



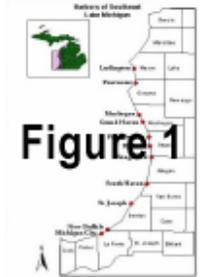
**US Army Corps  
of Engineers®**

Engineer Research and  
Development Center

## Detroit District, Ludington, Michigan, to Michigan City, Indiana

### ISSUE

The Southeast Lake Michigan Region extends 172 miles from Michigan City, Indiana, in the south through Ludington, Michigan, in the north (Figure 1). Of the 12 harbors in this region, 11 are federal structures. The exception is Port Sheldon. The region was chosen for an RSM demonstration program because of its many and large navigation structures; its diverse shoreline, consisting of sandy beaches and high glacial till bluffs; current erosion issues; a large number of private shore protection efforts; and the considerable amount of available dredging data for the 12 harbors. In addition to the dredging data, there has been a considerable amount of other data collected within this region. Seven of the federal harbors within the Southeast Lake Michigan Region have been designated as Section 111. The purpose of a Section 111 study is to determine the effects of a federal navigation structure on the shoreline and develop plans to mitigate damages to the shoreline attributable to those structures. Ludington Harbor is the most northern Section 111 study in the region. Furthermore, the Southeast Lake Michigan Region has been the focus of an on-going Lake Michigan Potential Damages Study (LMPDS) that has generated a variety of data and analyses tools called the Flood and Erosion Prediction System (FEPS).



**Figure 1**

### RSM DEMONSTRATION PROJECT GOALS

The major goal of the Detroit District's RSM demonstration project is to develop an erosion management plan for the unprotected fragile clay bluffs of the Great Lakes Region, while also exploring the feasibility of implementing a policy where concerned stakeholders may contribute funds for large scale beach nourishment projects. Several initiatives will yield data for improved RSM efforts.

**SUMMARY**

The following RSM demonstration initiatives were identified:

**Sediment Budget Analysis**

The Detroit District initiated work in FY01 to develop a sediment budget analysis from St. Joseph, Michigan, to Michigan City, Indiana. The objectives of this study are to:

- Assemble existing and new geo-spatial data in an ArcView format.
- Evaluate rates of historic sediment supply, longshore sediment transport (LST) patterns, and deposition in sediment sinks with the FEPS created by the LMPDS.
- Create a sediment budget using the Corps' Sediment Budget Analysis System (SBAS).
- Create a comprehensive database to assist in the determination of managing sediment.

**GIS Database**

Historic National Oceanic and Atmospheric Administration (NOAA) surveys were re-surveyed in FY01 under RSM and LMPDS. The comparison of the two survey sets at some locations can span 55 years and gives insight into the evolution of the shoreline (Figure 2). Section 111 monitoring data were digitized and entered into the geographic information systems (GIS) database from existing mylars. SHOALS data were gathered and entered into the GIS database, providing the ability to locate shoals and offshore sand bars. In FY03, a significant amount of data will be joined with the existing database along with the FEPS analysis tool developed under LMPDS.

**Development of Dredged Material Placement Policy (DMPP)**

The RSM demonstration program will expedite the development of a DMPP within the District to maximize nearshore benefits from sediment placement. By improving coordination between offices within the District and with state agencies, it will be possible to eliminate contradictions in sediment management policies, reduce conflicts in planning, ensure that existing sediment placement locations defined through past studies are utilized efficiently, prevent placement of dredged material in areas where potential for adverse effects exist, and discourage the placement of material where no value to the shoreline can be obtained.

### **Development of Dredged Material Placement Monitoring Program**

This program will complement the DMPP by supplying the scientific reasoning for dredged material placement location selection. The main objectives and needs for the monitoring program include the following:

- A cost-efficient monitoring method will be created for monitoring of harbors within a region without increasing present funds available through the Section 111 authority.
- Data will be analyzed by comparing contours from postnourishment surveys as well as historic bathymetric data to monitoring surveys performed under the monitoring program. Changes in the shoreline will be documented and conveyed to the dredging plan development team for insertion into the dredging specifications.
- Funding for the monitoring program may be accomplished by a proposal to redefine the present Section 111 authority to address all harbors within a littoral region. This would require the insertion of the RSM concept into the existing authority. Instead of focusing on erosion mitigation for a single harbor within a region, the authority would address erosion mitigation within a region, thus allowing for proper sediment management for all harbors within the littoral cell.

### **Feasibility Study for Bypassing Program at New Buffalo Harbor, Michigan**

It is necessary to initiate a feasibility study for a by-passing program at New Buffalo Harbor, Michigan. While this harbor is not a Section 111 site, the District has been placing dredged material on the down-drift side of the harbor since 1980. It is a relatively new harbor, having been constructed in 1975. Surveys in recent years now show that cohesive soils are being exposed down-drift of the harbor due to insufficient supplies of sediment. Three main factors believed to contribute to insufficient supplies are (a) private shore structures that prohibit bluff erosion and therefore sediment from entering the nearshore, (b) the federal harbor trapping sand in the north accretion fillet, and (c) a natural cohesive shoreline with minimal sand supply.

It is proposed that by changing current dredging procedures, maintenance costs could be reduced while slowing the rate of

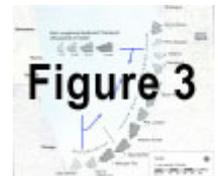
shoaling at the harbor mouth. This altered dredging method would consist of dredging a trench at the shoreline along the north accretion fillet. While material is being by-passed by hydraulic dredge, bulldozers would excavate a thin top layer of sand from the accretion fillet and fill in the new trench. With this method a large amount of material can be by-passed to help reduce current erosion down-drift and create an area updrift for sediment to accumulate while maintaining a safe recreation beach area. The by-passing dredge program would be similar to the existing operations because it would need to be scheduled within the O&M maintenance dredge cycle. However, it would be expected that fewer dredging projects would need to be scheduled over time.

Another possibility to implement a by-passing program and reduce shoaling is to install permanent dredging equipment. With current technologies available, this possibility may be feasible.

## STATUS

Although the SBAS has not been completed and a complete report is not yet available, some pertinent information has already been obtained:

- One of the key findings of this study is the definition of a littoral cell located in the southeast corner of Lake Michigan. LST rates were calculated by inputting wave and lake level data in a two-dimensional coastal processes model called COSMOS. The results of this model predicted the net littoral transport direction as well as volumetric flow for a large portion of the RSM demonstration site. Inflection points were discovered to exist at Port Sheldon, Michigan, and Gary Harbor, Indiana. These inflection points define the boundaries of the littoral cell (Figure 3).
- Preliminary numerical modeling has been completed at the federal harbor at Saugatuck, Michigan (Figure 4). The modeling suggests 100 percent by-passing of the net LST at the present time, with the exception of shoaled material. If dredged material is properly placed down-drift of the structures, then impacts of the jetties on the regional sediment budget could be minimal.



- Preliminary sediment budget calculations are not in equilibrium at the moment. Possible reasons for the discrepancies include: (a) historical recession rate values are too high, (b) shoreline armoring has significantly reduced the introduction of new material to the littoral system, and (c) lake bottom sand cover is unquantifiable at this time.
- The accretion fillets at the older harbors on the southeast shores of Lake Michigan appear to be at or near capacity, and thus their impact in the future is anticipated to be small in comparison to reduced sediment supply from shoreline armoring.

**LESSONS LEARNED**

Obstacles to RSM in the Great Lakes include the fact that there are small markets on the Great Lakes. Not very many are capable or willing to meet 35/65 percent cost-sharing. Also, the Section 111 authority and other project authorities and funding streams focus on only one harbor, and not the general region in which the harbor resides. Furthermore, many properties along the Great Lakes are in private ownership, limiting the number of public lands available for community-based projects.

**KEY WORDS**

Littoral cell, erosion, longshore sediment transport, sediment sinks, fillet

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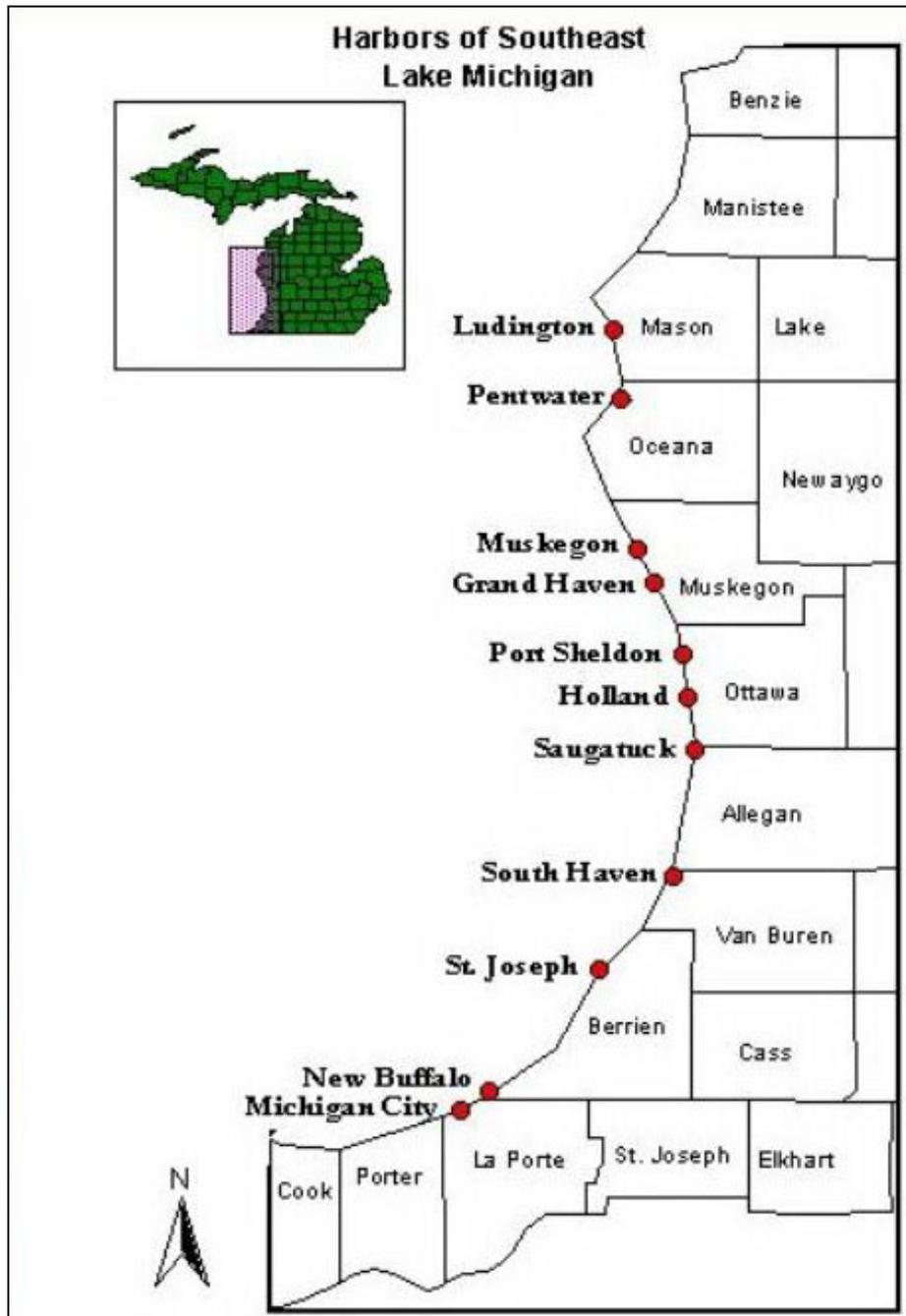


Figure 1. Southeast Lake Michigan Region [back to text reference](#)

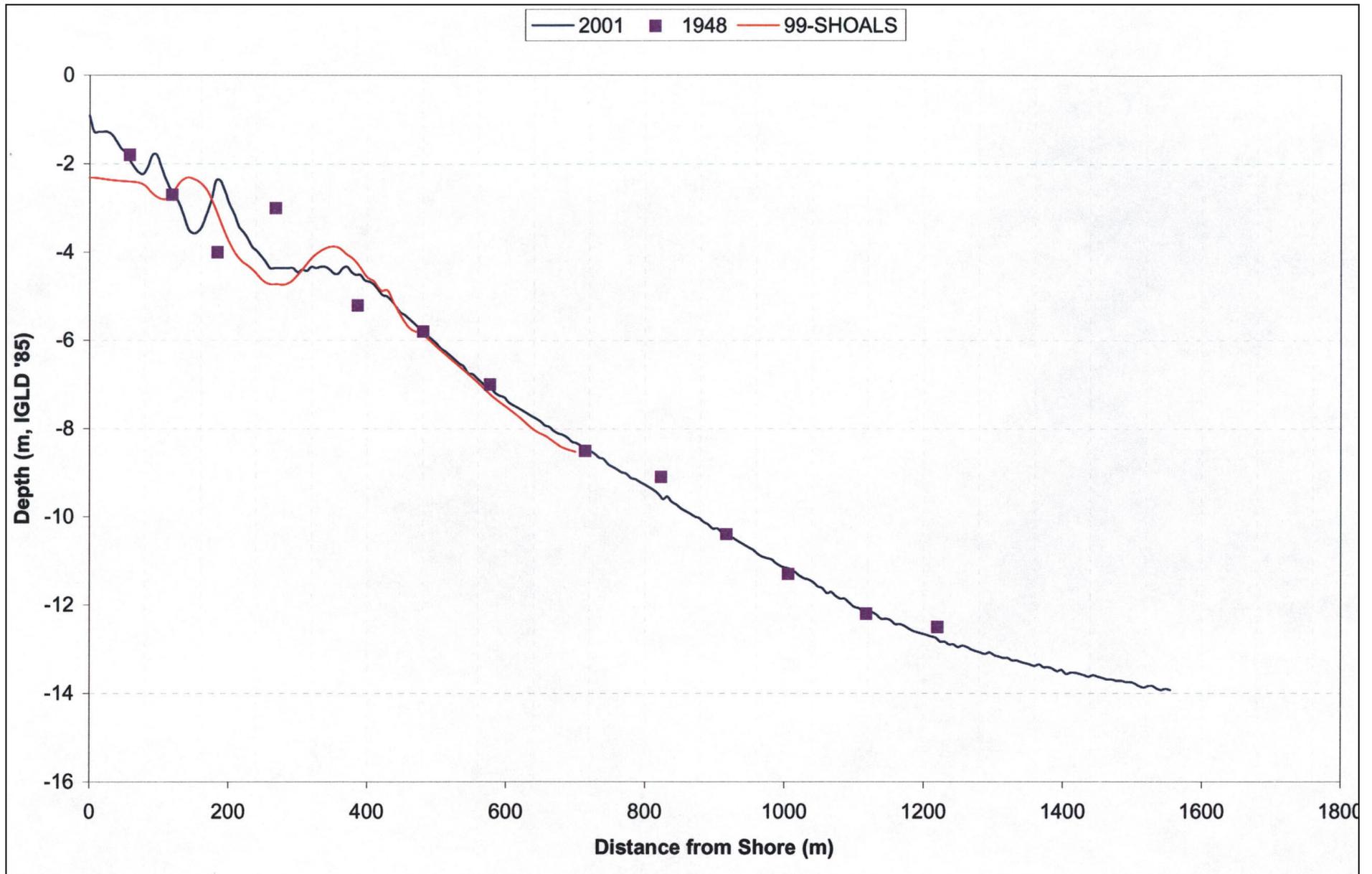


Figure 2. NOAA surveys [back to text reference](#)

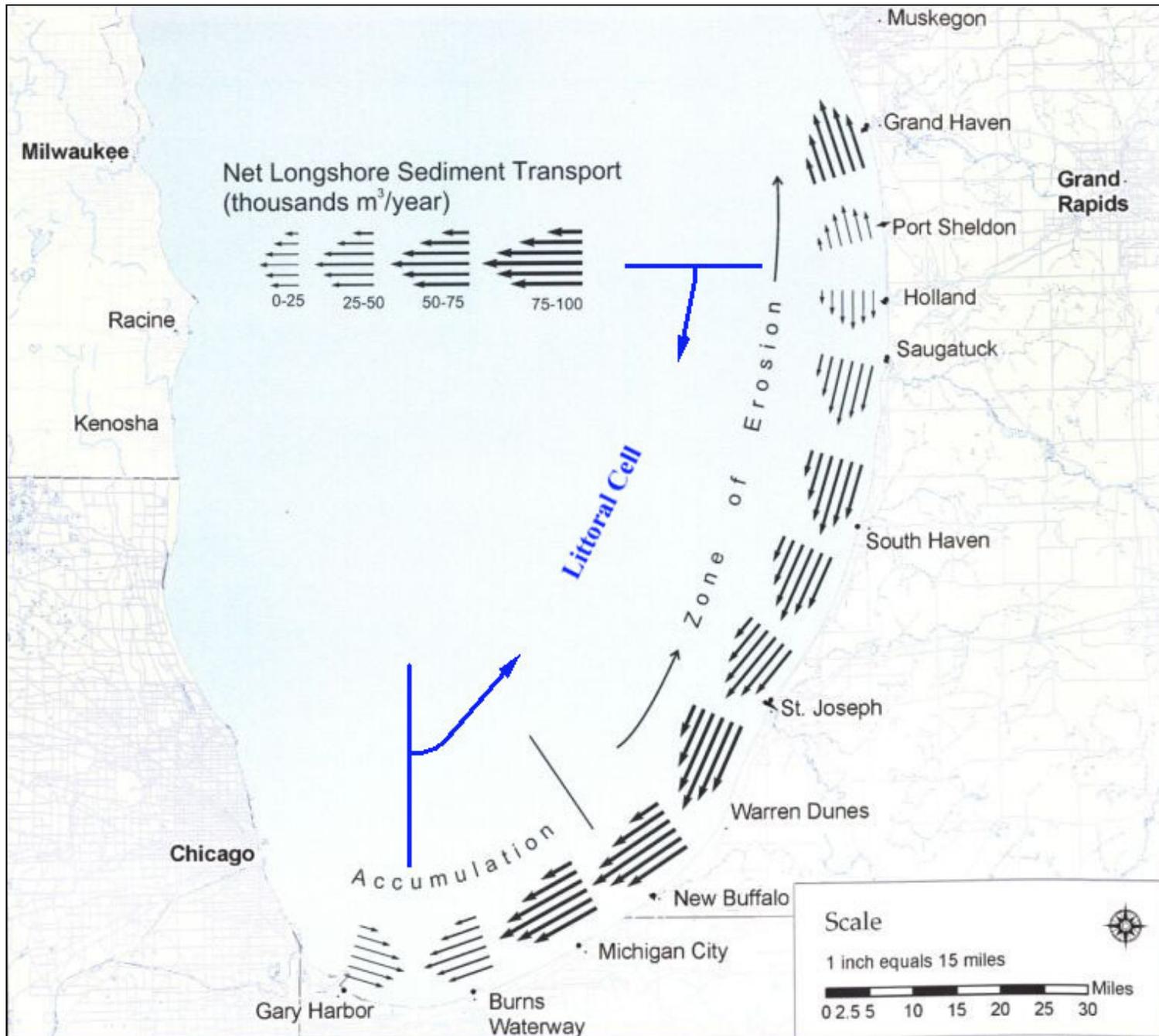


Figure 3. Littoral cell [back to text reference](#)

# Existing Conditions

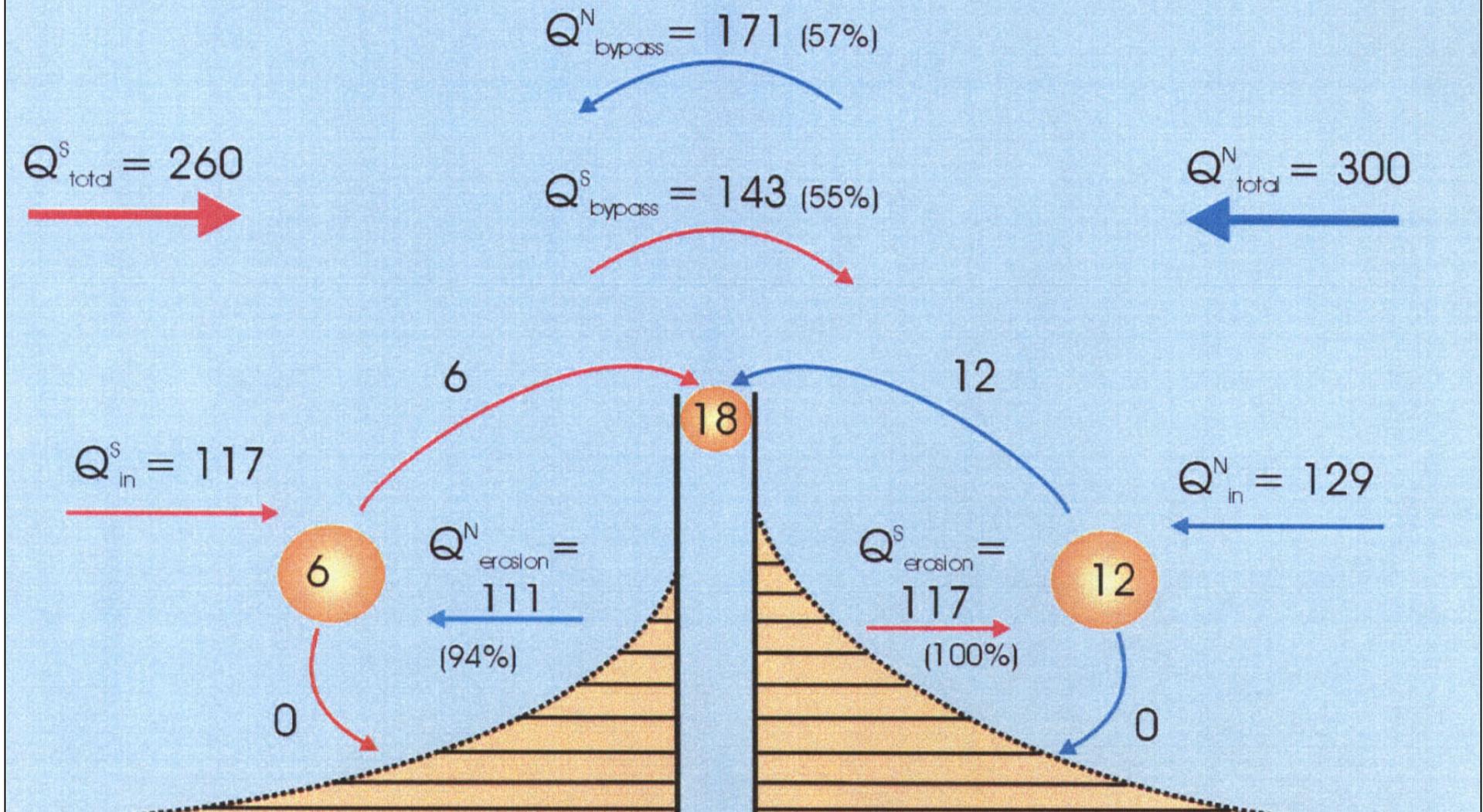


Figure 4. Saugatuck, Michigan, numerical model [back to text reference](#)