent of Indiana Dunes National Lakeshore or their delegates shall direct the operations and measures agreed to in this instrument.

VIII. AUTHORIZING SIGNATURES

IN WITNESS THEREOF, the parties to this agreement have signed their names and executed this Memorandum of Understanding.

USACE

Name: Vincent V. Quarles
Title: Colonel, U.S. Army
District Commander
Date: 06 AUG 2010
Address:
Department of the Army
Chicago District, Corps of Engineers
111 North Canal Street
Chicago, Illinois 60606-7206

National Park Service

Name: Constantine Dillon
Title: Superintendent

Date:
Address:
National Park Service
Indiana Dunes National Lakeshore
1100 North Mineral Springs Road
Porter, IN 46304-1299

"McAhron, Ron" <rmcahron@dnr.IN.gov>

05/24/2011 08:12 AM

To <Brenda_Waters@nps.gov>

cc <Bob_Daum@nps.gov>, <Charles_Morris@nps.gov>, "Davis, Steve" <sdavis@dnr.IN.gov>, "Molnar, Mike" <mmolnar@dnr.IN.gov>, <Erin_Flanagan@nps.gov>

Subject RE: Shoreline MOU

Brenda:

Sorry for the delayed response. I have been advised that our procedures strongly discourage IDNR from entering MOU's with agencies and entities outside state government. We are not opposed to Steve being involved in the project; in fact we believe he would be an asset. If you have a less formal vehicle to accomplish that end, we would be glad to work with you on that. I am thinking along the lines of a confidentiality agreement.

Ron McAhron
Deputy Director
IDNR
402 W. Washington St Rm 256
Indianapolis, IN 46204
Phone (317) 232-1557
Cell (317) 696-9307

-----Original Message-----
From: Brenda_Waters@nps.gov [mailto:Brenda_Waters@nps.gov]
Sent: Thursday, April 21, 2011 11:48 AM
To: McAhron, Ron
Cc: Bob_Daum@nps.gov; Charles_Morris@nps.gov; Davis, Steve; Molnar, Mike; Erin_Flanagan@nps.gov
Subject: Shoreline MOU

Dear Ron,

Thank you for calling me last week, it was good to get to speak with you about the shoreline plan and our draft MOU. Spring is a busy time of the year so I want to let you know I will be out of the office from April 22 to May 2. I don't want to slow down our progress while I am out. If you have the red-lined MOU for the Shoreline Plan ready while I am out of the office, could you please send it to Bob Daum and Charlie Morris? They will be able to move it forward. Their emails are bob_daum@nps.gov and charles_morris@nps.gov.

I appreciate your help and IDNR's continued participation by Steve Davis. His expertise in coastal processes continues to add value to our planning process.

Sincerely,
Brenda

****
Brenda Waters
Assistant Chief of Natural Resources
Indiana Dunes National Lakeshore
1100 N Mineral Springs Road
Porter, IN 46304
Office: (219) 395-1552
Fax: (219) 395-1588
****

Brenda Waters/INDU/NPS
06/03/2011 09:34 AM

To "McAhron, Ron" <rmcahron@dnr.IN.gov>
cc Bob_Daum@nps.gov, Charles_Morris@nps.gov, Erin_Flanagan@nps.gov, "Molnar, Mike" <mmolnar@dnr.IN.gov>, "Davis, Steve" <sdavis@dnr.IN.gov>, Nicholas Chevance/Omaha/NPS@NPS
bcc
Subject RE: Shoreline MOU

Ron,

Thank you for getting back to with the decision on the Shoreline MOU between NPS and IDNR. We appreciate the assistance and expertise that IDNR has provided through Steve Davis as we work to develop the Shoreline Plan/EIS. At this point in the planning process, it seems most appropriate for us to continue our with informal communication and cooperation. We look forward to your comments on the draft Plan/EIS. It is scheduled to be available for public review this winter.

Sincerely,
Brenda

****
Brenda Waters
Assistant Chief of Natural Resources
Indiana Dunes National Lakeshore
1100 N Mineral Springs Road
Porter, IN 46304
Office: (219) 395-1552
Fax: (219) 395-1588
****

APPENDIX C: TECHNICAL REFERENCES (PAGES 341 THROUGH 392)
IS AVAILABLE IN ELECTRONIC FORMAT AT

HTTP://PARKPLANNING.NPS.GOV/PROJECTHOME.CFM?PROJECTID=33151

APPENDIX C: TECHNICAL REFERENCES

(AVAILABLE ONLINE ONLY)

C1: WAVE CLIMATE AND LONGSHORE SEDIMENT TRANSPORT ANALYSIS
C2: LAKE MICHIGAN WAVAD HINDCAST — 1982 TO 2007
C3: 1951/1952 TO 2010 SHORELINE CHANGE ANALYSIS
C4: SUMMARY OF REGIONAL SHORELINE CHANGE ANALYSIS (1951/52 TO 2010)
C5: DETAILED SHORELINE CHANGE MEASUREMENTS

APPENDIX C1: WAVE CLIMATE AND LONGSHORE SEDIMENT TRANSPORT ANALYSIS

SITE

The Indiana Dunes National Lakeshore (INDL) is located at the southern end of Lake Michigan, with the coastal boundaries of the park defined by Michigan City Harbor in the northeast and Gary/USX Steel Harbor in the west. Refer to figure 1 for a location map. This is a highly modified coastal environment. It is also a landscape of contrast, featuring some of the most unique beaches and coastal dune habitat in North America, located in between large lakefill projects, ports and harbors.

This report describes our technical analysis performed for the lake levels and waves at the site, along with longshore sediment transport modeling. Based on this technical analysis, it also describes the implications for the shoreline change rates documented in a companion report (1951/1952 to 2010 Shoreline Change Analysis, Indiana Dunes National Lakeshore, Baird 2011). Collectively, this information was utilized to develop long-term potential Shoreline Restoration Plans for the INDL.

WATER LEVEL AND WAVE ANALYSIS

This section of the report describes the procedures undertaken in order to quantify the lake level conditions and wave climate at the project site. Together, the waves and water levels determine the design conditions used to establish the level of shore protection required. For example, the established conditions will be used to design "soft" erosion mitigation techniques, such as beach nourishment and "hard" structures, such as breakwaters or groins (emergent or submerged).

Typically, various conditions are analyzed to determine the wave climate at a site in the Great Lakes. The USACE utilizes a set of design conditions established using the (10:20 and (20:10) criteria. The (10:20) and (20:10) method is a combined return period criteria that uses both the 1:10 year water level with the 1:20 year wave height, and the 1:20 year water level with the 1:10 year wave height, respectively. Whichever combination results in a larger design wave at the structure governs as the design condition.

Coastal erosion protection structures around the Great Lakes typically use 25 to 50-year design life engineering calculations. It is important to recognize that this assumption is no guarantee that the coastal structure will actually last for 25 or 50 years. A storm event that exceeds the design conditions may occur in any given year.

FIGURE 1: LOCATION MAP FOR THE INDIANA DUNES NATIONAL LAKESHORE

It is also noted that with a regular monitoring program in place and maintenance repairs as needed, the coastal structures might be functional at the end of their 25 to 50-year design life. For the purposes of this conceptual design study, a 50-year design life was assumed for engineering structures.

The following section describes a risk assessment approach to establish an appropriate set of design conditions for the site.

Risk Assessment to Establish Design Conditions

Risk is defined as the probability that a given design event (e.g., a specified combination of monthly mean water level, storm surge and wave height) will be reached or exceeded at least once during the project life. If the design event is reached or exceeded, there will be certain consequences that must be taken into consideration. For example, there may be damage to the structure and the possibility of habitat loss and economic damages.

The level of acceptable risk should be defined and accepted by the project Owner during the first stages of a project with a firm understanding of the implications for different levels of risk. The International Navigation Association (PIANC 2003) provides basic guidance on the selection of appropriate risk levels for breakwater design; this approach has also been adopted by the International Organization for Standardization (ISO) in the Draft International Standard 21650. PIANC establishes four safety classes (very low, low, normal, and high), and evaluates them based upon potential risk of human injury, environmental and economic consequences. This information provides some insight on the level of acceptable risk for design purposes. table 1 summarizes maximum acceptable risk based on various "safety class" levels (PIANC 2003), along with examples provided in ISO/DIN 21650.

The safety class and desired limit state selected for this project were based on our review of the PIANC guidance and will require additional consultation with the National Park Service (NPS) in a final design phase. At this time, the appropriate safety class for potential shoreline protection structures is assumed to be "very

TABLE 1: MAXIMUM ACCEPTABLE RISK

Safety Class	Indicators	SLS*	ULS**	Examples (ISO/DIS 21650:2007)
Very Low	No risk to human injury Small environmental consequences Small economic consequences	40%	20%	Small coastal structures.
Low	No risk to human injury Some environmental consequences Some economic consequences	20%	10%	Larger coastal structures such as breakwaters in deep water and exposed seawalls protecting infrastructure.
Normal	Risk to human injury Significant environmental consequences High economic or political consequences	10%	5%	Breakwaters protecting a LNG-terminal or power station.
High	Risk to human injury Significant environmental consequences Very high economic or political consequences	5%	1%	Sea dyke protecting a populated low land.

Source: PIANC, 2003.

Notes:

*Serviceability Limit State (SLS): e.g., overtopping, settlement of foundation soil

**Ultimate Limit State (ULS): e.g., foundation failure, failure of significant portion of structure low", and this relates to a condition where there is no direct risk of human injury and small environmental or economic consequences associated with the failure of the structure (i.e. impacts before it can be repaired). According to Serviceability Limit State (SLS), the acceptable maximum probability of failure during the lifetime of a structure of this description is 40% (PIANC 2003). These assumptions will have to be further discussed and verified with the NPS in a final design project phase.

Assuming a design life of 50-years and applying the standard formula (refer Equation 1) for calculating the risk of an event occurring, it was determined that the corresponding design return period event is 100 years.

EQUATION 1: RISK OF AN EVENT OCCURRING WITHIN A SPECIFIED DESIGN LIFE

$$Risk = 1 - \left(1 - \frac{1}{Tr}\right)^{DesignLife}$$

Lake Level and Storm Surge Analysis

Water levels on Lake Michigan vary both in the long-term in response to continental scale climatic conditions, as well as in the short term due to the passage of individual storm events, creating short duration storm surges. Storm surge is a local increase in the water level caused by wind stresses applied to the water surface and regional scale pressure gradients.

The computer model HYDSTAT was used to complete a joint probability analysis (JPA) for long term monthly mean lake levels and short term surge data. HYDSTAT is a well recognized model that has been used extensively around the Great Lakes for flood level and water related hazard studies (USACE 1988; OMNR 1989). Refer to Baird (2010) for additional information on the model and recent applications throughout the Great Lakes Basin.

To assess storm surge, 41 years of hourly measured water level data from the National Oceanic & Atmospheric Administration (NOAA) Calumet Harbor gage (9087044) on Lake Michigan were obtained for the period 1970-2010. A surge event was defined as any period of time where the lake level was greater than +0.8 ft above the still water level for more than 3 consecutive hours, with a minimum of 24 hours between successive events. From this population of events, the largest annual surge was selected for the 41 year period of record. These surge events were used for the first independent variable and extreme value analysis in HYDSTAT.

The lakewide monthly mean data for Lake Michigan was analyzed from 1954 to 2010 to establish an annual maximum monthly mean lake level. 1954 corresponded to the beginning of the temporal analysis in the 1988 USACE study. This annual maximum series of monthly mean lake levels was used as the second independent variable for the HYDSTAT analysis.

HYDSTAT was then used to perform a JPA on the two independent variables (still water level and storm surge) and select an appropriate probability distribution for the data. The Log Pearson 3 distribution was selected for the HYDSTAT output and used to establish the return period lake levels in table 2 on page 330. The lake levels are presented as an elevation relative to Vertical Datum IGLD85, and above Low Water Datum of 577.5 feet. For reference, table 2 also includes the extreme lake levels with a return period of 10, 50, 100 and 500, as published by the USACE 1988 study. It should be noted that this study relied on data from 1954 to 1986, which is a much shorter temporal duration than our present analysis (e.g., 24 years of additional information is now available). Since some of those years featured very high lake levels (e.g., 1998), the updated results in table 2 are approximately 0.7 ft higher than the levels reported in the 1988 USACE report.

The 1988 USACE report was updated in 1993 and the findings are summarized in a report entitled Design Water Level Determination on the Great Lakes (USACE, 1993). The reported 10-, 50-, and 100-Year lake level (still water with combined surge) values are 582.94, 583.41 and 584.34 feet IGLD85, respectively. Refer to table 2 for summarized information.

TABLE 2: RESULTS OF THE JOINT PROBABILITY ANALYSIS (SURGE AND MEAN LAKE LEVEL) FOR THE CALUMET GAGE

Return Period (years)	Lake Level (ft LWD)	Baird Lake Level (ft IGLD 85)	USACE 1988 (ft IGLD 85)	USACE 1993 (ft IGLD 85)
2	4.0	581.5	–	–
5	5.1	582.6	–	–
10	5.7	583.2	582.5	582.9
25	6.4	583.9	–	–
50	6.8	584.3	583.6	583.4
100	7.2	584.7	584.0	584.3
200	7.5	585.0	–	–
500	7.9	585.4	584.9	–

Notes:

ft = foot (feet)

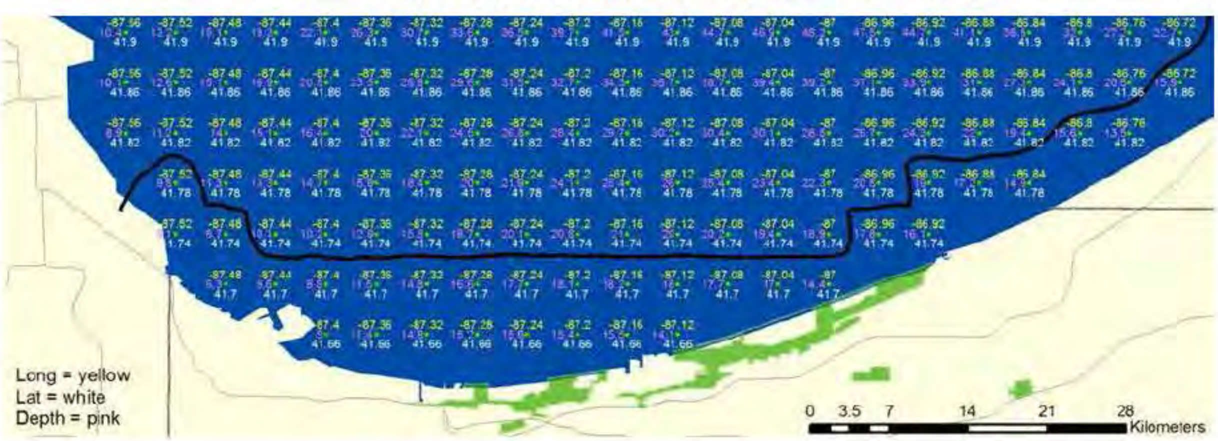
USACE = U.S. Army Corps of Engineers

Wind-Wave Hindcast with the WAVAD Model

Wave data for the site was obtained from Baird's in-house Lake Michigan wave hindcast model at a point in the central portion of the study area (Lat 41.66, Long -87.12). Refer to figure 2, which identifies all the model output locations (modeling results considered) for the southern portion of Lake Michigan. The water depth at the selected point is 46 ft below CD. This data was transformed to a depth of 6 ft below CD, which is the anticipated depth for any potential engineering structures that might be considered. For reference, the nature of these potential structures had not been determined at the time the hindcast analysis was performed; therefore, it was assumed the structures could include submerged shoals (underwater stone berms) that enhance local beach conditions.

WAVAD was developed by the Engineering Research Development Center, Coastal Hydraulics Laboratory of the USACE (Resio and Perrie, 1989). The model simulates wave growth and propagation in deep water. For additional information on the WAVAD modeling and similar applications in the Great Lakes Basin, refer to the Baird summary presented after the references list.

FIGURE 2: WAVAD GRID POINTS FOR SOUTHERN LAKE MICHIGAN



At a reference water depth of 6 ft below CD for engineering structures, it was determined the waves are depth limited at the site using the lake levels presented in table 2 on page 330. In other words, the wave height is controlled by water depth. Consequently, the return period for the design event is directly related to the extreme water levels shown in table 3.

As outlined in the risk assessment, a 100 year event was recommended for designing engineering structures. This corresponds to a lake level of 7.2 ft above CD and a breaking wave height of 10.7 ft.

LONGSHORE SEDIMENT TRANSPORT MODELING

The results of the longshore sediment transport modeling completed for the study area are described in this section and build on the previous technical investigation completed by Baird (2004) at Michigan City.

Regional Sediment Modeling

The COSMOS 2-dimensional computer model was applied to calculate the Longshore Sediment Transport (LST) rates at 2 km (1.25 miles) intervals along the shoreline between New Buffalo and the Port of Indiana Industrial Complex over the 45-year period of 1956 to 2000. The beach profiles extended out to a depth of approximately 15 m (49 feet) below CD and were assumed to be covered with a sandy layer.

A uniform sand grain size of 0.3 mm was used based on sediment samples collected during a previous site visit (Baird 2003).

Waves in the study area were transformed to a 15 m water depth at each calculation point using linear refraction and shoaling equations. The input wave data had a yearly scatter format and was split into North and West wave files (separated based on a shore perpendicular azimuth at each profile) to estimate contributions from each direction. The contributions will be referred to as southward and northward components, respectively, hereafter. Calculations were conducted at almost 30 different points along the shoreline.

Figure 3 on page 332 shows the 45-year average annual cross-shore distribution of LST for a typical beach profile. Sediment motion extends out to beyond 10 m (33 feet) below CD. The existence of two bars on the profile results in two peaks in the LST curves. The shallow depths over the bar induces wave breaking and results in larger depth average currents and near-bottom orbital velocities, leading to higher LST rates. There is also a third peak near the shoreline in the swash zone followed by a change in net transport direction from south to north. The northward transport is the cumulative effect of smaller waves that arrive mostly from the west, which is the dominate wind direction but features a smaller fetch compared to the north. Regional variations of LST are discussed in the following subsections.

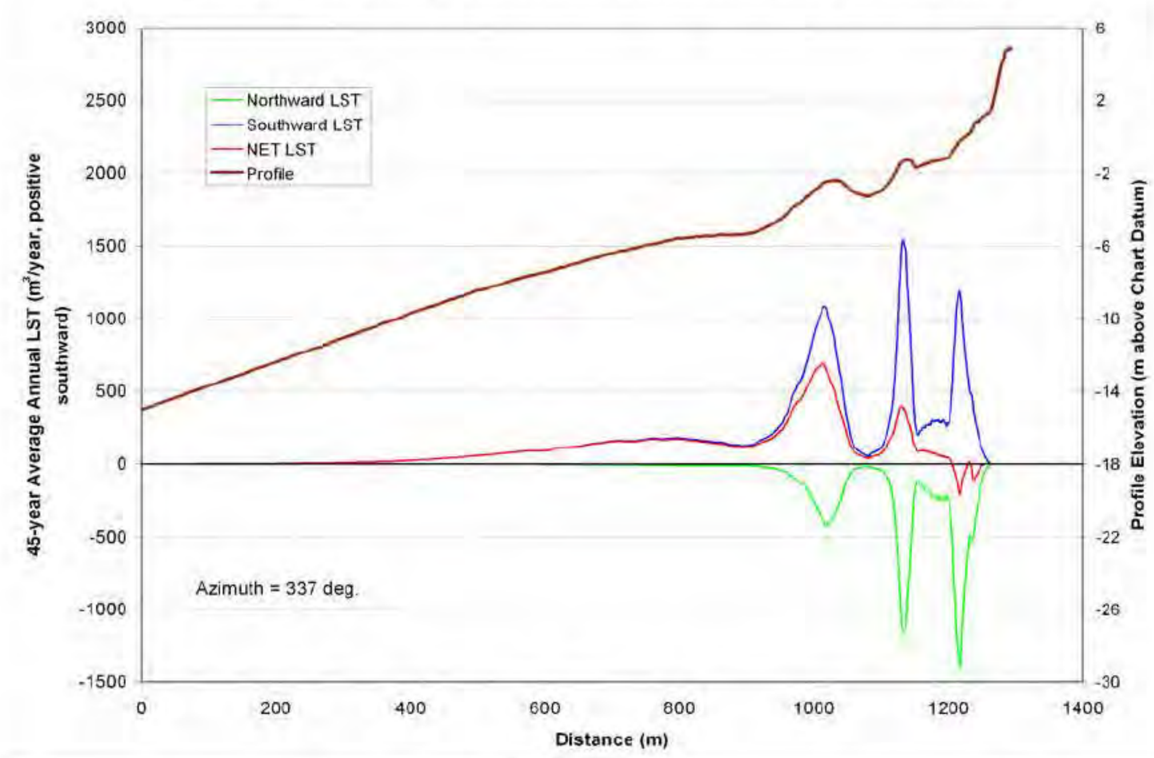
TABLE 3: RETURN PERIOD LAKE LEVELS AND WAVE HEIGHTS

Return Period (years)	Lake Level (ft LWD)	Total Water Depth (ft)	Depth Limited Wave Height (ft)
2	4.0	10.0	8.2
5	5.1	11.1	9.1
10	5.7	11.7	9.6
25	6.4	12.4	10.1
50	6.8	12.8	10.4
100	7.2	13.2	10.7

Notes:

ft = foot (feet)

FIGURE 3: CROSS-SHORE DISTRIBUTION OF LST FOR A TYPICAL BEACH PROFILE



LST for Pre-Harbor Shoreline

In order to understand the regional LST pattern prior to construction of the harbors and ports, COSMOS runs were completed for the shoreline and the shoreline orientation based on the 15 m contour taken from the 1874 historical survey. Calculated pre-harbor regional LST and its northward and southward components are shown in figure 4 on page 333. In this figure, distances are referenced to Michigan City Harbor which is located at 0 km. It may be seen that net LST decreases gradually from 250,000 m^3/year (327,000 yd^3/year) at New Buffalo to about

170,000 m^3/year (222,000 m^3/year) at the Port of Indiana Industrial Complex. These results suggest historically the shorelines between New Buffalo and the Industrial Complex were accreting. This long term trend of accretion also supports the lake level studies of Baedke and Thompson (2000), which document the formation of the Indiana Dunes at the southern end of Lake Michigan over the last 4,700 years.

LST Estimates for Existing Conditions

Calculated regional LST rates for the existing conditions between New Buffalo and the Port of Indiana Industrial Complex are shown in figure 5 on page 333. The calculated historic rates from the previous section are also shown in this figure for comparison. While the potential incoming and outgoing transport rates to the study area are the same as their historic rates, differences are noticed around the Michigan City Harbor. It may be seen that the formation of the updrift fillet and the resulting change in the shoreline orientation has resulted in a stronger negative LST gradient than the pre-harbor condition. This fact combined with the trapping potential of the harbor are the principal factors responsible for the creation and growth of the fillet beach. Immediately downdrift of Michigan City Harbor, a positive or increasing LST gradient extending to about 4 km downdrift is calculated. This positive LST gradient and the sediment budget deficit at Mount Baldy (Baird 2004) are responsible for the observed erosion in this area.

FIGURE 4: LST FOR PRE-SETTLEMENT SHORELINE ORIENTATION

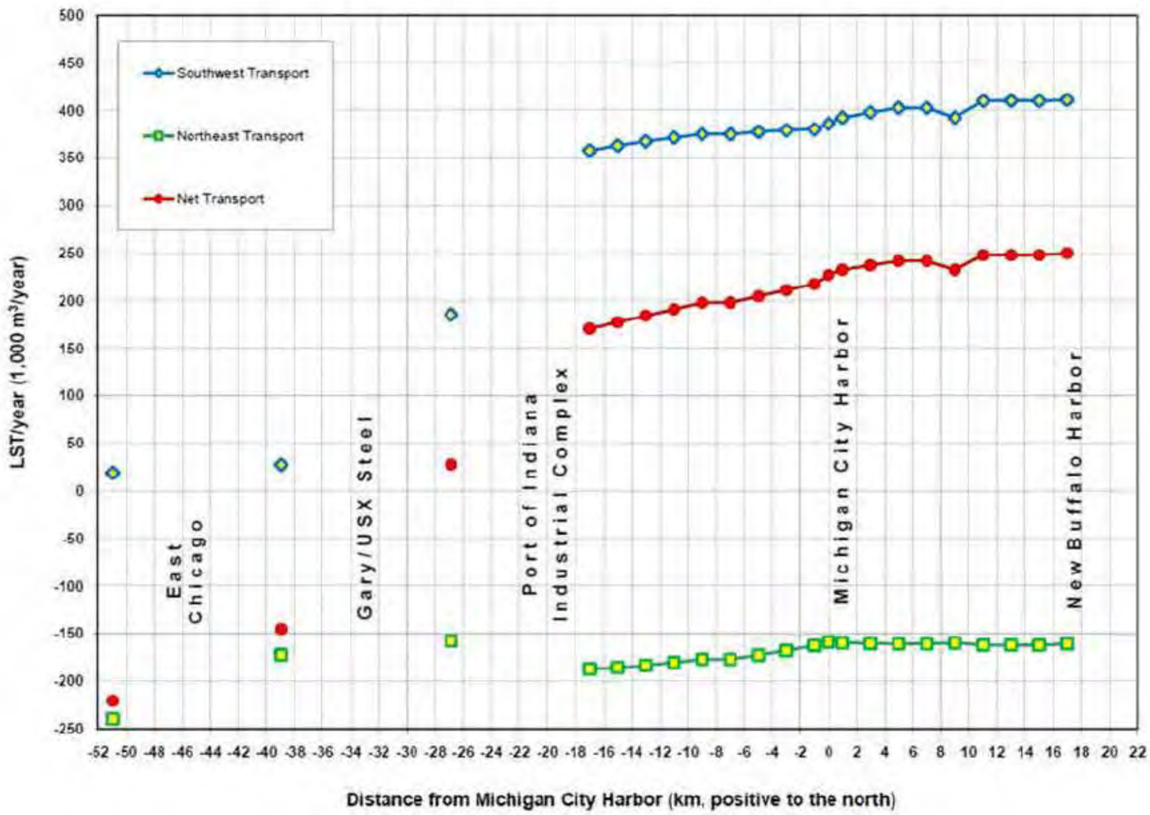
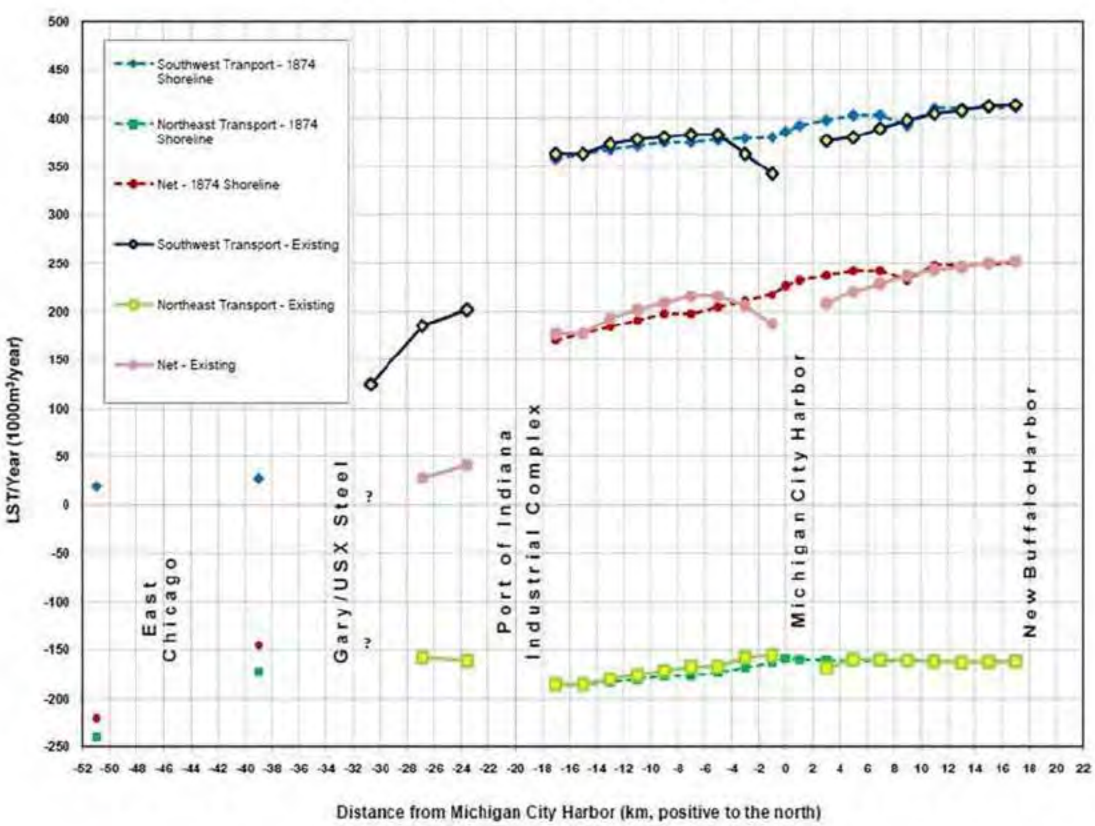


FIGURE 5: LST FOR CURRENT SHORELINE ORIENTATION



IMPLICATIONS FOR FUTURE SHORELINE CHANGE RATES

The following sections discuss the implications of the sediment transport modeling for future shoreline change rates in the study area, and provide baseline conditions for development of project restoration plans.

Future Trends at Harbors

There are three main areas within the project shoreline that constitute littoral barriers, disrupting the natural sediment flow in an alongshore direction. These man-made harbors trap sediment on the northeast or updrift side and lead to erosion on the southwest or downdrift side.

The three main harbors are:

- Michigan City Harbor (initial construction in 1834, Harbor completed in early 1900s)
- Port of Indiana Industrial Complex (constructed in the late 1960s)
- Gary USX Steel (constructed in early 1900s)

The total impacts of these harbors are somewhat difficult to quantify. The analysis to estimate the total sediment volumes is based on detailed aerial photographs from pre-Harbor conditions to present; quantities dredged, and harbor bypassing. Based on preliminary calculations, the total quantities of accreted sediment immediately north-east of the harbors is:

- Michigan City Harbor: 28.2M cubic meters (36.8M cubic yards). Does not include the volume of sediment dredged in the navigation channel and artificially bypassed;
- Port of Indiana Industrial Complex: 3.5M cubic meters (4.6M cubic yards). Does not include sediment dredged and artificially bypassed/backpassed, which totals 1.7M cubic meters (2.2M cubic yards); and
- Gary USX Steel: 2.2M cubic meters (2.9M cubic yards). This is based on the current shoreline orientation defined by the confined disposal facility constructed post-1950.

Figures 6, 7, and 8 on pages 335 and 336 document the fillet beaches and historical shoreline change rates at the three harbors.

Trends for the National Lakeshore

A companion report entitled 1951/52 to 2010 Shoreline Change Analysis, Indiana Dunes National Lakeshore (Baird 2011) documented trends in the study area shoreline over the last 60 years. The following bullet points comment on anticipated future trends based on the findings of this report and the status quo for sediment bypassing and beach nourishment activities within the study area (refer to figure 6 in the Baird (2011) report for the locations of Reaches A to G):

- **Reach A - Mount Baldy Erosion Zone**: Despite the placement of over 1 million cubic yards of beach nourishment since 1974, the beach and dunes immediate downdrift of the Michigan City Harbor continued to erode. Based on the LST modeling and the downdrift sediment budget deficit, this trend will continue for the status quo beach nourishment program (approximately 29,000 cubic yards per year, long-term average quantity);
- **Reach B – Beverly Shores to the Middle of Dune Acres**: The long term trend of “dynamically stable” is anticipated to continue. Beach position will be dynamic and respond to changes in lake levels. Locally, periods of erosion may threaten infrastructures, such as the revetment protecting portions of Lake Front Drive along Beverly Shores;
- **Reach C (Port of Indiana Industrial Complex Fillet Beach) and Reach E (Town of Ogden Dunes)**: The shoreline position in these two reaches is highly modified by the Port of Indiana Industrial Complex, dredging and mechanical sediment bypassing. The shoreline trend for Reaches C and E will be highly dependent on the degree of sediment management in the future, which may be investigated by as part of a reconnaissance study by the USACE (anticipated 2012). The current trends are anticipated in the future;

- **Reach F – West Beach to Miller**: The trend of dynamically stable will continue in the future if the status quo for sediment bypassing continues; and
- Reach G – Gary USX Steel Harbor Fillet Beach: Continued fillet beach growth is anticipated.

FIGURE 6: 1834 TO 2002 SHORELINE COMPARISON AT MICHIGAN CITY

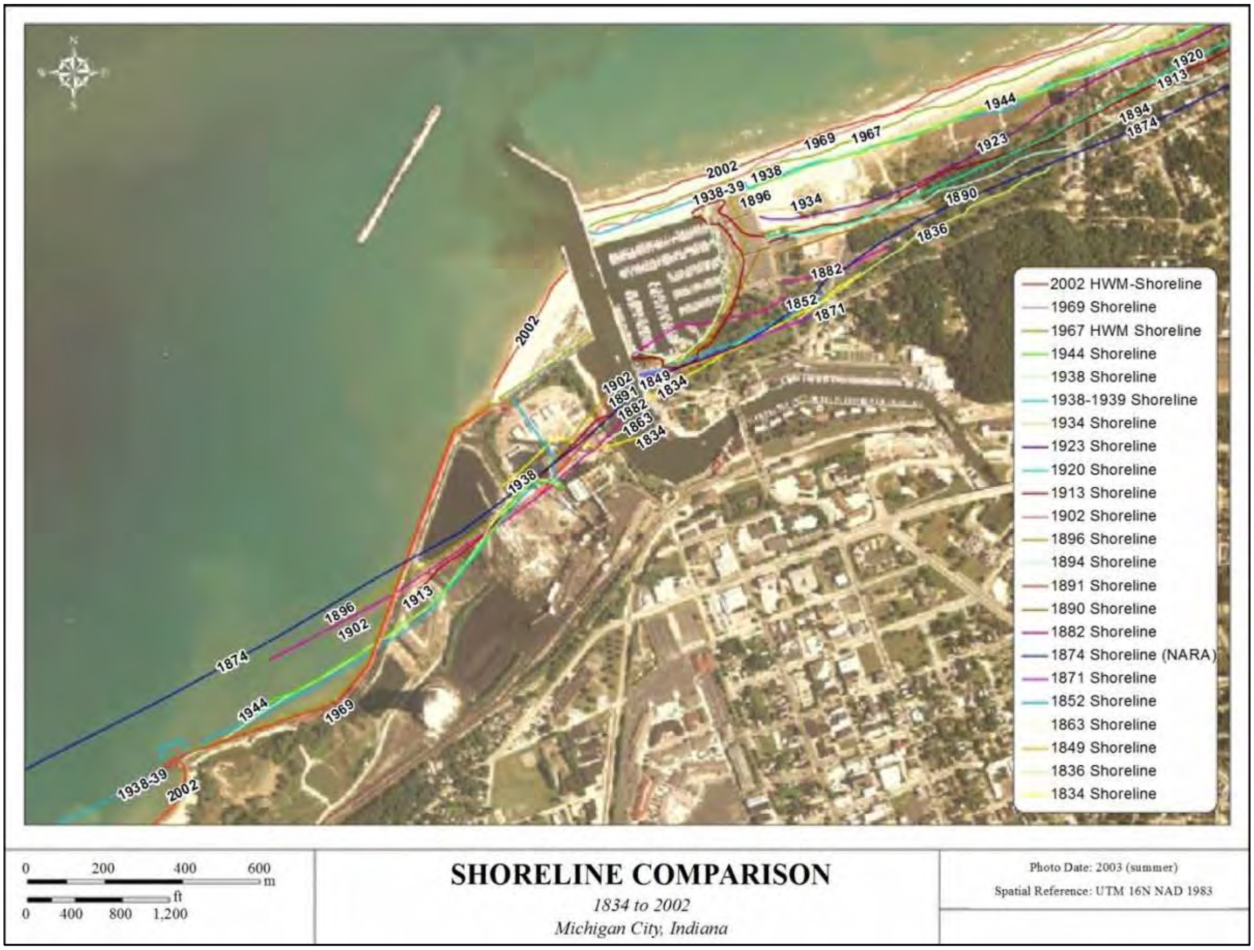


FIGURE 7: 1951/1952 TO 2010 FILLET BEACH AT THE PORT OF INDIANA INDUSTRIAL COMPLEX

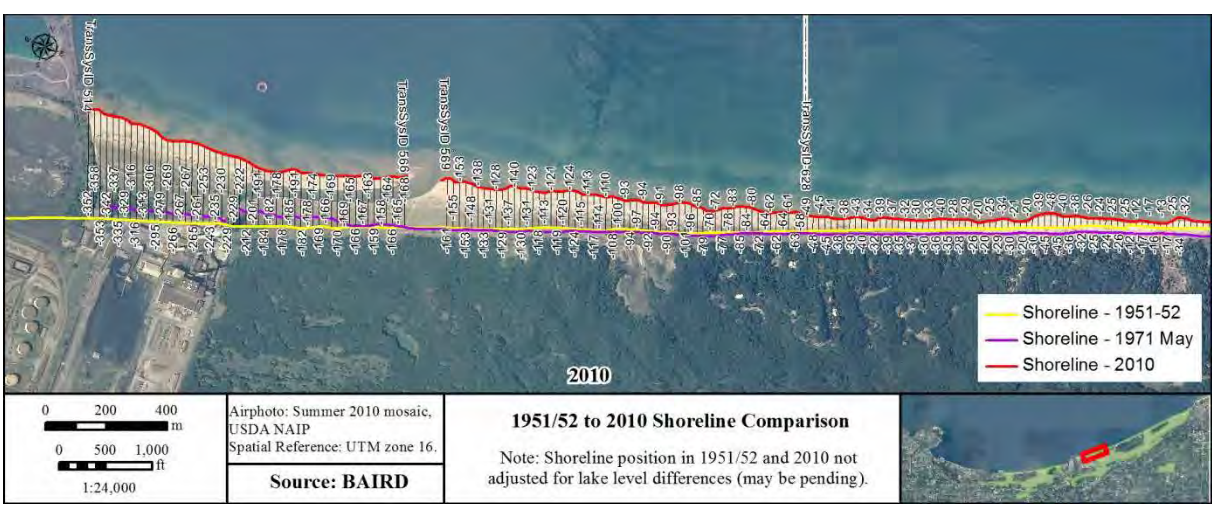
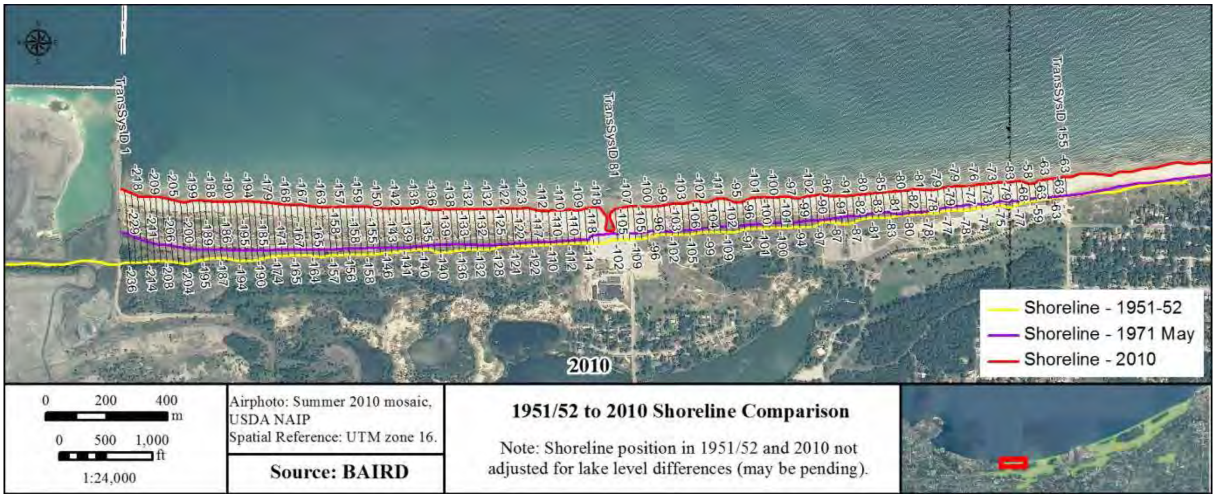


FIGURE 8: 1951/1952 TO 2010 FILLET BEACH AT THE GARY/USX STEEL HARBOR



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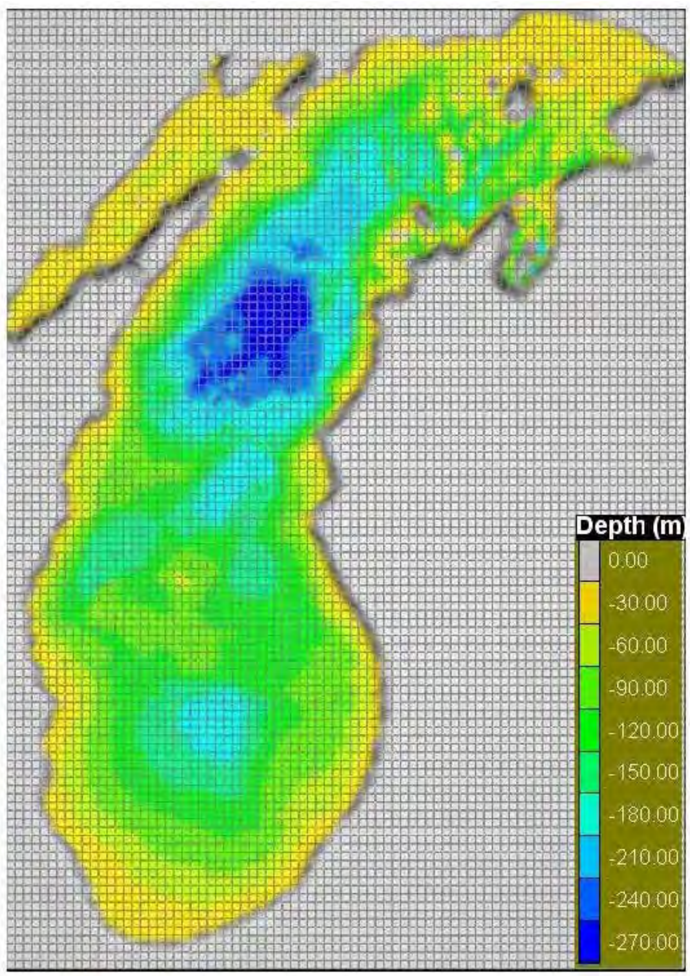
APPENDIX C2: LAKE MICHIGAN WAVAD HINDCAST — 1982 TO 2007

The wave climate for the southern end of Lake Michigan was initially evaluated with the aid of WIS data (specifically LM007) but it did not cover a suitable temporal period (WIS extends from 1956-1987) and was only 3 hour data. Therefore, a limited WAVAD wind-wave hindcast was completed for Lake Michigan (1982-2007), with output saved for the grid cells for the southern end of the lake. The primary input to WAVAD was 25 years of wind data obtained from offshore NOAA buoy #45007. Since the buoy is decommissioned in the winter, this period was covered using wind data from Milwaukee Mitchel Airport. Figure 1 shows the model grid, which contains 82 x 116 grid points. The grid spacing is 0.04 deg.

A detailed description of the WAVAD model and application on Lake Ontario is provided in Baird (2003) and Scott et al.(2004). A description of a recent application on Lake Erie is provided in Baird (2008).

FIGURE 1: WAVE MODEL GRID



The model results were verified against the offshore buoy data. Figure 2 presents the quantile-quantile (Q-Q) plot between measured and modeled output at the offshore buoy location. Figure 3 on page 339 shows the time series comparison of measured and modeled data. In general, the modeled wave height results agree well with measured data, but slightly underestimates the large waves (Hm0 >2.5 m). Figure 4 on page 340 presents a snapshot of the model result.

FIGURE 2: Q-Q COMPARISON BETWEEN MEASURED AND MODELED WAVE HEIGHT

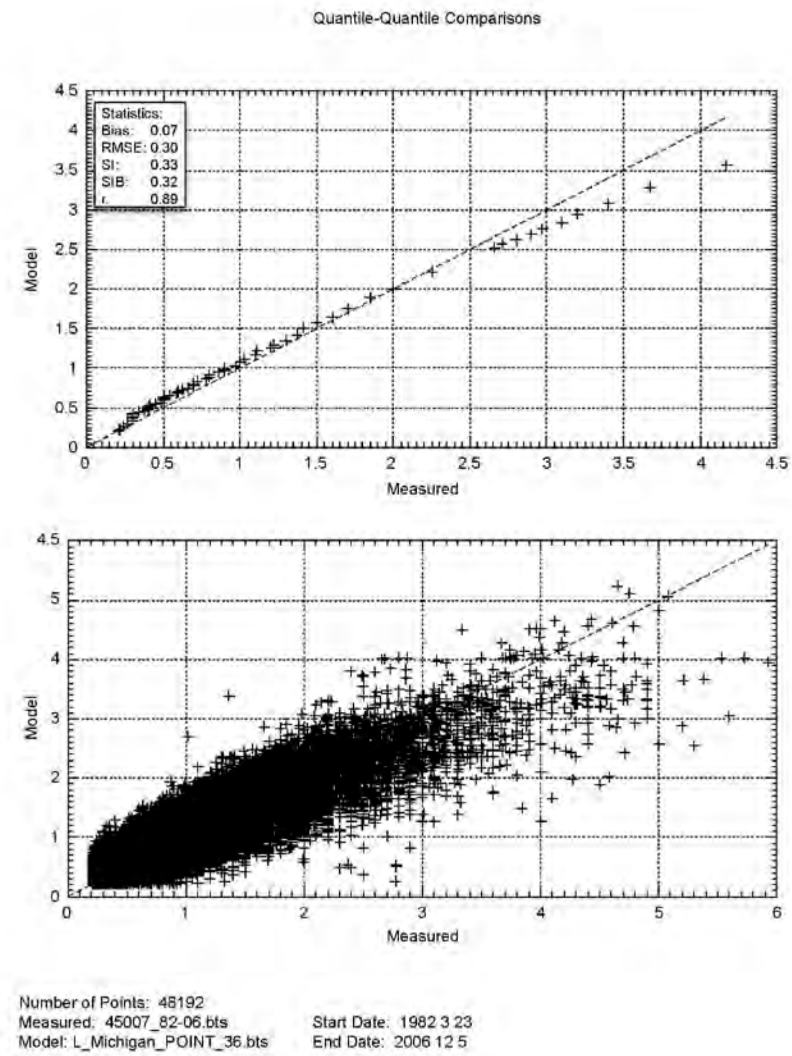


FIGURE 3: TIME SERIES COMPARISON BETWEEN MEASURED AND MODELED RESULT

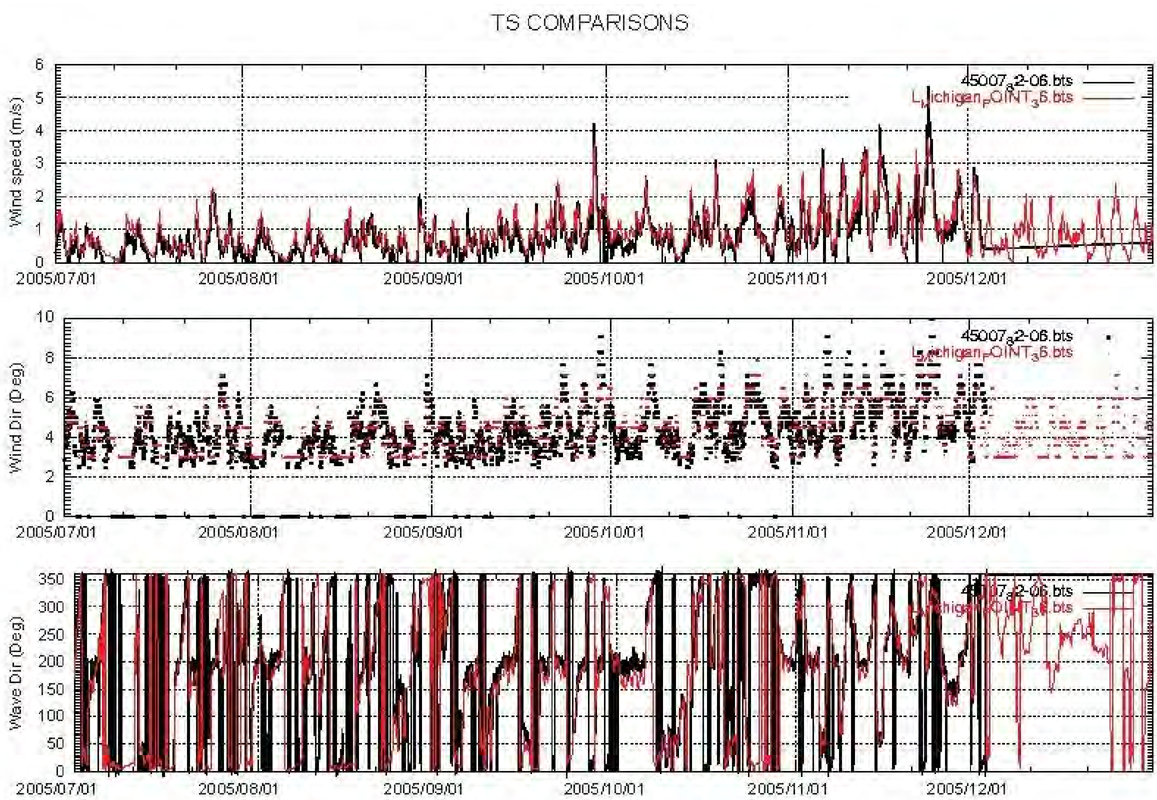
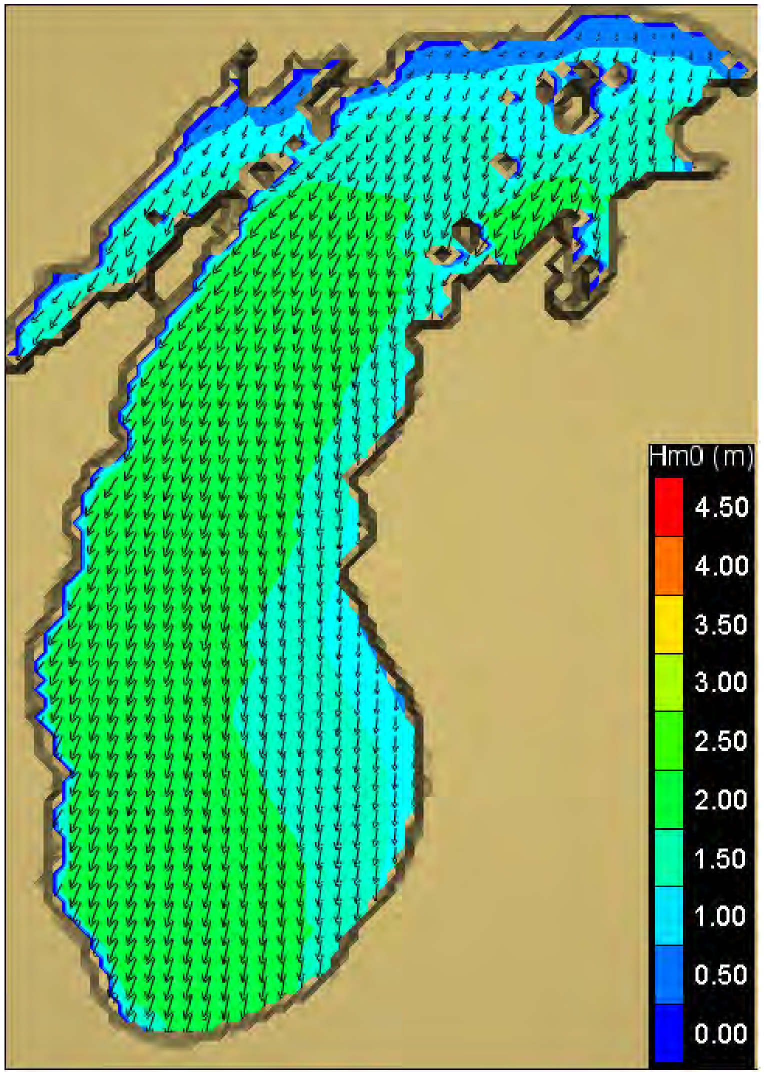


FIGURE 4: A SNAPSHOT OF WAVE MODEL RESULT



APPENDIX C3: 1951/1952 TO 2010 SHORELINE CHANGE ANALYSIS

SITE

Indiana Dunes National Lakeshore (INDL) is located at the southern end of Lake Michigan, with the coastal boundaries of the park defined by Michigan City Harbor in the northeast and Gary/USX Steel Harbor in the west. Refer to figure 1 for a location map. This is a highly modified coastal environment. It is also a landscape of contrast, featuring some of the most unique beaches and coastal dune habitat in North America, located in between large lakefill projects, ports and harbors.

This report describes the methods, results and implications of a shoreline change analysis for Indiana Dunes National Lakeshore completed with aerial photography from 1951/52 to 2010. The analysis is regional in nature, not focused on individual properties or a small segment of beach. Rather, this is a high level analysis of long term changes in the shoreline position over the last 60 years.

Older aerial photographs than 1951 might exist to document the shoreline evolution and the construction of man-made structures (the first jetties at Michigan City were constructed in 1836). However, the shoreline chance focus is on understanding the last 60 years of data and using this information to make management decisions for future project planning and implementation.

Another set of acquired aerial photographs covered the period of May 1971, which closely follows the completion of the lakefill project for the Port of Indiana.

INFLUENCE OF LAKE LEVELS AND STORMS

This region of Lake Michigan is classified as a sandy shoreline and in fact is one of the sandiest regions of the entire Great Lakes (Baird 2001). In other words, there is an abundance of sand on the lake bottom, along the beaches and in the dunes. In a completely natural system, which this is not, sand is transported in both a longshore and cross-shore direction in response to waves and currents generated during storms. Over long temporal periods, the magnitude and directionality of the storms influences the rate at which sand is transported along the coast and ultimately the resulting morphology of the shoreline. From previous technical studies, the net direction for longshore sediment transport within the limits of the study are from the northeast to the southwest (Baird 2004). Additional sediment transport modeling was completed to quantify the longshore rates (see Wave Climate and Longshore Sediment Transport Analysis).

FIGURE 1: LOCATION MAP FOR INDIANA DUNES NATIONAL LAKESHORE

Sandy shorelines are, by definition, dynamic. The position of the waterline, beach width and dunes are constantly responding to changes in lake levels and severe storm events. For example, the nearshore lake bottom, bars and beach respond to periods of rising lake levels by transferring sediment offshore (in a cross-shore direction), often leading to erosion of the dune and beach. Conversely, during periods of falling or low lake levels, sand is transferred onshore, beach width increases and aeolian processes transfer more sand into the foredune. This is typically a period of beach and dune building in the Great Lakes.

The long term lake level cycles for Lake Michigan, as recorded by the lakewide monthly mean water level, are presented in figure 2. Low Water Datum (LWD) is noted with the red line. The natural range for the still water level is almost 7 feet, which excludes the effects of storm surge. Since 1998, Lake Michigan water levels have been fluctuating in a range close to LWD, and for many locations within the study area, beaches have responded by migrating lakeward, new foredunes are growing and dune vegetation has migrated lakeward. Refer to the beach conditions in figures 3 and 4. Both pictures document a growing broad wide foredune; given the lack of shrub/woody vegetation, this accumulation began during the current low lake level period.

During periods of rising lake levels or the highs recorded in the early 1970s, mid 1980s or late 1990s, the beaches within the study area would have been significantly smaller as sand is transported in an offshore direction. In some locations, active dune erosion was likely occurring during severe storm events. In figures 3 and 4, the limit of vegetation was likely much closer to the deciduous tree line along the older dune crest.

In addition to the cross-shore response of the beaches to fluctuating lake levels, the change in the water surface elevation from the low to high cycles also exerts a strong influence on beach conditions by either exposing or covering a significant portion of the sandy beach.

FIGURE 2: LAKE MICHIGAN MONTHLY MEAN LAKE LEVELS, 1865 TO PRESENT

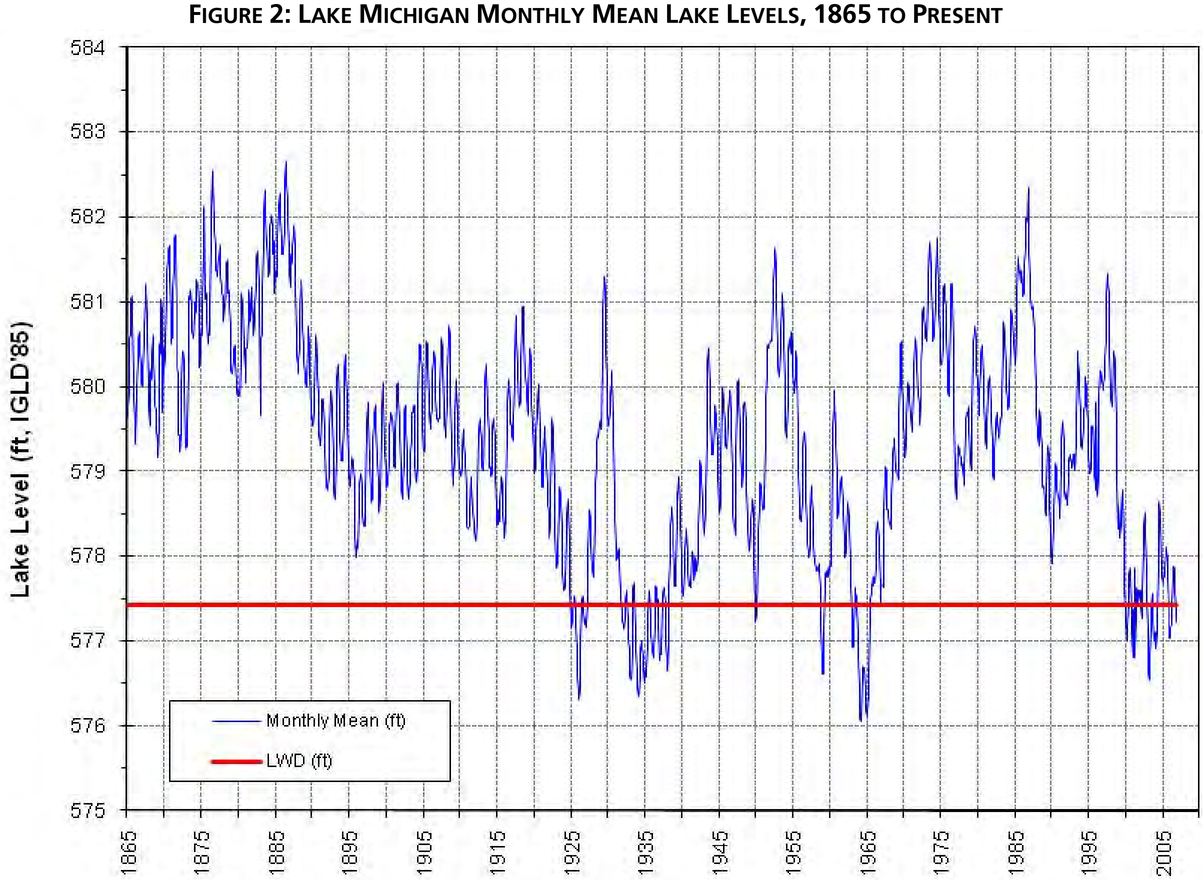


FIGURE 3: BEACH AT THE BOUNDARY OF BEVERLY SHORES AND INDIANA DUNES STATE PARK (LOOKING NORTHEAST)

FIGURE 4: BEACH CONDITIONS AT WEST BEACH, LOOKING WEST

INFLUENCE OF COASTAL STRUCTURES ON LONGSHORE SEDIMENT TRANSPORT

As discussed in Section 2.0, the direction of net longshore sediment transport within the study area is from the northeast to the southwest. When large coastal structures, such as a harbor or port, are constructed along the shoreline, they disrupt the natural flow of sediment. Typically, sediment accumulates on the updrift side of the structure, as it acts much like a large groyne. Refer to figure 5 for a conceptual sketch of this process. Downdrift of the structure, erosion typically occurs on the shadow of the port or harbor, as depicted in figure 5 for the groyne.

Within the limits of the study area, the shoreline evolution has been influenced by three very large port and harbor structures, namely the Michigan City Harbor, which is protected by Federal jetty structures, the Port of Indiana Industrial Complex, and the Gary Indiana/US Steel Harbor. The first structures at Michigan City were constructed in 1836 and have trapped approximately 36.6 million cubic yards of sediment (Baird 2005). The Port of Indiana Industrial Complex was much more recent, with construction completed in the late 1960s. The Gary Indiana/US Steel followed shortly after the Port of Indiana Industrial Complex. The influence of these large coastal structures on shoreline evolution within the study area is discussed in Section 5 of this report.

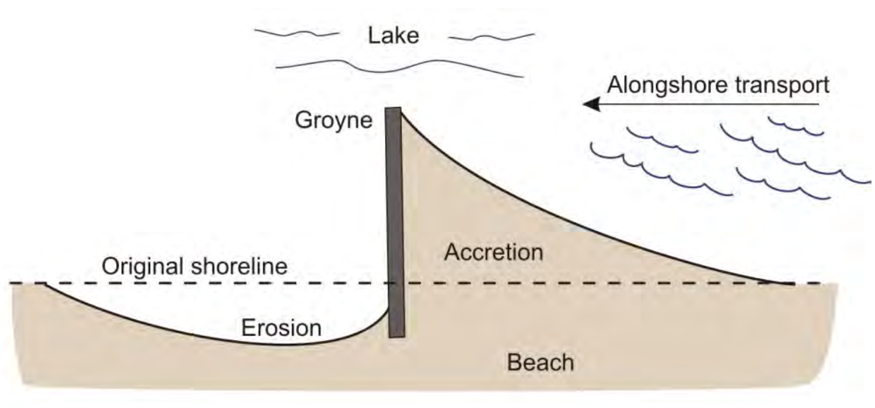
METHODS

The comparison of the shoreline position is based on aerial photo interpretation. Using photos from different temporal periods provides insight into long term trends. In order to compare photos from different temporal periods, the photos must be orthorectified. The orthorectification process takes aerial photos and removes the visual distortions created by topographical variations and the camera lens. Once an aerial photo has been orthorectified, it is commonly referred to as an orthophoto. When aerial photos from different time periods are orthorectified to a common geographic base, direct measurements and comparisons can be made between them.

The most recent set of aerial photographic imagery obtained for the study area is Summer 2010 from the US Department of Agriculture (USDA), Farm Service Agency (FSA), Aerial Photography Field Office (APFO), National Agriculture Imagery Program (NAIP).

These are provided by the USDA as ready-to-use orthophotos. The orthophotos have a 1 meter (3 feet) ground resolution. The oldest set of available and acquired aerial photos with sufficient resolution detail is a set of photos

FIGURE 5: INFLUENCE OF COASTAL STRUCTURES (GROYNES) ON BEACH ACCRETION AND EROSION



from December 1951 and March 1952 from the US Department of the Interior (USDI), US Geological Survey (USGS). These photos were orthorectified using PCI Geomatica's OrthoEngine software, using ground control information taken from the USDA 2010 orthophotos and using an elevation model provided by the USGS. These orthophotos have a ground resolution of 3 meters (9 feet).

To compare the shoreline position change between these two time periods, the visible water's edge was digitally traced using E.S.R.I.'s ArcGIS ArcMap software at a scale of 1:3,000 and is considered as shoreline for the water level on the day of the photography. Since the water level in 1951/52 and 2010 were not identical, direct measurements between these two shorelines would introduce a bias associated with the lower lake level conditions during the 2010 photography. Table 1 summarizes all the photographs utilized in this analysis, along with the date of capture and the associated monthly mean lake level (ft, IGLD'85).

TABLE 1: SUMMARY OF AIR PHOTOGRAPHS AND MONTHLY MEAN LAKE LEVELS

Date	Shoreline Extent	Monthly Mean Lake Level (feet)
12/9/1951	Gary to Beverly Shores	580.5
3/27/1952	Beverly Shores to Michigan City	580.6
5/3/1971	Gary to Port of Indiana Industrial Complex	580.3
5/14/1971	Port of Indiana Industrial Complex to Michigan City	580.3
06 to 08/2010	Entire Study Area	578.3

The lake surface elevation difference between the 1951/52 photos and those captured in 2010 was 2.25 ft. To correct for this difference in lake levels, the beach and nearshore slopes for the sections of shoreline between Michigan City and the Port of Indiana Industrial Complex were analyzed next. Using recent LIDAR topography and bathymetry, the average beach slope between the 580.5 to 583.5 ft contours (IGLD'85) was calculated to be 1:18 (V:H). The same procedure was applied to a 2,300-foot stretch of shoreline between the Port of Indiana Industrial Complex and Gary. Here the calculated beach slope was 1:15 (V:H).

Since the trend in lake levels between the 1951/52 aerial photograph and 2010 was a drop in water level of 2.25 ft, and the former lakebed in 1951/52 is now exposed due to lower water level conditions, the nearshore slope was also calculated between the 570 and 580 ft contours for the shoreline between Michigan City and the Port of Indiana Industrial Complex. Based on the detailed LIDAR bathymetry, an average nearshore slope of 1:35 (V:H) was calculated. This slope (1:35) was used to correct the shoreline change transects described in the following paragraphs.

To measure the change between these two shorelines, Baird has developed a tool that automates the process of measuring transects between the shorelines at a user defined interval (Zuzek et al, 2003) along a fixed baseline. For this study area, an interval of 66 feet was chosen, resulting in 1,450 transect lines measuring the difference in the shoreline position from 1951/52 and 2010. The individual transects are coded with information such as length, angle and trend (erosion/accretion). The length of each individual transect was corrected in our spreadsheet to account for the lakeward position of the 2010 shoreline due to a lake level that was 2.25 feet lower than the conditions that existed in 1951/52. The corrected transect information was used to characterize the change in shoreline position at the individual transects and establish regional trends or reaches within the study limits.

RESULTS

The study area from Michigan City to Gary Indiana has been sub-divided into seven reaches based on the recorded long term shoreline change trends. The reach name, length, trend and average shoreline change rate is summarized in table 2 and visually in the figures attached at the end of this report. To note that the erosion transects are shown in red and the accretion transects are depicted in yellow.

TABLE 2: SHORELINE REACHES AND LONG-TERM TREND (1951/52 TO 2010)

Reach	Name	Approximate Length	Trend	1951/52 to 2010 Average Shoreline Change Rate
Michigan City				
A	Mount Baldy Erosion Zone	11,300 ft	Erosion	4.5 ft/yr
B	Beverly Shores to Dune Acres	42,600 ft	Dynamically Stable	n/a
C	Port of Indiana Industrial Complex Fillet Beach	7,700 ft	Accretion	7.6 ft/yr
Port of Indiana Industrial Complex				
D	Burns Waterway Small Boat Harbor–Fillet Beach	3,900	Accretion	2.1 ft/yr
E	Town of Ogden Dunes	3,900 ft	Erosion	2.7 ft/yr
Gary Indiana / U.S. Steel				
F	West Beach to Miller	15,100 ft	Dynamically Stable	n/a
G	Gary USX Steel Harbor–Fillet Beach	11,500 ft	Accretion	5.1 ft/yr

Notes:
ft = feet
ft/yr = feet per year
U.S. = United States

The shoreline transects for the study area are plotted in detail on a series of formatted map panels and attached to this report. Each map presents the 1951/52 photograph with the 1951/52 and 2010 shorelines and the 2010 photograph with the 1951/52 and 2010 shorelines overlaid. On these maps, the shoreline position was not corrected. However, the individual transect measurements were corrected for the shoreline change rates reported in table 2 above.

It is also worth noting that the 1971 shoreline is also included on the individual map tiles. The difference in the lake level from 1951/52 to 1971 was 0.25 ft and thus the actual positions can be compared without a correction. This photo series was selected for the analysis since it corresponded closely to the post-construction era for the Port of Indiana and Gary. A summary of the shoreline change analysis results is presented as follows.

Reach A: Downdrift of the Michigan City jetties and the steel sheet pile wall protecting the NIPSCO property, the Mount Baldy erosion zone extends approximately 2 miles. The long-term erosion rate for this reach is 4.5 ft/yr. Without the ongoing nourishment program, the erosion rate would be even higher.

Reach B: This reach extends from the Beverly Shores community to the western limits of the Dune Acres, a total distance of 8 miles. Between 1951/52 and present, once the transect measurements were corrected for lake level differences, the average rate of change was accretion of approximately 0.3 ft/yr (which is likely within the error limits of the analysis). The present waterline position is heavily influenced by the current period of low lake levels. Once high lake levels return, a considerable amount of this accreted beach will erode. Also, for many of the transects, the trend from 1951/52 and 1971 was actually erosion. Therefore, this portion of the study area has been classified as dynamically stable. In other words, both periods of erosion and accretion have occurred and will occur in the future. The product of these shoreline fluctuations is a net change of close to zero.

The dynamic nature of this shoreline is further highlighted by the 1951/52 to 2010 shoreline comparison for the Beverly Shores area. Although the beach has migrated lakeward from 1951/52 to 2010, some of cottages that were located lakeward of the road are now gone. It is possible they were lost or damaged during the high lake period between early 1970 and late 1990. The visible waterline in the 1971 photo series confirms that parts of the shoreline eroded during this period of high lake levels.

Reach C: The updrift fillet beach at the Port of Indiana Industrial Complex is 1.5 miles in length and has been rapidly accreting since the port was constructed. The average accretion rate is 7.6 ft/yr. Without the Port of Indiana Industrial Complex, this sediment would be spread along the beaches of Ogden Dunes to Marquette Park.

Reach D: Since the construction of the jetties at the mouth of the Burns Waterway Small Boat Harbor, the relatively straight 1971 shoreline is re-aligned against the jetties. The average accretion rate from 1951/52 to 2010 is 2.1 ft/yr) for a distance of approximately 0.75 miles. However, based on the position of the 1971 shoreline, it appears the sand in this sub-cell has just migrated into the present fillet beach (not a net gain to the sub-cell).

Reach E: The beach fronting the Town of Ogden Dunes community has a long-term erosion rate of 2.7 ft/yr, which is attributed to the sediment starved conditions created by the Port of Indiana Industrial Complex.

Reach F: Between the Port of Indiana Industrial Complex and Gary USX Steel Harbor, 2.8 miles of shoreline is classified as dynamically stable. Although the average transect change rate was accretion of 0.65 ft/yr, this rate of change is considered to be within the error of the analysis and is also highly influenced by the present low water conditions. The position of the 1971 shoreline was very similar to the 1951/52 conditions. The present wide beach conditions could change significantly during average or high lake levels.

Reach G: The fillet beach adjacent to the Gary USX Steel Harbor-east breakwater is 2.2 miles in length and features an average accretion rate of 5.1 ft/yr. A significant volume of sediment has accumulated in this region and this process will continue, especially if dredging around NIPSCO intake and mechanical bypassing continue. At some point in the future, sediment will migrate along the outer limit of the Gary USX Steel Harbor and some will accumulate in the navigation channel.

USACE INDIANA SHORELINE MONITORING REPORT (2008)

The USACE has been nourishing the shoreline downdrift of Michigan City since 1974. In 2008 a comprehensive monitoring report was prepared to review the shoreline evolution between Michigan City and the Port of Indiana using aerial photographs and beach profile surveys. The following bullet points highlight key findings relevant to the present investigation for Indiana Dunes National Lakeshore:

- Between 1974 and 2004, nourishment was placed on the beach immediate east of Mount Baldy on 11 out of 30 years. A total of 925,000 cubic yards was placed from upland sources and sediment bypassed at Michigan City, for an annual average of approximately 30,800 cubic yards.
- Baird's (2004) sediment budget study determined there was a 105,000 cubic yard deficit at Mount Baldy due to the sand trapped at Michigan City. Therefore, despite the substantial effort to nourish the beaches downdrift of the harbor, erosion will continue until this deficit is substantially reduced.
- Since the focus of the investigation was monitoring downdrift shoreline evolution following the beach nourishment, aerial photographs were analyzed from 1979, 2000 and 2005. A 2 ft contour was derived from the photographs by digitizing the shoreline and adjusting the position landward or lakeward using a fixed beach slope. A fourth 2 ft contour was derived from a 1997 SHOALS survey of the study area.
- Shoreline change measurements were made of 400 ft intervals along a baseline from 1979 to 2005, then annualized as ft/yr. Qualitative descriptors were also generated for the measurements at 400 ft intervals. Figure 18 from the USACE report is reproduced in this report.
- The shoreline change analysis generally identified similar trends to the results summarized in this report, with significant erosion fronting the Mount

Baldy dunes even in light of the beach nourishment and a large accretion zone to the east of the Port of Indiana/NIPSCO plant. For the central portion of the shoreline (Beverly Shores and State Park), the USACE report identified accretion rates ranging from "very slow" to "moderate" to a few isolated cases of "rapid". The "rapid" classification appears to be attributed to sand waves moving along the coastline. The Baird analysis in this report for the central region concluded the shoreline was dynamically stable but it should be noted the duration of our analysis was much longer (1952/52 to 2010). From 1951/52 to 1971 the shoreline actually eroded in some locations, which was part of the rationale for classifying this region as dynamically stable. It should also be noted when positional errors due to photo registration and digitizing the shorelines are considered, small rates of change actually fall within the error limits of the analysis. Refer to Zuzek et al. (2003).

- Nine beach profiles offshore of Mount Baldy were analyzed from 1997 to 2005. Based on a 3 dimensional surface comparison of the raw point data, the net lakebed change was a small gain of 0.1 ft (averaged across the entire area). Refer to the figure reproduced in this report. It should be noted that the change was not uniform, with significant accretion at the shoreline (0 to +6 ft). This accretion was likely attributed to both the beach nourishment program and the significant drop in lake levels from 1997 to 2005. Offshore of the beach, there are significant areas were lakebed erosion ranging from 1 to 4 feet were documented. As the lakebed in this region is presumed to be exposed glacial sediment (lacustrine clay), this erosion represents the permanent removal and lowering of the lake bottom. This finding is an important design consideration for developing long-term shoreline stabilization options for the park in the future.

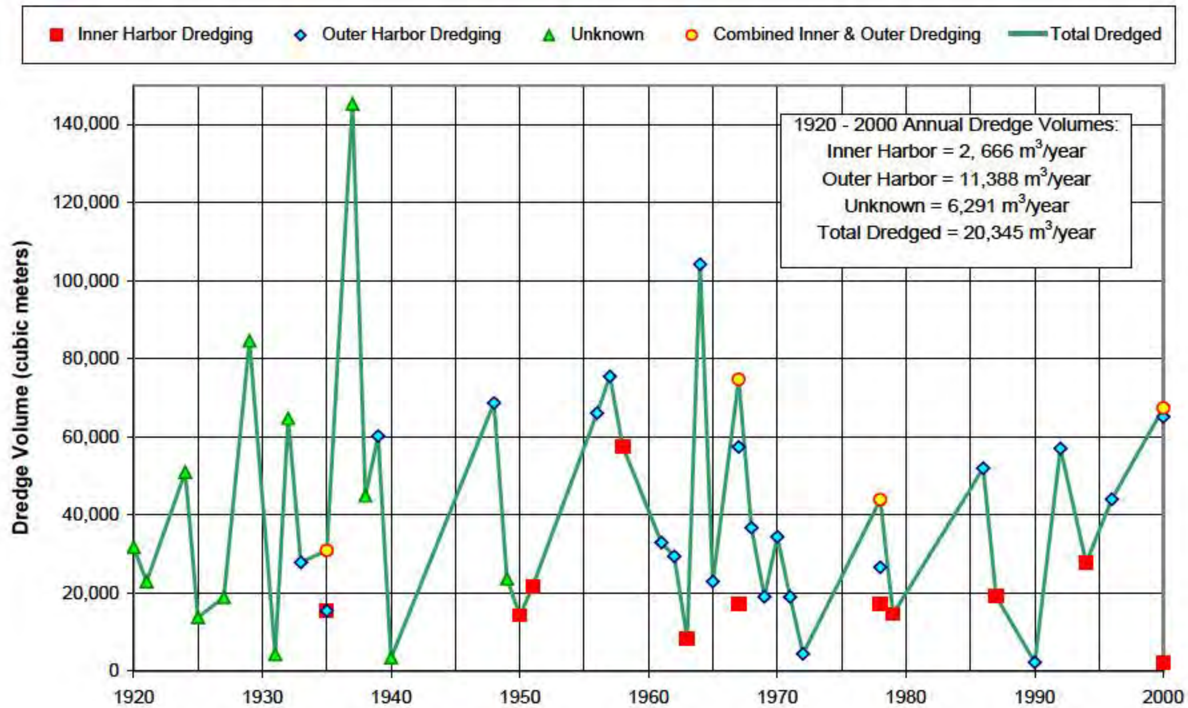
DREDGING AND BEACH NOURISHMENT SUMMARY

Dredging and beach nourishment data in the project area has been compiled from various sources. This data, together with the shoreline evolution analysis, will provide useful information in support of the shoreline restoration alternatives. The dredging and beach nourishment records for Michigan City were assembled by the USACE-Chicago District from 1920 to 2000. Data for Burns Harbor Waterway, Burns Small Boat Harbor and NIPSCO/Bailly Intake has been summarized from USACE from 1980 to 2009. The Mount Baldy beach nourishment data has been assembled from both NPS and USACE data.

Michigan City

The historical records provided the year and volume of sediment removed from the lake bed, but the location of the dredging is not specified. Consequently, the location of the dredging is categorized as: inner harbor, outer harbor, combined inner and outer harbor or unknown. The results of this analysis are presented graphically for the period of 1920 to 2000 in figure 6. The individual colored symbols indicate the location of the dredging, while the green line is the cumulative yearly total, regardless of location.

FIGURE 6: MICHIGAN CITY DREDGING SUMMARY



Burns Waterway, Small Boat Harbor and NIPSCO/Bailly

The historical records provided the for Burns Waterway Harbor between 1986 and 2009 show that a total of 537,000 cubic yards have been dredged, and placed as open-water disposal offshore of the Harbor.

Dredging records between 1985 and 2009 for the Burns Small Boat Harbor show that 282,000 cubic yards of materials have been removed and placed on the beach immediately west of the harbor breakwater (NPS Portage Lakefront), and in the near-shore area of Ogden Dunes.

The NIPSCO/Bailly water intake location has been dredged to -21 feet water depth at LWD since 1980 by NIPSCO and, starting in 2006, by USACE. The maintenance program has been irregular, making planning predictions of future dredging needs difficult.

A total of 2,212,000 cubic yards of sand has been removed and primarily placed in the near-shore area in front of Ogden Dunes (1,487,500 cubic yards) while Beverly Shores received a total of 311,500 cubic yards. The remaining quantity had an unspecified open-water placement location.

One noteworthy finding is that the Ogden Dunes beach nourishment started to occur in 1986, allowing placement of material 1,500 feet offshore, and 1,500 feet west of the Burns Waterway Small Boat Harbor inner breakwater. The dredged material placement involves open water disposal in a water depth between 12 feet (considered safe draft for opening split-hull barges bottom hull) and 18 feet (considered safe water depth in order not to allow the placed sand to migrate offshore). The most current permit (revised in 1995) allows placement within 1,500 feet of the shoreline.

Based on consecutive 2006, 2007, 2008, and 2009 dredging quantities, an average annual quantity of 118,000 cubic yards has been removed from the NIPSCO intake and placed at Ogden Dunes. To note that for 7 consecutive years (between 1999 and 2006) no dredging occurred. On a long-term (1986 to 2009) average basis, approximately 74,000 cubic yards have been placed at Ogden Dunes.

The Beverly Shores area was nourished only between 1986 and 1999, with an average quantity of 52,000 cubic yards per dredging event. No other nourishment records were found. Table 3 shows a summary of the Burns Waterway, Small Boat Harbor, and NIPSCO/Bailly quantities dredged.

TABLE 3: DREDGING SUMMARY FOR BURNS WATERWAY SMALL BOAT HARBOR (1980 TO 2009)

Project	Year	Qty. (cyds)
Burns Waterway Harbor	2009	49,000
	2008	55,000
	2007	100,0000
	1996	266,000
	1986	67,000
Burns Small Boat Harbor	2009	80,000
	2000	143,000
	1985	59,000
NIPSCO Intake (USACE Dredging)	2009	110,000
	2008	105,000
	2007	228,000
	2006	30,000
NIPSCO Intake (USACE Dredging)	1999	165,000
	1997	146,000
	1995	118,000
	1992	209,000
	1989	288,000
	1986	320,000
	1982	218,000
	1980	275,000
Total		3,3031,000

Mount Baldy

The beaches fronting Mount Baldy have been nourished since 1974. A total of 792,884 cubic yards have been trucked to the site from upland sources and placed on the beach. In addition, 371,373 cubic yards of sediment dredged hydraulically from the Michigan City Harbor has been placed on the beach. When annualized, approximately 31,465 cubic yards of sand has been placed since 1974 as a long-term average quantity. To note this is a lot less than the calculated 105,000 cubic yards deficit needed due to the sand trapped at Michigan City.

Therefore, despite the efforts to stabilize the shore, the beach and dune continue to erode at Mount Baldy. A summary of the Mount Baldy beach nourishment is presented in table 4.

TABLE 4: BEACH NOURISHMENT FOR MOUNT BALDY (1974 TO 2008)

Project	Year	Upland (Trucking) Qty. (cyds)	Michigan City Harbor (Hydraulic Dredging) Qty. (cyds)
Mount Baldy Beach Nourishment*	2010	56250	
	2008	17,273	30,159
	2007	17,273	
	2005	9500	13,962
	2004	17,500	
	2003	52,298	51,119
	2001	42,750	
	2000		85,251
	1999	36,000	
	1998	107,000	
	1997	73,000	
	1996	57,000	48,201
	1992		74,642
	1987		68,039
	1981	80,000	
	1974	227,000	
Total		792,844	371,373

Notes:
cyds = cubic yards
qty = quantity

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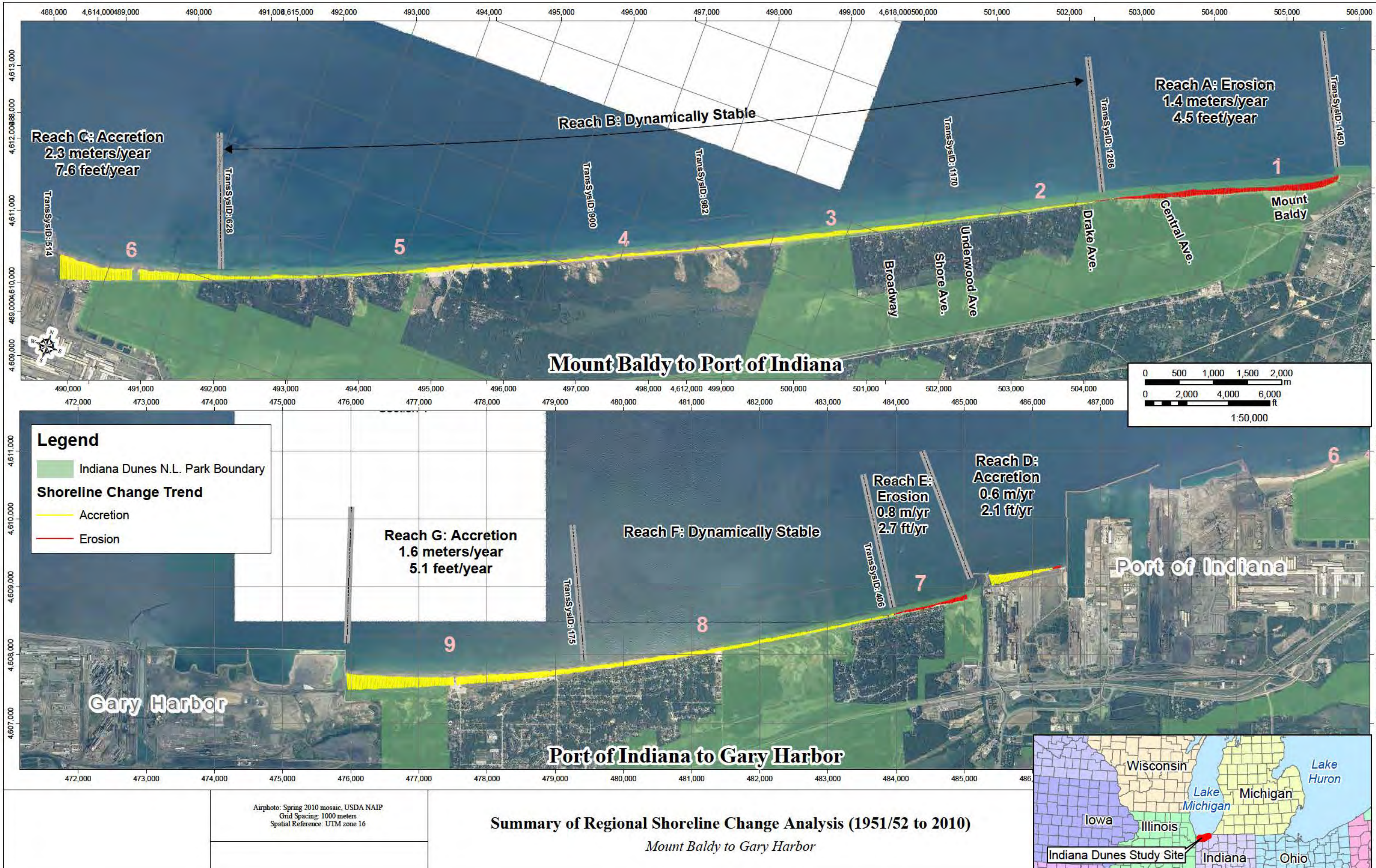
2001 FEPS Development and Application to the Lake Michigan Potential Damages Study Prototype Counties. Prepared for the USACE, Detroit District.

2004 Evaluation of Dredged Material Management Plans for Michigan City. Prepared for the USACE, Detroit District.

U.S. Army Corps of Engineers (USACE), Chicago District
2010 Burns Waterway Harbor, Indiana Shoreline Damage Mitigation Reconnaissance Study.

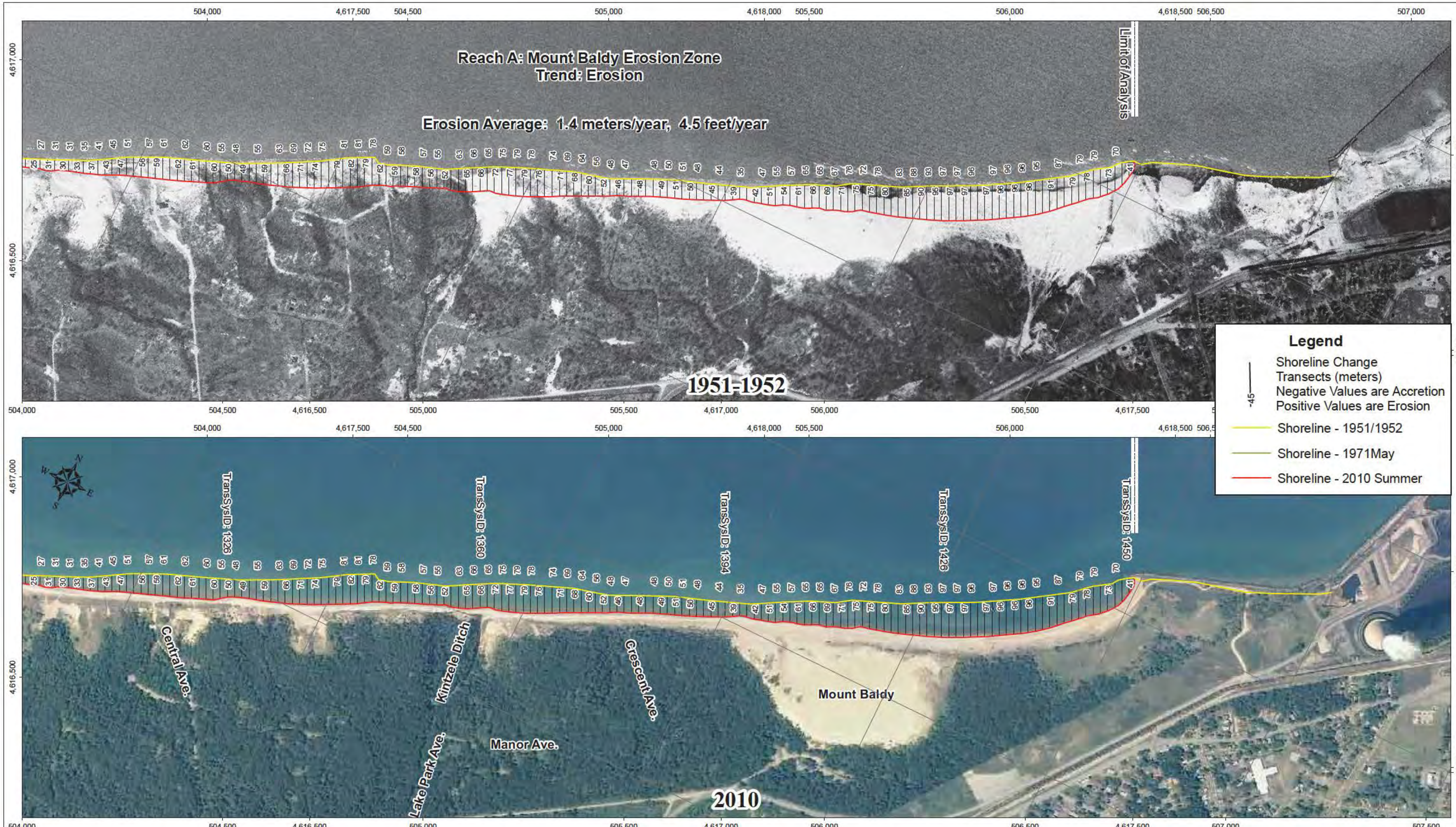
Zuzek, P.J., R.B. Nairn, and S.J. Thieme
2003 Spatial and Temporal Considerations for Calculating Shoreline Change Rates in the Great Lakes Basin. Journal of Coastal Research, Special Issue No. 38.



Airphoto: Spring 2010 mosaic, USDA NAIP
Grid Spacing: 1000 meters
Spatial Reference: UTM zone 16

Summary of Regional Shoreline Change Analysis (1951/52 to 2010)

Mount Baldy to Gary Harbor



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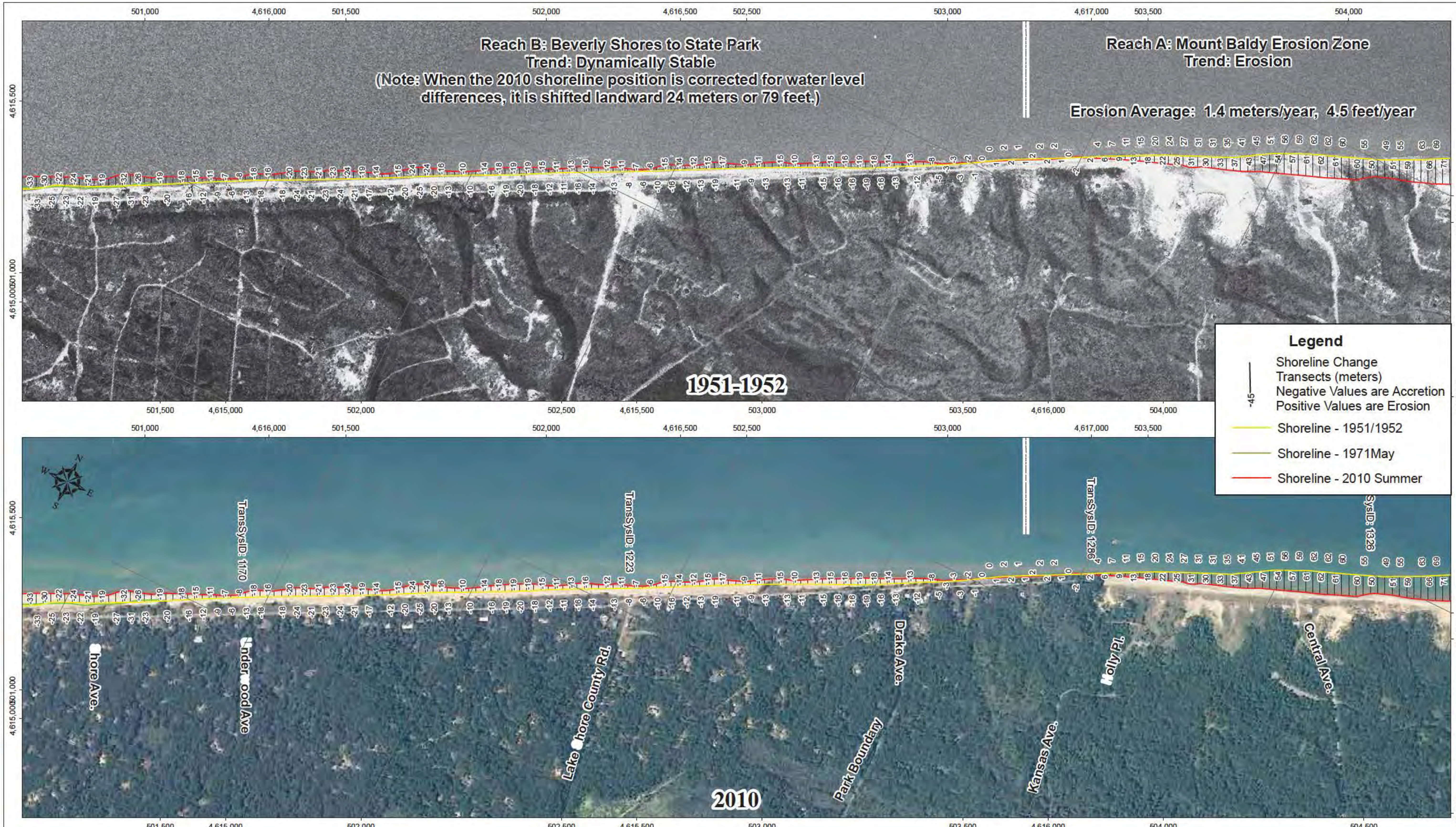
Top Airphotos: Dec 1951 and March 1952, USGS
Bottom Airphoto: Summer 2010 mosaic, USDA NAIP
Grid Spacing: 500 meters
Spatial Reference: UTM zone 16

1951/52 to 2010 Shoreline Comparison (transects in meters)

Note: Shoreline position in 1951/52 and 2010 not adjusted for lake level differences on these maps. However, individual transect values were adjusted for lake levels for the rates reported on these maps.

Map Published: 2011Jan17



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0 500 1,000 ft

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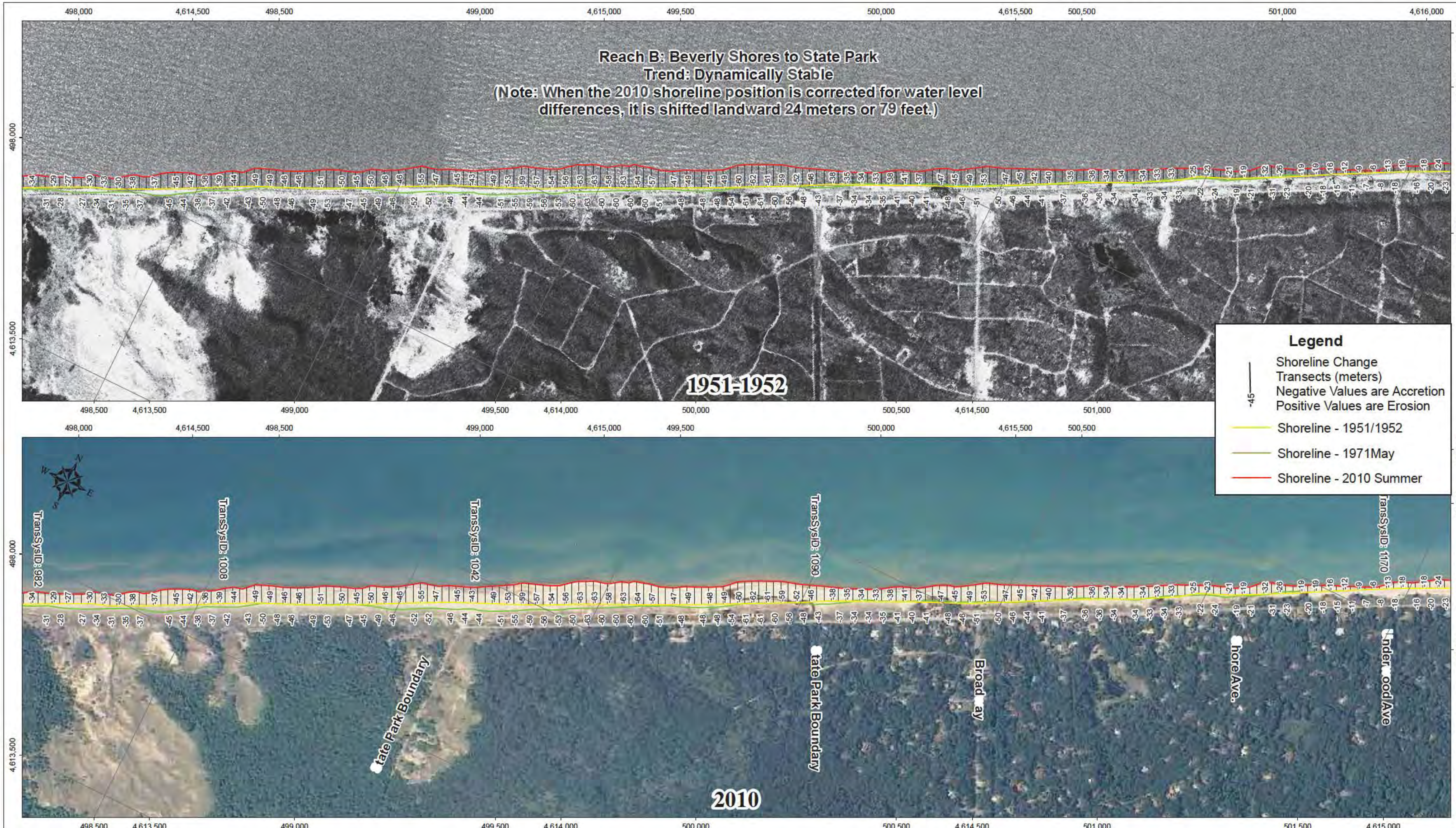
Top Airphotos: Dec 1951 and March 1952, USGS
Bottom Airphoto: Summer 2010 mosaic, USDA NAIP
Grid Spacing: 500 meters
Spatial Reference: UTM zone 16

1951/52 to 2010 Shoreline Comparison (transects in meters)

Note: Shoreline position in 1951/52 and 2010 not adjusted for lake level differences on these maps. However, individual transect values were adjusted for lake levels for the rates reported on these maps.

373

Map Published: 2011Jan17



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0 500 1,000 ft

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Top Airphotos: Dec 1951 and March 1952, USGS
Bottom Airphoto: Summer 2010 mosaic, USDA NAIP
Grid Spacing: 500 meters
Spatial Reference: UTM zone 16

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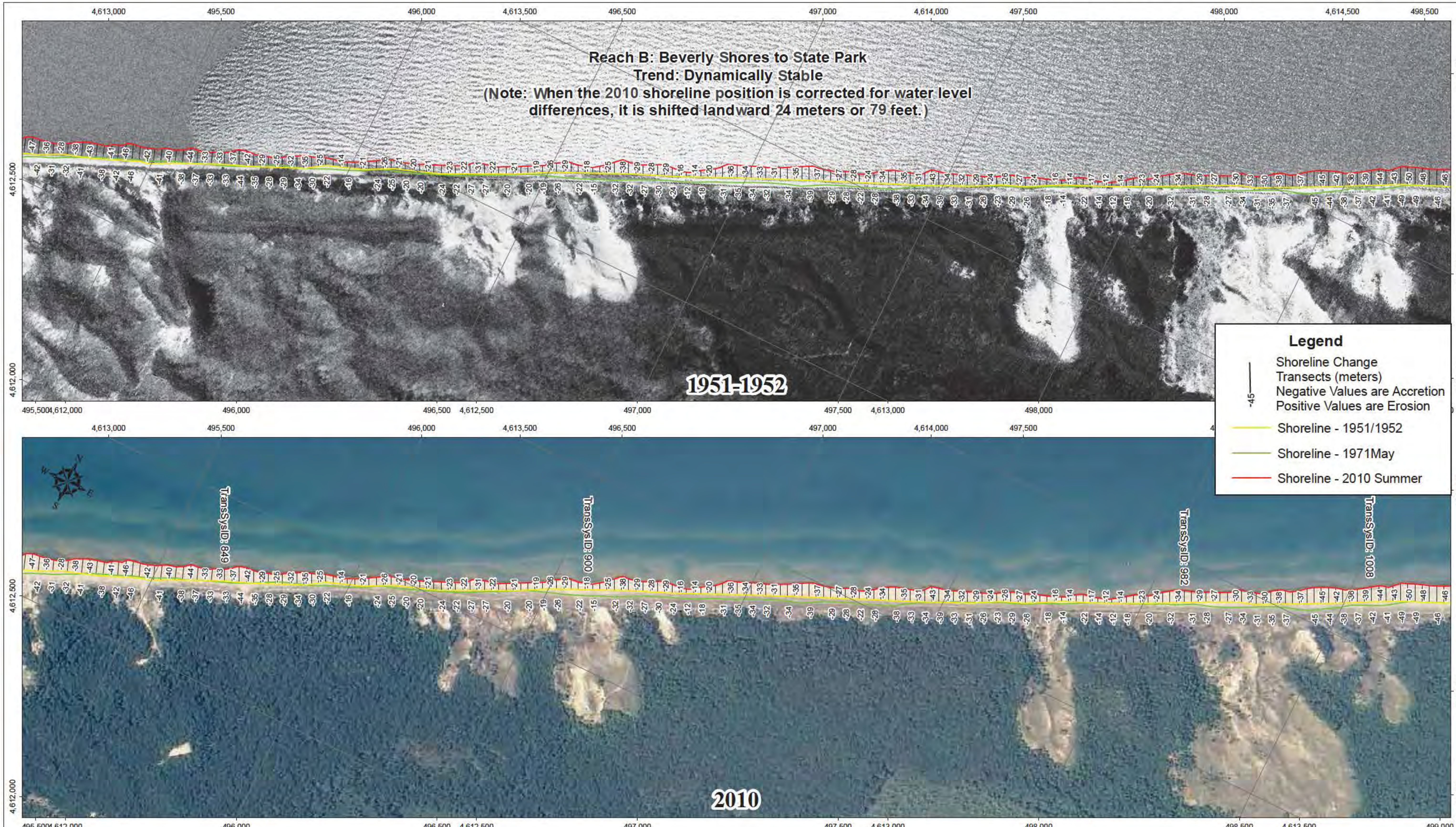
Note: Shoreline position in 1951/52 and 2010 not adjusted for lake level differences on these maps. However, individual transect values were adjusted for lake levels for the rates reported on these maps.



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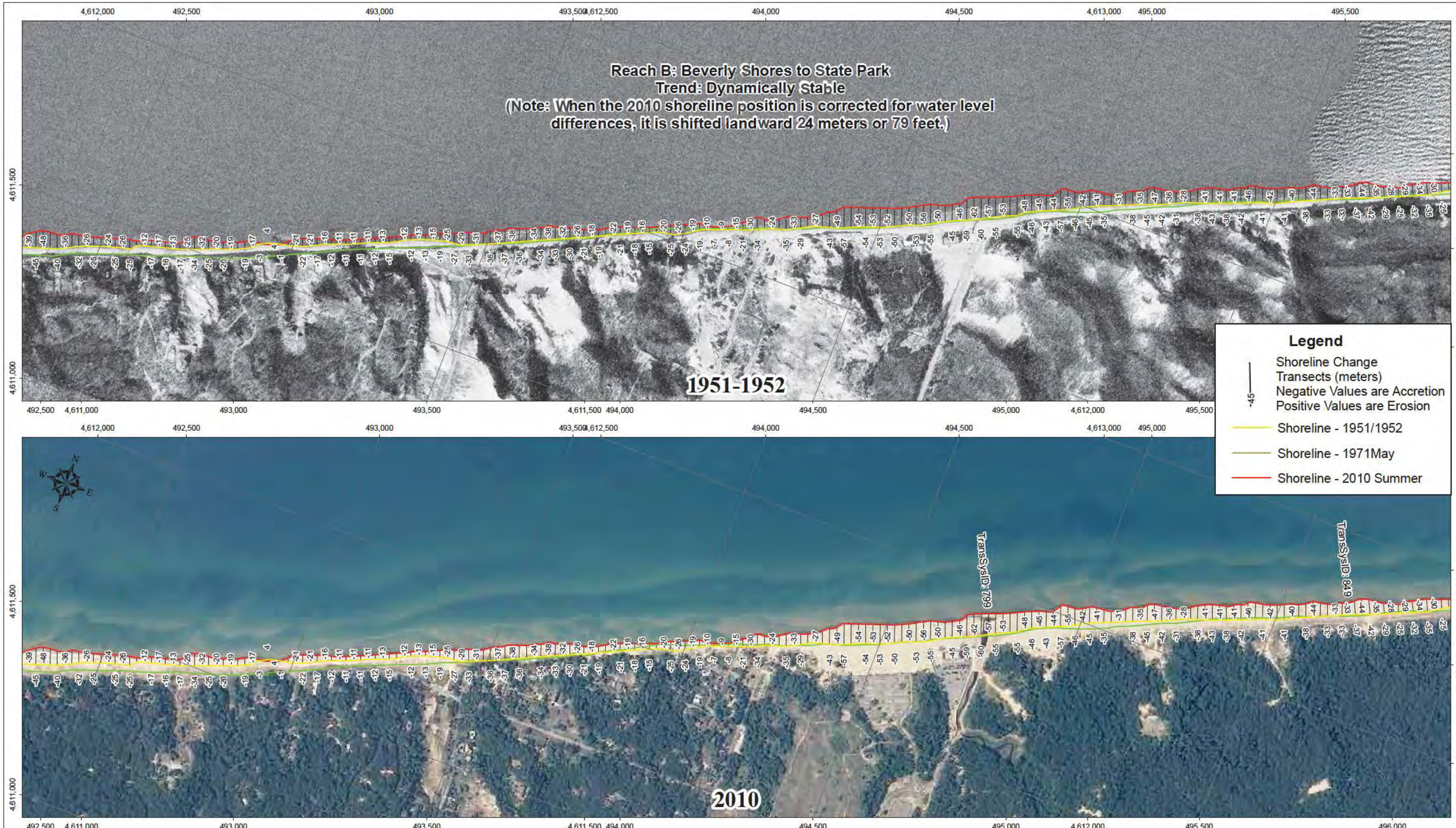
Top Airphotos: Dec 1951 and March 1952, USGS
Bottom Airphoto: Summer 2010 mosaic, USDA NAIP
Grid Spacing: 500 meters
Spatial Reference: UTM zone 16

1951/52 to 2010 Shoreline Comparison (transects in meters)

Note: Shoreline position in 1951/52 and 2010 not adjusted for lake level differences on these maps. However, individual transect values were adjusted for lake levels for the rates reported on these maps.



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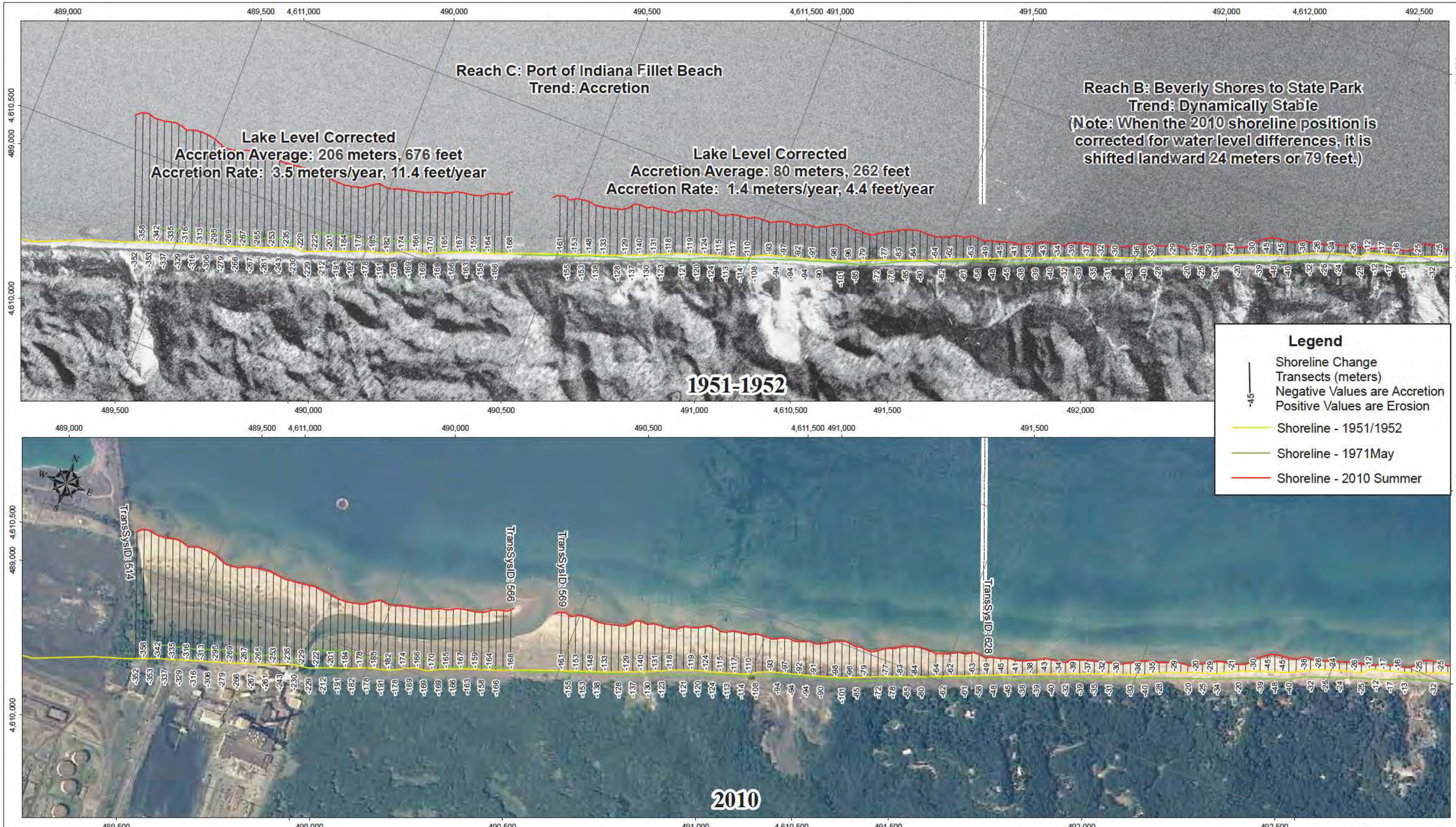
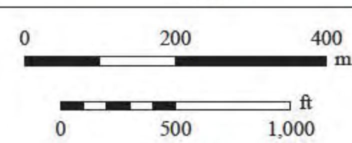
Top Airphotos: Dec 1951 and March 1952, USGS
Bottom Airphoto: Summer 2010 mosaic, USDA NAIP
Grid Spacing: 500 meters
Spatial Reference: UTM zone 16

1951/52 to 2010 Shoreline Comparison (transects in meters)

Note: Shoreline position in 1951/52 and 2010 not adjusted for lake level differences on these maps. However, individual transect values were adjusted for lake levels for the rates reported on these maps.





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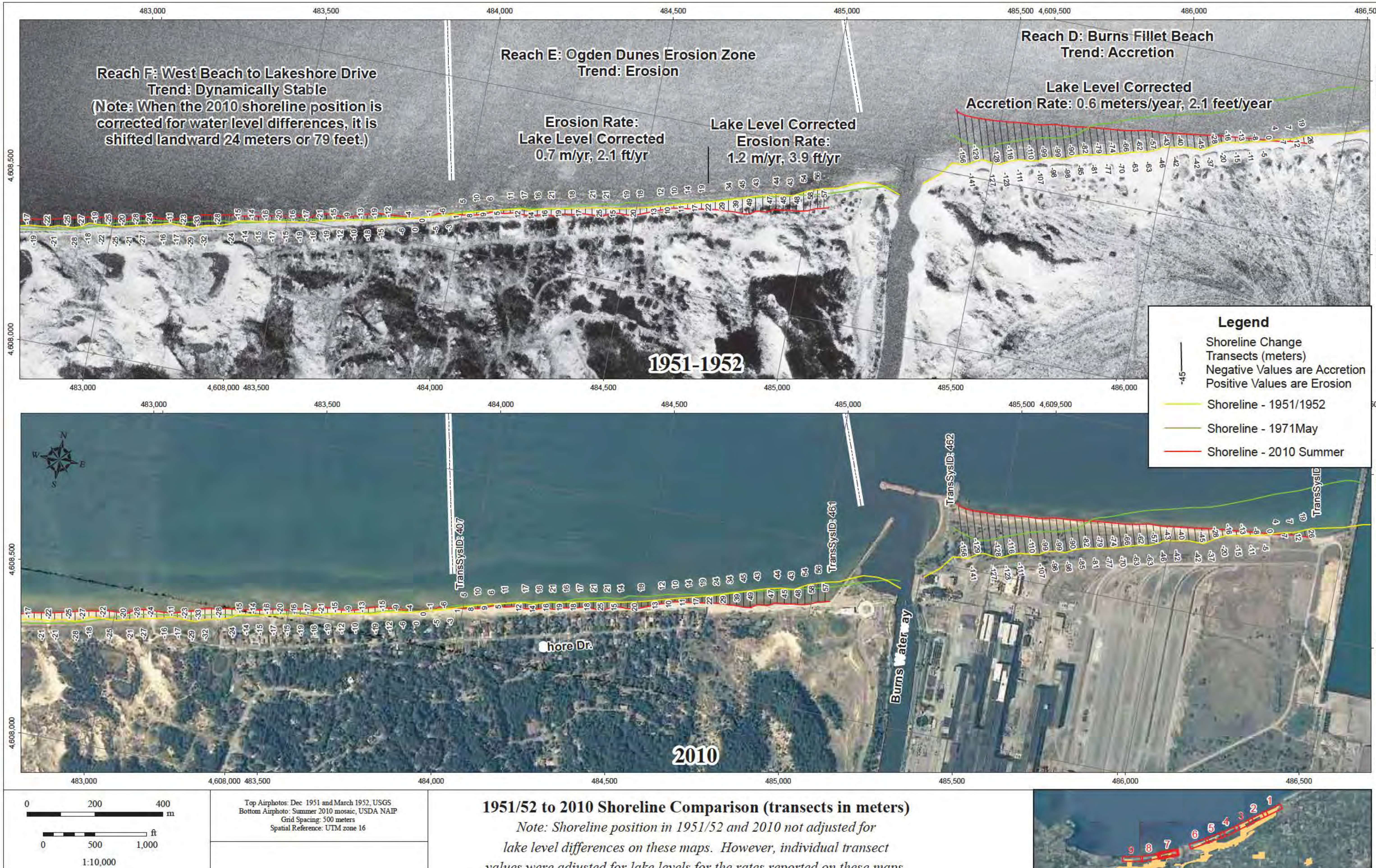
Top Airphotos: Dec 1951 and March 1952, USGS
Bottom Airphoto: Summer 2010 mosaic, USDA NAIP
Grid Spacing: 500 meters
Spatial Reference: UTM zone 16

1951/52 to 2010 Shoreline Comparison (transects in meters)

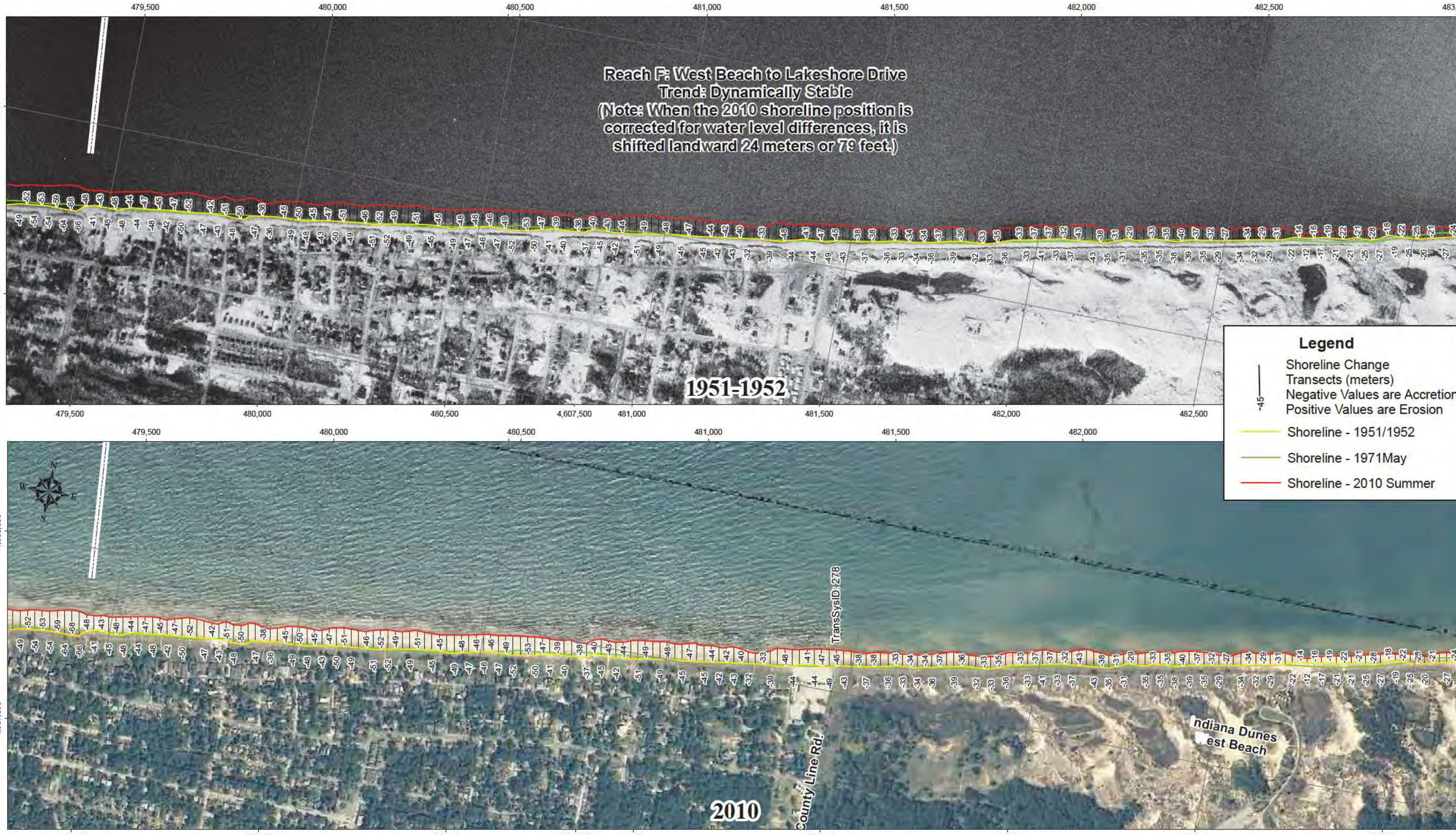
Note: Shoreline position in 1951/52 and 2010 not adjusted for lake level differences on these maps. However, individual transect values were adjusted for lake levels for the rates reported on these maps.



Top Airphotos: Dec 1951 and March 1952, USGS
Bottom Airphoto: Summer 2010 mosaic, USDA NAIP
Grid Spacing: 500 meters
Spatial Reference: UTM zone 16

1951/52 to 2010 Shoreline Comparison (transects in meters)

Note: Shoreline position in 1951/52 and 2010 not adjusted for lake level differences on these maps. However, individual transect values were adjusted for lake levels for the rates reported on these maps.



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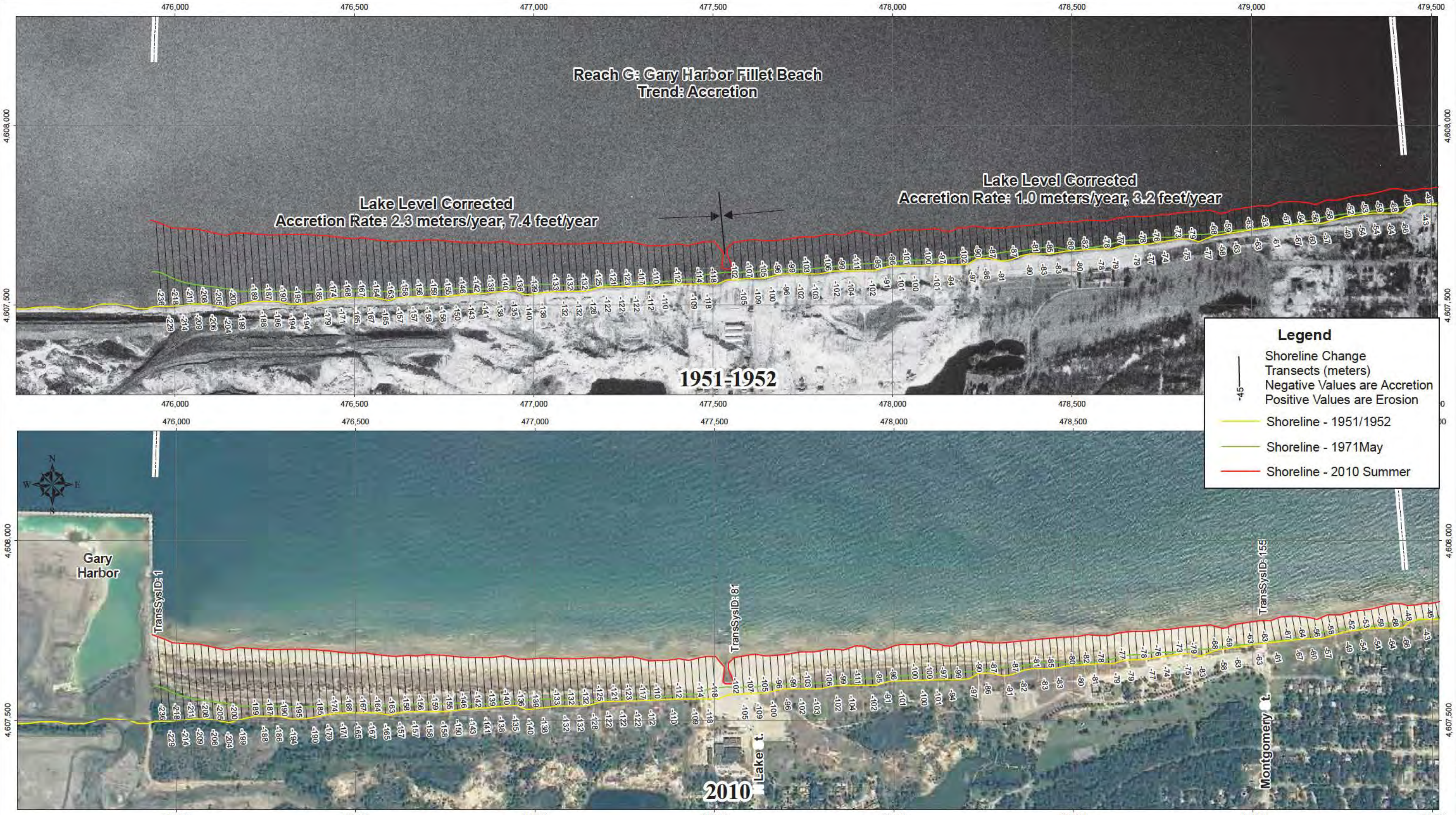
Top Airphotos: Dec 1951 and March 1952, USGS
Bottom Airphoto: Summer 2010 mosaic, USDA NAIP
Grid Spacing: 500 meters
Spatial Reference: UTM zone 16

1951/52 to 2010 Shoreline Comparison (transects in meters)

Note: Shoreline position in 1951/52 and 2010 not adjusted for lake level differences on these maps. However, individual transect values were adjusted for lake levels for the rates reported on these maps.



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Top Airphotos: Dec 1951 and March 1952, USGS
Bottom Airphoto: Summer 2010 mosaic, USDA NAIP
Grid Spacing: 500 meters
Spatial Reference: UTM zone 16

1951/52 to 2010 Shoreline Comparison (transects in meters)

Note: Shoreline position in 1951/52 and 2010 not adjusted for lake level differences on these maps. However, individual transect values were adjusted for lake levels for the rates reported on these maps.

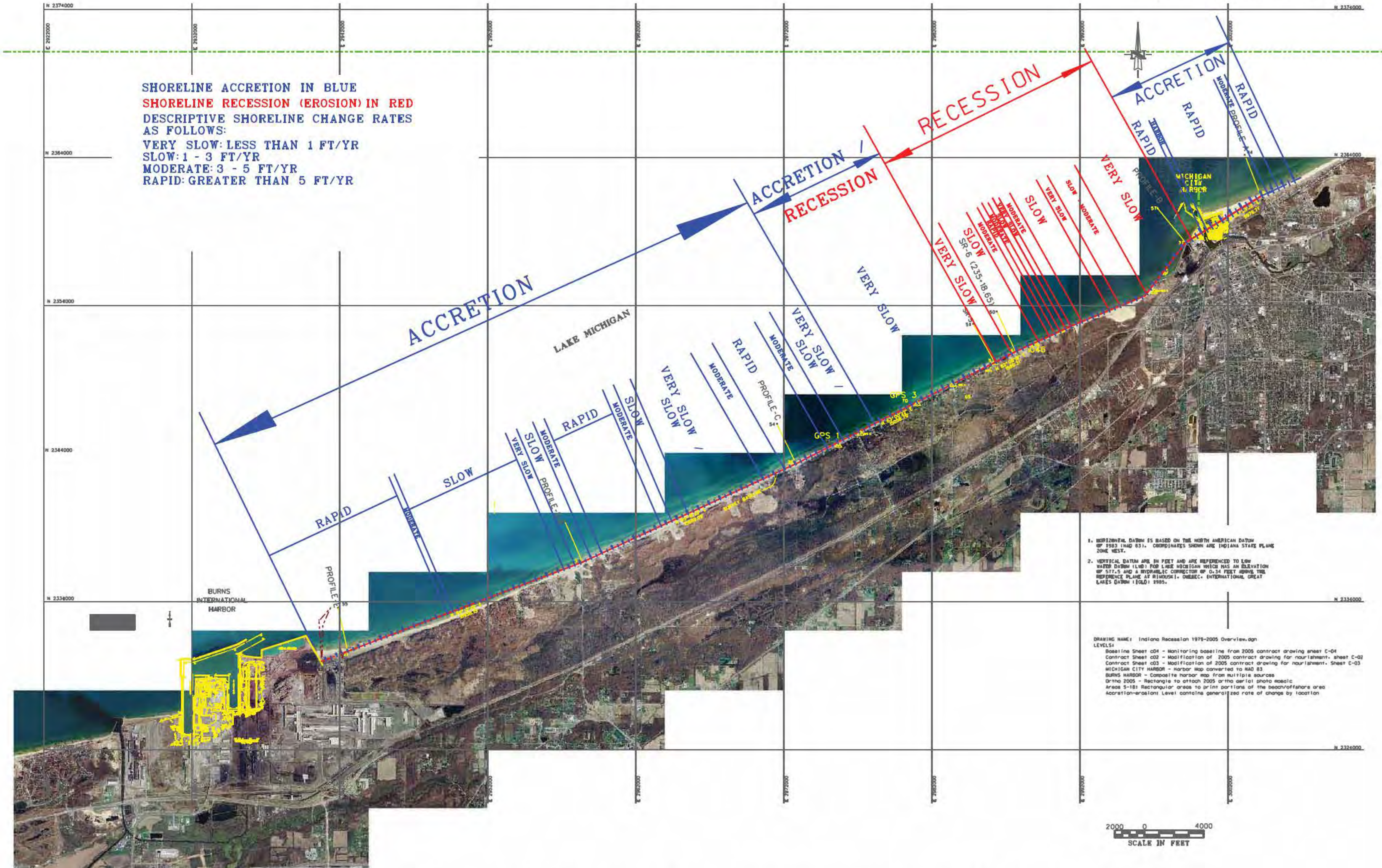
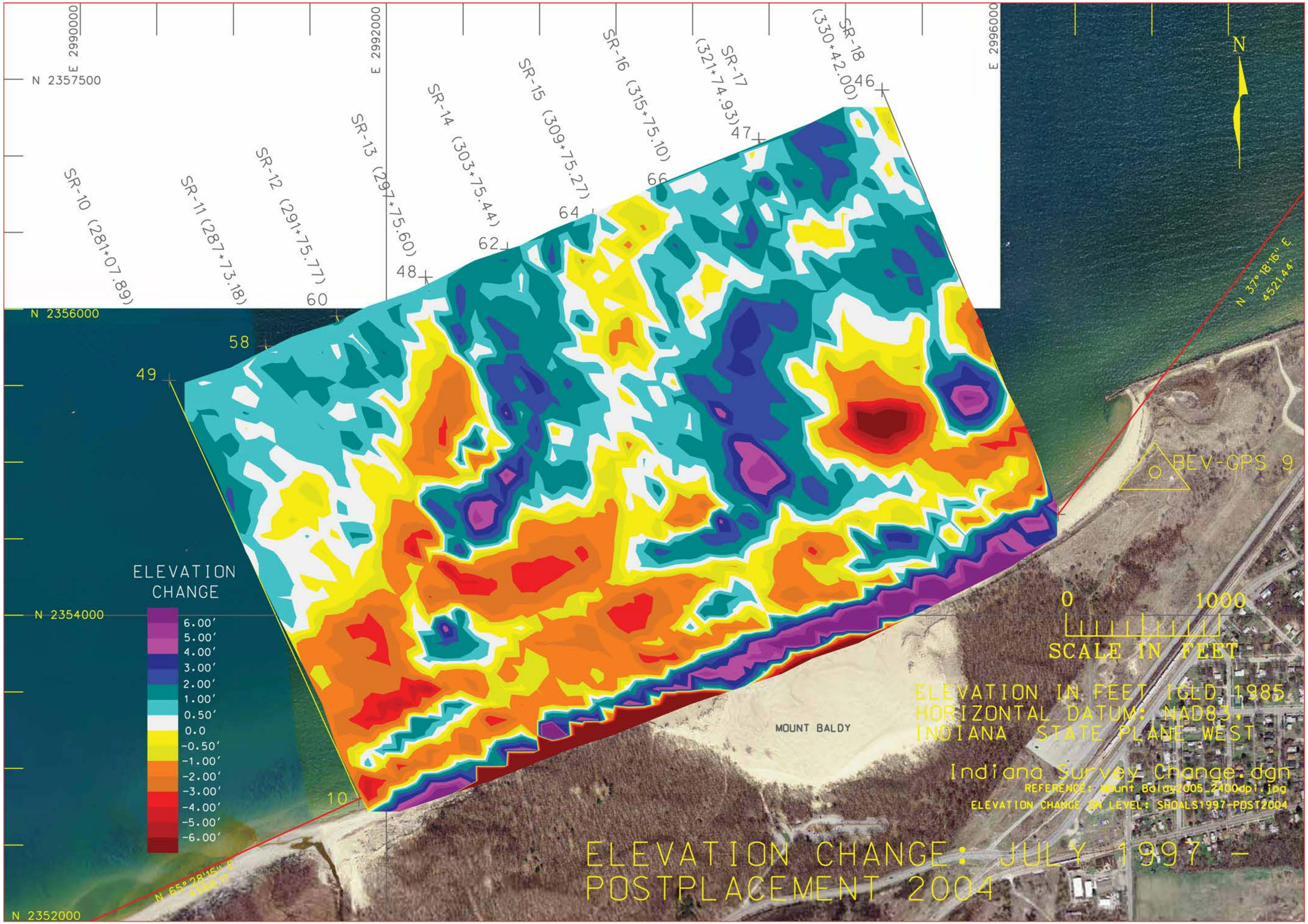


FIGURE 18. INDIANA SHORELINE RECESSION OVERVIEW: 1979-2005


E 2990000
E 2992000
E 2996000
N 2357500
N 2356000
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N 2352000
SR-10 (281+07.89)
SR-11 (287+73.18)
SR-12 (291+75.77)
SR-13 (297+75.60)
SR-14 (303+75.44)
SR-15 (309+75.27)
SR-16 (315+75.10)
SR-17 (321+74.93)
SR-18 (330+42.00)
N
BEV-GPS 9
ELEVATION CHANGE
6.00'
5.00'
4.00'
3.00'
2.00'
1.00'
0.50'
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-4.00'
-5.00'
-6.00'
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SCALE IN FEET
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HORIZONTAL DATUM: NAD83,
INDIANA STATE PLANE WEST
Indiana Survey Change.dgn
MOUNT BALDY
ELEVATION CHANGE: JULY 1997 -
POSTPLACEMENT 2004

47

APPENDIX D: SPECIES LISTS

D1: Reach 1 Endangered, Threatened, And Rare Plant Species List

D2: Reach 2 Endangered, Threatened, And Rare Plant Species List

D3: Reach 3 Endangered, Threatened, And Rare Plant Species List

D4: Reach 4 Endangered, Threatened, And Rare Plant Species List

D5: Summary Of Park Plants Of Concern

D6: Panne Wetland Species Table

D7: Park Plants of Concern and List of Species Occurring in the Dune Complex

D8: Wildlife Species Of Conservation Concern

D9: Bird Species Of Conservation Concern

D10: Summary Of Benthic Species In Lake Michigan Nearshore

APPENDIX D1: REACH 1 ENDANGERED, THREATENED, AND RARE PLANT SPECIES LIST

INDIANA COUNTY ENDANGERED, THREATENED AND RARE SPECIES LIST FOR REACH 1
LAPORTE COUNTY (CRESCENT DUNE TO LAKEFRONT DRIVE EAST/CENTRAL BEACH)

Species Name	Common Name	Federal	State	INDU Locations/ Notes
Vascular Plants				
Arctostaphylos uva-ursi	bearberry, bearberry manzanita, kinnikinnick, mealberry		SR	Foredune complex, dune complex
Minuartia michauxii var. *michauxii*			SR	Prairie-dry, foredune complex
Aristida longespica var. *geniculata*			SR	
Aristida tuberculosa	seaside threeawn		SR	
Symphyotrichum sericeum	western silver aster		SR	
Cornus rugosa	round-leaf dogwood, roundleaf dogwood		SR	
Corydalis sempervirens	rock harlequin		ST	
Diervilla lonicera	northern bush honeysuckle, northern bush-honeysuckle		SR	
Drosera intermedia	spoonleaf sundew		SR	
Eleocharis melanocarpa	blackfruit spikerush		ST	
Epigaea repens	trailing arbutus		WL	
Equisetum variegatum	variegated horsetail, variegated scouring-rush, variegated scouringrush		SE	
Juncus balticus var. *littoralis*	Baltic rush		SR	
Juncus pelocarpus	brownfruit rush		SE	
Juncus scirpoides	needlepod rush		ST	
Juniperus communis var. *depressa*	common juniper		SR	Dune complex, foredune complex
Lathyrus japonicus var. *maritimus*	beach pea		SE	Foredune complex
Linum striatum	ridged yellow flax, rigid flax		WL	
Lycopodiella inundata	inundated clubmoss		SE	

Species Name	Common Name	Federal	State	INDU Locations/ Notes
Myriophyllum pinnatum	cut-leaf water-milfoil, cutleaf watermilfoil, green parrotfeather		SE	
Najas gracillima	slender waternymph		ST	
Oenothera perennis	little evening-primrose		SR	
Oryzopsis asperifolia	roughleaf ricegrass, white-grain mountain-rice grass		SE	
Piptatherum pungens	mountain ricegrass		SX	
Pinus banksiana	black pine, gray pine, hudson bay pine, jack pine, scrub pine		SR	Dune complex, foredune complex
Pinus strobus	eastern white pine, eastern white pine, northern white pine, soft pine, weymouth pine, white pine		SR	
Platanthera hyperborea	northern bogorchid, northern green orchid		ST	
Polygonella articulata	coastal jointweed		SR	Dune complex, foredune complex
Polygonum careyi	carey's smartweed, Carey's smartweed, renouée de Carey		ST	
Potamogeton friesii	flat-stalk pondweed, Fries' pondweed		ST	
Potamogeton praelongus	white-stem pondweed, whitestem pondweed		ST	
Potamogeton pulcher	heartleaf pondweed, spotted pondweed		SE	
Potamogeton pusillus	baby pondweed, small pondweed		WL	
Potamogeton robbinsii	Robbins pondweed, Robbins' pondweed		SR	
Potamogeton strictifolius	narrowleaf pondweed, straight-leaf pondweed		ST	
Argentina anserina	silverweed cinquefoil		ST	Foredune complex
Prunus pensylvanica	fire cherry, pin cherry		SR	
Rhynchospora scirpoides	longbeak beaksedge		ST	
Pyrola americana	American wintergreen		SR	
Clinopodium arkansanum	limestone calamint		SE	

Species Name	Common Name	Federal	State	INDU Locations/ Notes
Sisyrinchium montanum	mountain blue-eyed grass, mountain blue-eyed grass, strict blue-eyed grass, strict blue-eyed-grass		SE	
Solidago simplex var. *gillmanii*	Deam's goldenrod, Rand's goldenrod		ST	Foredune complex, blowouts/open dunes
Sparganium androcladum	branched bur-reed, branched burreed, branching bur-reed		ST	
Triantha glutinosa	sticky tofieldia		SR	
Utricularia subulata	zigzag bladderwort		ST	

Source: IDNR (2011); Wilhelm (1990)

Notes:

SX = state extirpated
SE = state endangered
ST = state threatened
SR = state rare
SRE = reintroduced
WL = watch list

APPENDIX D2: REACH 2 ENDANGERED, THREATENED, AND RARE PLANT SPECIES LIST

INDIANA COUNTY ENDANGERED, THREATENED AND RARE SPECIES LIST FOR REACH 2
PORTER COUNTY (BEVERLY SHORES TO INDIANA DUNES SP)

Species Name	Common Name	Federal	State	INDU Locations/Notes
Vascular Plant				
Arctostaphylos uva-ursi	bearberry, bearberry manzanita, kinnikinnick, mealberry		SR	
Minuartia michauxii var. *michauxii*	Michaux's stitchwort		SR	Prairie-dry, foredune complex
Aristida longespica var. *geniculata*			SR	
Aristida tuberculosa	seaside threeawn		SR	
Symphyotrichum sericeum	western silver aster		SR	
Carex aurea	golden sedge, golden-fruit sedge		SR	
Carex eburnea	bristle-leaf sedge, bristleleaf sedge		SR	
Carex garberi	elk sedge, Garber's sedge		ST	
Chimaphila umbellata ssp. cisatlantica	pipsissewa		ST	
Cirsium pitcheri	Pitcher's thistle, sand dune thistle	LT	ST	Foredune complex, confined to blowouts
Cornus rugosa	round-leaf dogwood, roundleaf dogwood		SR	
Cyperus houghtonii	Houghton's flatsedge		SE	
Dichanthelium portoricense	Hemlock Witchgrass		SR	
Diervilla lonicera	northern bush honeysuckle, northern bush-honeysuckle		SR	
Drosera intermedia	spoonleaf sundew		SR	
Eleocharis melanocarpa	blackfruit spikerush		ST	
Epigaea repens	trailing arbutus		WL	
Chamaesyce polygonifolia	chamésyce à feuilles de renouée, seaside sandmat, seaside spurge		SR	Foredune complex
Fuirena pumila	dwarf umbrella-sedge, dwarf umbrellasedge		ST	
Geranium bicknellii	Bicknell's cranesbill, northern crane's-bill		SE	

Species Name	Common Name	Federal	State	INDU Locations/Notes
Lipocarpha micrantha	dwarf bulrush, lipocarphe à petites fleurs, small-flower halfchaff sedge, smallflower halfchaff sedge, smallflower hemicarpha		SE	
Hudsonia tomentosa	hudsonie tomenteuse, sand golden-heather, sand-heather, woolly beachheather		ST	
Juncus balticus var. *littoralis*	Baltic rush		SR	
Juncus pelocarpus	brownfruit rush		SE	
Juncus scirpoides	needlepod rush		ST	
Juniperus communis var. *depressa*	common juniper		SR	Dune complex, foredune complex
Lathyrus japonicus var. *maritimus*	beach pea		SE	
Linum striatum	ridged yellow flax, rigid flax		WL	
Ludwigia sphaerocarpa	globefruit primrose-willow, globefruit primrosewillow		SE	
Lycopodiella inundata	inundated clubmoss		SE	
Myriophyllum pinnatum	cut-leaf water-milfoil, cutleaf watermilfoil, green parrotfeather		SE	
Myriophyllum verticillatum	whorl-leaf watermilfoil, whorled water-milfoil, whorlleaf milfoil, whorlleaf watermilfoil		SR	
Najas gracillima	slender waternymph		ST	
Orobanche fasciculata	clustered broom-rape, clustered broomrape, purple broomrape, tufted broomrape		SE	
Oryzopsis asperifolia	roughleaf ricegrass, white-grain mountain-rice grass		SE	
Piptatherum pungens	mountain ricegrass		SX	
Piptatherum racemosum			SR	
Pinus banksiana	black pine, gray pine, hudson bay pine, jack pine, scrub pine		SR	Dune complex, foredune complex
Pinus strobus	eastern white pine, eastern white pine, northern white pine, soft pine, weymouth pine, white pine		SR	

Species Name	Common Name	Federal	State	INDU Locations/Notes
Platanthera hyperborea	northern bogorchid, northern green orchid		ST	
Polygala paucifolia	gaywings		SE	
Polygonella articulata	coastal jointweed		SR	Dune complex, foredune complex
Polygonum careyi	carey's smartweed, Carey's smartweed, renouée de Carey		ST	
Polygonum hydropiperoides	swamp smartweed		ST	
Potamogeton pulcher	heartleaf pondweed, spotted pondweed		SE	
Potamogeton pusillus	baby pondweed, small pondweed		WL	
Potamogeton richardsonii	red-head pondweed, Richardson pondweed, Richardson's pondweed		SR	
Potamogeton strictifolius	narrowleaf pondweed, straight-leaf pondweed		ST	
Argentina anserina	silverweed cinquefoil		ST	Foredune complex
Prunus pensylvanica	fire cherry, pin cherry		SR	
Rhynchospora scirpoides	longbeak beaksedge		ST	
Pyrola americana	American wintergreen		SR	
Rhus aromatica var. *arenaria*	fragrant sumac		SR	
Rhynchospora macrostachya	tall horned beaksedge		SR	
Salix cordata	heartleaf willow		ST	Foredune complex
Schoenoplectus hallii	Hall's bulrush		SE	
Scirpus purshianus var. *purshianus*	weakstalk bulrush		SR	
Selaginella rupestris	ledge spike-moss, northern selaginella, rock spikemoss		ST	
Sisyrinchium montanum	mountain blue-eyed grass, mountain blueeyed grass, strict blue-eyed grass, strict blue-eyed-grass		SE	
Solidago ptarmicoides	prairie goldenrod, upland white aster, verge-d'or faux-ptarmica, white flat-top goldenrod		SR	
Solidago simplex var. *gillmanii*	Deam's goldenrod, Rand's goldenrod		ST	Foredune complex, blowouts/ open dunes
Sparganium androcladum	branched bur-reed, branched burreed, branching bur-reed		ST	

Species Name	Common Name	Federal	State	INDU Locations/Notes
Spiranthes magnicamporum	Great Plains ladies'-tresses, Great Plains ladiestresses		SE	
Talinum rugospermum	prairie fameflower		ST	
Utricularia cornuta	horned bladderwort		ST	
Utricularia subulata	zigzag bladderwort		ST	
Zannichellia palustris	horned pondweed, horned poolmat, horned-pondweed		SR	

SOURCE: IDNR (2011); Wilhelm (1990)

Notes:

LT = federally listed threatened

SX = state extirpated

SE = state endangered

ST = state threatened

SR = state rare

SRE = reintroduced

WL = watch list

APPENDIX D3: REACH 3 ENDANGERED, THREATENED, AND RARE PLANT SPECIES LIST

INDIANA COUNTY ENDANGERED, THREATENED AND RARE SPECIES LIST FOR REACH 3
PORTER COUNTY (DUNES ACRES/BAILLY TO PORTAGE LAKEFRONT PARK/OGDEN DUNES)

Species Name	Common Name	Federal	State	INDU Locations
Vascular Plants				
Arctostaphylos uva-ursi	bearberry, bearberry manzanita, kinnikinnick, mealberry		SR	Portage Lakefront Park, located along Burns Ditch. Population in decline
Minuartia michauxii var. *michauxii*	Michaux's stitchwort		SR	Prairie-dry, foredune complex
Aristida longespica var. *geniculata*			SR	
Aristida tuberculosa	seaside threeawn		SR	
Symphyotrichum sericeum	western silver aster		SR	
Carex aurea	golden sedge, golden-fruit sedge		SR	
Carex eburnea	bristle-leaf sedge, bristleleaf sedge		SR	
Carex garberi	elk sedge, Garber's sedge		ST	
Chimaphila umbellata ssp. cisatlantica	pipsissewa		ST	
Cirsium pitcheri	Pitcher's thistle, sand dune thistle	LT	ST	Confined to blowout at Bailly
Cornus rugosa	round-leaf dogwood, roundleaf dogwood		SR	
Cyperus houghtonii	Houghton's flatsedge		SE	
Dichanthelium portoricense	Hemlock Witchgrass		SR	
Diervilla lonicera	northern bush honeysuckle, northern bush-honeysuckle		SR	
Drosera intermedia	spoonleaf sundew		SR	
Eleocharis melanocarpa	blackfruit spikerush		ST	
Epigaea repens	trailing arbutus		WL	
Chamaesyce polygonifolia	chamésyce à feuilles de renouée, seaside sandmat, seaside spurge		SR	Foredune complex
Fuirena pumila	dwarf umbrella-sedge, dwarf umbrellasedge		ST	
Geranium bicknellii	Bicknell's cranesbill, northern crane's-bill		SE	

Species Name	Common Name	Federal	State	INDU Locations
Lipocarpha micrantha	dwarf bulrush, lipocarphe à petites fleurs, small-flower halfchaff sedge, smallflower halfchaff sedge, smallflower hemicarpha		SE	
Hudsonia tomentosa	hudsonie tomenteuse, sand golden-heather, sand-heather, woolly beachheather		ST	
Juncus balticus var. *littoralis*	Baltic rush		SR	
Juncus pelocarpus	brownfruit rush		SE	
Juncus scirpoides	needlepod rush		ST	
Juniperus communis var. *depressa*	common juniper		SR	Dune complex, foredune complex
Lathyrus japonicus var. *maritimus*	beach pea		SE	
Linum striatum	ridged yellow flax, rigid flax		WL	
Ludwigia sphaerocarpa	globefruit primrose-willow, globefruit primrosewillow		SE	
Lycopodiella inundata	inundated clubmoss		SE	
Myriophyllum pinnatum	cut-leaf water-milfoil, cutleaf watermilfoil, green parrotfeather		SE	
Myriophyllum verticillatum	whorl-leaf watermilfoil, whorled water-milfoil, whorlleaf milfoil, whorlleaf watermilfoil		SR	
Najas gracillima	slender waternymph		ST	
Orobanche fasciculata	clustered broom-rape, clustered broomrape, purple broomrape, tufted broomrape		SE	
Oryzopsis asperifolia	roughleaf ricegrass, white-grain mountain-rice grass		SE	
Piptatherum pungens	mountain ricegrass		SX	
Piptatherum racemosum			SR	Unique to West Beach
Pinus banksiana	black pine, gray pine, hudson bay pine, jack pine, scrub pine		SR	Dune complex, foredune complex
Pinus strobus	eastern white pine, eastern white pine, northern white pine, soft pine, weymouth pine, white pine		SR	

Species Name	Common Name	Federal	State	INDU Locations
Platanthera hyperborea	northern bogorchid, northern green orchid		ST	
Polygala paucifolia	gaywings		SE	
Polygonella articulata	coastal jointweed		SR	Dune complex, foredune complex
Polygonum careyi	carey's smartweed, Carey's smartweed, renouée de Carey		ST	
Polygonum hydropiperoides	swamp smartweed		ST	
Potamogeton pulcher	heartleaf pondweed, spotted pondweed		SE	
Potamogeton pusillus	baby pondweed, small pondweed		WL	
Potamogeton richardsonii	red-head pondweed, Richardson pondweed, Richardson's pondweed		SR	
Potamogeton strictifolius	narrowleaf pondweed, straight-leaf pondweed		ST	
Argentina anserina	silverweed cinquefoil		ST	Foredune complex
Prunus pensylvanica	fire cherry, pin cherry		SR	
Rhynchospora scirpoides	longbeak beaksedge		ST	
Pyrola americana	American wintergreen		SR	
Rhus aromatica var. *arenaria*	fragrant sumac		SR	
Rhynchospora macrostachya	tall horned beaksedge		SR	
Salix cordata	heartleaf willow		ST	Foredune complex
Schoenoplectus hallii	Hall's bulrush		SE	
Scirpus purshianus var. *purshianus*	weakstalk bulrush		SR	
Selaginella rupestris	ledge spike-moss, northern selaginella, rock spikemoss		ST	
Sisyrinchium montanum	mountain blue-eyed grass, mountain blueeyed grass, strict blue-eyed grass, strict blue-eyed-grass		SE	
Solidago ptarmicoides	prairie goldenrod, upland white aster, verge-d'or faux-ptarmica, white flat-top goldenrod		SR	
Solidago simplex var. *gillmanii*	Deam's goldenrod, Rand's goldenrod		ST	Foredune complex, blowouts/open dunes, Portage Lakefront Park population
Sparganium androcladum	branched bur-reed, branched burreed, branching bur-reed		ST	

Species Name	Common Name	Federal	State	INDU Locations
Spiranthes magnicamporum	Great Plains ladies'-tresses, Great Plains ladiestresses		SE	
Talinum rugospermum	prairie fameflower		ST	
Utricularia cornuta	horned bladderwort		ST	
Utricularia subulata	zigzag bladderwort		ST	
Zannichellia palustris	horned pondweed, horned poolmat, horned-pondweed		SR	
Selaginella apoda	meadow spike-moss, meadow spikemoss, sélaginelle apode		WL	
Shepherdia canadensis	russet buffalo-berry, russet buffaloberry		SX	
Triantha glutinosa	sticky tofieldia		SR	

SOURCE: IDNR (2011); Wilhelm (1990)

Notes:

LT = federally listed threatened
SX = state extirpated
SE = state endangered
ST = state threatened
SR = state rare
SRE = reintroduced
WL = watch list

APPENDIX D4: REACH 4 ENDANGERED, THREATENED, AND RARE PLANT SPECIES LIST

INDIANA COUNTY ENDANGERED, THREATENED AND RARE SPECIES LIST FOR REACH 4 PORTER AND LAKE COUNTIES (WEST BEACH TO MILLER UNIT)

Species Name	Common Name	Federal	State	INDU locations/Notes
Vascular Plants				
Agalinis skinneriana	Skinner's false foxglove		ST	
Arctostaphylos uva-ursi	bearberry, bearberry manzanita, kinnikinnick, mealberry		SR	
Minuartia michauxii var. *michauxii*	Michaux's stitchwort		SR	Prairie-dry, foredune complex
Aristida longespica var. *geniculata*			SR	
Aristida tuberculosa	seaside threeawn		SR	
Symphyotrichum sericeum	western silver aster		SR	
Carex aurea	golden sedge, golden-fruit sedge		SR	Unique to Miller unit
Carex crawei	crawe sedge, Crawe's sedge		ST	
Carex eburnea	bristle-leaf sedge, bristleleaf sedge		SR	Unique to West Beach
Carex garberi	elk sedge, Garber's sedge		ST	
Ceanothus herbaceus	céanothe à feuilles étroites, inland ceanothus, Jersey tea, prairie redroot		SE	
Chimaphila umbellata ssp. cisatlantica	pipsissewa		ST	Extremely rare at West Beach
Cirsium pitcheri	Pitcher's thistle, sand dune thistle	LT	ST	Foredune complex, confined to blowouts
Cornus rugosa	round-leaf dogwood, roundleaf dogwood		SR	
Corydalis sempervirens	rock harlequin		ST	
Cyperus houghtonii	Houghton's flatsedge		SE	
Dichanthelium portoricense	Hemlock Witchgrass		SR	
Diervilla lonicera	northern bush honeysuckle, northern bush-honeysuckle		SR	
Drosera intermedia	spoonleaf sundew		SR	
Eleocharis microcarpa	smallfruit spikerush			Unique to West Beach
Eleocharis melanocarpa	blackfruit spikerush		ST	Unique to West Beach
Epigaea repens	trailing arbutus		WL	

Species Name	Common Name	Federal	State	INDU locations/Notes
Equisetum variegatum	variegated horsetail, variegated scouring-rush, variegated scouringrush		SE	Unique to Miller unit
Chamaesyce polygonifolia	chamésyce à feuilles de renouée, seaside sandmat, seaside spurge		SR	Foredune complex, declining in beach area throughout
Fuirena pumila	dwarf umbrella-sedge, dwarf umbrellasedge		ST	
Geranium bicknellii	Bicknell's cranesbill, northern crane's-bill		SE	
Glyceria borealis	northern mannagrass, small floating manna grass, small floating mannagrass		SE	
Lipocarpha micrantha	dwarf bulrush, lipocarphe à petites fleurs, small-flower halfchaff sedge, smallflower halfchaff sedge, smallflower hemicarpha		SE	
Hudsonia tomentosa	hudsonie tomenteuse, sand golden-heather, sand-heather, woolly beachheather		ST	
Juncus balticus var. *littoralis*	Baltic rush		SR	
Juncus pelocarpus	brownfruit rush		SE	
Juncus scirpoides	needlepod rush		ST	
Juniperus communis var. *depressa*	common juniper		SR	Dune complex, foredune complex
Lathyrus japonicus var. *maritimus*	beach pea		SE	
Linum striatum	ridged yellow flax, rigid flax		WL	
Ludwigia sphaerocarpa	globefruit primrose-willow, globefruit primrosewillow		SE	
Lycopodiella inundata	inundated clubmoss		SE	
Myriophyllum pinnatum	cut-leaf water-milfoil, cutleaf watermilfoil, green parrotfeather		SE	
Myriophyllum verticillatum	whorl-leaf watermilfoil, whorled water-milfoil, whorlleaf milfoil, whorlleaf watermilfoil		SR	Unique to Miller unit
Najas gracillima	slender waternymph		ST	
Oenothera perennis	little evening-primrose		SR	
Orobanche fasciculata	clustered broom-rape, clustered broomrape, purple broomrape, tufted broomrape		SE	

Species Name	Common Name	Federal	State	INDU locations/Notes
Oryzopsis asperifolia	roughleaf ricegrass, white-grain mountain-rice grass		SE	
Piptatherum pungens	mountain ricegrass		SX	
Piptatherum racemosum			SR	Unique to West Beach
Pinus banksiana	black pine, gray pine, hudson bay pine, jack pine, scrub pine		SR	Foredune complex, located around pannes
Pinus strobus	eastern white pine, eastern white pine, northern white pine, soft pine, weymouth pine, white pine		SR	
Platanthera hyperborea	northern bogorchid, northern green orchid		ST	
Platanthera lacera	green fringed orchid		WL	
Polygala paucifolia	gaywings		SE	
Polygonella articulata	coastal jointweed		SR	Dune complex, foredune complex
Polygonum careyi	carey's smartweed, Carey's smartweed, renouée de Carey		ST	
Polygonum hydropiperoides	swamp smartweed		ST	
Potamogeton pulcher	heartleaf pondweed, spotted pondweed		SE	Unique to Miller unit
Potamogeton pusillus	baby pondweed, small pondweed		WL	
Potamogeton richardsonii	red-head pondweed, Richardson pondweed, Richardson's pondweed		SR	
Potamogeton robbinsii	Robbins pondweed, Robbins' pondweed		SR	
Potamogeton strictifolius	narrowleaf pondweed, straight-leaf pondweed		ST	
Argentina anserina	silverweed cinquefoil		ST	Foredune complex
Dasiphora floribunda	shrubby cinquefoil			Unique to Miller unit (pannes)
Prunus pensylvanica	fire cherry, pin cherry		SR	
Rhynchospora scirpoides	longbeak beaksedge		ST	
Pyrola americana	American wintergreen		SR	
Rhus aromatica var. *arenaria*	fragrant sumac		SR	
Rhynchospora macrostachya	tall horned beaksedge		SR	
Rubus flagellaris	northern dewberry, whiplash dewberry		SE	
Salix cordata	heartleaf willow		ST	Foredune complex

Species Name	Common Name	Federal	State	INDU locations/Notes
Clinopodium arkansanum	limestone calamint		SE	
Schoenoplectus hallii	Hall's bulrush		SE	
Scirpus purshianus var. *purshianus*	weakstalk bulrush		SR	
Selaginella apoda	meadow spike-moss, meadow spikemoss, sélaginelle apode		WL	
Selaginella rupestris	ledge spike-moss, northern selaginella, rock spikemoss		ST	
Shepherdia canadensis	russet buffalo-berry, russet buffaloberry		SX	
Sisyrinchium montanum	mountain blue-eyed grass, mountain blueeyed grass, strict blue-eyed grass, strict blue-eyed-grass		SE	
Solidago ptarmicoides	prairie goldenrod, upland white aster, verge-d'or faux-ptarmica, white flat-top goldenrod		SR	
Solidago simplex var. *gillmanii*	Deam's goldenrod, Rand's goldenrod		ST	Foredune complex, blowouts/open dunes
Sparganium androcladum	branched bur-reed, branched burreed, branching bur-reed		ST	
Spiranthes magnicamporum	Great Plains ladies'-tresses, Great Plains ladiestresses		SE	
Talinum rugospermum	prairie fameflower		ST	
Triantha glutinosa	sticky tofieldia		SR	
Utricularia cornuta	horned bladderwort		ST	
Utricularia subulata	zigzag bladderwort		ST	
Zannichellia palustris	horned pondweed, horned poolmat, horned-pondweed		SR	

SOURCE: IDNR (2011); Wilhelm (1990)

Notes:

LT = federally listed threatened
LE = federally listed endangered
SX = state extirpated
SE = state endangered
ST = state threatened
SR = state rare
SRE = reintroduced
WL = watch list

Species	ITIS Name	Flowering	Habitat	State Status	Federal Status	Common Name	ITIS Common Name(s)	Growth Form	Life Cycle	Family	Class	Native/ Non*
Listed Endangered, Threatened and Rare												
Lathyrus japonicus glaber	*Lathyrus japonicus* var. *maritimus*	Jul	Foredune complex	Endangered		beach pea	beach pea	Vine	Perennial	Fabaceae	Dicot	Native
Arctostaphylos uva-ursi coactilis	*Arctostaphylos uva-ursi*	Apr May Jun	Foredune complex, dune complex	Rare		bearberry	bearberry, bearberry manzanita, kinnikinnick, mealberry	Shrub	Perennial	Ericaceae	Dicot	Native
Arenaria stricta	*Minuartia michauxii* var. *michauxii*	May Jun Jul	Prairie dry, foredune complex	Rare		stiff sandwort	Michaux's stitchwort	Forb	Annual, Perennial	Caryophyllaceae	Dicot	Native
Euphorbia polygonifolia	*Chamaesyce polygonifolia*	Jul Aug Sep	Foredune complex	Rare		seaside spurge	chamésyce à feuilles de renouée, seaside sandmat, seaside spurge	Forb	Annual	Euphorbiaceae	Dicot	Native
Juniperus communis depressa	*Juniperus communis* var. *depressa*		Dune complex, foredune complex	Rare		common juniper	common juniper	Shrub	Perennial	Cupressaceae	Gymnosperm	Native
Pinus banksiana	*Pinus banksiana*		Dune complex, foredune complex	Rare		jack pine	black pine, gray pine, hudson bay pine, jack pine, scrub pine	Tree	Perennial	Pinaceae	Gymnosperm	Native
Polygonella articulata	*Polygonella articulata*	Aug Sep Oct	Dune complex, foredune complex	Rare		jointweed	coastal jointweed	Forb	Annual	Polygonaceae	Dicot	Native

Species	ITIS Name	Flowering	Habitat	State Status	Federal Status	Common Name	ITIS Common Name(s)	Growth Form	Life Cycle	Family	Class	Native/ Non*
Rhus aromatica var arenaria	*Rhus aromatica* var. *arenaria*		Foredune complex, savanna complex	Rare		fragrant sumac	fragrant sumac	Shrub	Perennial	Anacardiaceae	Dicot	Native
Cirsium pitcheri	*Cirsium pitcheri*	Jun Jul	Foredune complex	Threatened	Threatened	sand thistle	Pitcher's thistle, sand dune thistle	Forb	Perennial	Asteraceae	Dicot	Native
Potentilla anserina	*Argentina anserina*	May Jun Jul Aug Sep	Foredune complex	Threatened		silverweed	silverweed cinquefoil	Forb	Perennial	Rosaceae	Dicot	Native
Salix syrticola(FC) indiana–Cordata	*Salix cordata*	Apr May Jun Jul	Foredune complex	Threatened		dune willow	heartleaf willow	Shrub	Perennial	Salicaceae	Dicot	Native
Solidago racemosa gillmani	*Solidago simplex* var. *gillmanii*	Jul Aug Sep Oct Nov	Pannes, foredune complex	Threatened		dune goldenrod	Deam's goldenrod, Rand's goldenrod	Forb	Perennial	Asteraceae	Dicot	Native

Source: IDNR (2011); Wilhelm (1990)

APPENDIX D6: PANNE WETLAND SPECIES TABLE

INDU List of Panne Wetland Species Observed in the Early 2000s in Nutrient Poor Sand Based Wetlands at West Beach; Ogden Dunes; Miller
April 2011

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
West Beach		
Acer rubrum	*Acer rubrum*	red maple
Agalinis purpurea	*Agalinis purpurea*	purple false foxglove
Ailanthus altissima	*Ailanthus altissima*	ailanthus, copal tree, tree of heaven, tree-of-heaven
Amaranthus hybridus	*Amaranthus hybridus*	green pigweed, slim amaranth, smooth amaranth, smooth pigweed
Ambrosia artemisiifolia	*Ambrosia artemisiifolia*	annual ragweed, common ragweed, low ragweed, ragweed, Roman wormwood, short ragweed, small ragweed
Amelanchier sp. *(A. arborea/A. laevis)*	*Amelanchier* sp. *(A. arborea/A. laevis)*	serviceberry
Ammophila breviligulata	*Ammophila breviligulata*	American beachgrass
Andropogon scoparius	*Schizachyrium scoparium*	little bluestem
Anemone cylindrica	*Anemone cylindrica*	candle anemone, cottonweed
Arabis lyrata	*Arabis lyrata*	lyrate rockcress
Arctostaphylos uva-ursi coactilis	*Arctostaphylos uva-ursi*	bearberry, bearberry manzanita, kinnikinnick, mealberry
Aristida intermedia	*Aristida longespica var. geniculata*	slimspike threeawn
Aristida purpurascens	*Aristida purpurascens*	arrowfeather threeawn
Aristida tuberculosa	*Aristida tuberculosa*	seaside threeawn
Artemisia caudata	*Artemisia campestris* ssp. *caudata*	field sagewort, field wormwood, Pacific wormwood
Asclepias incarnata	*Asclepias incarnata*	rose milkweed, swamp milkweed
Asclepias syriaca	*Asclepias syriaca*	broadleaf milkweed, common milkweed
Asclepias verticillata	*Asclepias verticillata*	eastern whorled milkweed, whorled milkweed
Aster dumosus	*Symphyotrichum dumosum*	rice button aster
Aster lateriflorus	*Symphyotrichum lateriflorum*	calico aster
Aster novae-angliae	*Symphyotrichum novae-angliae*	New England aster
Aster ptarmicoides (Solidago ptarmicoides)	*Solidago ptarmicoides*	prairie goldenrod, upland white aster, verge-d'or faux-ptarmica, white flat-top goldenrod
Aster simplex	*Symphyotrichum lanceolatum*	white panicle aster
Berberis thunbergii	*Berberis thunbergii*	Japanese barberry
Bidens spp.	*Bidens spp.*	beggartick, beggarticks, devil's sticktight, Spanish needles
Cakile edentula	*Cakile edentula*	American searocket
Calamagrostis canadensis	*Calamagrostis canadensis*	bluejoint, bluejoint reedgrass
Calamovilfa longifolia	*Calamovilfa longifolia var. magna*	prairie sandreed

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Campylium sp. *(moss)*	*Campylium* sp.	campylium moss
Carex garberi	*Carex garberi*	elk sedge, Garber's sedge
Carex viridula	*Carex viridula*	green sedge, little green sedge
Celastrus orbiculatus	*Celastrus orbiculatus*	Asian bittersweet, Asiatic bittersweet, oriental bittersweet, tsuru-ume-mo-doki
Cephalanthus occidentalis	*Cephalanthus occidentalis*	buttonbush, common buttonbush
Chara spp.	*Chara spp.*	muskgrass, stonewort, muskwort
Cirsium arvense	*Cirsium arvense*	Californian thistle, Canada thistle, Canadian thistle, creeping thistle, field thistle
Cladium mariscoides	*Cladium mariscoides*	smooth sawgrass
Corispermum hyssopifolium	*Corispermum americanum*	American bugseed
Cornus obliqua	*Cornus obliqua*	silky dogwood
Cornus stolonifera	*Cornus sericea*	redosier, redosier dogwood
Cotoneaster sp. *(C. acutifolia?)*	*Cotoneaster* sp. *(C. acutifolius?)*	cononeaster (Peking cotoneaster?)
Cycloloma atriplicifolium	*Cycloloma atriplicifolium*	tumble ringwing, winged pigweed, winged-pigweed
Cyperus erythrorhizos	*Cyperus erythrorhizos*	red-root flat sedge, redroot flatsedge, redroot nutgrass
Cyperus ferruginescens	*Cyperus odoratus*	fragrant flatsedge, rusty flat sedge
Cyperus rivularis	*Cyperus bipartitus*	brook flatsedge, shining flat sedge, slender flatsedge
Cyperus strigosus	*Cyperus strigosus*	stawcolored flatsedge, strawcolor flatsedge, strawcolor nutgrass, strawcolored flatsedge, strawcolored nutgrass
Daucus carota	*Daucus carota*	bird's nest, Queen Anne's lace, wild carrot
Dryopteris thelypteris / T. palustris	*Thelypteris palustris var. pubescens*	eastern marsh fern
Echinochloa crusgalli	*Echinochloa crus-galli*	barnyard grass, barnyardgrass, cockspur, Japanese millet, large barnyard grass, watergrass
Eleocharis compressa	*Eleocharis compressa*	flat-stem spike-rush, flatstem spikerush, flatstemmed spikesedge
Eleocharis elliptica	*Eleocharis elliptica*	elliptic spikerush
Eleocharis geniculata	*Eleocharis geniculate*	Canada spikesedge
Eleocharis olivacea	*Eleocharis flavescens var. olivacea*	bright green spikerush
Eleocharis pauciflora	*Eleocharis quinqueflora*	few-flower spike-rush, few-flower spikerush, fewflower spikerush, fewflowered spikesedge
Epilobium coloratum	*Epilobium coloratum*	purple-leaf willowherb, purpleleaf willowherb, willowweed
Equisetum hyemale	*Equisetum hyemale*	horsetail, scouring horsetail, scouringrush, scouringrush horsetail, tall scouring-rush, western scouringrush
Equisetum variegatum	*Equisetum variegatum*	variegated horsetail, variegated scouring-rush, variegated scouringrush
Equisetum x ferrissii	*Equisetum x ferrissii*	ferris horsetail, Ferriss' horsetail

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Eragrostis spectabilis	*Eragrostis spectabilis*	petticoat-climber, purple lovegrass
Erechtites hieracifolia	*Erechtites hieraciifolius*	American burnweed, burnweed
Erigeron canadensis	*Conyza Canadensis*	Canada horseweed, Canadian horseweed, horseweed, horseweed fleabane, mares tail, marestail
Eupatorium altissimum	*Eupatorium altissimum*	tall joepyeweed, tall thoroughwort
Eupatorium maculatum	*Eutrochium maculatum*	eupatoire maculée, spotted joepyeweed
Eupatorium perfoliatum	*Eupatorium perfoliatum*	boneset, Chapman's thoroughwort, common boneset
Eupatorium serotinum	*Eupatorium serotinum*	late eupatorium, lateflowering thoroughwort
Euphorbia corollata	*Euphorbia corollata*	flowering spurge, floweringspurge euphorbia
Fragaria virginiana	*Fragaria virginiana*	thickleaved wild strawberry, Virginia strawberry, wild strawberry
Fraxinus sp.	*Fraxinus* sp.	ash
Galium pilosum	*Galium pilosum*	hairy bedstraw
Gentiana crinita	*Gentianopsis crinita*	fringed gentian, greater fringed gentian, greater fringed-gentian
Gnaphalium sp.	*Pseudognaphalium* sp.	cudweed, false cudweed, pseudognaphalium
Habenaria hyperborea	*Platanthera hyperborea*	northern bogorchid, northern green orchid
Helianthus petiolaris	*Helianthus petiolaris*	prairie sunflower, showy sunflower
Hypericum kalmianum	*Hypericum kalmianum*	kalm's st. john's-wort, Kalm's St. Johnswort, millepertuis de Kalm
Juncus alpinus	*Juncus alpinoarticulatus*	northern green rush
Juncus articulatus	*Juncus articulatus*	jointed rush, jointleaf rush
Juncus balticus	*Juncus balticus var. littoralis*	Baltic rush
Juncus brachycephalus	*Juncus brachycephalus*	small-head rush, smallhead rush
Juncus nodosus	*Juncus nodosus*	jointed rush, knotted rush
Juncus torreyi	*Juncus torreyi*	torrey rush, Torrey's rush
Juniperus communis	*Juniperus communis var. depressa*	common juniper
Juniperus virginiana	*Juniperus virginiana*	eastern red-cedar, eastern redcedar, genévrier rouge, red cedar juniper
Leersia oryzoides	*Leersia oryzoides*	rice cut grass, rice cutgrass
Liatris aspera	*Liatris aspera*	rough gayfeather, tall blazing star, tall gayfeather
Linum medium	*Linum medium var. texanum*	stiff yellow flax, sucker flas
Linum striatum	*Linum striatum*	ridged yellow flax, rigid flax
Liparis loeselii	*Liparis loeselii*	yellow wide-lip orchid, yellow widelip orchid
Lobelia kalmii	*Lobelia kalmii*	brook lobelia, Ontario lobelia
Lonicera sp.	*Lonicera* sp.	honeysuckle
Lycopus americanus	*Lycopus americanus*	American bugleweed, American water horehound, American waterhorehound, cut-leaf water-horehound, water horehound, waterhorehound
Lycopus uniflorus	*Lycopus uniflorus*	bugleweed, northern bugleweed, northern water-horehound, oneflower bugleweed

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Lythrum salicaria	*Lythrum salicaria*	purple loosestrife, purple loosestrife or lythrum, purple lythrum, rainbow weed, salicaire, spiked loosestrife
Mahonia repens	*Mahonia repens*	creeping barberry, creeping mahonia, oregon grape, Oregongrape, trunkee barberry
Maianthemum canadense interius	*Maianthemum canadense*	Canada mayflower, false lily-of-the-valley, twoleaved Solomonseal
Melilotus alba	*Melilotus alba*	white sweetclover
Morus alba (often just seedlings)	*Morus alba*	mulberry, white mulberry
Oenothera biennis	*Oenothera biennis*	common evening primrose, common evening-primrose, common eveningprimrose, evening primrose (common), hoary eveningprimrose, king's-cureall
Opuntia humifusa	*Opuntia humifusa*	devil's-tongue, Nopal del este, pricklypear
Panicum capillare	*Panicum capillare*	annual witchgrass, common panic grass, common witchgrass, panicgrass, ticklegrass, tumble panic, tumbleweed grass, witches hair, witchgrass
Panicum implicatum	*Dichanthelium acuminatum var. acuminatum*	tapered rosette grass
Panicum virgatum	*Panicum virgatum*	old switch panic grass, switchgrass
Parthenocissus quinquefolia	*Parthenocissus quinquefolia*	American ivy, fiveleaved ivy, Virginia creeper, woodbine
Phalaris arundinacea	*Phalaris arundinacea*	reed canary grass, reed canarygrass
Phragmites australis	*Phragmites australis*	common reed
Pinus banksiana	*Pinus banksiana*	black pine, gray pine, hudson bay pine, jack pine, scrub pine
Plantago rugelii	*Plantago rugelii*	black-seed plantain, blackseed plantain, Rugel's plantain
Poa compressa	*Poa compressa*	Canada bluegrass, flat-stem blue grass
Pogonia ophioglossoides	*Pogonia ophioglossoides*	snake-mouth orchid, snakemouth orchid
Polygonum hydropiperoides	*Polygonum hydropiperoides*	swamp smartweed
Polygonum lapathifolium	*Polygonum lapathifolium*	curltop ladysthumb, curlytop knotweed, curlytop smartweed, dock-leaf smartweed, nodding smartweed, pale smartweed, smartweed
Polygonum pensylvanicum	*Polygonum pensylvanicum*	Pennsylvania knotweed, Pennsylvania smartweed, pinkweed, pinweed
Polygonum persicaria	*Polygonum persicaria*	lady's-thumb, ladysthumb, ladysthumb smartweed, smartweed, spotted knotweed, spotted ladysthumb, spotted smartweed
Polygonum punctatum	*Polygonum punctatum*	dotted smartweed
Populus deltoides	*Populus deltoides*	common cottonwood, cottonwood, eastern cottonwood, plains cottonwood

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Potamogeton sp. *(P. div.,gram.,ill.)*	*Potamogeton* sp. *(P. diversifolius; P. gramineus; P. illinoensis)*	pondweed (waterthread, waterthread pondweed; grassy pondweed, variableleaf pondweed; illinois pondweed, Illinois pondweed, potamot de l'Illinois)
Potentilla anserina	*Argentina anserina*	silverweed cinquefoil
Potentilla simplex	*Potentilla simplex*	common cinquefoil, oldfield cinquefoil, oldfield fivefingers, spreading cinquefoil
Proserpinaca palustris crebra	*Proserpinaca palustris var. crebra*	marsh mermaidweed
Prunus pumila	*Prunus pumila*	sand cherry, sandcherry
Prunus virginiana	*Prunus virginiana*	chokecherry, chokecherry (common), common chokecherry, Virginia chokecherry
Ptelea trifoliata	*Ptelea trifoliata var. mollis*	common hoptree
Quercus velutina	*Quercus velutina*	black oak
Rhamnus frangula	*Frangula alnus*	glossy buckthorn
Rhus aromatica	*Rhus aromatica var. arenaria*	fragrant sumac
Rhus typhina	*Rhus hirta*	staghorn sumac
Rhynchospora capillacea	*Rhynchospora capillacea*	horned beakrush, needle beaksedge
Robinia pseudoacacia	*Robinia pseudoacacia*	black locust, false acacia, yellow locust
Rubus sp. *(seedlings)*	*Rubus* sp.	blackberry, brambles, framboises, ronces
Rudbeckia hirta	*Rudbeckia hirta*	black-eyed Susan, blackeyed Susan
Sabatia angularis	*Sabatia angularis*	rosepink, squarestem rosegentian
Salix fragilis	*Salix fragilis*	crack willow
Salix glaucophylloides	*Salix myricoides var. myricoides*	bayberry willow
Salix interior	*Salix interior*	sandbar willow
Salix syrticola	*Salix cordata*	heartleaf willow
Salsola kali	*Salsola kali*	prickly Russian thistle, Russian thistle, tumbleweed
Sassafras albidum	*Sassafras albidum*	sassafras
Scirpus acutus	*Schoenoplectus acutus var. acutus*	hardstem bulrush, Tule bulrush
Scirpus pungens (S. amer.)	*Schoenoplectus pungens var. pungens*	common threesquare
Scirpus validus	*Schoenoplectus tabernaemontani*	great bulrush, soft-stem bulrush, softstem bulrush
Scleria verticillata	*Scleria verticillata*	low nutrush
Scutellaria lateriflora	*Scutellaria lateriflora*	blue skullcap, mad dog skullcap
Senecio pauperculus	*Packera paupercula*	balsam groundsel
Silene cucubalus	*Silene vulgaris*	bladder campion, bladder silene, cowbell, maiden's tears, maiden's-tears, maidenstears, rattleweed
Smilacina stellata	*Maianthemum stellatum*	false Solomon's seal, little false Solomon's-seal, star false Solomon's-seal, star-flower Solomon's-seal, starry false lily of the valley, starry false Solomon's seal, starry false Solomon's-seal, starry Solomon's-seal

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Solanum dulcamara	*Solanum dulcamara*	bitter nightshade, bittersweet nightshade, blue nightshade, climbing nightshade, European bittersweet, fellenwort, woody nightshade
Solidago altissima	*Solidago altissima* ssp. *altissima*	Canada goldenrod, late goldenrod
Solidago caesia	*Solidago caesia*	wreath goldenrod
Solidago gigantea	*Solidago gigantea*	giant goldenrod
Solidago graminifolia	*Euthamia graminifolia*	flat-top goldentop, flattop goldentop, slender goldentop
Solidago nemoralis	*Solidago nemoralis*	dyersweed goldenrod, gray goldenrod
Solidago racemosa	*Solidago simplex var. gillmanii*	Deam's goldenrod, Rand's goldenrod
Solidago rugosa	*Solidago rugosa*	wrinkleleaf goldenrod
Sonchus sp.	*Sonchus* sp.	sow thistle, sowthistle
Sonchus uliginosus	*Sonchus arvensis* ssp. *uliginosus*	field sow-thistle, field sowthistle, marsh sowthistle, moist sowthistle, perennial sowthistle, sowthistle
Spiranthes cernua	*Spiranthes cernua*	nodding ladies'-tresses, nodding ladiestresses, white nodding ladies'-tresses
Taraxacum sp.	*Taraxacum* sp.	dandelion
Thuidium sp. *(fern-moss)*	*Thuidium* sp.	thuidium moss
Toxicodendron radicans	*Toxicodendron radicans*	eastern poison ivy, poison ivy, poisonivy
Tradescantia ohiensis	*Tradescantia ohiensis*	bluejacket, Ohio spiderwort
Triglochin maritimum	*Triglochin maritimum*	arrowgrass, seaside arrow-grass, seaside arrowgrass, shore arrowgrass
Typha angustifolia	*Typha angustifolia*	narrow-leaf cat-tail, narrowleaf cattail
Typha x hybrid	*Typha x glauca*	white cattail
Ulmus seedling	*Ulmus* sp.	elm
Utricularia cornuta	*Utricularia cornuta*	horned bladderwort
Utricularia subulata	*Utricularia subulata*	zigzag bladderwort
Verbascum thapsus	*Verbascum thapsus*	big taper, common mullein, flannel mullein, flannel plant, great mullein, mullein, velvet dock, velvet plant, woolly mullein
Verbena hastata	*Verbena hastata*	blue verbena, blue vervain, Simpler's-joy, swamp verbena
Viburnum opulus	*Viburnum opulus var. opulus*	European cranberrybush
Vitis riparia	*Vitis riparia*	river-bank grape, riverbank grape
Yucca smalliana	*Yucca flaccida*	weak-leaf yucca
Miller		
Agalinis purpurea	*Agalinis purpurea*	purple false foxglove
Agrostis alba	*Agrostis gigantea*	black bent, redtop, water bentgrass
Ailanthus altissima	*Ailanthus altissima*	ailanthus, copal tree, tree of heaven, tree-of-heaven
Alisma subcordatum	*Alisma subcordatum*	alisma subcorde, American water plantain, southern water plantain, waterplaintain
Andropogon scoparius	*Schizachyrium scoparium*	little bluestem

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Apocynum sibiricum	*Apocynum cannabinum*	common dogbane, dogbane, hemp dogbane, Indian hemp, Indian-hemp, Indianhemp, prairie dogbane
Arabis lyrata	*Arabis lyrata*	lyrate rockcress
Arctostaphylos uva-ursi coactilis	*Arctostaphylos uva-ursi*	bearberry, bearberry manzanita, kinnikinnick, mealberry
Aristida intermedia	*Aristida longespica var. geniculata*	slimspike threeawn
Artemisia caudata	*Artemisia campestris* ssp. *caudata*	field sagewort, field wormwood, Pacific wormwood
Asclepias incarnata	*Asclepias incarnata*	rose milkweed, swamp milkweed
Asclepias syriaca	*Asclepias syriaca*	broadleaf milkweed, common milkweed
Asparagus officinalis	*Asparagus officinalis*	asparagus, garden asparagus, garden-asparagus
Aster azureus	*Symphyotrichum oolentangiense*	skyblue aster
Aster dumosus	*Symphyotrichum dumosum*	rice button aster
Aster ptarmicoides (Solidago)	*Solidago ptarmicoides*	prairie goldenrod, upland white aster, verge-d'or faux-ptarmica, white flat-top goldenrod
Berberis thunbergii	*Berberis thunbergii*	Japanese barberry
Bidens vulgata	*Bidens vulgata*	big devil's beggartick, tall beggarticks, western sticktight
Calamagrostis canadensis	*Calamagrostis canadensis*	bluejoint, bluejoint reedgrass
Calamovilfa longifolia	*Calamovilfa longifolia var. magna*	prairie sandreed
Carex comosa	*Carex comosa*	longhair sedge
Carex viridula	*Carex viridula*	green sedge, little green sedge
Celastrus orbiculatus	*Celastrus orbiculatus*	Asian bittersweet, Asiatic bittersweet, oriental bittersweet, tsuru-ume-mo-doki
Cephalanthus occidentalis	*Cephalanthus occidentalis*	buttonbush, common buttonbush
Chara spp.	*Chara spp.*	muskgrass, stonewort, muskwort
Cirsium arvense	*Cirsium arvense*	Californian thistle, Canada thistle, Canadian thistle, creeping thistle, field thistle
Cirsium vulgare	*Cirsium vulgare*	bull thistle, common thistle, spear thistle
Cladium mariscoides	*Cladium mariscoides*	smooth sawgrass
Corispermum hyssopifolium	*Corispermum americanum*	American bugseed
Cornus obliqua	*Cornus obliqua*	silky dogwood
Cornus stolonifera	*Cornus sericea*	redosier, redosier dogwood
Cyperus erythrorhizos	*Cyperus erythrorhizos*	red-root flat sedge, redroot flatsedge, redroot nutgrass
Cyperus ferruginescens	*Cyperus odoratus*	fragrant flatsedge, rusty flat sedge
Cyperus rivularis	*Cyperus bipartitus*	brook flatsedge, shining flat sedge, slender flatsedge
Dryopteris thelypteris / T. palustris	*Thelypteris palustris var. pubescens*	eastern marsh fern
Dulichium arundinaceum	*Dulichium arundinaceum*	threeway sedge
Eleocharis compressa	*Eleocharis compressa*	flat-stem spike-rush, flatstem spikerush, flatstemmed spikesedge

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Eleocharis elliptica	*Eleocharis elliptica*	elliptic spikerush
Eleocharis erythropoda	*Eleocharis erythropoda*	bald spike-rush, bald spikerush, spikesedge
Eleocharis olivacea	*Eleocharis flavescens var. olivacea*	bright green spikerush
Epilobium ciliatum	*Epilobium ciliatum*	fringed willowherb, hairy willowherb, hairy willowweed
Equisetum hyemale	*Equisetum hyemale*	horsetail, scouring horsetail, scouringrush, scouringrush horsetail, tall scouring-rush, western scouringrush
Equisetum variegatum	*Equisetum variegatum*	variegated horsetail, variegated scouring-rush, variegated scouringrush
Equisetum x ferrissii	*Equisetum x ferrissii*	ferris horsetail, Ferriss' horsetail
Erechtites hieracifolia	*Erechtites hieraciifolius*	American burnweed, burnweed
Eupatorium altissimum	*Eupatorium altissimum*	tall joepyeweed, tall thoroughwort
Eupatorium maculatum	*Eutrochium maculatum*	eupatoire maculée, spotted joepyeweed
Eupatorium perfoliatum	*Eupatorium perfoliatum*	boneset, Chapman's thoroughwort, common boneset
Eupatorium serotinum	*Eupatorium serotinum*	late eupatorium, lateflowering thoroughwort
Euphorbia corollata	*Euphorbia corollata*	flowering spurge, floweringspurge euphorbia
Fragaria virginiana	*Fragaria virginiana*	thickleaved wild strawberry, Virginia strawberry, wild strawberry
Fraxinus sp.	*Fraxinus* sp.	ash
Gentiana crinita	*Gentianopsis crinita*	fringed gentian, greater fringed gentian, greater fringed-gentian
Hypericum kalmianum	*Hypericum kalmianum*	kalm's st. john's-wort, Kalm's St. Johnswort, millepertuis de Kalm
Hypericum majus	*Hypericum majus*	greater Canadian St. John's-wort, large St Johnswort, large St. Johnswort
Iris virginica	*Iris virginica*	Virginia iris
Juncus alpinus	*Juncus alpinoarticulatus*	northern green rush
Juncus balticus	*Juncus balticus var. littoralis*	Baltic rush
Juncus brachycephalus	*Juncus brachycephalus*	small-head rush, smallhead rush
Juncus canadensis	*Juncus canadensis*	Canadian rush
Juncus nodosus	*Juncus nodosus*	jointed rush, knotted rush
Juniperus communis	*Juniperus communis*	common juniper, dwarf juniper, genévrier commun
Juniperus virginiana	*Juniperus virginiana*	eastern red-cedar, eastern redcedar, genévrier rouge, red cedar juniper
Leersia oryzoides	*Leersia oryzoides*	rice cut grass, rice cutgrass
Lemna sp. *(most likely L. minor)*	*Lemna* sp. *(most likely L. minor)*	duckweed (most likely common duckweed, least duckweed, lesser duckweed)
Liatris aspera	*Liatris aspera*	rough gayfeather, tall blazing star, tall gayfeather
Linum medium	*Linum medium var. texanum*	stiff yellow flax, sucker flas
Linum striatum	*Linum striatum*	ridged yellow flax, rigid flax

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Lithospermum croceum	*Lithospermum caroliniense var. croceum*	Carolina puccoon
Lobelia kalmii	*Lobelia kalmii*	brook lobelia, Ontario lobelia
Lonicera sp.	*Lonicera* sp.	honeysuckle
Lonicera tatarica	*Lonicera tatarica*	bush honeysuckle, Tartarian honeysuckle, Tatarian honeysuckle
Lycopus americanus	*Lycopus americanus*	American bugleweed, American water horehound, American waterhorehound, cut-leaf water-horehound, water horehound, waterhorehound
Lycopus rubellus	*Lycopus rubellus*	taperleaf bugleweed, taperleaf water horehound
Lycopus uniflorus	*Lycopus uniflorus*	bugleweed, northern bugleweed, northern water-horehound, oneflower bugleweed
Lythrum alatum	*Lythrum alatum*	wing-angle loosestrife, winged lythrum
Lythrum salicaria	*Lythrum salicaria*	purple loosestrife, purple loosestrife or lythrum, purple lythrum, rainbow weed, salicaire, spiked loosestrife
Mimulus ringens	*Mimulus ringens*	Allegheny monkey-flower, Allegheny monkeyflower, ringen monkeyflower
Muhlenbergia mexicana	*Muhlenbergia mexicana*	Mexican muhly
Nuphar advena	*Nuphar lutea* ssp. *advena*	yellow pond-lily, yellow pondlily
Panicum capillare	*Panicum capillare*	annual witchgrass, common panic grass, common witchgrass, panicgrass, ticklegrass, tumble panic, tumbleweed grass, witches hair, witchgrass
Panicum implicatum	*Dichanthelium acuminatum var. acuminatum*	tapered rosette grass
Panicum virgatum	*Panicum virgatum*	old switch panic grass, switchgrass
Parthenocissus quinquefolia	*Parthenocissus quinquefolia*	American ivy, fiveleaved ivy, Virginia creeper, woodbine
Pedicularis lanceolata	*Pedicularis lanceolata*	swamp lousewort
Phragmites australis	*Phragmites australis*	common reed
Pinus banksiana	*Pinus banksiana*	black pine, gray pine, hudson bay pine, jack pine, scrub pine
Polygonum amphibium	*Polygonum amphibium*	water knotweed, water smartweed
Polygonum hydropiperoides	*Polygonum hydropiperoides*	swamp smartweed
Polygonum lapathifolium	*Polygonum lapathifolium*	curltop ladysthumb, curlytop knotweed, curlytop smartweed, dock-leaf smartweed, nodding smartweed, pale smartweed, smartweed
Polygonum persicaria	*Polygonum persicaria*	lady's-thumb, ladysthumb, ladysthumb smartweed, smartweed, spotted knotweed, spotted ladysthumb, spotted smartweed
Populus deltoides	*Populus deltoides*	common cottonwood, cottonwood, eastern cottonwood, plains cottonwood
Populus tremuloides	*Populus tremuloides*	quaking aspen

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Potamogeton crispus	*Potamogeton crispus*	curly pondweed, curly-leaved pondweed
Potamogeton robbinsii	*Potamogeton robbinsii*	Robbins pondweed, Robbins' pondweed
Potamogeton sp. *(P. div.,gram.,ill.)*	*Potamogeton* sp. *(P. diversifolius; P. gramineus; P. illinoensis)*	pondweed (waterthread, waterthread pondweed; grassy pondweed, variableleaf pondweed; illinois pondweed, Illinois pondweed, potamot de l'Illinois)
Proserpinaca palustris crebra	*Proserpinaca palustris var. crebra*	marsh mermaidweed
Prunus pumila	*Prunus pumila*	sand cherry, sandcherry
Prunus virginiana	*Prunus virginiana*	chokecherry, chokecherry (common), common chokecherry, Virginia chokecherry
Ptelea trifoliata	*Ptelea trifoliata var. mollis*	common hoptree
Pycnanthemum tenuifolium	*Pycnanthemum tenuifolium*	narrowleaf mountainmint, narrowleaf mountianmint
Pycnanthemum virginianum	*Pycnanthemum virginianum*	Virginia mountain-mint, Virginia mountainmint, Virginia mountianmint
Quercus palustris	*Quercus palustris*	pin oak
Quercus velutina	*Quercus velutina*	black oak
Rhus aromatica	*Rhus aromatica var. arenaria*	fragrant sumac
Rhynchospora capillacea	*Rhynchospora capillacea*	horned beakrush, needle beaksedge
Rosa palustris	*Rosa palustris*	swamp rose
Rudbeckia hirta	*Rudbeckia hirta*	black-eyed Susan, blackeyed Susan
Sabatia angularis	*Sabatia angularis*	rosepink, squarestem rosegentian
Salix glaucophylloides	*Salix myricoides var. myricoides*	bayberry willow
Salix interior	*Salix interior*	sandbar willow
Salix nigra	*Salix nigra*	black willow
Salix syrticola	*Salix cordata*	heartleaf willow
Satureja arkansana	*Clinopodium arkansanum*	limestone calamint
Scirpus acutus	*Schoenoplectus acutus var. acutus*	hardstem bulrush, Tule bulrush
Scirpus pungens (S. amer.)	*Schoenoplectus pungens var. pungens*	common threesquare
Scirpus validus	*Schoenoplectus tabernaemontani*	great bulrush, soft-stem bulrush, softstem bulrush
Scleria verticillata	*Scleria verticillata*	low nutrush
Scutellaria epilobifolia	*Scutellaria galericulata*	hooded skullcap, marsh scullcap, marsh skullcap
Senecio pauperculus	*Packera paupercula*	balsam groundsel
Smilacina stellata	*Maianthemum stellatum*	false Solomon's seal, little false Solomon's-seal, star false Solomon's-seal, star-flower Solomon's-seal, starry false lily of the valley, starry false Solomon's seal, starry false Solomon's-seal, starry Solomon's-seal
Solanum dulcamara	*Solanum dulcamara*	bitter nightshade, bittersweet nightshade, blue nightshade, climbing nightshade, European bittersweet, fellenwort, woody nightshade

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Solidago altissima	*Solidago altissima* ssp. *altissima*	Canada goldenrod, late goldenrod
Solidago gigantea	*Solidago gigantea*	giant goldenrod
Solidago graminifolia	*Euthamia graminifolia*	flat-top goldentop, flattop goldentop, slender goldentop
Solidago nemoralis	*Solidago nemoralis*	dyersweed goldenrod, gray goldenrod
Sorghastrum nutans	*Sorghastrum nutans*	Indiangrass, yellow indian-grass
Sphagnum sp.	*Sphagnum* sp.	sphagnum
Spiranthes cernua	*Spiranthes cernua*	nodding ladies'-tresses, nodding ladiestresses, white nodding ladies'-tresses
Toxicodendron radicans	*Toxicodendron radicans*	eastern poison ivy, poison ivy, poisonivy
Triglochin maritimum	*Triglochin maritimum*	arrowgrass, seaside arrow-grass, seaside arrowgrass, shore arrowgrass
Typha angustifolia	*Typha angustifolia*	narrow-leaf cat-tail, narrowleaf cattail
Typha x hybrid	*Typha x glauca*	white cattail
Ulmus pumila	*Ulmus pumila*	Chinese elm, Siberian elm
Utricularia cornuta	*Utricularia cornuta*	horned bladderwort
Utricularia gibba	*Utricularia gibba*	conespur bladderpod, humped bladderwort
Utricularia vulgaris	*Utricularia macrorhiza*	common bladderpod, common bladderwort, greater bladderwort
Vitis riparia	*Vitis riparia*	river-bank grape, riverbank grape
Xanthium strumarium	*Xanthium strumarium*	Canada cocklebur, cocklebur, cockleburr, common cocklebur, rough cocklebur, rough cockleburr
Ogden Dunes		
Agalinis purpurea	*Agalinis purpurea*	purple false foxglove
Ammophila breviligulata	*Ammophila breviligulata*	American beachgrass
Andropogon scoparius	*Schizachyrium scoparium*	little bluestem
Arabis lyrata	*Arabis lyrata*	lyrate rockcress
Arctostaphylos uva-ursi coactilis	*Arctostaphylos uva-ursi*	bearberry, bearberry manzanita, kinnikinnick, mealberry
Artemisia caudata	*Artemisia campestris* ssp. *caudata*	field sagewort, field wormwood, Pacific wormwood
Aster dumosus	*Symphyotrichum dumosum*	rice button aster
Aster ptarmicoides (Solidago)	*Solidago ptarmicoides*	prairie goldenrod, upland white aster, verge-d'or faux-ptarmica, white flat-top goldenrod
Aster simplex	*Symphyotrichum lanceolatum*	white panicle aster
Berberis thunbergii	*Berberis thunbergii*	Japanese barberry
Calamovilfa longifolia	*Calamovilfa longifolia var. magna*	prairie sandreed
Campylium sp. *(moss)*	*Campylium* sp.	campylium moss
Carex viridula	*Carex viridula*	green sedge, little green sedge
Celastrus orbiculatus	*Celastrus orbiculatus*	Asian bittersweet, Asiatic bittersweet, oriental bittersweet, tsuru-ume-mo-doki
Chara spp.	*Chara spp.*	muskgrass, stonewort, muskwort
Cirsium vulgare	*Cirsium vulgare*	bull thistle, common thistle, spear thistle
Cladium mariscoides	*Cladium mariscoides*	smooth sawgrass

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Corispermum hyssopifolium	*Corispermum americanum*	American bugseed
Cornus stolonifera	*Cornus sericea*	redosier, redosier dogwood
Cyperus rivularis	*Cyperus bipartitus*	brook flatsedge, shining flat sedge, slender flatsedge
Daucus carota	*Daucus carota*	bird's nest, Queen Anne's lace, wild carrot
Eleocharis elliptica	*Eleocharis elliptica*	elliptic spikerush
Eleocharis geniculata	*Eleocharis geniculata*	Canada spikesedge
Eleocharis pauciflora	*Eleocharis quinqueflora*	few-flower spike-rush, few-flower spikerush, fewflower spikerush, fewflowered spikesedge
Equisetum variegatum	*Equisetum variegatum*	variegated horsetail, variegated scouring-rush, variegated scouringrush
Equisetum x ferrissii	*Equisetum x ferrissii*	ferris horsetail, Ferriss' horsetail
Erigeron canadensis	*Conyza canadensis*	Canada horseweed, Canadian horseweed, horseweed, horseweed fleabane, mares tail, marestail
Eupatorium perfoliatum	*Eupatorium perfoliatum*	boneset, Chapman's thoroughwort, common boneset
Fimbristylis autumnalis	*Fimbristylis autumnalis*	slender fimbry
Fragaria virginiana	*Fragaria virginiana*	thickleaved wild strawberry, Virginia strawberry, wild strawberry
Gentiana crinita	*Gentianopsis crinita*	fringed gentian, greater fringed gentian, greater fringed-gentian
Helianthus petiolaris	*Helianthus petiolaris*	prairie sunflower, showy sunflower
Hemicarpha micrantha	*Lipocarpha micrantha*	dwarf bulrush, lipocarphe à petites fleurs, small-flower halfchaff sedge, smallflower halfchaff sedge, smallflower hemicarpha
Hypericum kalmianum	*Hypericum kalmianum*	kalm's st. john's-wort, Kalm's St. Johnswort, millepertuis de Kalm
Juncus alpinus	*Juncus alpinoarticulatus*	northern green rush
Juncus balticus	*Juncus balticus var. littoralis*	Baltic rush
Juncus brachycephalus	*Juncus brachycephalus*	small-head rush, smallhead rush
Juncus nodosus	*Juncus nodosus*	jointed rush, knotted rush
Juniperus communis	*Juniperus communis*	common juniper, dwarf juniper, genévrier commun
Juniperus virginiana	*Juniperus virginiana*	eastern red-cedar, eastern redcedar, genévrier rouge, red cedar juniper
Lechea tenuifolia	*Lechea tenuifolia*	narrowleaf pinweed
Lemna sp. *(most likely L. minor)*	*Lemna* sp. *(most likely L. minor)*	duckweed (most likely common duckweed, least duckweed, lesser duckweed)
Lobelia kalmii	*Lobelia kalmii*	brook lobelia, Ontario lobelia
Lycopus americanus	*Lycopus americanus*	American bugleweed, American water horehound, American waterhorehound, cut-leaf water-horehound, water horehound, waterhorehound
Lycopus uniflorus	*Lycopus uniflorus*	bugleweed, northern bugleweed, northern water-horehound, oneflower bugleweed

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Lythrum salicaria	*Lythrum salicaria*	purple loosestrife, purple loosestrife or lythrum, purple lythrum, rainbow weed, salicaire, spiked loosestrife
Mahonia repens	*Mahonia repens*	creeping barberry, creeping mahonia, oregon grape, Oregongrape, trunkee barberry
Morus alba (often just seedlings)	*Morus alba*	mulberry, white mulberry
Nepeta cataria	*Nepeta cataria*	catmint, catnip, catwort, field balm
Oenothera biennis	*Oenothera biennis*	common evening primrose, common evening-primrose, common eveningprimrose, evening primrose (common), hoary eveningprimrose, king's-cureall
Opuntia humifusa	*Opuntia humifusa*	devil's-tongue, Nopal del este, pricklypear
Panicum implicatum	*Dichanthelium acuminatum var. acuminatum*	tapered rosette grass
Panicum virgatum	*Panicum virgatum*	old switch panic grass, switchgrass
Phalaris arundinacea	*Phalaris arundinacea*	reed canary grass, reed canarygrass
Phragmites australis	*Phragmites australis*	common reed
Pinus banksiana	*Pinus banksiana*	black pine, gray pine, hudson bay pine, jack pine, scrub pine
Populus deltoides	*Populus deltoides*	common cottonwood, cottonwood, eastern cottonwood, plains cottonwood
Prunus virginiana	*Prunus virginiana*	chokecherry, chokecherry (common), common chokecherry, Virginia chokecherry
Ptelea trifoliata	*Ptelea trifoliata var. mollis*	common hoptree
Quercus velutina	*Quercus velutina*	black oak
Rhynchospora capillacea	*Rhynchospora capillacea*	horned beakrush, needle beaksedge
Rosa multiflora	*Rosa multiflora*	multiflora rose
Rosa palustris	*Rosa palustris*	swamp rose
Rubus sp. *(seedlings)*	*Rubus* sp.	blackberry, brambles, framboises, ronces
Sabatia angularis	*Sabatia angularis*	rosepink, squarestem rosegentian
Salix discolor	*Salix discolor*	pussy willow
Salix fragilis	*Salix fragilis*	crack willow
Salix glaucophylloides	*Salix myricoides var. myricoides*	bayberry willow
Salix interior	*Salix interior*	sandbar willow
Salsola kali	*Salsola kali*	prickly Russian thistle, Russian thistle, tumbleweed
Sassafras albidum	*Sassafras albidum*	sassafras
Scirpus acutus	*Schoenoplectus acutus var. acutus*	hardstem bulrush, Tule bulrush
Scirpus pungens (S. amer.)	*Schoenoplectus pungens var. pungens*	common threesquare
Scirpus validus	*Schoenoplectus tabernaemontani*	great bulrush, soft-stem bulrush, softstem bulrush
Scleria verticillata	*Scleria verticillata*	low nutrush
Senecio pauperculus	*Packera paupercula*	balsam groundsel

Species	Integrated Taxonomic Information System (ITIS) Name	Common Name
Smilacina stellata	*Maianthemum stellatum*	false Solomon's seal, little false Solomon's-seal, star false Solomon's-seal, star-flower Solomon's-seal, starry false lily of the valley, starry false Solomon's seal, starry false Solomon's-seal, starry Solomon's-seal
Solanum dulcamara	*Solanum dulcamara*	bitter nightshade, bittersweet nightshade, blue nightshade, climbing nightshade, European bittersweet, fellenwort, woody nightshade
Solidago altissima	*Solidago altissima* ssp. *altissima*	Canada goldenrod, late goldenrod
Solidago gigantea	*Solidago gigantea*	giant goldenrod
Solidago graminifolia	*Euthamia graminifolia*	flat-top goldentop, flattop goldentop, slender goldentop
Solidago nemoralis	*Solidago nemoralis*	dyersweed goldenrod, gray goldenrod
Solidago rugosa	*Solidago rugosa*	wrinkleleaf goldenrod
Sonchus uliginosus	*Sonchus arvensis* ssp. *uliginosus*	field sow-thistle, field sowthistle, marsh sowthistle, moist sowthistle, perennial sowthistle, sowthistle
Triglochin maritimum	*Triglochin maritimum*	arrowgrass, seaside arrow-grass, seaside arrowgrass, shore arrowgrass
Typha angustifolia	*Typha angustifolia*	narrow-leaf cat-tail, narrowleaf cattail
Utricularia cornuta	*Utricularia cornuta*	horned bladderwort
Utricularia subulata	*Utricularia subulata*	zigzag bladderwort
Viburnum opulus	*Viburnum opulus var. opulus*	European cranberrybush

SOURCE: Prepared by Daniel Mason, NPS

Note:

For the most part nomenclature follow Flora of Chicago; however a few names may reflect recent changes per the Flora of North America.

APPENDIX D7: PARK PLANTS OF CONCERN AND LIST OF SPECIES OCCURRING IN THE DUNE COMPLEX

Species	ITIS Name	Flowering	Habitat	State Status	Federal Status	Common Name	ITIS Common Name(s)	Growth Form	Life Cycle	Family	Class	Native/ Non*
Listed Endangered, Threatened and Rare												
Lathyrus japonicus glaber	*Lathyrus japonicus* var. *maritimus*	Jul	Foredune complex	Endangered		beach pea	beach pea	Vine	Perennial	Fabaceae	Dicot	Native
Arctostaphylos uva-ursi coactilis	*Arctostaphylos uva-ursi*	Apr May Jun	Foredune complex, dune complex	Rare		bearberry	bearberry, bearberry manzanita, kinnikinnick, mealberry	Shrub	Perennial	Ericaceae	Dicot	Native
Arenaria stricta	*Minuartia michauxii* var. *michauxii*	May Jun Jul	Prairie dry, foredune complex	Rare		stiff sandwort	Michaux's stitchwort	Forb	Annual, Perennial	Caryophyllaceae	Dicot	Native
Euphorbia polygonifolia	*Chamaesyce polygonifolia*	Jul Aug Sep	Foredune complex	Rare		seaside spurge	chamésyce à feuilles de renouée, seaside sandmat, seaside spurge	Forb	Annual	Euphorbiaceae	Dicot	Native
Juniperus communis depressa	*Juniperus communis* var. *depressa*		Dune complex, foredune complex	Rare		common juniper	common juniper	Shrub	Perennial	Cupressaceae	Gymnosperm	Native
Pinus banksiana	*Pinus banksiana*		Dune complex, foredune complex	Rare		jack pine	black pine, gray pine, hudson bay pine, jack pine, scrub pine	Tree	Perennial	Pinaceae	Gymnosperm	Native
Polygonella articulata	*Polygonella articulata*	Aug Sep Oct	Dune complex, foredune complex	Rare		jointweed	coastal jointweed	Forb	Annual	Polygonaceae	Dicot	Native
Rhus aromatica var arenaria	*Rhus aromatica* var. *arenaria*		Foredune complex, savanna complex	Rare		fragrant sumac	fragrant sumac	Shrub	Perennial	Anacardiaceae	Dicot	Native
Cirsium pitcheri	*Cirsium pitcheri*	Jun Jul	Foredune complex	Threatened	Threatened	sand thistle	Pitcher's thistle, sand dune thistle	Forb	Perennial	Asteraceae	Dicot	Native

Species	ITIS Name	Flowering	Habitat	State Status	Federal Status	Common Name	ITIS Common Name(s)	Growth Form	Life Cycle	Family	Class	Native/ Non*
Potentilla anserina	*Argentina anserina*	May Jun Jul Aug Sep	Foredune complex	Threatened		silverweed	silverweed cinquefoil	Forb	Perennial	Rosaceae	Dicot	Native
Salix syrticola(FC) indiana-Cordata	*Salix cordata*	Apr May Jun Jul	Foredune complex	Threatened		dune willow	heartleaf willow	Shrub	Perennial	Salicaceae	Dicot	Native
Solidago racemosa gillmani	*Solidago simplex* var. *gillmanii*	Jul Aug Sep Oct Nov	Pannes, foredune complex	Threatened		dune goldenrod	Deam's goldenrod, Rand's goldenrod	Forb	Perennial	Asteraceae	Dicot	Native
Desirable Beach Plant Assemblage (would also include E. polygonifoilia)												
Arabis lyrata	*Arabis lyrata*	Apr May Jun Jul Aug Sep	Foredune complex, dune complex, savanna complex	No status		sand cress	lyrate rockcress	Forb	Annual	Brassicaceae	Dicot	Native
Artemisia caudata	*Artemisia campestris* ssp. *caudata*	Aug Sep Oct	Foredune complex, dune complex	No status		beach wormwood	field sagewort, field wormwood, Pacific wormwood	Forb	Biennial	Asteraceae	Dicot	Native
Cakile edentula	*Cakile edentula*	Jul Aug Sep Oct	Foredune complex	No status		sea rocket	American searocket	Forb	Annual	Brassicaceae	Dicot	Native
Corispermum hyssopifolium	*Corispermum americanum*	Aug Sep	Foredune complex, dune complex	No status		common bugseed	American bugseed	Forb	Annual	Chenopodiaceae	Dicot	Native
Cycloloma atriplicifolium	*Cycloloma atriplicifolium*	Jul Aug Sep	Foredune complex, dune complex, savanna complex	No status		winged pigweed	tumble ringwing, winged pigweed, winged-pigweed	Forb	Annual	Chenopodiaceae	Dicot	Native

Species	ITIS Name	Flowering	Habitat	State Status	Federal Status	Common Name	ITIS Common Name(s)	Growth Form	Life Cycle	Family	Class	Native/ Non*
List of Species (native and non-native) Occurring in the Beach/Dune Complex (not including wetlands/pannes)												
Ammophila breviligulata	*Ammophila breviligulata*		Foredune complex	No status		marram grass	American beachgrass	Graminoid	Perennial	Poaceae	Monocot	Native
Andropogon scoparius	*Schizachyrium scoparium*		Prairie wet, prairie dry, foredune complex	No status		little bluestem grass	little bluestem	Graminoid	Perennial	Poaceae	Monocot	Native
Asclepias viridiflora	*Asclepias viridiflora*	Jun Jul	Foredune complex, prairie dry, dist dry	No status		short green milkweed	green antelopehorn milkweed, green comet milkweed, green milkweed	Forb	Perennial	Asclepiadaceae	Dicot	Native
Calamovilfa longifolia	*Calamovilfa longifolia* var. *magna*		Dist dry, dune complex, foredune complex	No status		sand reed	prairie sandreed	Graminoid	Perennial	Poaceae	Monocot	Native
Carex tonsa	*Carex tonsa* var. *tonsa*		Foredune complex	No status		sedge	shaved sedge	Graminoid	Perennial	Cyperaceae	Monocot	Native
Carex umbellata	*Carex umbellata*		Foredune complex	No status		hairy false early sedge	parasol sedge	Graminoid	Perennial	Cyperaceae	Monocot	Native
Celastrus orbiculatus	*Celastrus orbiculatus*		Dune complex, savanna complex	No status		oriental bittersweet	Asian bittersweet, Asiatic bittersweet, oriental bittersweet, tsuru-ume-mo-doki	Shrub	Perennial	Celastraceae	Dicot	Non-native
Celastrus scandens	*Celastrus scandens*	May Jun	Dist-dry, Foredune complex, savanna complex	No status		climbing bittersweet	American bittersweet, staffvine, waxwork	Shrub	Perennial	Celastraceae	Dicot	Native

Species	ITIS Name	Flowering	Habitat	State Status	Federal Status	Common Name	ITIS Common Name(s)	Growth Form	Life Cycle	Family	Class	Native/ Non*
Centaurea maculosa	*Centaurea stoebe* ssp. *micranthos*	Jun Jul Aug Sept Oct	Foredune complex, dune complex, savanna complex	No status		spotted knapweed	spotted knapweed	Forb	Perennial	Asteraceae	Dicot	Invasive Non-native
Cirsium arvense	*Cirsium arvense*		Dune complex, Savanna complex	No status		Canada thistle	Californian thistle, Canada thistle, Canadian thistle, creeping thistle, field thistle	Forb	Perennial	Asteraceae	Dicot	Non-native
Cynoglossum officinale	*Cynoglossum officinale*		Foredune	No status		hound's tongue	common houndstongue, gypsy-flower, gypsyflower, hound's tongue, houndstongue	Forb	Bi-annual	Boraginaceae	Dicot	Non-native
Diervilla lonicera	*Diervilla lonicera*		Dune complex, savanna complex	No status		bush honeysuckle	northern bush honeysuckle, northern bush-honeysuckle	Shrub	Perennial	Caprifoliacea	Dicot	Non-native
Elymus canadensis	*Elymus canadensis*		Foredune complex, dune complex	No status		Canada wild rye	Canada wildrye	Graminoid	Perennial	Poaceae	Monocot	
Helianthus petiolaris	*Helianthus petiolaris*	Jun Jul Aug Sep Oct Nov	Dist dry, dune complex, foredune complex	No status		petioled sunflower	prairie sunflower, showy sunflower	Forb	Perennial	Asteraceae	Dicot	
Juniperus virginiana crebra	*Juniperus virginiana*		Foredune complex, dune complex	No status		eastern red cedar	eastern red-cedar, eastern redcedar, genévrier rouge, red cedar juniper	Tree	Perennial	Pinaceae	Gymnosperm	Native

Species	ITIS Name	Flowering	Habitat	State Status	Federal Status	Common Name	ITIS Common Name(s)	Growth Form	Life Cycle	Family	Class	Native/ Non*
Leymus arenarius	*Leymus arenarius*		Foredune complex	No status		lyme grass	sand ryegrass	Graminoid	Perennial	Poaceae	Monocot	Invasive Non-native
Lithospermum croceum	*Lithospermum caroliniense* var. *croceum*	Apr May Jun Jul Aug Sep Oct	Foredune complex, dist dry	No status		hairy puccoon	Carolina puccoon	Forb	Perennial	Boraginaceae	Dicot	
Melilotus officinalis	*Melilotus officinalis*		Dune complex, savanna complex	No status		sweet clover	yellow sweet-clover, yellow sweetclover	Forb	Perennial	Fabeaceae	Dicot	Non-native
Oenothera biennis	*Oenothera biennis*	Jun Jul Aug Sep Oct	Savanna complex, dune complex, dist dry, foredune complex	No status		common evening primrose	common evening primrose, common evening-primrose, common evening primrose, evening primrose (common), hoary evening primrose, king's-cureall	Forb	Biennial	Onagraceae	Dicot	
Opuntia humifusa	*Opuntia humifusa*	Jun Jul	Savanna complex, dune complex, foredune complex	No status		prickly pear	devil's-tongue, Nopal del este, pricklypear	Forb	Perennial	Cactaceae	Dicot	Native
Populus candicans X jackii	*Populus candicans X jackii*	Apr May	Foredune complex	No status		balm-of-Gilead, Jack's poplar	balm-of-Gilead, Jack's poplar					Non-native

Species	ITIS Name	Flowering	Habitat	State Status	Federal Status	Common Name	ITIS Common Name(s)	Growth Form	Life Cycle	Family	Class	Native/ Non*
Populus deltoides	*Populus deltoides*	Apr May	Foredune complex,	No status		cottonwood	common cottonwood, cottonwood, eastern cottonwood, plains cottonwood	Tree	Perennial	Salicaceae	Dicot	Non-native
Populus nigra italica	*Populus nigra*		Foredune complex	No status		lombardy poplar	black cottonwood, black poplar, Lombardy poplar, Lombardy's poplar	Tree	Perennial	Salicaceae	Dicot	Non-native
Populus X jackii	*Populus x jackii*		Foredune complex	No status		balm-of-Gilead	balm-of-Gilead	Tree	Perennial	Salicaceae	Dicot	Non-native
Prunus pumila	*Prunus pumila*	Apr May Jun	Foredune complex, savanna complex	No status		sand cherry	sand cherry, sandcherry	Shrub	Perennial	Rosaceae	Dicot	Native
Ptelea trifoliata mollis	*Ptelea trifoliata* var. *mollis*	Jun	Dune complex, foredune complex	No status		wafer ash, hop tree	common hoptree	Shrub	Perennial	Rutaceae	Dicot	Native
Pteridium aquilinum latiusculum	*Pteridium aquilinum* var. *latiusculum*		Foredune complex, dune complex, savanna complex	No status		bracken fern	bracken, bracken fern, northern bracken fern, western brackenfern	Fern	Perennial	Polypodiaceae	Filicinae	Native

Species	ITIS Name	Flowering	Habitat	State Status	Federal Status	Common Name	ITIS Common Name(s)	Growth Form	Life Cycle	Family	Class	Native/ Non*
Rhamnus cathartica	*Rhamnus cathartica*		Foredune complex, dune complex, savanna complex	No status		buckthorn	carolina buckthorn, common buckthorn, European buckthorn, European waythorn, Hart's thorn, nerprun cathartique	Tree	Perennial	Rhamnaceae	Dicot	Non-native
Robinia pseudoacacia	*Robinia pseudoacacia*		Foredune complex, dune complex, savanna complex	No status		black locust	black locust, false acacia, yellow locust	Tree	Perennial	Fabeaceae	Dicot	Invasive Non-native
Smilax lasioneura	*Smilax lasioneura*	Apr May Jun	Foredune	No status		common carrion flower	Blue Ridge carrion-flower, Blue Ridge carrionflower, smilax	Forb	Perennial	Liliaceae	Monocot	Native
Solidago nemoralis	*Solidago nemoralis*	Aug Sep	Prairie dry, dune complex, savanna complex, foredune complex	No status		old field goldenrod	dyersweed goldenrod, gray goldenrod	Forb	Perennial	Asteraceae	Dicot	Native
Sporobolus cryptandrus	*Sporobolus cryptandrus*		Foredune complex, dist dry, savanna complex	No status		sand dropseed	sand dropseed	Graminoid	Perennial	Poaceae	Monocot	Native
Triplasis purpurea	*Triplasis purpurea*		Prairie dry, foredune complex, dune complex	No status		sand grass	purple sand grass, purple sandgrass	Graminoid	Annual	Poaceae	Monocot	Native

Source: IDNR (2011); Wilhelm (1990)

APPENDIX D8: WILDLIFE SPECIES OF CONSERVATION CONCERN

Species Name	Common Name	Federal	State	INDU Locations/Notes
Amphibians				
Acris crepitans crepitans	Northern cricket frog		SSC	marshes/streams/lakes
Ambystoma laterale	Blue-spotted salamander		SSC	woodlands with sandy soil
Hemidactylium scutatum	Four-toed salamander		SE	bogs/woodland ponds/swamps
Necturus maculosus maculosus	Common mudpuppy		SSC	large lakes and streams
Lethobates pipiens	Northern leopard frog		SSC	bogs/marshes/shallow ponds
Reptiles				
Clemmys guttata	Spotted turtle		SE	marshes/bogs/lakes/wooded ponds
Clonophis kirtlandii	Kirtlands's snake		SE	wet grassy areas along wetlands
Emydoidea blandingii	Blanding's turtle		SE	primary aquatic/marsh
Opheodrys vernalis	Smooth green snake		SE	sandy oak woods/tall grass prairie
Sistrurus catenatus catenatus	Eastern massasauga	C	SE	marshes/fens/lake margins/dry prairie/old fields/swamp
Thamnophis proximus proximus	Western ribbon snake		SSC	wetlands
Mammals				
Condylura cristata cristata	Star-nosed mole		SSC	bog/fen/other wetlands (muck lands)
Lasionycteris notivagans	Silver-haired bat		SSC	roosts in cracks of trees/forages over water
Lasiurus borealis	Red bat		SSC	roosts in foliage of trees/forges in open habitats
Lasiurus cinereus	Hoary bat	No Status	SSC	roosts in foliage of trees/forges in open habitats
Lontra canadensis canadensis	River otter		SSC	large lakes and streams
Lynx rufus rufus	Bobcat	No Status	SSC	mixed habitats
Mustela nivalis rixosa	Least weasel		SSC	woods/grasslands/hedgerows/pond edges
Myotis lucifugus	Little brown myotis		SSC	roosts in buildings and hollow trees/forages over water
Myotis septentrionalis	Northern myotis		SSC	roosts in cracks and under bark in trees/forages in woodlots

Species Name	Common Name	Federal	State	INDU Locations/Notes
Myotis sodalis	Indiana myotis	LE	SE	roosts in cracks and under bark in trees/forages at edge of woodlots
Nycticeius humeralis	Evening bat		SE	roosts in buildings and hollow trees/forages in woodlots and open habitats
Pipistrellus subflavus	Tricolored bat		SSC	roosts in buildings and tree foliage/forages in woodlots and open habitats
Sorex hoyi hoyi	Pygmy shrew		SSC	bogs/marshes/hardwood forest (must have moist soils)
Spermophilus franklinii	Franklin's ground squirrel		SE	open areas with cover (Savanna?)
Taxidea taxus jacksoni	Badger		SSC	blowouts/prairie/farmland

SOURCE: IDNR (2011)

Notes:

C = candidate species for federal listing

LE = federally listed endangered

SE = state endangered

SSC = species of special concern

APPENDIX D9: BIRD SPECIES OF CONSERVATION CONCERN

Species Name	Common Name	Federal	State	INDU Locations/ Notes
Botaurus lentiginosus	American Bittern		SE	
Ixobrychus exilis	Least Bittern		SE	
Ardea alba	Great Egret		SSC	
Nycticorax nycticorax	Black-crn Night-Heron		SE	
Nyctanassa violacea	Yellow-crn Night-Heron		SE	
Pandion haliaetus	Osprey		SE	
Haliaeetus leucocephalus	Bald Eagle	LT,PDL	SE	
Circus cyaneus	Northern Harrier		SE	
Buteo lineatus	Red-shouldered Hawk		SSC	
Buteo platypterus	Broad-winged Hawk	No Status	SSC	
Falco peregrinus anatum	Peregrine Falcon	No Status	SE	
Rallus elegans	King Rail		SE	
Rallus limicola	Virginia Rail		SE	
Gallinula chloropus	Common Moorhen	No Status	SE	
Grus Canadensis	Sandhill Crane	No Status	SSC	
Charadrius melodus circumcinctus	Piping Plover	LE	SE	
Bartramia longicauda	Upland Sandpiper		SE	
Phalaropus tricolor	Wilson's Phalarope		SSC	
Childonias niger	Black Tern		SE	
Tyto alba pratincola	Barn Owl		SE	
Lanius ludovicianus	Loggerhead Shrike	No Status	SE	Has many subspecies
Cistothorus platnesis	Sedge Wren		SE	Two subspecies
Cistothorus palustris	Marsh Wren		SE	Many subspecies
Vermivora chrysoptera	Golden-winged Warbler		SE	
Dendroica cerulea	Cerulean Warbler		SE	
Wilsonia citrina	Hooded Warbler		SSC	
Ammodramus henslowii henslowii	Henslow's Sparrow		SE	
Sturnell neglecta	Western Meadowlark		SSC	
Xanthocephalus xanthocephalus	Yellow-headed Blackbird		SE	

SOURCE: Brock (2011)

Notes:

LT = listed threatened species

PD = proposed for delisting

SE = state endangered

SSC = species of special concern

APPENDIX D10: SUMMARY OF BENTHIC SPECIES IN LAKE MICHIGAN NEARSHORE

Taxa	Common Name	Native Species	Invasive Species	Habitat type
Turbellaria	Planarians	X		On substrate, under rocks, debris
Nematoda	Roundworms	X		On substrate and debris, within interstitial spaces of granular substrate
Bivalvia	Clams			See below
Sphaeriidae	Fingernail clams	X		On and in granular substrate
Dreissenoidea	–	X		See below
Dreissena polymorpha	Zebra Mussels		X	Attached to solid substrate
Dresissena bugensis	Quagga mussels		X	Attached to solid substrate
Oligochaeta	Segmented aquatic worms/sludge worms			Within interstitial spaces of granular substrate
Aeolosomatidae	–	X		
Enchytraeidae	–	X		
Lumbriculidae	–	X		
Stylodrilus heringianus	–	X		
Tubificidae	–			
Aulodrilus americanus	–	X		
A. limnobius	–	X		
A. pluriseta	–	X		
Ilyocryptus freyi	–	X		
I. templetoni	–	X		
Limnodrilus cervix		X		
L. claparadieanus	–	X		
L. hoffmeisteri	–	X		
L. spiralis	–	X		
L. udekemianus	–	X		
Opisthonais serpentia	–	X		
Potamothrix moldaviensis	–	X		
P. vejdovskyi moldaviensis	–	X		
Quistrodrilus multisetosus	–	X		
Rhyacodrilus coccineus	–	X		
Spirosperma ferox	–	X		
S. nikolskyi	–	X		
Tubifex ignotus	–	X		
T. americanus	–	X		
T. Tubifex	–	X		

Taxa	Common Name	Native Species	Invasive Species	Habitat type
T. superiorensis	–	X		
Variechaetidrilus augustipenis	–	X		
Naididae	–			
Amphichaeta leydigi	–	X		
Chaetogaster diastrophus	–	X		
Nais variabilis	–	X		
Paranais frici	–	X		
Piguetiella blanci	–	X		
Piguetiella michiganensis	–	X		
Uncinais uncinate	–	X		
Vejdovskyella intermedia	–	X		
Hirudinea	Leeches	X		Warm, protected shallow waters; under stones; some species are free-living and some are parasitic and found on fish, turtles, etc.
Tardigrada	Water bears			Within interstitial spaces of the substrate
Dactylobiotus sp.	–	X		
Acari	Aquatic mites	X		
Crustacea	Crustaceans			
Ostracoda	Seed shrimp	X		On and in sandy substrates, algal mats, debris and mud
Amphipoda	Scuds, sideswimmers			On and in granular substrates
Diporeia sp.	–	X		
Decapoda	Crayfish, shrimp			Within and on cobble substrate
Orconectes rusticus	Rusty crayfish		X	
Copepoda	Copepods			On and in granular substrate
Eurytemora affinis	–	X		
Acanthocyclops brevispinosus	–	X		
Diacyclops nanus	–	X		
Eucyclops agilis	–	X		
Canthocampus robertcookeri	–	X		
Heteropsyllus sp.	–	X		
Heteropsyllus nr. nunni	–		X	
Nitokra hibernica	–	X		
Paracyclops chiltoni	–	X		
Schizopera borutskyi	–		X	
Cladocera	Water fleas			On vegetation or organic material; some species free-living in the water column
Alona sp.	–	X		
Bythotrephes longimanus	Spiny waterflea		X	

Taxa	Common Name	Native Species	Invasive Species	Habitat type
Cercopagis pengoi	Fishhook waterflea		X	
Graptoleberis sp.	–	X		
Monospilus sp.	–	X		
Diptera	Flies, mosquitoes, midges			
Chironomidae	Midges	X		Live in and on the substrate
Axarus spp.	–	X		
Chironomus sp.	–	X		
Cladotanytarsus sp.	–	X		
Cryptotanytarsus sp.	–	X		
Monodiamesa sp.	–	X		
Orthocladius/Cricotopus sp.	–	X		
Paracladopelma sp.	–	X		
Psectrocladius sp.	–	X		
Tanytarsus sp.	–	X		

Source: Last *et al.* (1995)

Appendix E: Concern Response Report

IMPACT ANALYSIS: GENERAL METHODOLOGY FOR ESTABLISHING IMPACTS / EFFECTS
IMPACT TOPICS DISMISSED FOR DETAILED ANALYSIS: WATER QUALITY
ISSUES: CLIMATE CHANGE
PLAN IMPLEMENTATION AND SIGNAL OF FUTURE INTENT: REMOVAL OF HARDENED STRUCTURE
PURPOSE AND NEED IS NOT VALID OR SUBSTANTIATED
COST OF IMPLEMENTING THE PROJECT IS PROHIBITIVE
COMPLIANCE WITH FEDERAL, STATE, AND LOCAL LAW
PARK LEGISLATION / AUTHORITY
PARK OPERATIONS: EFFECTS OF PROPOSAL AND ALTERNATIVES
THREATENED AND ENDANGERED SPECIES AND SPECIES OF CONCERN: IMPACT OF PROPOSAL AND ALTERNATIVES
TERRESTRIAL HABITAT: IMPACT OF PROPOSAL AND ALTERNATIVES
TERRESTRIAL MANAGEMENT PROPOSED ACTIONS

CONCERN RESPONSE REPORT

The Shoreline Restoration and Management Plan/Draft Environmental Impact Statement (EIS) was made available for public review and comment during a 60-day period ending September 13, 2012. A total of 99 correspondence were submitted.

Substantive comments on the EIS focused on several topics, including issue with varying associated impacts to the environment, private lands, as well as others. The largest numbers of comments were related to the cobble berm associated with draft alternative E and its potential impacts to the shoreline, recreation, and private properties. A summary of the public comments received and the park responses to those comments are provided below.

ARCHAEOLOGY – SHIPWRECKS – ADDITIONAL RESOURCES

Concern Statement:

The EIS does not address all of the submerged cultural resources within the project's Area of Potential Effect (APE). The resources include shipwrecks that have been researched and mapped by the Indiana Coastal Management Program. The existence of these shipwrecks was mentioned at initial scoping meetings for the Shoreline Management Plan, and we would like to see acknowledgement of these cultural resources included in the Final EIS. Some new research is available now on these resources but was not referenced in the plan.

Response:

On pages 26 and 27 of the section, "Impact Topics Dismissed from Further Consideration," information about the J.D. Marshall (12PR0723) and the Muskegon (12LE0381) sites, which are within the APE for the proposed project, is provided; shipwrecks outside of the APE were not mentioned because they would not be affected by the project.

As a public document, the plan/EIS cannot disclose details and specific site locations of archeological resources. The noted section provides a general historic overview of the project area, but as a resource topic dismissed from detailed analysis there is no requirement to detail all the specific sites.

ARCHAEOLOGY – SHIPWRECKS – COASTAL PROCESSES

Concern Statement:

The EIS is unclear about the effects the various alternatives, including the preferred alternative with the submerged berm, would have on submerged archeological sites located along the shoreline. Some of the effects will be direct, such as the potential to place the berm within the boundaries of sites, increasing sediment flow that would cover several archeological sites, or accelerate the scouring of the lake bed at these locations. We believe that a more detailed assessment should address the potential direct and indirect impacts the proposed project activities may have on submerged cultural resources.

Response:

National Park Service (NPS) archeologists disagree with the presumption that nourishment material would adversely affect historic and archeological sites by accelerating the scouring effect. Nourishment activities have been conducted in the area since 1974 with no evidence of such adverse effects. Additional analysis would be conducted at the time of construction/nourishment activities to verify that the submerged resources would not be adversely affected. The illustration of the berm in the draft EIS associated with alternative E was not drawn to scale and gave the impression that stone would be placed directly on submerged resources. This was never the case. Because of concerns expressed about alternative E, a new alternative, F has been developed that meets the needs and objectives of the plan without the construction of a berm. A letter would be prepared by Indiana Dunes National Lakeshore personnel and submitted to the Indiana state historic preservation officer (SHPO) that would provide a more detailed description of the cultural resources in the project area and discuss potential effects to these resources. Per Section 106 of the National Historic Preservation Act (NHPA), implementation of the project would not proceed until the Indiana SHPO concurs with the National Park Service on a determination of "no adverse effects" to historic or archeological resources. However, with the new alternative, it is not anticipated that any of the proposed activities would alter the natural littoral drift pattern.

PLAN – CULTURAL RESOURCES

Concern Statement:

Effects of this project on submerged cultural resources have not been addressed within the draft EIS, and as such we disagree with the determination that the alternatives would have no effect on cultural resources. In addition, it would seem that the submerged cultural resources have not been addressed with regard to Section 106 of NHPA.

Response:

The National Park Service has already initiated consultation with SHPO.

The National Park Service does not believe that putting sediments into the water will have an adverse effect on submerged resources, and no sediment would be placed directly on resources during nourishment activities under any alternative.

The illustration in the draft EIS of the berm in alternative E was not to scale and gave the impression that stone would be placed directly on submerged resources. This was never the case. However, because of concerns expressed about alternative E, a new preferred alternative has been developed that meets the needs and objectives of the plan without the construction of a berm.

PLAN – CULTURAL RESOURCES – ADDITIONAL DOCUMENT REVIEW

Concern Statement:

Previous and current research which addresses submerged cultural resources along Indiana's shoreline should have been reviewed during the preparation of the draft EIS. The potential effects of the proposed project on the submerged resources were only addressed in a generalized manner - the effects of each of the alternatives were not adequately defined.

Response:

The cited previous and current documents will be reviewed by an NPS archeologist.

As noted by one of the commenters, some of the new research was unavailable to the National Park Service when the draft was developed. References will be included to the commenters report in the bibliography.

Under the new preferred alternative, the National Park Service will not be placing cobble on submerged resources.

The National Park Service has already initiated consultation with SHPO.

PLAN – CULTURAL RESOURCES

Concern Statement:

There are no archaeologists included on the list of "Preparers and Consultants," nor was any reference made to the NPS's submerged cultural resource team.

Response:

The list of "Preparers and Consultants" will be revised to reflect the NPS archaeologist Jay Sturdevant on the plan/draft EIS planning team.

Concern Statement:

It is recommended that the NPS include the following conditions within the draft EIS (1) Section 106 of the NHPA would be completed; (2) the Indiana SHPO would be consulted on any proposed project activity; (3) an archaeological survey would be conducted; and (4) archaeological sites would be avoided or mitigated) as well as the assessment of potential impacts in each applicable section of the draft EIS in regards to cultural resources. It is also recommended that a current records review be conducted to identify all known archaeological sites within the area.

Response:

The park has initiated consultation with the SHPO. Additional analysis would be conducted at the time of construction/nourishment activities to verify that the submerged resources would not be adversely affected. A letter would be prepared by Indiana Dunes National Lakeshore personnel and submitted to the Indiana SHPO that would provide a more detailed description of the cultural resources in the project area and discuss potential effects to these resources. Per Section 106 of NHPA, the National Park Service would seek a determination of "no adverse effects" to historic or archeological resources from the Indiana SHPO.

The National Park Service will include in the final EIS the conditions that the Indiana SHPO will be consulted on any proposed project activity in addition to the mitigation already included in the draft EIS in chapter 2 (page 50) that states, "areas selected for construction and beach nourishment activities would be surveyed to ensure that cultural resources (i.e., archeological sites, historic structures, and cultural landscapes) in the area of affect are identified and protected by avoidance or, if necessary, mitigation measures."

BEACH NOURISHMENT – GENERAL – AQUATIC FAUNA

Concern Statement:

The EIS is unclear how it addresses terrestrial and aquatic site disturbance issues within the APE. Fish displacement and potential effects on fish spawning should be minimized, and localized effects on benthic communities should be examined. Further, on-site best management practices (BMPs) need to be incorporated to protect adjacent habitats, and efforts taken to prevent impacts to threatened and endangered species.

Response:

Displacement of fish assemblages would be minor and limited in scope. Fish would tend to avoid the immediate placement area, but would remain in the coastal system and return once conditions return to normal (Horvath 1999). While the displacement would be limited, the park service will work with the Indiana Department of Natural Resources (IDNR), who has permitting authority over beach fill operations, to time beach nourishment events to minimize these impacts. Beach nourishment at reaches 1 and 3 has been ongoing, off and on, for the past 25 years or more. These nourishment activities have all been coordinated with IDNR, and to date there have been no long-term impacts associated with fish displacement.

Since beach nourishment activities have been going on for some time, it is likely the current composition of the benthic community in the shoreline affected by beach nourishment is a reflection of those activities. The activities would be detrimental to individual benthic organisms or localized communities within the affected shoreline, but would not significantly alter the benthic populations in the Southern Lake Michigan shoreline as a whole.

Impacts to terrestrial systems from the active beach fill operations are also associated with beach nourishment. Appropriate BMPs would be used when applicable. Typical construction site BMPs that would not be applicable to beach nourishment would include those associated with filling riparian wetlands (lake/shore interface) and some erosion prevention measures.

In accordance with Director's Order 77 and Procedural Manual #77-1: Wetland Protection (January 2012), the NPS classifies wetlands according to the Cowardin system under which the system definition states that a wetland must have at least one of three attributes. Shorelines and beaches meet the third attribute: the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year. Per Procedural Manual #77-1, the interface between Lake Michigan and the beach is considered wetlands and as such needs to have a Wetlands Statement of Finding completed. Procedural Manual 77-1, section 4.2 "Excepted Actions" identifies certain types of activities that require modified approaches to achieve the objectives of E.O. 11990 while reducing delay and paperwork. "Excepted Actions" described in this subsection are those actions that may be excepted from the Statement of Findings requirements described in sections 5.3.4 and 5.3.5 and the compensation requirements discussed in section 5.2.3 of these procedures. The specific exception is (h) Actions designed to restore degraded (or completely lost) wetland, stream, riparian, or other aquatic habitats or ecological processes. For this exception, "restoration" refers to reestablishing environments in which natural ecological processes can, to the extent practicable, function as they did prior to disturbance.

Due to the nature of beach nourishment as a mitigative measure to protect beach "wetlands" the National Lakeshore completed a sediment compatibility analysis (Morris and Eshlemen 2011) for the most probable beach nourishment sources and submitted to the NPS Water Resources Division requesting an exemption from the Rule. The sediment compatibility analysis demonstrated that beach nourishment materials form in-lake sources were sufficiently compatible to grant the requested exemption.

Typically BMPs are put in place to prevent the excessive erosion of disturbed lands and limit the mobility of those suspended sediments. These measures are not applicable in this instance as they are in direct contradiction with the intended outcome of the beach nourishment (i.e., sediment transport).

BEACH NOURISHMENT – GENERAL – CLIMATE

Concern Statement:

Figures illustrating beach nourishment areas in the EIS are unclear and out of scale and the operational details for the sand bypass system are unclear during the winter months. We suggest using an adaptive management approach to determine beach nourishment needs through time, and that dredged sands be kept in the littoral system and not disposed of offshore.

Response:

The current preferred alternative is to primarily use nourishment material from dredged and non-dredged sources with onshore placement. There is no intent to dispose of sediments offshore. The specific source of the material would be determined in coordination with the IDNR.

The images in figure 3-5 are conceptual, depicting the general areas identified for beach nourishment under the alternatives presented; specific nourishment events could take place anywhere within these general areas. Often beach nourishments in the past have been tied to necessary dredging operations at adjacent harbor facilities. Since these harbors are the primary blocking mechanism of littoral sediment transport with the National Lakeshore, they routinely need maintenance and associated funding needed to maintain these harbors vary depending on a number of complex factors. This inherent uncertainty tied to maintenance operation facilitates the need for the EIS to capture a wide range of placement volumes. This does not preclude the modeling studies that have shown that the 105,000 yds^3 for reaches 1 and 2, and 74,000 yds^3 for reaches 3 and 4 of nourishment volumes proposed in the draft EIS would be required for the foreseeable future without respect to maintenance dredging needs.

For alternatives that include the proposed sand bypass system, the bypass system would be located below the frost line and the pump systems would require on-going maintenance to properly function following the winter months.

BEACH NOURISHMENT – GENERAL – FREQUENCY

Concern Statement:

The EIS does not provide sufficient variety in the range of alternative with respect to placement years. We suggest the EIS consider a wider range of placement options that incorporate placement frequency at more than just 1 and 5 years. We recommend alternative C-1 for reaches 3 and 4.

Response:

There are seven alternatives for reaches 1 and 2 and four alternatives for reaches 3 and 4, for a total of 11 alternatives presented in the draft EIS. In addition, alternatives that were considered but eliminated from further consideration are discussed in Chapter 2. The analysis of annual and 5-year nourishment frequencies captures a reasonable range for nourishment activities. There could be a limitless amount of variation that could conceivably be analyzed as alternatives (such as nourishment intervals between 1 and 5 years, and variations in quantities and placement length); however, the National Park Service believes the alternatives selected represent a reasonable spectrum, and that inclusion of multiple sub-variations would present no additional benefit in presenting the most environmentally acceptable and cost-effective plan.

This plan will not preclude necessary maintenance dredging up-drift of either reaches 1 or 3, however it should be understood that maintenance dredging alone will not provide quantities of sediment necessary to satisfy the sediment deficit at these sites. The intent was to fulfill the sediment deficit at reaches 1 and 3 regardless of other actions, such as maintenance dredging, which does not provide the quantities needed.

The preferred alternative for reaches 3 and 4 has been revised to alternative C-1 with annual nourishment.

BEACH NOURISHMENT – GENERAL – SAND

Concern Statement:

The EIS is unclear in defining the physical, chemical, and biological condition of acceptable beach nourishment sand. Methods for identifying acceptable sources should be clearly defined, and priority should be placed on using dredged source material rather than trucked in materials.

Response:

The current preferred alternative is to use nourishment material from a dredged source with onshore placement. The dredging source would be determined during the permitting process, based on consultation with local stakeholders and consideration of engineering constraints.

The lakeward boundary of the park extends 300 feet from the ordinary high-water mark into Lake Michigan. This shoreline area is highly dynamic and, for most of the 13 miles of shoreline within the park, is sediment limited (in need of nourishment). Dredging materials from within the park boundary is impractical and directly contradictory to the objectives of the plan/EIS. However, sediments that have accreted further offshore in the vicinity of both the Michigan City Harbor and Burns International Harbor continue to cause problems with both navigation and industrial uses due to their excess. These two locations have been identified as the most probable donor locations for beach nourishment sediments. As such, the National Park Service has assessed the physical, chemical, and biological conditions of the target nourishment areas and performed a sediment compatibility analysis (Morris and Eshlemen 2011; Simon et al. 2012) to ensure those accreted donor nourishment materials meet the desired criteria.

The intent of beach nourishment is to replicate, with donor materials, the ambient condition such that the nourished condition is indistinguishable physically, chemically and biologically from the ambient or native condition. To establish the ambient condition for beach nourishment activities within the Indiana Dunes National Lakeshore, the park used a geometric design to characterize both long-shore and cross-shore variability in sediments by collecting grab samples from 70 locations (nodes) within a 100 by 90 meter sampling zone. Nodes were arranged in a staggered grid formation maintaining 10 meters distance from each adjacent node. Sampling zones were arranged such that approximately half the nodes would fall on land while the other half would be in the water. Samples within each nourishment area were composited and analyzed for sediment chemistry, toxicity, grain size characterization, porosity, and compaction. Specific methods and results from these analyses can be found in Simon et al. 2012.

The text for the no action alternative in reach 1 will be revised to include nourishment from both mined and dredged sources.

BEACH NOURISHMENT – MT. BALDY – SAND

Concern Statement:

The EIS is unclear in defining the beach nourishment target area within reach 1. The EIS refers to Mt. Baldy, but we question if the EIS should indicate Crescent Dune which is adjacent to Mt. Baldy to the east? Additionally, the EIS repeatedly suggests sand mining updrift of Michigan City Harbor. However, little information is provided on the implication to Michigan City Beaches should this occur. We recommend the EIS focus more attention on utilizing those sands that have bypassed the Harbor.

Response:

The current preferred alternative is to use nourishment material from a dredged source with onshore placement. The EIS has used the term Mt. Baldy because it is a readily recognized landmark, but the nourishment would actually take place at the adjacent Crescent Dune.

The preferred alternative has been revised to a new hybrid alternative F which includes annual beach nourishment with a mix of small natural stone at the shoreline of reach 1. The source location of the nourishment material would be determined in coordination with IDNR in areas of accretion so that dredging activities would not disturb areas of equilibrium. Alternative sources would be identified prior to implementation of the alternatives. Accretion areas have been identified as source locations and dredging would bring these areas to more closely represent natural shoreline processes. In the event that an identified source is not appropriate, an alternate location would be selected. The text in the plan/EIS has been revised to reflect coordination with IDNR for selection of nourishment source material.

With regard to the concerns that the National Park Service focus more on utilizing the sediments that have bypassed the Michigan City facility, the sediment budget calculated for reaches 1 and 2 clearly indicate that there is insufficient sediment getting beyond that facility. Therefore the EIS indicates a desire to obtain sediments that are trapped by that facility and return them to the shoreline system.

Note that because lake levels have dropped, more beach is visible; however, that does not mean that the beach is building up. The Mt. Baldy area continues to be exposed to continued erosion which would be more pronounced as lake levels rise again.

BEACH NOURISHMENT – PORTAGE LAKEFRONT – OTHER

Concern Statement:

The preferred alternative for reach 3 will provide too much sand in one slug and will have unintended effects on navigational access to Burns International Harbor. Increased frequency of small slugs of sand will prevent excessive navigational issues and will also allow for seasonal needs dictated by extreme weather events to be addressed more directly.

Response:

Under the discussion of alternative C-5: Beach Nourishment via Dredged Sources, 5-Year Frequency in Chapter 2 (page 67), the text states, "Sediment could be captured by the federal channel at the Burns International Harbor, which could increase maintenance dredging costs." The National Park Service acknowledges that dredging would be required to reestablish more natural flow as more sediment in the water would naturally migrate into the waterway.

Dredging is currently conducted by the U.S. Army Corps of Engineers (USACE) as a duty to maintain navigation of the harbor; National Park Service assumes that the USACE would continue to maintain the harbor during storm events if nourishment material from reach 3 is deposited in the harbor through natural wave action. While wave induced deposition of sediments into the harbor are unavoidable natural consequences of operating a harbor along southern Lake Michigan that blocks littoral sediment transport, the National Park Service realizes that placing an entire 5-year sediment deficit volume of nourishment material on the beach at Portage Lakefront and River Walk (alternative C-5) may exacerbate navigational issues at the harbor beyond that which would naturally occur. Thus, the preferred alternative for reaches 3 and 4 has been changed to alternative C-1 with annual nourishment which was assessed in the draft EIS. Under alternative C-1 only the annual sediment deficit would be placed in a given year. Any harbor maintenance issues associated with this placement volume should be consistent with natural conditions.

COBBLE BERM – COST, ENGINEERING, AND SHORELINE DYNAMICS

Concern Statement:

The EIS does not sufficiently discuss: the scope of the cost of implementing alternative E, Submerged Cobble Berm; the engineering specifications and functional application of the cobble berm technology in Lake Michigan; or the cobble berms effects on wave and current dynamics along the shoreline. The cobble berm would modify the existing shoreline dynamic and push the erosion problem further to the west along reach 2.

Response:

Due to the conceptual nature of the alternative presented in the Draft EIS, the costs were estimates based upon professional judgment. The estimated cost for alternative E, Submerged Cobble Berm and Beach Nourishment, Annual Frequency was $20.4 million. It was recognized that additional engineering studies would be necessary to implement the alternative. However, a hybrid alternative (alternative F), which incorporates the full diversity of nourishment materials using an approach other than the berm, has been developed as the new preferred alternative. This alternative, consisting of annual nourishment with a mix of small natural stone at the shoreline at reach 1, incorporates desired aspects of multiple alternatives which will meet park purposes and objectives, yet addresses public concern with the draft preferred alternative E. There is no reason to believe that nourishment activities in Reach 1 would cause erosion problems further west down the shore in Reach 2.

COBBLE BERM – HABITAT – CLAY VALLEY

Concern Statement:

The EIS does not fully address the effects of the cobble berm on existing lake-bottom conditions. The cobble would increase down-cutting and threaten unique offshore "clay valley" habitats used for fish spawning.

Response:

The Indiana Dunes National Lakeshore shoreline within reach 1 is currently experiencing a high rate of erosion. The sandy substrate at the base of Mount Baldy has eroded away, exposing a clay layer that is now being undercut by wave action. The cobble berm would decrease rather than increase down-cutting.

The submerged cobble berm would be comprised of aggregate material from local glacial deposits which would be re-distributed across the lake bottom by natural wave action. The distribution would move the smaller aggregate closer to the shoreline, while the larger material would generally stay within a few feet of the submerged cobble berm. Distribution would be variable, depending on the intensity of storm events. Prior to breakdown of the submerged cobble berm, wave energy within the nearshore would be dissipated, thus increasing the likelihood of sediment retention in the nearshore. After the submerged cobble berm has been spread along the lake substrate, lakebed down-cutting would decrease as the aggregate material would create a protective layer.

The region of the clay utilized by yellow perch for spawning lies in 30 plus feet of water. The 30-foot depth is beyond the depth of closure where active wave energy would transport the cobble material; therefore, the material would not be expected to move into the clay valley depressions and impact the yellow perch populations.

However, the hybrid alternative (alternative F), which incorporates the full diversity of natural sediment aggregate using an approach other than the berm, has been developed as the new preferred alternative. This alternative, consisting of annual nourishment with a mix of small natural stone at the shoreline at reach 1, incorporates desired aspects of multiple alternatives which will meet park purposes and objectives, yet addresses public concern with the draft preferred alternative E.

COBBLE BERM – HABITAT – INVASIVES

Concern Statement:

The EIS does not fully address the ecological consequences of placing large quantities of cobble on the lakebed, nor does it provide sufficient evidence that these materials are a natural component of the system. These cobble materials would provide habitat for invasive fish species and attachment surfaces for both invasive muscles and cladophora adjacent to known yellow perch spawning habitats.

Response:

Glacial remnants of rock and cobble are common along the dynamically stable shoreline along reach 1 (Morris et al. 2014). The sandy habitats around Beverly Shores were sampled in the summer of 2011 to determine sediment composition. Sediment samples were collected from a matrix of 70 stations distributed both long-shore and cross-shore to capture a 100-meter reach.

No alternative proposed would either promote or hinder Zebra or Quagga mussel populations. These mussel species already exist in Lake Michigan and none of the proposed alternatives would alter this fact. Live Zebra and Quagga mussels are infrequently found in the active shoreline region as the dynamic and abrasive nature of the churning sediment and rock prevents stable attachment surfaces. In the summer of 2011, over 500 sediment samples were collected using a sediment dredge from the shoreline affected by beach nourishment. No live Zebra or Quagga mussels were found, though there were a number of dead shells likely washed in from deeper, more stable habitats that would be unaffected by shoreline processes.

The abrasive nature of the dynamic shoreline regions also limits the ability of *Cladophora* to attach to solid surfaces. The successful integration of natural gravels and stones into the sand rich composition of the shoreline area of reach 1 will result in a condition that is indistinguishable from that already existing in dynamically stable down-drift areas (Morris et al. 2014). As there is currently no excessive cladophora or botulism issue in this area, there is no reason to believe that restoring reach 1 to a condition approximating conditions in the dynamically stable (Baird 2004) sections of reach 2 will change.

The shoreline region affected by beach nourishment is not a highly utilized habitat by round gobies. The dynamic sediment rich habitats found along the southern Lake Michigan shoreline do not offer the larger interstitial spaces preferred by round gobies for reproduction. While larger stone substrate is natural to the system (Morris et al. 2014; Hawley and Judge 1969) it is typically heavily embedded and regularly covered and exposed by the migration of sandbars both long-shore and cross-shore (Davis and McGeary 1965). National Park Service observations have shown that round goby presence along the shoreline is limited, and dominated by young individuals less than 50 millimeters (mm) long, generally considered one year old (MacInnis and Corkum 2000). From 2010 to 2011, over 240 sampling efforts, spread across 24 shoreline reaches within the Indian Dune National Lakeshore, were completed. A total of 22,924 individual fish were collected representing 31 species. Only 82 round goby individuals (0.004% of the total assemblage) were collected, having an average length of 50 mm. These data are consistent with other research around the Great Lakes. Moran and Simon (2013) found a similar relationship with natural gravel/sand substrates in Lake Erie. They observed a significant decrease in both relative abundance and catch per unit effort of round goby over natural gravel habitats. They attributed this, in part, to the highly territorial nature of adult male gobies (Jude et al. 1995) and their potential exclusion of smaller individuals from other, more desirable, habitats (Ray and

Corkum 2001; Johnson et al. 2005). There is no evidence to suggest the restoration of natural substrates, through beach nourishment would provide habitat opportunities that do not already exist along the shoreline. In actuality, research has shown that migration pathways of round gobies have not been via the shoreline area impacted by beach nourishment (Moran and Simon 2013), rather, they have spread throughout the region via the more stable lakebed pathways in water depth exceeding 30 feet, beyond the depth of closure, and outside the influence of costal processes. The clay valleys off-shore of reach 1 reside in approximately 30-feet of water and are already impacted by round gobies independently of beach nourishment activities. Habitats affected by beach nourishment are not desirable for round goby reproduction and those round gobies found in these habitats are small in size and represent only a tiny fraction of the total fish fauna.

Note that a hybrid alternative (alternative F), which incorporates the full diversity of natural sediment aggregate using an approach other than the berm, has been developed as the new preferred alternative. This alternative, consisting of annual nourishment with a mix of small natural stone at the shoreline at reach 1, incorporates desired aspects of multiple alternatives which will meet park purposes and objectives, yet addresses public concern with the draft preferred alternative E.

COBBLE BERM – NAVIGATIONAL / RECREATIONAL HAZARD

Concern Statement:

Figures provided in the EIS do not accurately present the placement of the cobble berm nor does it provide adequate information on how the berm will be marked to minimize risk to recreational boating craft.

Response:

It was recognized that additional engineering studies would be necessary to implement the alternative. The berm was intended to be installed in at least 6 feet of water which should have been no hazard for recreational boating. However, the potential for creating an attractive hazard was recognized, and the intent was to provide some temporary warning devices to keep swimmers away until the berm dissipated. A hybrid alternative (alternative F), which incorporates the full diversity of natural sediment aggregate using an approach other than the berm, has been developed as the new preferred alternative. This alternative, consisting of annual nourishment with a mix of small natural stone at the shoreline at reach 1, incorporates desired aspects of multiple alternatives which will meet park purposes and objectives, yet addresses public concern with the draft preferred alternative E.

COBBLE BERM – COBBLE – PHYSICAL MAKE-UP, INTEGRATION, AND MOVEMENT

Concern Statement:

The EIS does not fully address the hydrologic consequences of placing large quantities of cobble on the lakebed, nor does it provide sufficient evidence that these materials are a natural component of the system.

Response:

Due to the conceptual nature of the alternative presented in the draft EIS, it was recognized that additional engineering studies would be necessary to implement the alternative.

In 2012 the National Park Service studied the presence of large particles >19 mm (Table 1) in the onshore and aquatic zones along the southern coast of Lake Michigan, because this fraction was considered a critical part of the natural substrate (Morris et al. 2014). Figure 1 depicts the littoral transport in reaches 1 and 2.

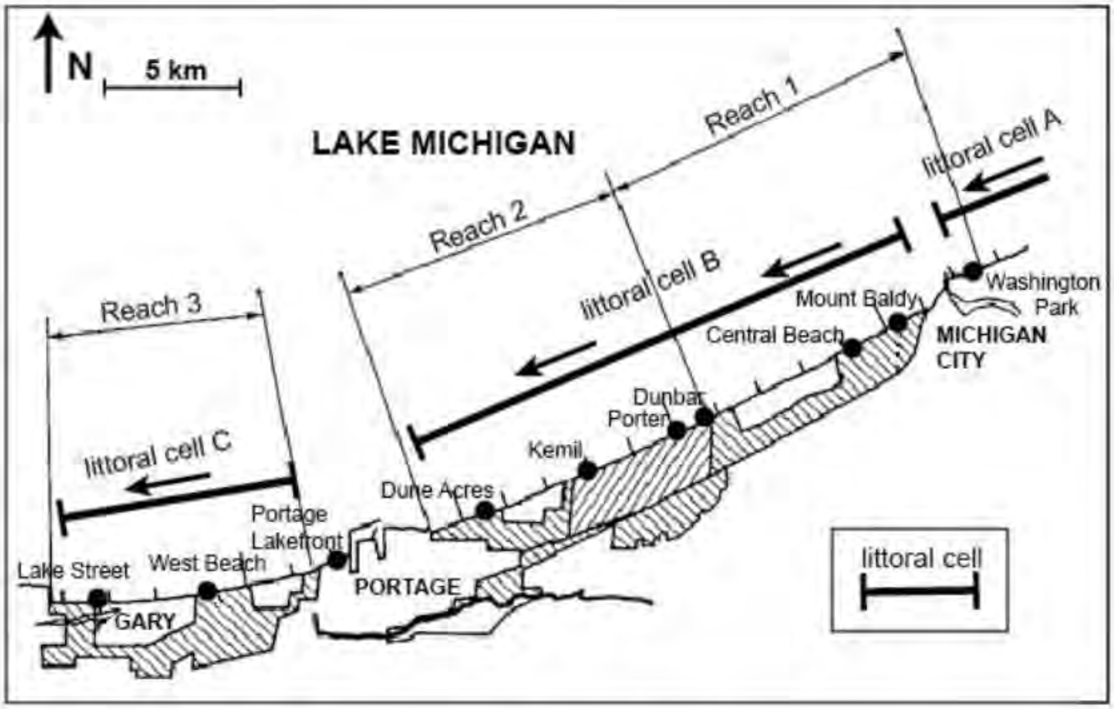

FIGURE 1. LITTORAL TRANSPORT.

TABLE 1. LARGE PARTICLE SIZE CATEGORIES FOLLOWING THE AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (UNIFIED) GRAIN-SIZE CLASSIFICATION. THE SEDIMENT SIZE PROVIDED REPRESENTS THE LOWER LIMIT OF EACH CATEGORY.

Size (mm)	Size (in.)	Classification
>300	>12.0	Boulder
75	3.0	Cobble
19	0.750	Coarse gravel

Particles with a single axis >19 mm were collected from five random square meter grids placed in the wash zone (land/water interface) during a 15 minute search and from three targeted square meter grids in a 15-minute search of the onshore zone. Individual particles were measured in the laboratory for maximum length or long diameter (a-axis), maximum width or intermediate diameter (b-axis), and maximum depth or short diameter (c-axis), and characterized in to three categories: compact, elongate, or platy (Figure 2).

(a) (b)

FIGURE 2. (A) DIMENSIONAL CLASSIFICATION OF LARGE PARTICLES (>19 MM) AFTER THE WORK OF SNEED AND FOLK (1952). (B) EXAMPLES OF COMPACT, ELONGATE, AND PLATY LARGE PARTICLES.

Large particles in the onshore zone. Six beaches contained large particles in the onshore zone though the number and dimensions varied from east to west, coincident with the local direction of movement of littoral drift. Beaches in reaches 1 and 2 including Mt Baldy, Central Beach, and Dunbar, are considered erosional or dynamically stable. These reaches contained a higher number of large particles than areas studied to the west in reach 3 and individual particles had a comparatively larger maximum length (a-axis). The large particles at Mt Baldy (n=75) had a maximum diameter length that varied from coarse gravel to small cobbles (range: 20.26-93.30 mm) with the mean size being coarse gravel 35.56 mm (Figure 3, Table 2). The large particles at Central Beach (n=23) had a maximum length that varied from coarse gravel to large cobbles (range: 34.09-139.51 mm) with the mean size being coarse gravel at 67.64 mm (Figure 3, Table 2).The large particles at Dunbar (n=107) had a maximum length that varied from coarse gravel to cobbles (range: 26.35-117.40 mm) with the mean size being coarse gravel at 59.76 mm (Figure 3, Table 2).

Large particle counts decreased or were absent at accretionary beaches where the reaches experience greater deposition of finer particles. The large particles at Portage Lakefront (n=79) had a maximum length within the coarse gravel class (range: 20.15-56.98 mm) with the mean size being coarse gravel at 30.35 mm (Figure 3, Table 2). The large particles at West Beach (n=31) had a maximum length that varied from coarse gravel to small cobbles (range: 23.08-90.30 mm) with the mean size being coarse gravel 46.79 mm (Figure 3, Table 2). There were no particles >19 mm found at Lake Street in the onshore zone. The large particle distributions at all onshore reaches are dominated by coarse gravels (Tables 4).

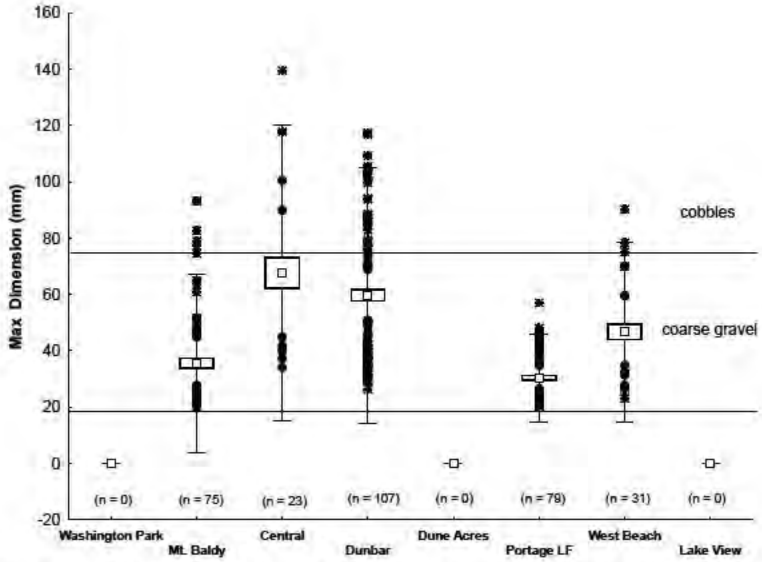

FIGURE 3. PEBBLE COUNT AND MAXIMUM DIMENSIONS OF LARGE FRACTION MATERIALS FROM THE ONSHORE ZONE IN EIGHT BEACHES IN THE INDIANA DUNES NATIONAL LAKESHORE.

TABLE 2. ONSHORE

Site	Coarse Gravel (19-75 mm)	Cobbles (75-300 mm)	Total Count
Mt. Baldy	71	4	75
Central Beach	15	8	23
Dunbar	82	25	107
Portage Lakefront	79	0	79
West Beach	28	3	31
Total	275	40	315

Large particles in the aquatic zone. Large particles in the aquatic (nearshore) zone are important for general sediment characterization and constitute a critical component of the substrate with regards to aquatic habitats. Large particles at Mt. Baldy (n=155) had a maximum length that varied from coarse gravel to small cobbles (18.41-93.30 mm) with the mean size being on the finer side of the coarse gravel class (25.83 mm) (Figure 4, Table 3). The largest particles were observed at Central Beach. Central Beach (n=129) had a maximum length that varied from coarse gravel to cobbles (21.47-165.10 mm) with the mean size being coarse gravel (51.17 mm) (Figure 4, Table 3). Dunbar Access had the highest total large particle count (n=256) and particles had a maximum length that varied from coarse gravel to small cobbles (20.01-117.40 mm) with the mean size being coarse gravel (32.01 mm). The large particle distributions at all onshore reaches are dominated by coarse gravels (Figure 4, Table 3).

Relationships among the six beaches show that the accretionary beaches of Washington Park, Dune Acres, Portage Lakefront, West Beach, and Lake Street Access did not contain large particles >19 mm in the aquatic zone (Figure 4). The data are consistent with results from onshore-offshore sediment profiles in previous work that observed small areas of anomalously coarse sediment (Hawley and Judge 1969) and a strong correlation between coarse sediment and troughs in the near shore zone (Davis and McGeary 1965).

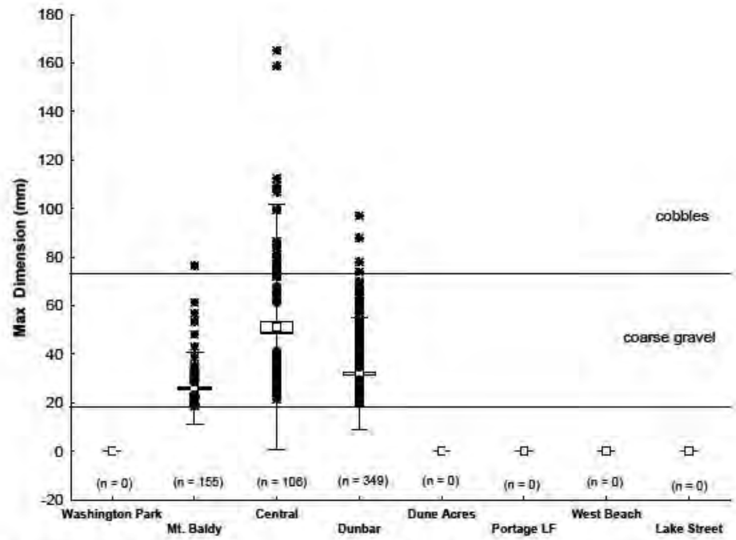

FIGURE 4. PEBBLE COUNT AND MAXIMUM DIMENSIONS OF LARGE FRACTION MATERIALS FROM THE AQUATIC ZONE IN EIGHT BEACHES IN THE INDIANA DUNES NATIONAL LAKESHORE.

TABLE 3. AQUATIC

Site	Coarse Gravel (19-75 mm)	Cobbles (75-300 mm)	Total Count
Mt. Baldy	142	12	155
Central Beach	92	14	106
Dunbar	346	3	349
Portage Lakefront	0	0	0
West Beach	0	0	0
Total	580	29	610

Pebble Dimensions. Note that each particle is classified on the ASTM (unified) Classification scale by measurement of the axis with longest diameter. Particles >19 mm are classified as "coarse gravel" if the long-axis measures 19-75 mm, "cobbles" if the long-axis measures 75-300 mm, and "boulders" if the long axis measures >300 mm. All large particles found on the southern shoreline of Lake Michigan fell within the range of coarse gravel to cobbles (19–300 mm) (Figure 3 and 4). However, the largest particle found was a cobble found at Central Beach, measuring 165.10 mm (6.5 in.).

All particles in this study meeting the size criteria of large pebbles or cobbles were classified as either compact, platy, or elongate according to the work of Sneed and Folk (1958) and Pirie (1965) (Figure 2, Tables 4 and 5). Particles are considered compact when the c:a and b:a ratios both exceed 0.5. Particles are classified in this study as platy when the c:a and b:a ratios are both less than 0.5 and when (a-b):(a-c) is less than 0.5. Remaining particles are classified as elongated according to the classification.

Large particles >19 mm were observed in the onshore zone at five of the seven study areas and >90% of those particles were classified as platy or elongate (Table 4). These particles represent the flat "beach rocks" often described by visitors. Large particles >19 mm were observed in the aquatic zone of three of the seven study areas (Table 5). Platy or elongate particles constitute 49%-75% of the large particle component of the substrate. At Mt. Baldy the large particle substrate in the aquatic zone was comprised of 25% compact particles and 75% flat (platy or elongate) particles. At Central and Dunbar Beaches the aquatic substrate was comprised of ~50% compact particles and ~50% flat (platy or elongate) particles.

TABLE 4. CLASSIFICATION OF LARGE PARTICLES >19 MM COLLECTED AT INDIVIDUAL STUDY SITES FOR THE ONSHORE ZONES ACCORDING TO SNEED AND FOLK (1958). NUMBER IS PARENTHESES REPRESENT PERCENT OF TOTAL PARTICLES.

Site	Total Particles	No. of Compact	No. of Platy	No. of Elongate
Michigan City	0	0	0	0
Mt. Baldy (East)	75	0	64(85%)	11(15%)
Central Beach	23	1(4.5%)	21(91%)	1(4.5%)
Dunbar	107	0	88(82%)	19(18%)
Portage Lakefront	79	1(1)	62(79%)	16(20%)
West Beach	31	0	27(87%)	4(13%)
Lake Street	0	0	0	0

TABLE 5. CLASSIFICATION OF LARGE PARTICLES >19 MM COLLECTED AT INDIVIDUAL STUDY SITES FOR THE AQUATIC ZONES ACCORDING TO SNEED AND FOLK (1958). NUMBER IS PARENTHESES REPRESENT PERCENT OF TOTAL PARTICLES.

Site	Total Particles	No. of Compact	No. of Platy	No. of Elongate
Michigan City	0	0	0	0
Mt. Baldy (East)	155	40(26%)	52(34%)	63(41%)
Central Beach	106	54(51%)	35(33%)	17(16%)
Dunbar	349	160(46%)	77(22%)	112(32%)
Portage Lakefront	0	0	0	0
West Beach	0	0	0	0
Lake Street	0	0	0	0

A two-dimensional numerical model (COSMOS) was used to calculate sediment transport rates along the shoreline at selected intervals of 1.25 miles for current and historic pre-harbor conditions. The beach profiles extended out to a depth of approximately 15 meters (or approximately 49 feet) below chart datum (LWD). It was determined that the net longshore sediment transport gradually decreases from New Buffalo (200,000 yd^3 updrift of Michigan City) east to the Burns International Harbor. The average longshore sediment transport rate is estimated at less than 30,000 yd^3 per year near the Gary-U.S. Steel Harbor. Generally, larger particle size material would have a slower transport rate than finer sediment. Additional studies would be necessary to determine the sediment transport rate for the specific nourishment mix proposed.

ALTERNATIVE DEVELOPMENT PROCESS

Concern Statement:

One commenter expressed concern that the analysis of impacts in this EIS may be too speculative because of the conceptual nature of the alternatives. In addition, concerns are expressed about the length (shelf life) of the EIS at 20 years, rather than a much greater planning horizon.

Response:

The plan/final EIS is a management plan that would provide the partners/players/participants with guidelines for management decisions specific to shoreline restoration. Following approval of the plan, the National Park Service would be able to implement annual beach nourishment procedures outlined within the plan should that opportunity arise in the near future. The National Park Service believes that the alternatives (which present approaches for shoreline restoration) in this plan are defined with an overall appropriate level of detail to determine the general environmental and social effects allowing us to select a proposed alternative. Additional studies and plans may be necessary to move toward implementation as acknowledged in the plan/final EIS.

The 20-year period of analysis is National Park Service's normal planning horizon and is much more conservative. The National Park Service feels that forecasting out 50 years would be less accurate and potentially unresponsive to changes in the local environment than the shorter defined planning period.

CHOOSING BY ADVANTAGES PROCESS FOR SELECTION OF THE PREFERRED ALTERNATIVES

Concern Statement:

Concern was expressed about the process used to identify a preferred alternative.

Response:

The choosing by advantages (CBA) process is the National Park Service's method of providing a recommendation for the preferred alternative. Planning team decisions made during the CBA process were based on the importance of advantages between the alternatives. This involved identifying the attributes or characteristics of each alternative relative to the factors described in the Draft EIS, determining the advantages for each alternative for each factor, and then assessing the importance of each advantage. The relationship between the advantages and costs of each alternative were also considered. The CBA process was documented, is reproducible, and provided the rationale for recommending the preferred alternatives. Note: The alternatives presented in this plan present general guidelines for shoreline restoration and management. Site-specific elements within these general guidelines could require coastal modeling and scientific analysis prior to implementation however this does not preclude beach nourishment activities resulting from harbor maintenance activities.

DEVELOPMENT OF COSTS

Concern Statement:

Commenters state that an economic analysis was not part of the plan. Some felt that more attention to the costs of the proposals would have led to a better evaluation of them. The lump sum costs were felt to be inadequate. In addition, they question assumptions concerning the timing of activities, and note that some of the costs concerning the sediment bypass alternative seem inflated.

Response:

There is a cost comparison presented in Tables 2-2A and 2-2B of the draft EIS, and costs are included in the text description of the alternatives in Chapter 2. The relationship between the advantages and costs of each alternative were also considered during the CBA workshop. This information was used to identify the alternatives that provided the National Park Service and the public and private partners the greatest advantage for the most reasonable cost. Detailed costs were not developed due to the conceptual nature of the designs proposed for the alternatives. Costs estimates were conservatively developed for individual alternatives and did not assume combined mobilization events. The intent of the statement, "in all reaches of the project area at the same time" is that shoreline restoration would be implemented across all reaches of the project area from the implementation of the plan, rather than focusing on one reach and then another.

The costs associated with the bypass systems are only partially related to the length of the piping and the initial construction of the system. With alternative D for reaches 1 and 2, the source for material is located at some point north of the Michigan City Marina. The specific location of sediments will change periodically as the immediate location for the source for sediment changes. Sources immediate to the end of the bypass would likely be used first but would deplete over time. Then sediments from further away from the end of the bypass system would need to be moved to the bypass system, resulting in increased effort and costs. The source for sediment in alternative D for reaches 3 and 4, which is nearly half the annual volume needed in reaches 1 and 2, is not likely to change since it is located at the intake for the Northern Indiana Public Service Company (NIPSCO)/Bailly complex. Besides logistical costs, maintenance costs were also a factor; with nearly twice the volume, maintenance costs associated with the bypass in reaches 1 and 2 meant greater long term costs.

REQUIREMENT FOR FURTHER STUDIES

Concern Statement:

Commenters requested more analysis of some alternatives. Concerns were expressed about the potential impacts that needed more study, including impacts that are not necessarily environmental. Finally, one commenter expressed concern that while the EIS states where further studies are necessary, it does not clearly state what actions can take place after the finalization of the EIS process.

Response:

At this point, it would be premature to provide the level of detail requested by some of the commenters since it is not known which parties may be participating in the restoration efforts in the future. As stated in the EIS, operationally the National Park Service cannot accomplish the proposal actions on its own. Full implementation would require cooperation and coordination between local, state, and federal agencies. This plan will hopefully initiate a dialogue between stakeholders, and provides a study of potential solutions going forward. The National Park Service does believe that while some level of design might be required to proceed, the impact analysis is sufficient to allow some level of beach nourishment with appropriate consultation, but without additional compliance concerns.

As stated in the Summary (on page iv) and under "Needed Future Studies and Plans" (page 38), "Once this plan is completed, many of the nourishment activities proposed under the alternatives could be implemented without further compliance or study. Other more detailed studies and plans would be needed before some specific actions could be implemented, including design specifications." Nourishment and terrestrial management activities associated with the plan could be implemented without further compliance or study.

REACHES 1 AND 2 NEW ALTERNATIVE PROPOSED AND REACHES 3 AND 4 NEW ALTERNATIVE PROPOSED

Concern Statement:

Several commenters asked whether the National Park Service should look into replacing/modifying certain existing structures that currently interrupt the natural sediment flow along the shoreline. Other commenters suggested other modifications to the proposed alternatives by considering a 3-year nourishment interval and inquired about impacts.

Response:

A hybrid alternative (alternative F), which incorporates the full diversity of natural sediment aggregate using an approach other than the berm, has been developed as the new preferred alternative. This alternative, consisting of annual nourishment with a mix of natural stone at the shoreline at reach 1, incorporates desired aspects of multiple alternatives which will meet park purposes and objectives, yet addresses public concern with the draft preferred alternative E. Modification of harbor structures would not be within the National Park Service jurisdiction to implement. As such, modification of NIPSCO pier would not be within the National Park Service jurisdiction to implement.

The analysis of annual and 5-year nourishment frequencies captures a reasonable range for nourishment activities. There would be a limitless amount of variation that could conceivably be analyzed as alternatives (such as nourishment intervals between 1 and 5-years, and variations in quantities and placement length); however, the National Park Service believes the alternatives selected represent a reasonable spectrum, and that inclusion of multiple sub-variations would present no additional benefit in presenting the most environmentally acceptable and cost-effective plan.

Timing of heavy machinery mobilization and de-mobilization along with beach closures would be coordinated to minimize public intrusion. To the extent possible, efforts would be made to minimize impacts on visitor experience by conducting beach nourishment activities during off-peak months (i.e., during fall and winter months).

REACHES 1 AND 2 NEW MITIGATION PROPOSED AND REACHES 3 AND 4 NEW MITIGATION PROPOSED

Concern Statement:

One commenter suggested additional mitigation be spelled out in the final EIS, and requested a greater commitment to the mitigation already in the EIS.

Response:

The draft EIS was remiss in not properly defining the specific type of wetlands being referred to on page 48 for mitigation. The National Park Service has adopted the Cowardin definition of wetlands; besides the three criteria defined by the USACE as wetlands, the Cowardin definition includes shorelines that meet the USACE definition but wave action or other physical features (type of soil) prevents the formation of vegetation. For this plan, construction staging and operation would unavoidably be located within the shoreline wetland areas. Mitigation measures to minimize impacts to these types of wetlands are listed on page 48, and will be adopted by the Record of Decision. As stated on page 18, "Temporary impacts to the existing beach wetlands would be unavoidable within the specific site where the shoreline would be nourished. The post-restoration shoreline would be expected to result in the same acreage of the same wetland type as exists now, but shifted northward (or at least maintained in its present position) because a comparable shoreline profile is expected to develop. Since there would be no net loss of the beach wetland habitat, the project could be considered under the Restoration Exception in Section 4.2.1 (h) of NPS Director's Order (DO) 77-1: Wetland Protection and Procedural Manual #77-1."
As stated on page 50, the "rare, threatened, and endangered species' surveys would be determined as deemed warranted by NPS resource staff and specialists. It is the National Park Service's mission to preserve park resources and it is inherent within our mission to protect rare, threatened, or endangered species that could be affected by the proposed project." The National Park Service would make this commitment in the Record of Decision.

ALTERNATIVES ELIMINATED: HARDENED STRUCTURES

Concern Statement:

Commenters inquired about the consideration of a permanent fixed berm and why that was dismissed.

Response:

During scoping for the selection of the proposed alternatives, the planning team determined that alternatives with permanent, hardened structures would not meet the goals of the plan. Hardened structures have historically provided protection for infrastructure from erosion and storm events. However, these structures may not have been beneficial to the entire shoreline. The alternatives developed for this plan were developed to benefit the entire shoreline as opposed to a single land owner or shoreline user. The purpose of the draft EIS is to identify and develop strategies to restore the Indiana Dunes National Lakeshore shoreline and its processes with a reestablishment of more natural shoreline processes. The implementation of hardened structures would not be conducive to the reestablishment of more natural shoreline processes.

DESCRIPTION OF NO ACTION ALTERNATIVE

Concern Statement:

Commenters expressed concern that the EIS has mischaracterized the level of existing planning for the shoreline, and that the EIS has assumed existing conditions for the no action alternative that do not actually exist.

Response:

Shoreline feasibility studies of the Indiana coast and Congressional authorization to conduct beach nourishment are not the same as a comprehensive shoreline restoration plan that provides comprehensive guidance for restoring natural shoreline processes and preserving the shoreline ecosystems.

The National Park Service assumes that on average, the USACE nourishment activities would continue because that is consistent with current and past nourishment activities. Although it is understood that these activities are dependent upon Congressional earmarks, and that there is no guarantee that these earmarks would continue, the approach of defining the no-action alternative based upon recent nourishment programs is the more conservative approach. Effect from the implementation of action alternatives are defined based on a comparison with the no-Action alternatives. Had the no-action alternatives been defined under the assumptions that the USACE nourishment activities would not continue, then beneficial effects of the proposed nourishment would seem exaggerated, as would the adverse effects of the implementation of the no-action alternative. In addition, it would have presented conditions at the shoreline that actually do not exist; the shoreline has benefitted from periodic nourishment.

Defining alternative A as the "no-action" alternative is consistent with the National Environmental Policy Act of 1969, as amended, regulations of the Council on Environmental Quality (40 Code of Federal Regulations 1508.9), and NPS DO 12: Conservation Planning, Environmental Impacts Analysis, and Decision-making and its accompanying handbook. The no-action defines the activities that would occur in the event that none of the action alternatives are implemented; this is not always necessarily the same as "present practice." Since it can be assumed that the USACE would continue beach nourishment as they have in past years, it would not be realistic to evaluate an alternative where nourishment activities were terminated.

PROPOSED MODIFICATION TO REACHES 1 AND 2 PREFERRED ALTERNATIVE

Concern Statement:

One commenter questioned the discussion and use of adaptive management as described in the draft EIS.

Response:

The Draft EIS reads (page 46):

Approaches to Adaptive Management. Adaptive management is a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. It involves monitoring practices to determine if they are meeting the set objectives, and facilitating changes to the management practices, if needed, to ensure the objectives are met. Adaptive management is based on the premise that managed ecosystems are complex and unpredictable, and therefore cannot be effectively managed within a rigid management context.

The process of adaptive management is vital for the success of this plan. Each of the alternatives for the shoreline and beach complex and the proposed actions for the foredune and dune complex employ an adaptive management element involving monitoring and evaluation. This means that although each alternative includes estimates as to the effectiveness of the restoration actions ultimately some of those actions could be modified over time as knowledge is gained through implementation. For example, the proposed beach nourishment program would be evaluated to determine its effectiveness over the course of the plan's life. Monitoring of the shoreline profile and near shore habitats would be conducted to ensure that park resources were not negatively impacted by the implementation of an alternative.

Adaptive management can best be defined as a process that "…involves the clear statement of objectives, the identification of management alternatives, predictions of management consequences, recognition of uncertainties, monitoring of resource responses, and learning (National Research Council 2004). Adaptive management can be seen as a process of structured decision making (Williams et al. 2007), with special emphasis on iterative decisions that take uncertainty and the potential for learning into account." (Williams, B. K., and E.D. Brown 2012; Adaptive Management: The U.S. Department of the Interior Applications Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.)

The comment on the draft EIS requests the information that would be provided for an adaptive management process. The plan does realize the only way to correct the issues identified in the purpose and need is through some sort of modification of the sediment delivery systems, directly by nourishment. The alternatives focus on nourishment with existing sources of sediment either through use of moderate amounts of material on a year-by-year basis, or by much larger amounts of material that would last a longer period. The new alternative, which is the reworking of existing alternatives, only changes the composition of the nourishment material, but the essential delivery of restoration materials is through nourishment. The solution that can be realized through this plan appears to be rather simple – replace the lost sediment.

Therefore, the adaptive approach the National Park Service will take here will be more of a conventional state-specific management approach rather than a strict adaptive management approach; our management approach in the draft EIS was incorrectly identified. The Departmental guidance defines this approach as involving an assumption "…that the objectives are appropriate, the resource system is fully observed and understood, and the resource models reflect full understanding. New data are used to track the system's current status; however, structural uncertainty and surprise are not accounted for in the assessment of management alternatives." Our management action will involve only two variables, the amount of supplemental nourishment to be placed into the system and the timing of those placements.

We have revised the discussion on page 46 of the Draft EIS.

REACHES 1 AND 2 PREFERRED ALTERNATIVE GENERAL QUESTIONS

Concern Statement:

Several commenters had concerns regarding the preferred alternative for reaches 1 and 2.

Response:

As described under the project area definition on page 32 of the draft EIS, man-made structures in and around the project are barriers to natural littoral drift causing areas of accretion in some sections and erosion in others. The Michigan City Harbor is a barrier to the littoral drift causing areas of erosion in reach 1.

The reaches were grouped because actions to address erosion in reach 1 would affect reach 2; likewise, actions to address erosion in reach 3 would affect reach 4. However, no specific restoration action is required to be taken in reaches 2 and 4 since they are defined as dynamically stable, yet they benefit from the proposed actions in reaches 1 and 3, respectively. The goal of the plan is to develop strategies that would support the reestablishment of more sustainable shoreline sediment movement and a more natural ecosystem of shoreline vegetation, foredune, and dune complexes. The National Park Service cannot control the lake, but can develop strategies to offset erosional forces that are presented as a result of man-made structures in and around the lake. The plan is designed to benefit the entire shoreline rather than specific sites.

PROPOSED MODIFICATION TO REACHES 3 AND 4 PREFERRED ALTERNATIVE

Concern Statement:

One commenter requested additional information on alternative D in reaches 3 and 4, and felt the level of detail for this alternative was insufficient to dismiss it.

Response:

Alternative D for reaches 3 and 4 is still conceptual and engineering design has not been completed; therefore, the exact locations and schematics of the lift stations are not depicted. Alternative D was not eliminated from consideration and was analyzed in detail. However, this alternative was not selected as the preferred alternative because estimated maintenance costs and considerations of jurisdictional authority in combination with the potential environmental benefit ranked this alternative below the selected preferred alternative.

CONSULTATION AND COORDINATION – GENERAL COMMENTS

Concern Statement:

Many commenters expressed the need for cooperation and consultation with partners (municipal, state, and federal as well as private industry) to resolve issues associated with successful shoreline management.

Response:

For the plan to be successful there would need to be continued cooperation between all stakeholders in the area. NPS staff will actively coordinate with all parties on an on-going basis and to consult with the various agencies that have permitting and/or regulatory responsibilities. However, despite the fact that each has its own interests and responsibilities, a successful plan to address the shoreline cannot happen without dialogue and interaction among all parties.

IMPACT ANALYSIS: GENERAL METHODOLOGY FOR ESTABLISHING IMPACTS / EFFECTS

Concern Statement:

A commenter expressed concern that not all relevant projects were considered as part of the cumulative impacts.

Response:

The cumulative analysis in the draft EIS lists the projects in the vicinity that the National Park Service is aware of, and includes non-NPS led projects. If there are specific projects provided to the National Park Service that should be included in the cumulative analysis, those will be incorporated in the final EIS.

IMPACT TOPICS DISMISSED FOR DETAILED ANALYSIS: WATER QUALITY

Concern Statement:

Commenters expressed concern that the preferred alternative in reaches 1 and 2 would have impacts on water quality; especially waterborne pathogens. Similarly there was concern that water quality was dismissed as an impact topic.

Response:

The alternatives in this plan have a very low probability of either improving or adversely affecting the water quality of Lake Michigan and was dismissed from further analysis. Nourishment material would be clean and free of contamination. As stated on page 28 in Chapter 1, the permitting conducted prior to dredging, sediment placement, and berm or bypass construction activities would identify mitigation required to protect against human health concerns. In coordination with IDNR, test criteria (which would include algae and bacteria that could potentially be harmful to the public) would be established prior to commencement of nourishment activities.

ISSUES: CLIMATE CHANGE

Concern Statement:

Several commenters expressed concern that the plan be able to consider and anticipate changes due to climate change.

Response:

Climate change is addressed under "Planning Issues and Impact Topics" on page 22 of the draft EIS. As stated in the text, "While it is well accepted that climate change is occurring, the rate and severity of impacts at the park is, as yet, undefined. Extreme weather events have historically been documented in the area of the park, specifically in 1998 and 2010. The anticipated increased frequency and intensity of storm events have the potential to exacerbate the loss of sediment along the shoreline, thereby accelerating the accumulation of sediment on accreting shoreline reaches. These likely future conditions add emphasis to the need for an effective, long-term, beach restoration plan." The plan has been developed under the assumption that the effects of climate change, including lake levels, would continue to affect the shoreline.

The 100-year storm event was selected as the design condition for the shoreline improvements as a design that could withstand a worst-case scenario. Utilizing the 100-year storm event as a design condition is appropriate given the anticipated increased frequency and intensity of storm events that could exacerbate the loss of sediment along the shoreline as a result of climate change. These likely future conditions add emphasis to the need for an effective, long-term, beach restoration plan.

Beaches are dynamic systems that depend on a constant source of sediment to maintain themselves even when lake levels are going down. Sediment is normally carried by long-shore currents that run parallel to the beach until it is dropped onto sand bars just offshore. In summer, these sandbars are slowly moved beachward by small waves until they reach the shoreline, expanding the beach. In winter, before lake ice forms, large storm waves erode the beach pulling some of the sediment back out into the lake. Even with lower lake levels, nourishment would continue to be required to replenish sediment loss due to storm events.

PLAN IMPLEMENTATION AND SIGNAL OF FUTURE INTENT: REMOVAL OF HARDENED STRUCTURES

Concern Statement:

Some commenters requested clarification regarding the existing hardened structures in the project area that could be considered for removal.

Response:

The text in Chapter 1 under "Proposed Plan for Implementation" (page 21) has been revised to "Reestablishment of more natural shoreline processes could eventually allow the current structures within the Indiana Dunes National Lakeshore boundaries along the lakeshore to be removed in the future without endangering the adjacent infrastructure."

Decisions on current structures to be removed would be addressed in the future through more detailed planning efforts. Part of Crescent Dune area is armored with sheet piling. Approximately 650 feet of the seawall at Crescent Dune has recently been acquired by the National Park Service. Changes to management of this area would also need to be considered as part of a more detailed planning effort.

PURPOSE AND NEED IS NOT VALID OR SUBSTANTIATED

Concern Statement:

A few commenters indicated that this plan is not likely to result in a solution, or that it is a solution looking for a problem.

Response:

Unfortunately, not all of the Lake Michigan beach grows larger with lower lake levels. Beaches are dynamic systems that depend on a constant source of sediment to maintain themselves even when lake levels are going down. Sediment is normally carried by long-shore currents that run parallel to the beach until it is dropped onto sand bars just offshore. In summer, these sandbars are slowly moved beachward by small waves until they reach the shoreline expanding the beach. In winter, before lake ice forms, large storm waves erode the beach pulling some of the sediment back out into the lake.

Due to the presence of various industrial and navigational structures along Lake Michigan's southern shore, the transport of sediment along the shoreline has been interrupted. This has resulted in areas of accretion, in which the beach appears to be increasing in size as more sediment becomes trapped, and areas of erosion, in which sediment is carried away from the shoreline and transported downdrift. Since it would not be feasible to remove or modify the harbor, the plan/draft EIS proposes alternatives that would create conditions that more closely mimic natural coastal processes in the presence of the functioning harbors.

As stated in the Summary, "The plan provides the National Park Service with comprehensive guidance for restoring natural shoreline processes, preserving shoreline ecosystems, and providing opportunities for quality visitor experiences at Indiana Dunes National Lakeshore. The intent of the plan/draft EIS is not to provide specific and detailed answers to every issue facing the park, but rather to provide a framework to assist National Park Service managers, stakeholders, and locals governing bodies in making decisions." There is no guarantee that issues with shoreline conditions would be fixed, but with the implementation of this plan, NPS managers would have guidance for addressing these issues.

COST OF IMPLEMENTING THE PROJECT IS PROHIBITIVE

Concern Statement:

The potential benefits of the project are not justified by the cost.

Response:

The NPS is responsible for protecting resources in parks unimpaired for future generations. In addition to protecting park resources this project would benefit other land owners around the park.

COMPLIANCE WITH FEDERAL, STATE, AND LOCAL LAW

Concern Statement:

Commenters asked whether the plan is consistent with the Lake Michigan Coastal Zone Management Act for Indiana.

Response:

The National Park Service reviewed the alternatives presented in the plan and determined the implementation of the alternatives would be consistent with the Coastal Zone Management Act. The National Park Service has worked closely with IDNR during the development of the plan and will continue into the future of the plan. The plan would complement the Lake Michigan Coastal Program for areas that are within NPS jurisdiction.

PARK LEGISLATION / AUTHORITY

Concern Statement:

Some questioned how the plan considered the issues of ownership, authority, and funding in the development of the alternatives.

Response:

The plan has been developed by the National Park Service to provide a framework to assist NPS managers, stakeholders, and local governing bodies in making informed decisions. As stated on page 3 of the draft EIS, the USACE is a cooperating agency on the plan/draft EIS and was included in the decision-making. The IDNR was invited to participate as a cooperating agency but declined (see the Introduction on page 3 and Appendix B on page 321 of the draft EIS). The National Park Service has actively engaged the public, stakeholders, and government officials at the federal, state, and local levels throughout the planning process.

The National Park Service acknowledges that in order for the plan to be effective, full implementation of the plan would have to be a cooperative effort between all stakeholders in the area.

Implementation of the plan is dependent upon available funding. However, development of the plan/draft EIS is the first step toward providing for a comprehensive guidance for restoring natural shoreline processes, preserving the shoreline ecosystem, and providing opportunities for quality visitor experiences at Indiana Dunes National Lakeshore.

PARK OPERATIONS: EFFECTS OF PROPOSAL AND ALTERNATIVES

Concern Statement:

The draft EIS states that impacts to park operations as a result of alternative D would result in minor to moderate, short- to long-term impacts. The U.S. Environmental Protection Agency (USEPA) recommends additional information on the required staff resources, expected maintenance, timing, and costs in relation to the sand bypass system, particularly how these impacts differ from the other alternatives to be included in the final EIS.

The USEPA requested additional information about the sand bypass system.

Response:

As stated in Chapter 4 on page 226 of the draft EIS, "following construction, the permanent bypass system would require monitoring and routine maintenance, adding to existing park staff workloads, resulting in minor to moderate, long-term, adverse impacts on park operations." The estimated cost would be $35.4 million (see Table 2-2A in Chapter 2 on page 58). In the event alternative D is chosen as the preferred alternative for reaches 1 and 2, timing of construction would be contingent upon available funding.

As noted on page 38 of the draft EIS, detailed design and compliance efforts would be necessary prior to implementation of any of the alternatives involving construction.

THREATENED AND ENDANGERED SPECIES AND SPECIES OF CONCERN: IMPACT OF PROPOSAL AND ALTERNATIVES

Concern Statement:

One commenter asked whether the plan would impact piping plover habitat.

Response:

A summary of impacts on the piping plover habitat is provided in Chapter 4 under "Threatened and Endangered Species and Species of Concern" and is also summarized in Table 2-3, Alternatives Impacts Table, Reaches 1 and 2, and Table 2-4, Alternatives Impacts Table, Reaches 3 and 4. For all proposed alternatives, implementation of the proposed actions may affect, but is not likely to adversely affect, piping plover and their associated habitat.

As stated in Chapter 5, Consultation and Coordination, on page 243, the National Park Service contacted the U.S. Fish and Wildlife Service (FWS) in a letter dated July 2011. The letter advised the FWS of the National Park Service planning process for this plan/draft EIS and requested concurrence with a determination that the proposed project may affect, but is not likely to adversely affect endangered, threatened, and candidate species nor adversely modify piping plover critical habitat.

The FWS responded to the National Park Service's request in a letter dated August 8, 2011, and concurred with the National Park Service determination for special status species and critical habitat found within the proposed project area (which encompasses the shoreline of Lake Michigan between Michigan City in LaPorte County on the east, and the U.S. Steel breakwater in Gary in Lake County on the west). The Porter County shoreline of Lake Michigan is also included in the project area.

TERRESTRIAL HABITAT: IMPACT OF PROPOSAL AND ALTERNATIVES

Concern Statement:

Concerns were expressed about the placement of nourishment materials within the project area and the impact on terrestrial species; especially migratory shorebirds and state listed plants. It was suggested that placement of materials should be timed to minimize impacts on plants.

Response:

Activities associated with implementation of the plan, including nourishment, would be conducted in coordination with National Park Service wildlife biologists, and timed to reduce the impact to terrestrial species to the extent possible. Potential impacts to migratory shorebird habitat are not anticipated; however, further study would be conducted if warranted.

TERRESTRIAL MANAGEMENT PROPOSED ACTIONS

Concern Statement:

A number of comments were received related to the management of terrestrial resources in the project area including mitigation measures. A commenter requested a definition of the term "social trails" and which trails would be closed. Another commenter inquired how the NPS would ensure that contractors are following guidelines to prevent the spread of invasive plant species during implementation of the plan and how mitigation measures for topsoil would be used to prevent the spread of invasive plant species.

Response:

The specific social trails (paths created as a consequence of foot traffic, or the results of unplanned and undirected regular foot traffic) to be reduced have not been specifically identified. NPS management and resource staff would evaluate social trails on a case-by-case basis and identify those that are accelerating erosion and habitat degradation.

NPS staff would monitor contracts to ensure compliance with guidelines outlined within the plan. Terrestrial management guidelines within the draft EIS are specific to areas within the Indiana Dunes National Lakeshore boundaries.

The disturbed terrestrial environment from beach nourishment is primarily the shoreline/Beach. This area is predominantly sandy and has no organic layer (topsoil) and as such is not conducive to spreading invasive plant species as they will not sprout on the nutrient poor sand.

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