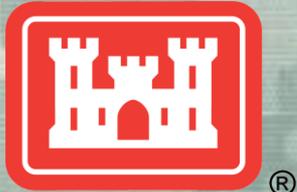


# Coastal Structures Risk Communication Southern Lake Michigan Harbors

Dave Wright  
Chief of Operations  
Detroit District

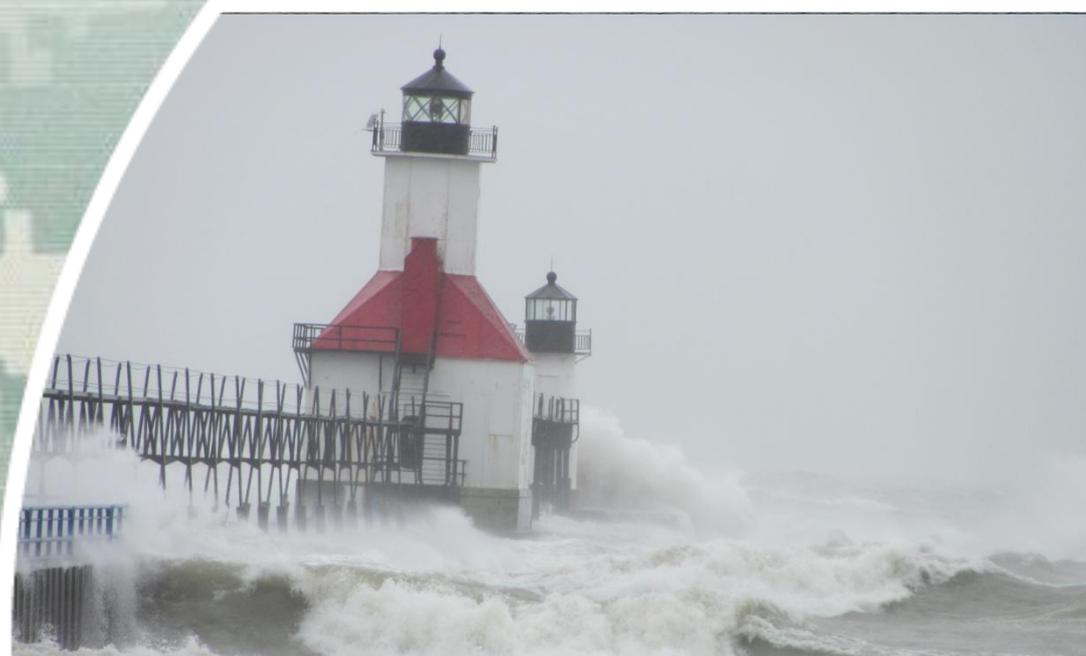
Timothy Kroll  
Operations Project Manager  
Chicago District

July 18, 2012



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US Army Corps of Engineers  
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# Introduction and Agenda

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## **Purpose:**

Communicate the risk of breakwater and structure conditions to local stakeholders and navigation system users. With a focus on structure condition, function, and economic consequences of coastal structures on the Great Lakes.

## **Focus Topics:**

1. Coastal Structure Risk Communication
2. Condition Assessment of Coastal Structures
3. Harbor Infrastructure Inventory Process
4. Next Steps and Open Discussion



# Regional Risk Communication Meetings



- Regional Meetings**
- #1 15 Aug
  - #2 8 Nov
  - #3 18 Jan
  - #4 18 Jul
  - #5 NE MI
  - #6 SE MI
  - #7 East Erie
  - #8 East Ont
  - #9 MN
  - #10 UP MI



# Coastal Structures

---

## Great Lakes Navigation



- 104+ miles of navigational structures on the Great Lakes
- Most built between 1860 and 1940
- Timber crib construction (typical)
- Low Lake water levels since the 1990's have accelerated deterioration



# Typical Coastal Structures



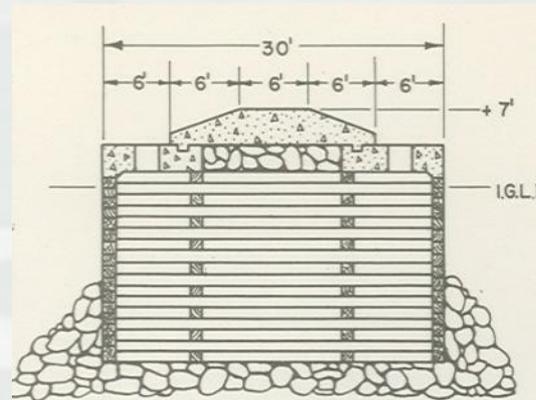
Steel Sheet  
Pile  
Structures



Rubble  
Mound/Laid-Up  
Stone Structures



Other  
Components:  
safety  
(railings,  
walking  
surface, etc.)



Typical Wood  
Crib/ Concrete  
Cap Structures  
Cross-section



# Structure Function/Consequences

---



**Contain and reduce shoaling in navigation channel**



**Protect navigation channel and shoreline infrastructure**



*St. Joseph Harbor, MI*

**Control wave climate within navigation channel and harbor**



# Coastal Structure Communication Objective

---

Program Objective: Communicate the risk of breakwater and structure conditions to local stakeholders and navigation system users

## Process:

### 1. **Conduct Condition Assessments**

- Commercial Harbors- Use detailed Breakwater Assessment Team (BAT) Evaluation
- Recreational Harbors- Rely on expert elicitation

### 2. **Conduct Harbor Infrastructure Inventory on all structures**

### 3. **Prepare summary document** that conveys the current condition of the harbor infrastructure as well as the risk involved in the event of failure

### 4. **Share with stakeholders** in regional meetings



# Harbor Infrastructure Inventory Process

---

- Gather information on critical infrastructure protected by federally maintained navigation structures
  - ▶ Review Documents:
    - Project Drawings
    - Harbor Fact Sheet
    - Aerial/Satellite Photography; Photo document critical infrastructure
  - ▶ Identify Critical Infrastructure to Visit
  - ▶ Research Identified Critical Infrastructure
- Site Visit Tasks
  - ▶ Met with Local Officials, Port Authority, Harbor Master, when available
  - ▶ Visit Identified Areas/Critical Infrastructure & Gather Information
- Post Site Visit Tasks
  - ▶ Create Report Following the Standard Report Template



# Harbor Infrastructure Inventory Report Content

---

- **HARBOR LOCATION**
- **PROJECT DESCRIPTION**

Authorization, harbor type (commercial or recreational), length of breakwater structures and channel
- **DATE OF SITE VISIT**
- **SUMMARY OF STRUCTURES**

Lists all structures and facilities that are believed to be protected by the federal navigation structures; also identify any other potential stakeholders
- **SUMMARY OF IMPACT**

Summarizes any potential damage that could be experienced if the federal breakwater fails.
- **DESCRIPTION OF STRUCTURES**

Aerial photo with all potential affected structures shown along with pictures and a brief description of each potentially affected structure



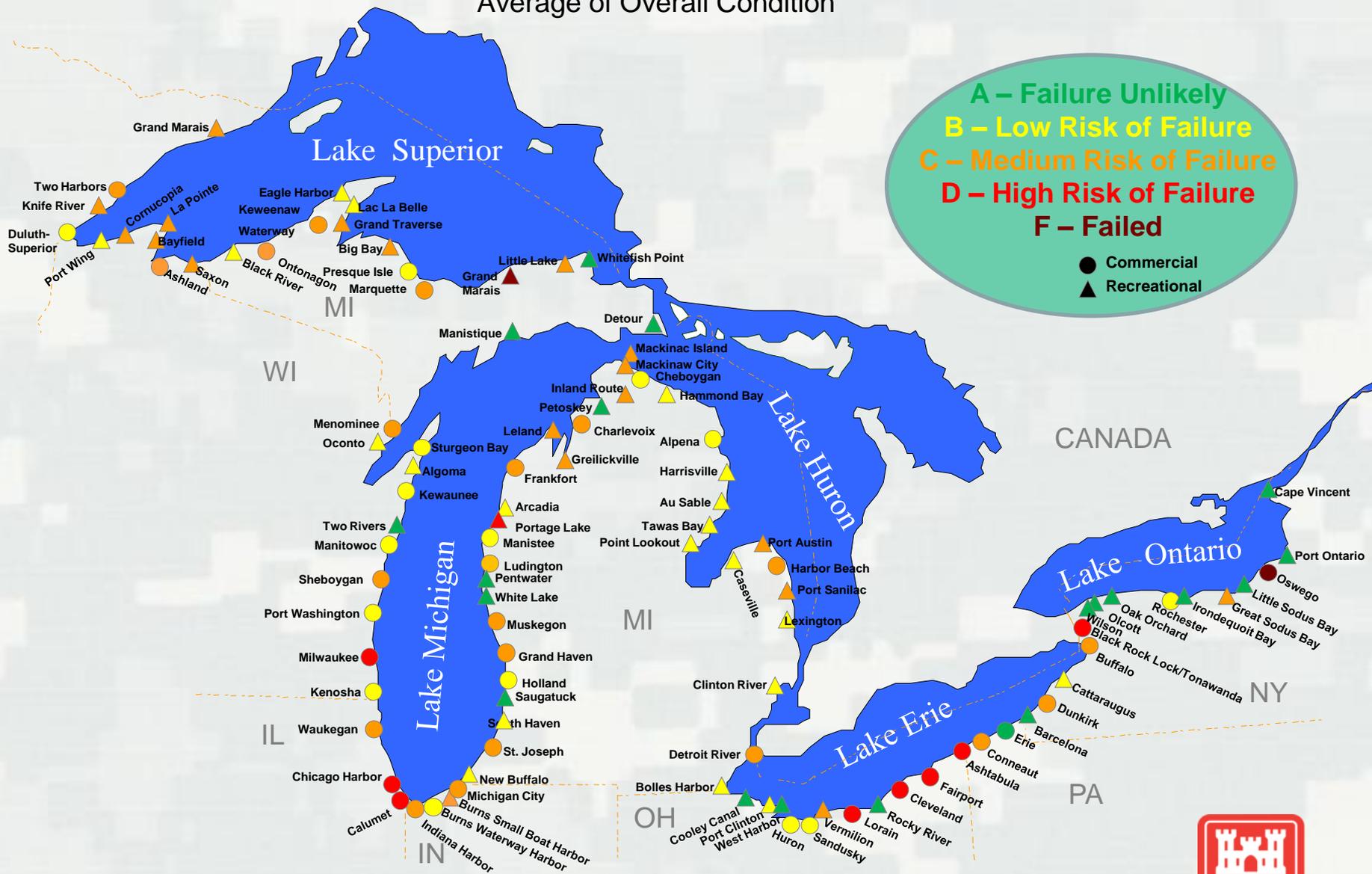
# High Level Display of Potential Impact Areas

- Three potential impact areas were defined at 500 ft intervals
- Shows potential value of land and infrastructure within each “potential impact area” based on tax assessment data



# Harbor Structure Condition Assessments

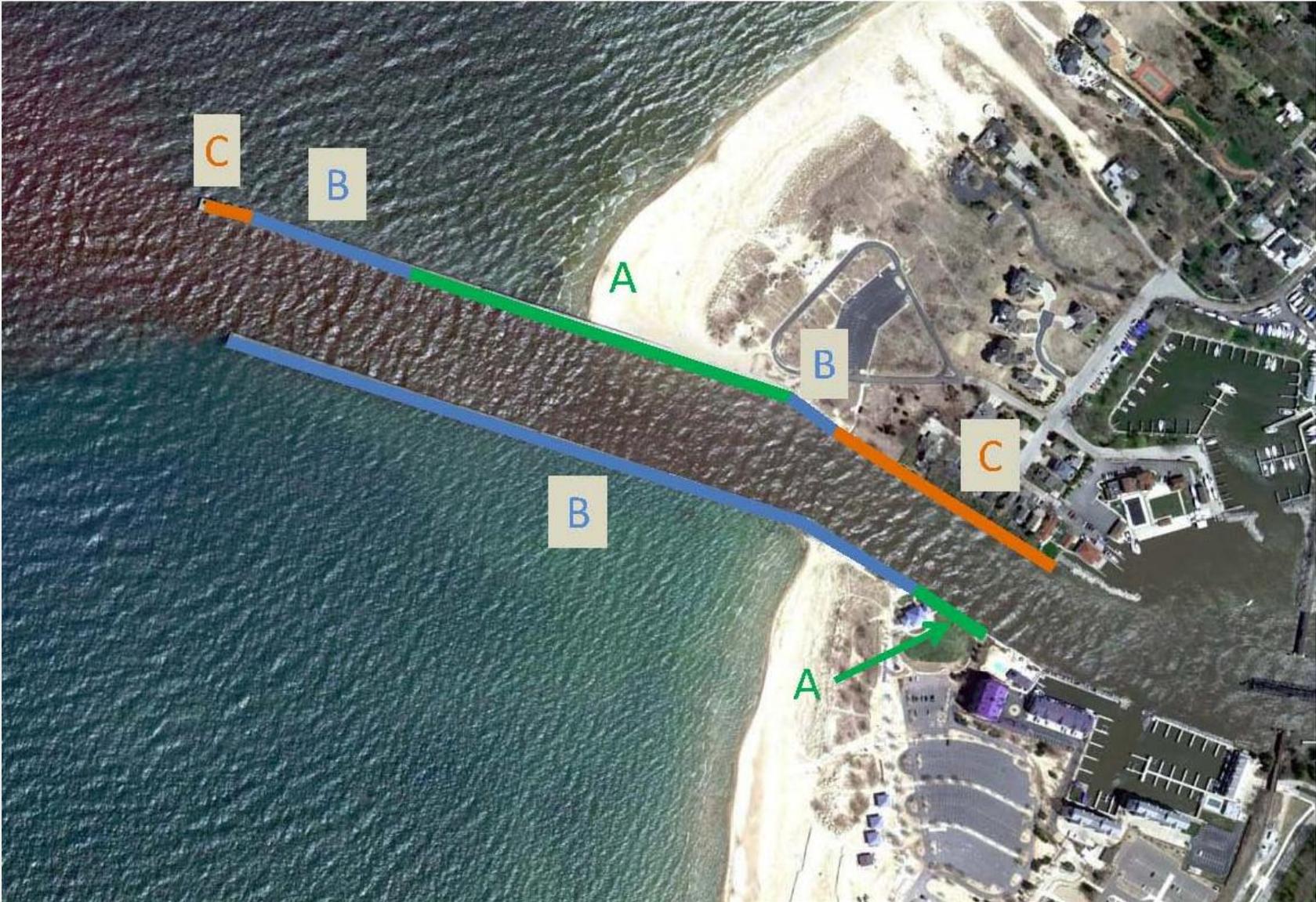
Average of Overall Condition



# Harbors of Southwest Michigan & Northern Indiana & Illinois



**St. Joseph Harbor:**  
C – Medium Risk of Failure





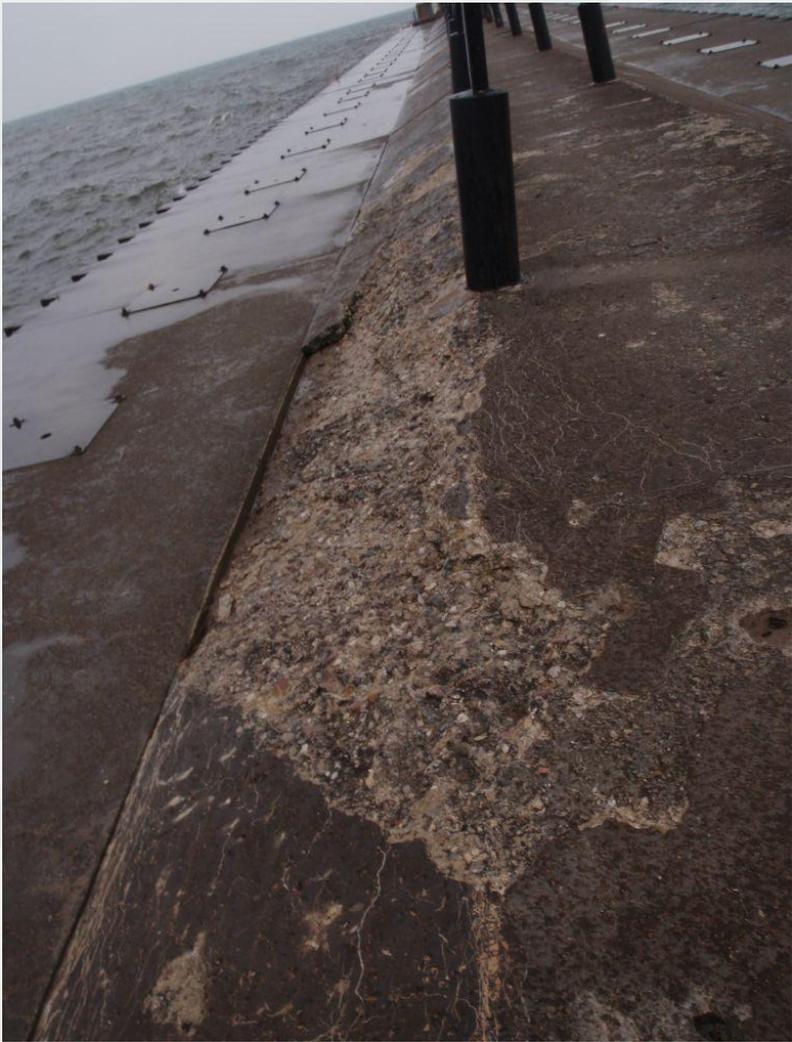
St. Joseph – North Pier



St. Joseph – North Pier



St. Joseph  
North Pier



# St. Joseph Harbor:

Overall rating of 'C'

## Infrastructure:

1. Tiscornia Park
2. United States Coast Guard – St. Joseph Station
3. West Basin Municipal Marina
4. LaFarge Corporation
5. Silver Beach County Park
6. Lighthouse Point
7. Waterfront Condominiums
8. CSX Railroad Bridge

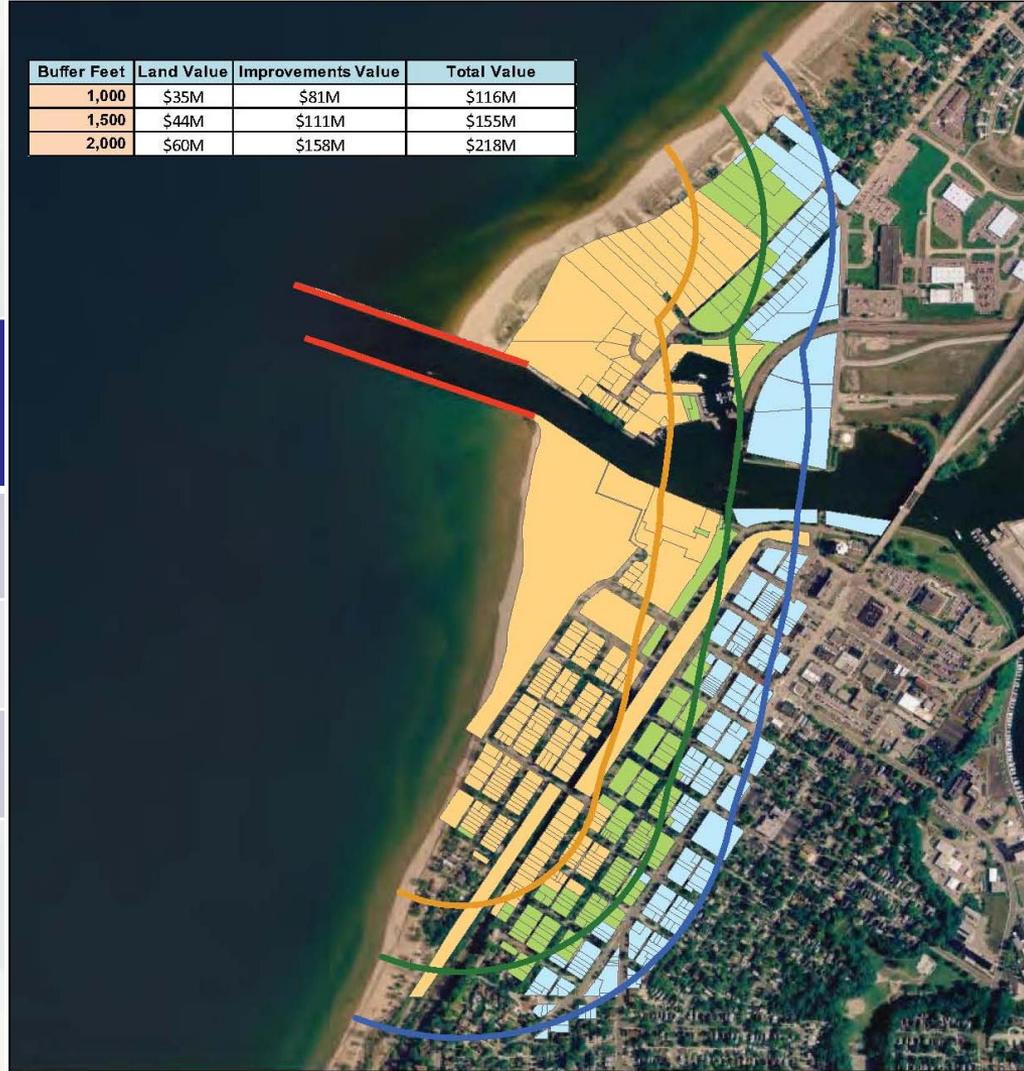


# St. Joseph Harbor:

## Potential Impact Areas

Buffer Feet	Land Value	Improvements Value	Total Value
1,000	\$35M	\$81M	\$116M
1,500	\$44M	\$111M	\$155M
2,000	\$60M	\$158M	\$218M

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
1,000	\$35M	\$81M	\$116M
1,500	\$44M	\$111M	\$155M
2,000	\$60M	\$158M	\$218M



**ST. JOSEPH HARBOR**  
St. Joseph, MI

0 475 950 1,900  
Feet

Imagery Source- NAIP 2010

Great Lakes Navigation

Created 16 SEP 2011- by T. Crockett- Buffalo District

**New Buffalo Harbor:  
B – Low Risk of Failure**



New Buffalo - North Breakwater





New Buffalo - North Breakwater

Un-even Grating

---

# New Buffalo - South Breakwater



# New Buffalo - South Breakwater Stone Deteriorating



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# New Buffalo Harbor:

Overall rating of 'B'

## Infrastructure:

1. Dunewood Condominiums
2. Lake Michigan Yacht Club
3. New Buffalo Beach
4. North Whittaker Street Bridge
5. City of New Buffalo Transient Marina
6. The Moorings Harbor
7. Oselka Marina



# New Buffalo Harbor: Potential Impact Areas

Buffer Feet	Land Value	Improvements Value	Total Value
1,000	\$16M	\$17M	\$33M
1,500	\$19M	\$22M	\$41M
2,000	\$28M	\$34M	\$62M



- Federal Structure
- Shoreline\_1000\_ft\_buffer
- Shoreline\_1500\_ft\_buffer
- Shoreline\_2000\_ft\_buffer
- Parcels\_1000\_ft\_buffer
- Parcels\_1500\_ft\_buffer
- Parcels\_2000\_ft\_buffer

## NEW BUFFALO HARBOR

New Buffalo, MI  
 0 500 1,000 2,000  
 Feet

Imagery Source- NAIP 2010



Created 16 SEP 2011- by T. Crockett- Buffalo District

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
1,000	\$16M	\$17M	\$33M
1,500	\$19M	\$22M	\$41M
2,000	\$28M	\$34M	\$62M

**Michigan City Harbor:**  
C – Medium Risk of Failure



# Michigan City Harbor

Complete collapse of first segment of  
East Pier Reach L





**Michigan City Harbor**

**Collapse of East Pier Reach L results in additional loss of fill stone in the rest of Reach L**

# Michigan City Harbor



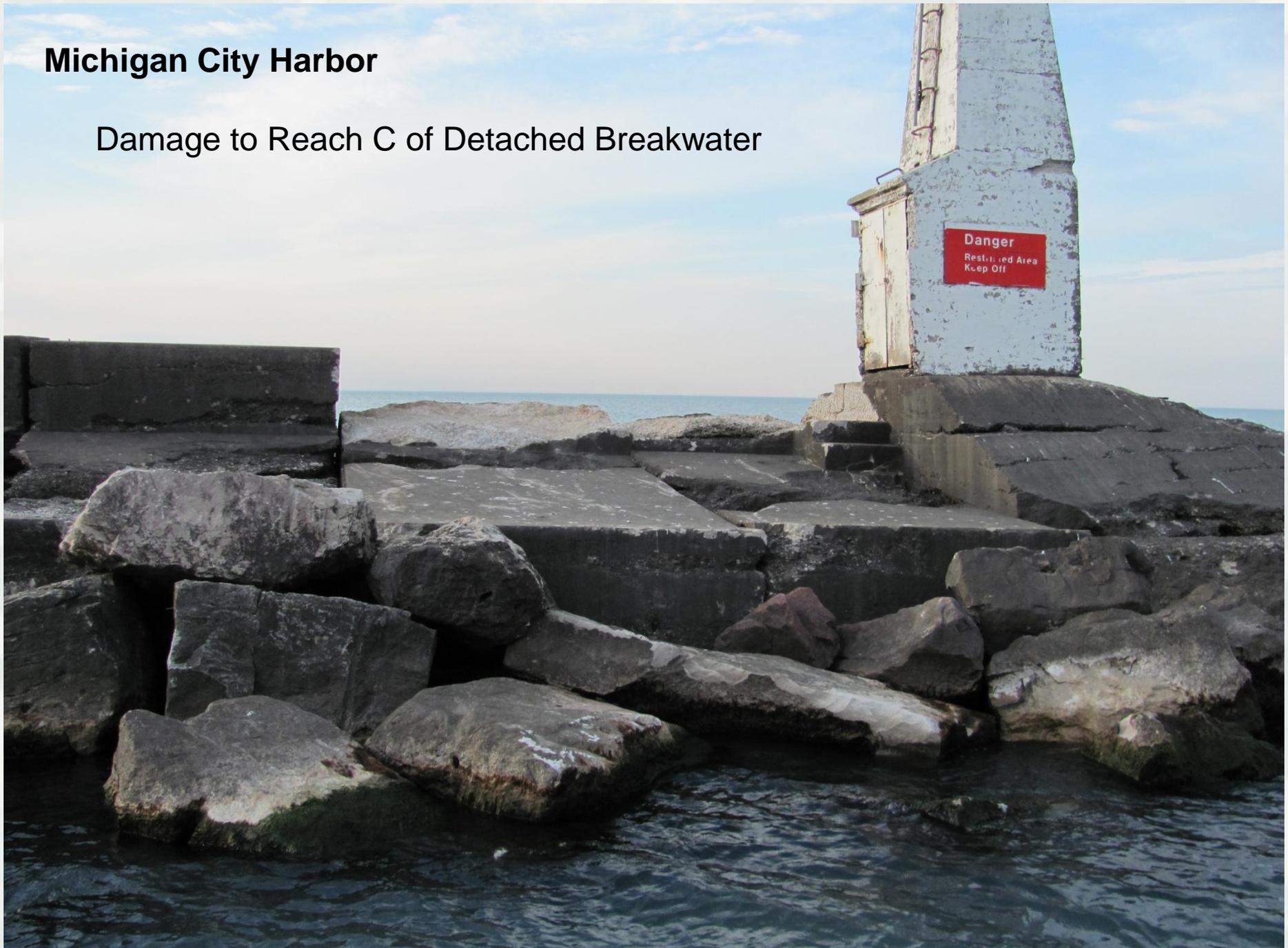
Onset of domino effect along  
Reach L of the East Pier



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# Michigan City Harbor

Damage to Reach C of Detached Breakwater



# Michigan City Harbor:

Overall rating of 'C', Detached Breakwater and a portion of West Pier rated 'D', Portion of East Pier rated 'F'

## Infrastructure:

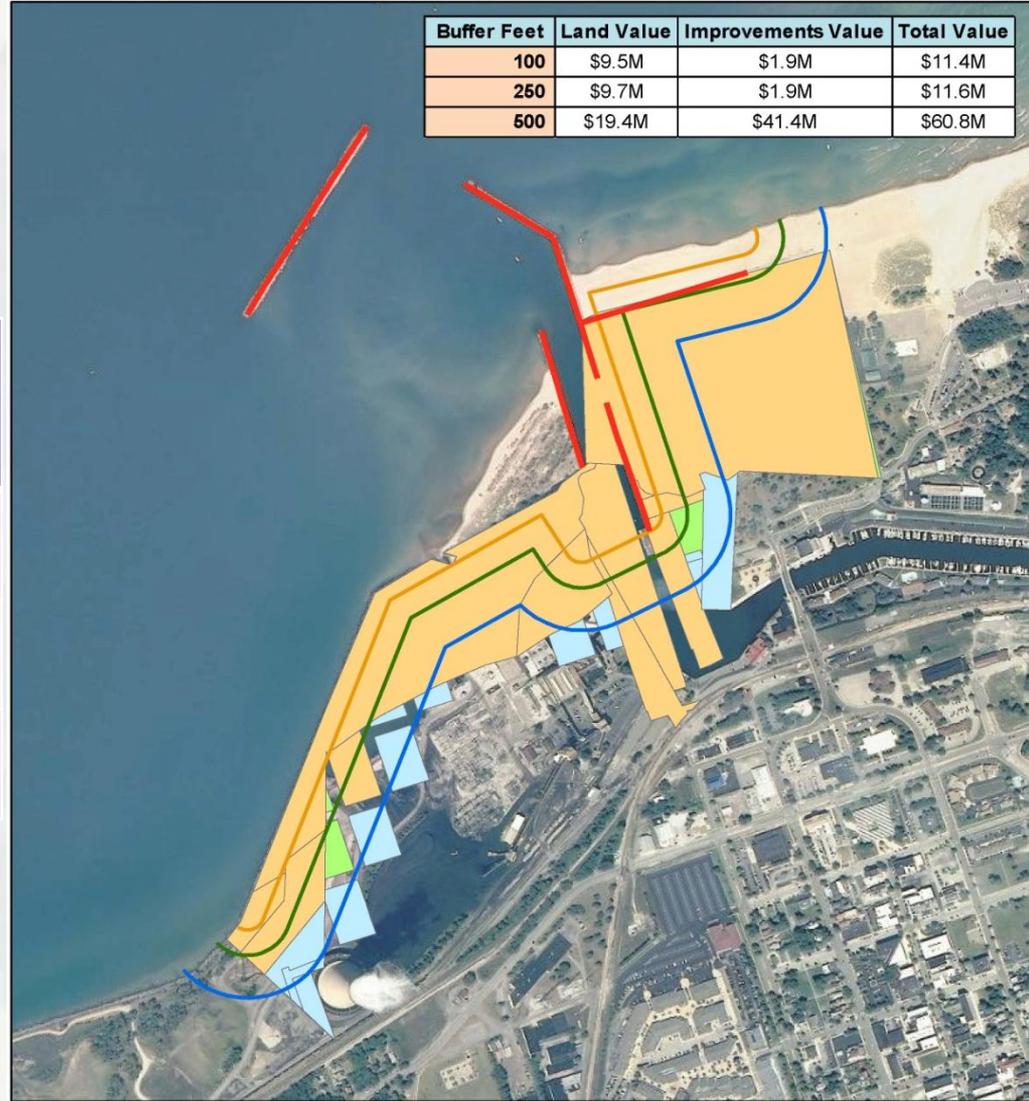
1. Northern Indiana Public Service Company
2. Washington Park – Marina Port Authority
3. U.S. Coast Guard – Station Michigan City
4. Giorgetti's Restaurant & Yacht Club Pub
5. Old Lighthouse Museum
6. Amtrak - Michigan City Station
7. Indiana Dept of Natural Resources (F&W Law Enforcement)
8. Formerly Goerg Boats & Motor, Inc.



# Michigan City Harbor:

## Potential Impact Areas

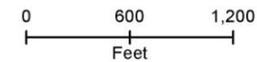
Buffer Feet	Land Value	Improvements Value	Total Value
100	\$9.5M	\$1.9M	\$11.4M
250	\$9.7M	\$1.9M	\$11.6M
500	\$19.4M	\$41.4M	\$60.8M



- Federal Structure
- Shoreline\_100\_ft\_buffer
- Shoreline\_250\_ft\_buffer
- Shoreline\_500\_ft\_buffer
- Parcels\_100\_ft\_buffer
- Parcels\_250\_ft\_buffer
- Parcels\_500\_ft\_buffer

### MICHIGAN CITY HARBOR

Michigan City, IN



Imagery Source- NAIP 2010



Created May 2012- by T. Crockett- Buffalo District

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# Burns Small Boat Harbor: B/C – Medium/Low Risk of Failure



## Burns Small Boat Harbor

West Breakwater -  
Construction of the walkway  
was completed in 2008



## Burns Small Boat Harbor

North Breakwater - the breakwater received a C rating due to loss of fill stone



# Burns Small Boat Harbor:

West Breakwater rated 'B', North Breakwater rated 'C'

## Infrastructure:

1. Portage Lakefront Riverwalk (Indiana Dunes National Lakeshore)



# Burns Small Boat Harbor: Potential Impact Areas

Buffer Feet	Land Value	Improvements Value	Total Value
100	\$2M	\$39.1M	\$41.1M
250	\$2M	\$39.1M	\$41.1M
500	\$2M	\$39.1M	\$41.1M

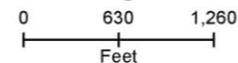


Buffer Feet	Land Value	Improv. Value	Total Assessed Value
100	\$2M	\$39.1M	\$41.1M
250	\$2M	\$39.1M	\$41.1M
500	\$2M	\$39.1M	\$41.1M

- Federal Structure
- Shoreline\_100\_ft\_buffer
- Shoreline\_250\_ft\_buffer
- Shoreline\_500\_ft\_buffer
- Parcels\_100\_ft\_buffer
- Parcels\_250\_ft\_buffer
- Parcels\_500\_ft\_buffer

## BURNS SMALL BOAT HARBOR

Portage, IN



Imagery Source- NAIP 2010



# Burns Waterway Harbor:

B – Low Risk of Failure



## Burns Waterway Harbor

Loss of fill stone along  
Rubblemound due to heavy  
wave action



**Burns Waterway Harbor**

Sliding of armor cap stone  
along North Breakwater



## Burns Waterway Harbor

Loss of fill stone along North  
Breakwater due to heavy wave  
action.



# Burns Waterway Harbor:

Overall rating of 'B', North Breakwater Head rated 'C'

## Infrastructure:

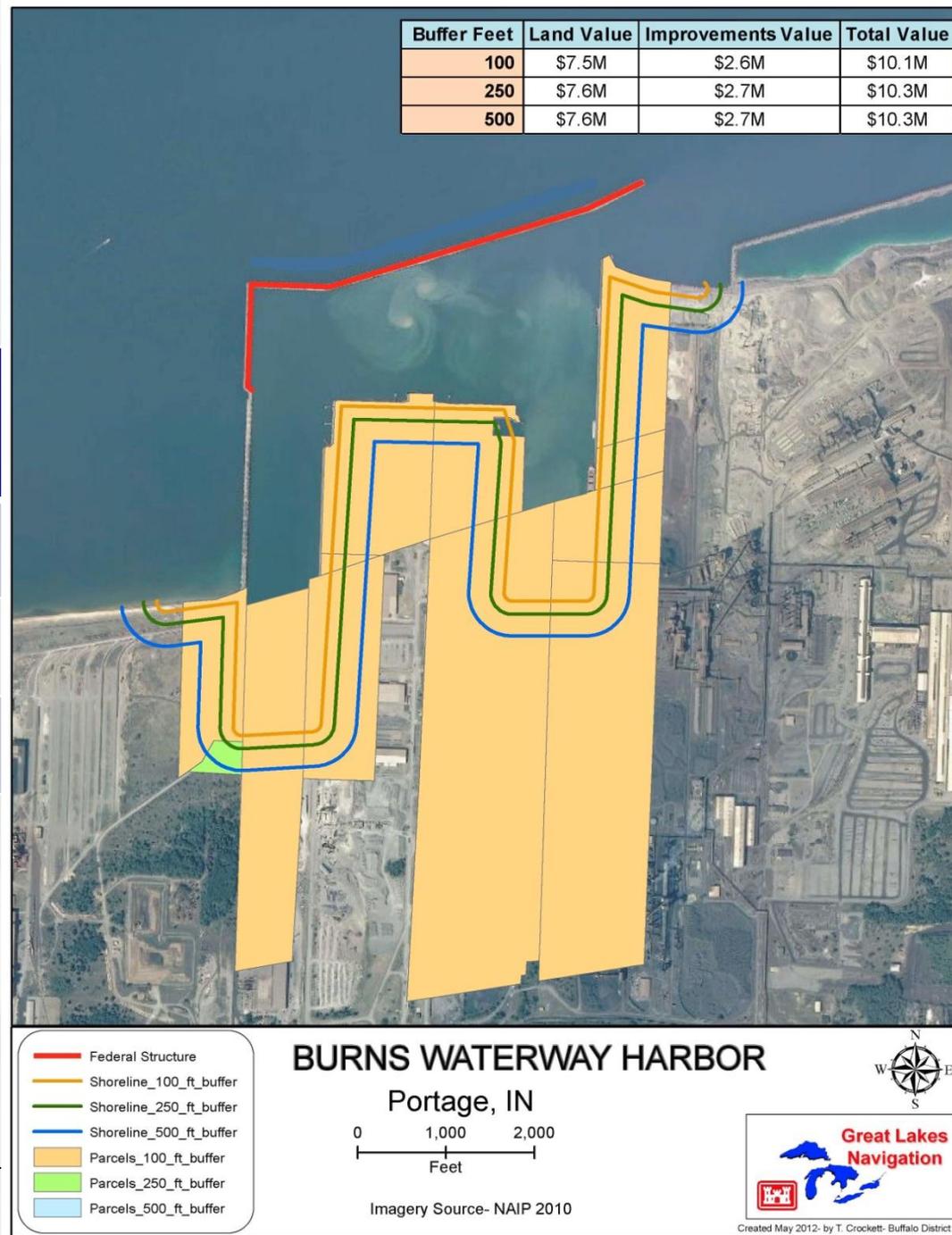
1. ArcelorMittal Burns Harbor Plant
2. Great Lakes Towing Co.
3. Cargill, Inc.
4. Lakes & Rivers Transfer
5. Carmeuse Lime and Stone
6. Frick Services
7. Federal Marine Terminals, Inc.
8. Tanco Terminals, Inc.



# Burns Waterway Harbor: Potential Impact Areas

Buffer Feet	Land Value	Improvements Value	Total Value
100	\$7.5M	\$2.6M	\$10.1M
250	\$7.6M	\$2.7M	\$10.3M
500	\$7.6M	\$2.7M	\$10.3M

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
100	\$7.5M	\$2.6M	\$10.1M
250	\$7.6M	\$2.7M	\$10.3M
500	\$7.6M	\$2.7M	\$10.3M

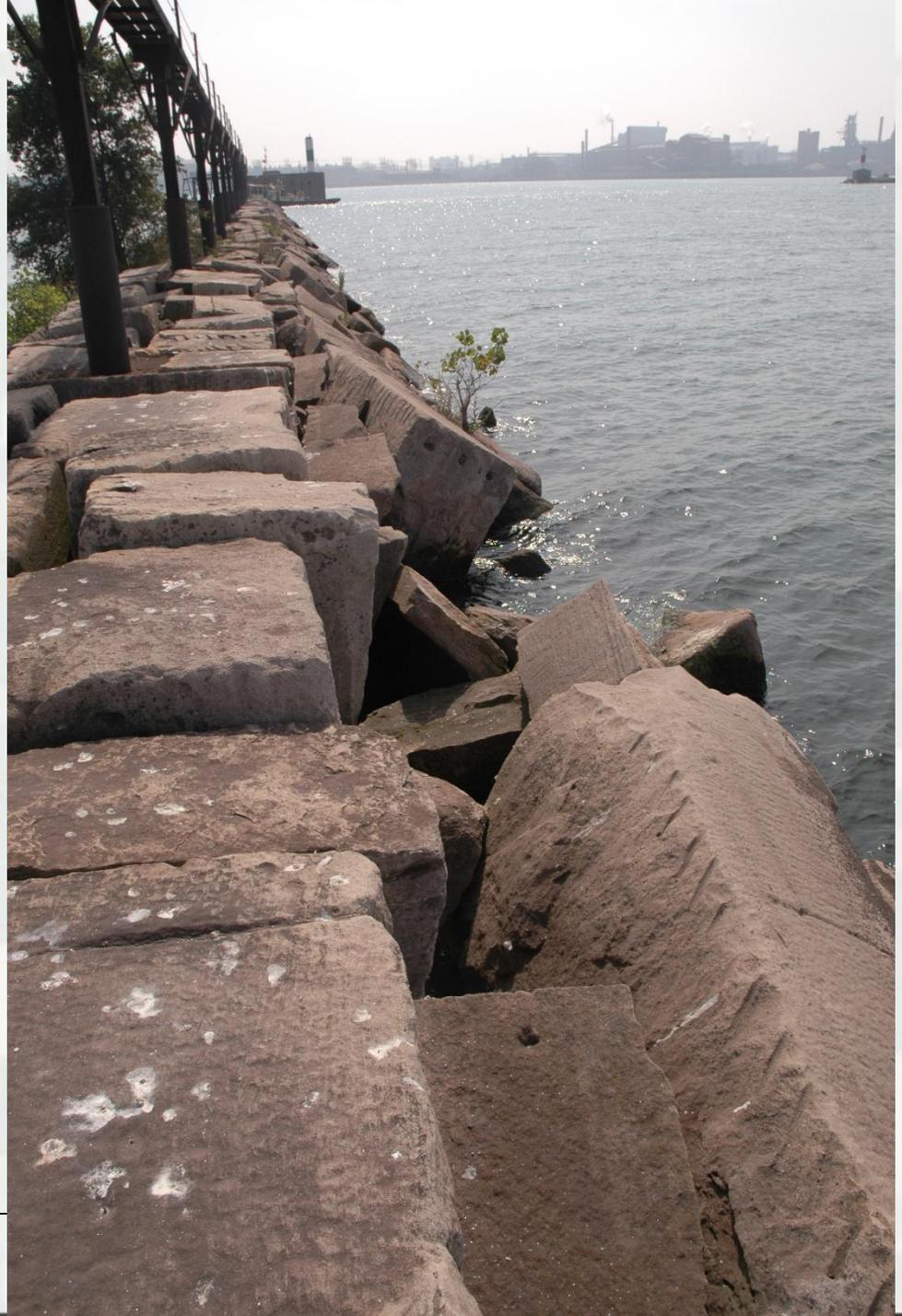


**Indiana Harbor:**  
C – Medium Risk of Failure



## Indiana Harbor

Collapse of laid-up structure due to loss of toe stone along Easterly Breakwater



# Indiana Harbor

## Spalling of concrete caisson of Easterly Breakwater



# Indiana Harbor



collapse of laid-up structure due to loss of toe stone along Northerly Breakwater



# Indiana Harbor:

Overall rating of 'C'

## Infrastructure:

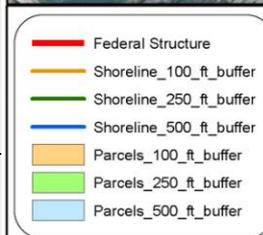
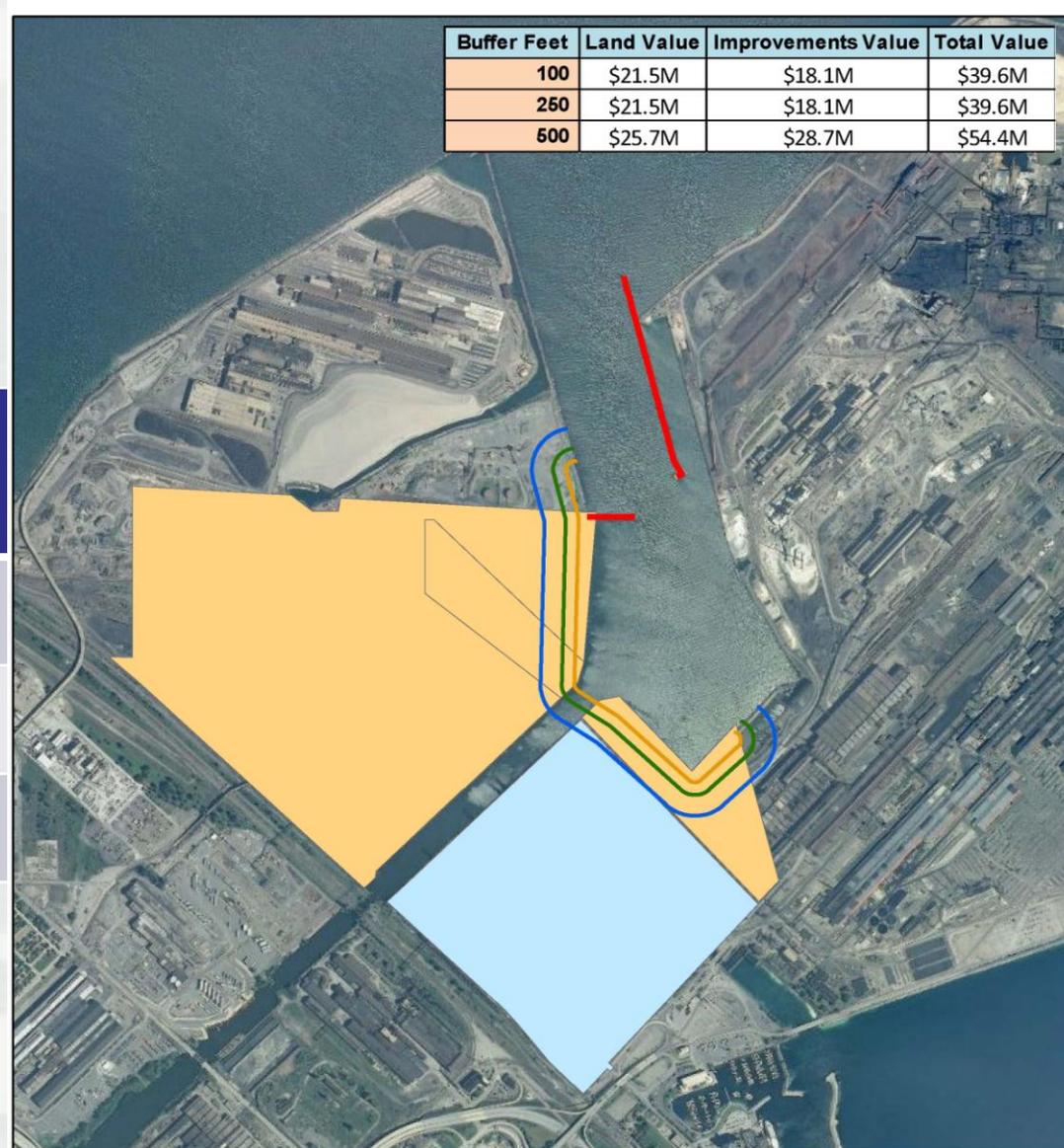
- 1. ArcelorMittal – Indiana Harbor Works



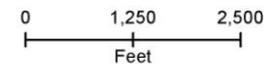
# Indiana Harbor: Potential Impact Areas

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
100	\$21.5M	\$18.1M	\$39.6M
250	\$21.5M	\$18.1M	\$39.6M
500	\$25.7M	\$28.7M	\$54.4M

Buffer Feet	Land Value	Improvements Value	Total Value
100	\$21.5M	\$18.1M	\$39.6M
250	\$21.5M	\$18.1M	\$39.6M
500	\$25.7M	\$28.7M	\$54.4M



## INDIANA HARBOR East Chicago, IN

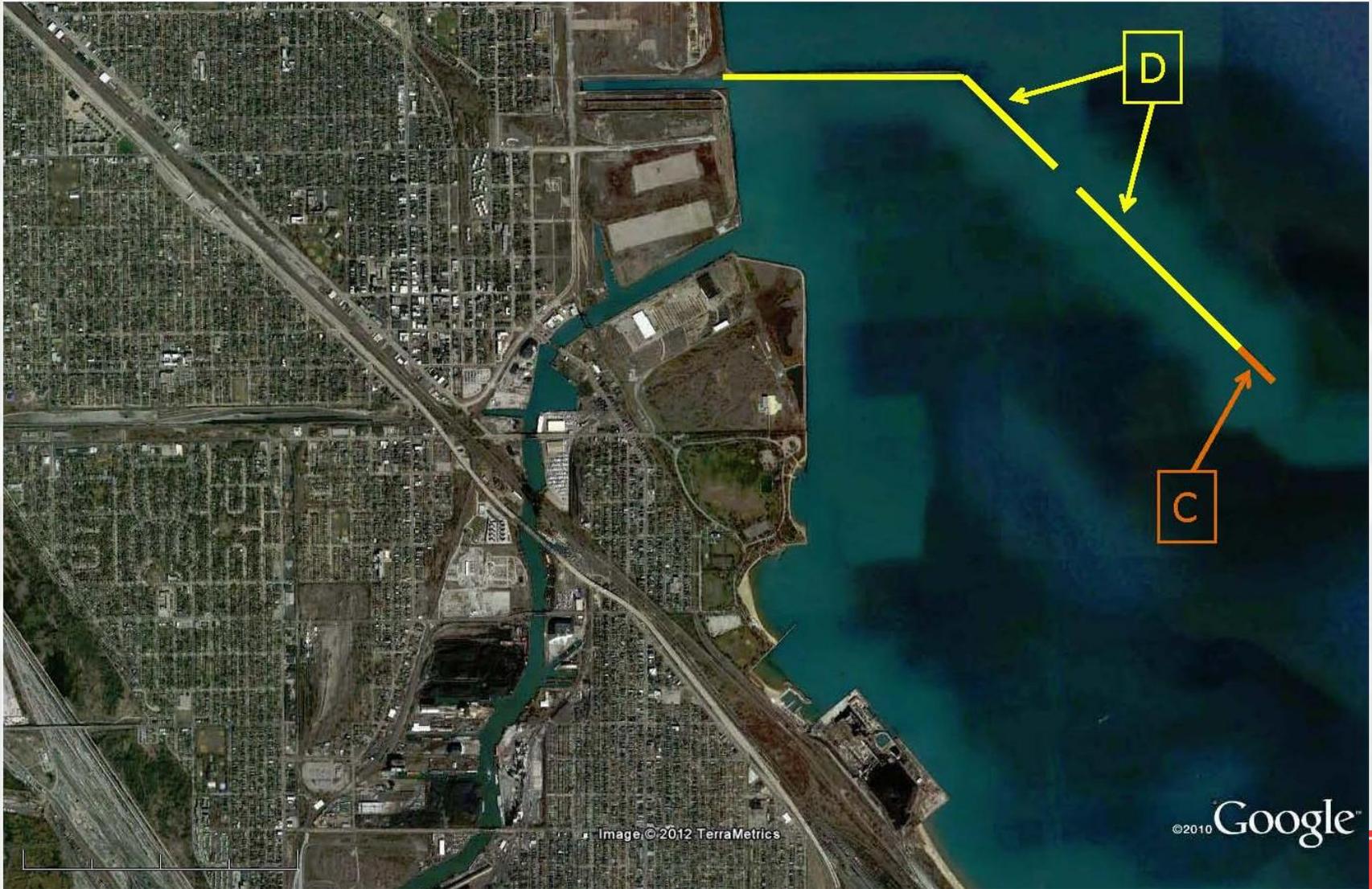


Imagery Source- NAIP 2010



Created May 2012- by T. Crockett- Buffalo District

# Calumet Harbor: D – High Risk of Failure



# Calumet Harbor



Complete collapse of segment  
along Crib Breakwater Reach B

# Calumet Harbor

Severe spalling along Crib Breakwater  
Reach B



## Calumet Harbor

Exposed timbers due to extreme spalling along Crib Breakwater Reach A



# Calumet Harbor

Collapse of concrete  
cap along Crib  
Breakwater Reach B



# Calumet Harbor



Damage to steel sheet pile cells along the Detached Steel Breakwater

## Calumet Harbor

Severe warping of steel sheet pile cells has caused settling of cap stones along the Detached Steel Breakwater



# Calumet Harbor:

Overall rating of 'D'

## Infrastructure:

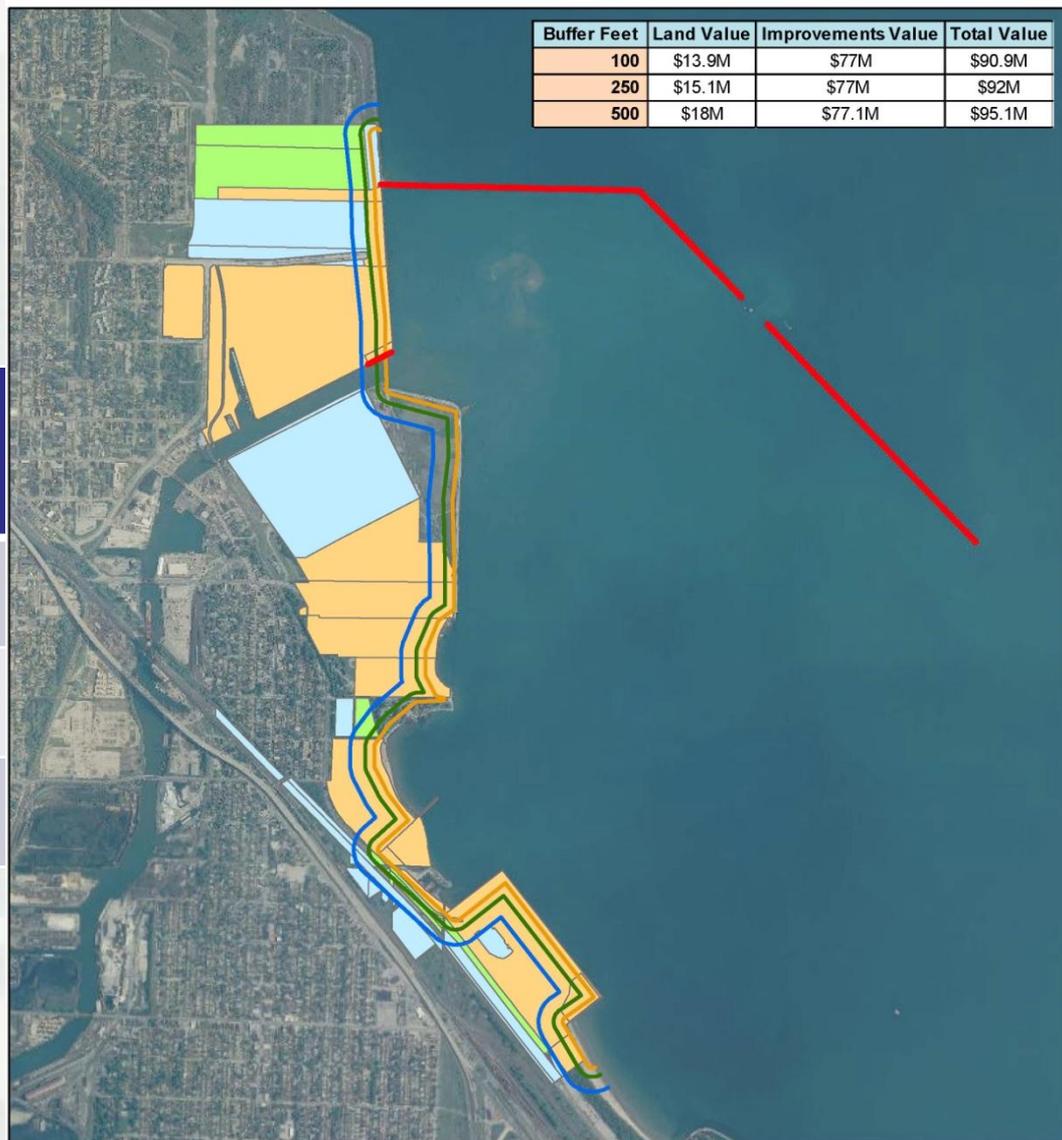
1. State Line Generation Plant
2. Calumet Yacht Club
3. U.S. Coast Guard – Station Calumet Harbor
4. Calumet Park Pavilion
5. Chicago Area Confined Disposal Facility
6. Chicago Area Stone Storage Dock
7. Illinois International Port District – Iroquois Landing
8. Calumet Harbor Operations Facility



# Calumet Harbor:

## Potential Impact Areas

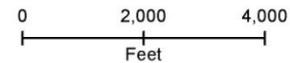
Buffer Feet	Land Value	Improv. Value	Total Assessed Value
100	\$13.9M	\$77M	\$90.9M
250	\$15.1M	\$77M	\$92M
500	\$18M	\$77.1M	\$95.1M



- Federal Structure
- Shoreline\_100\_ft\_buffer
- Shoreline\_250\_ft\_buffer
- Shoreline\_500\_ft\_buffer
- Parcels\_100\_ft\_buffer
- Parcels\_250\_ft\_buffer
- Parcels\_500\_ft\_buffer

### CALUMET HARBOR

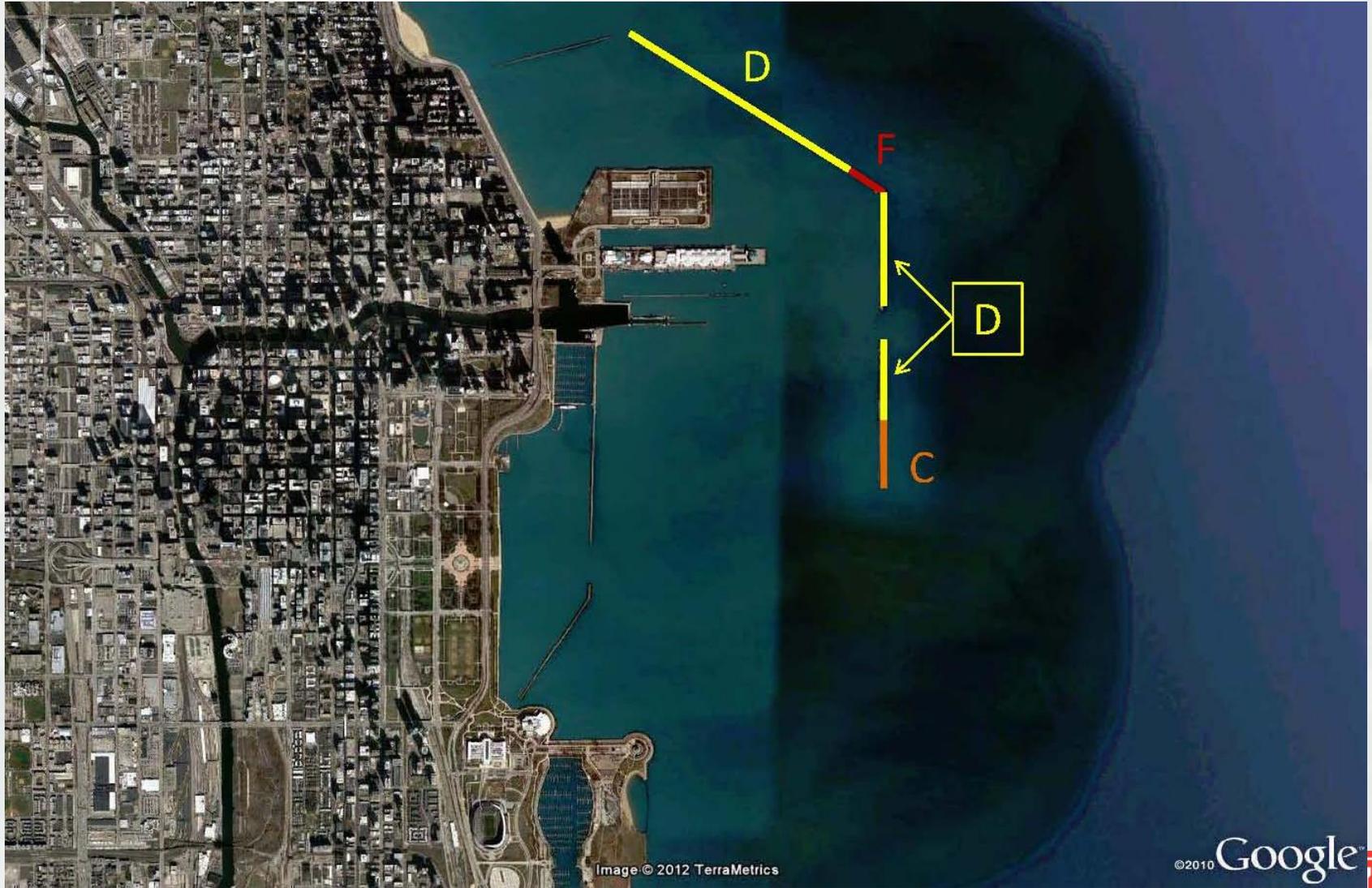
Calumet, IL



Imagery Source- NAIP 2010

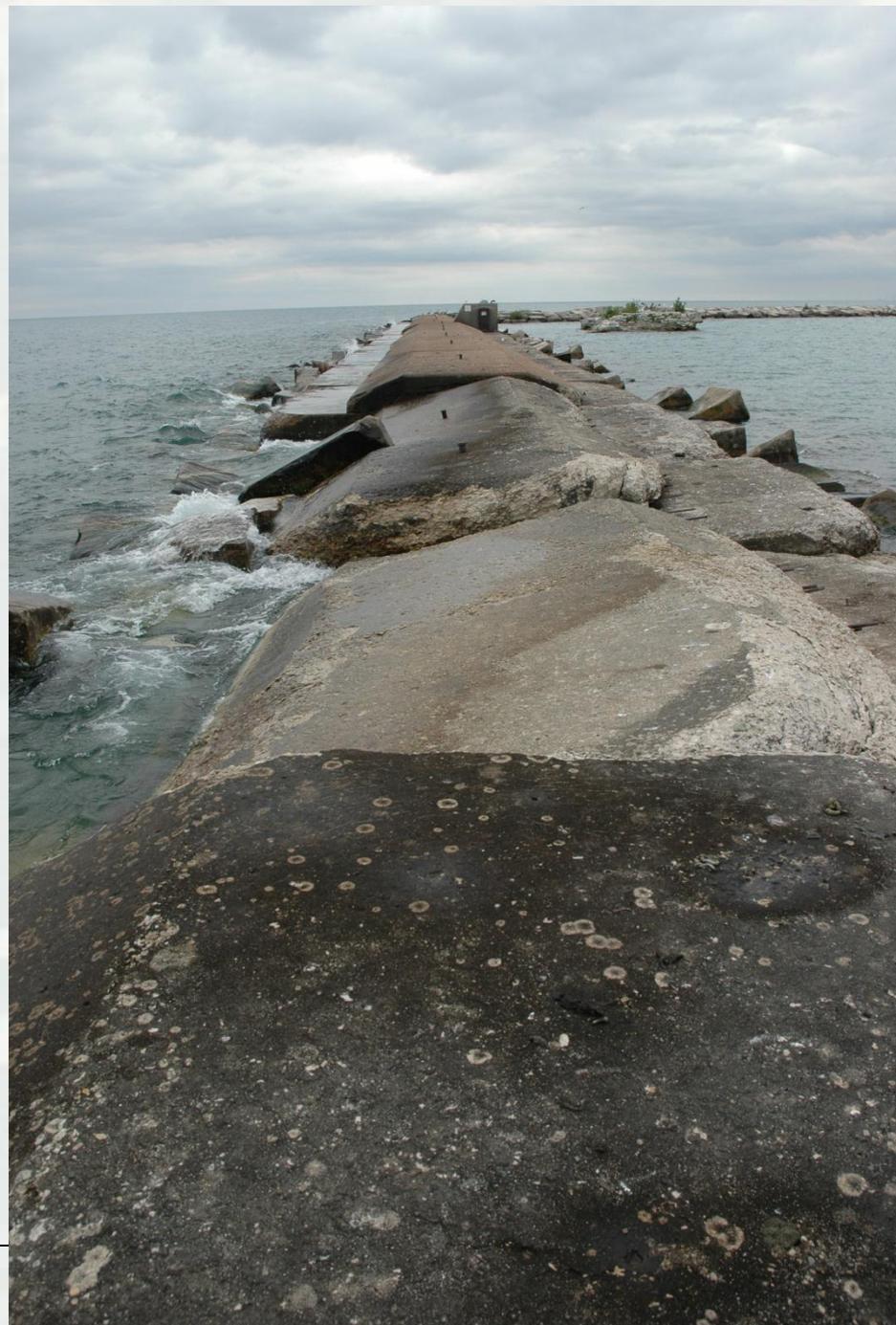


# Chicago Harbor: D – High Risk of Failure



# Chicago Harbor

Collapse of concrete superstructure  
along Exterior Breakwater



# Chicago Harbor



Complete loss of fill stone under concrete  
superstructure along the Exterior Breakwater

## Chicago Harbor

Extreme spalling and exposed rebar along the Exterior Breakwater



A photograph of the Chicago Harbor skyline. In the foreground, there is a large pile of dark, jagged rubble mounding against a concrete structure. The water is blue and rippled. In the background, several tall skyscrapers are visible under a clear blue sky. A small structure with a green light on top is situated on the right side of the rubble mound.

## Chicago Harbor

Rubble mounding of failed section of concrete superstructure along Exterior Breakwater

## Spalling along Exterior Breakwater



## Chicago Harbor

Rubble mounding of failed section of concrete superstructure  
along Exterior Breakwater

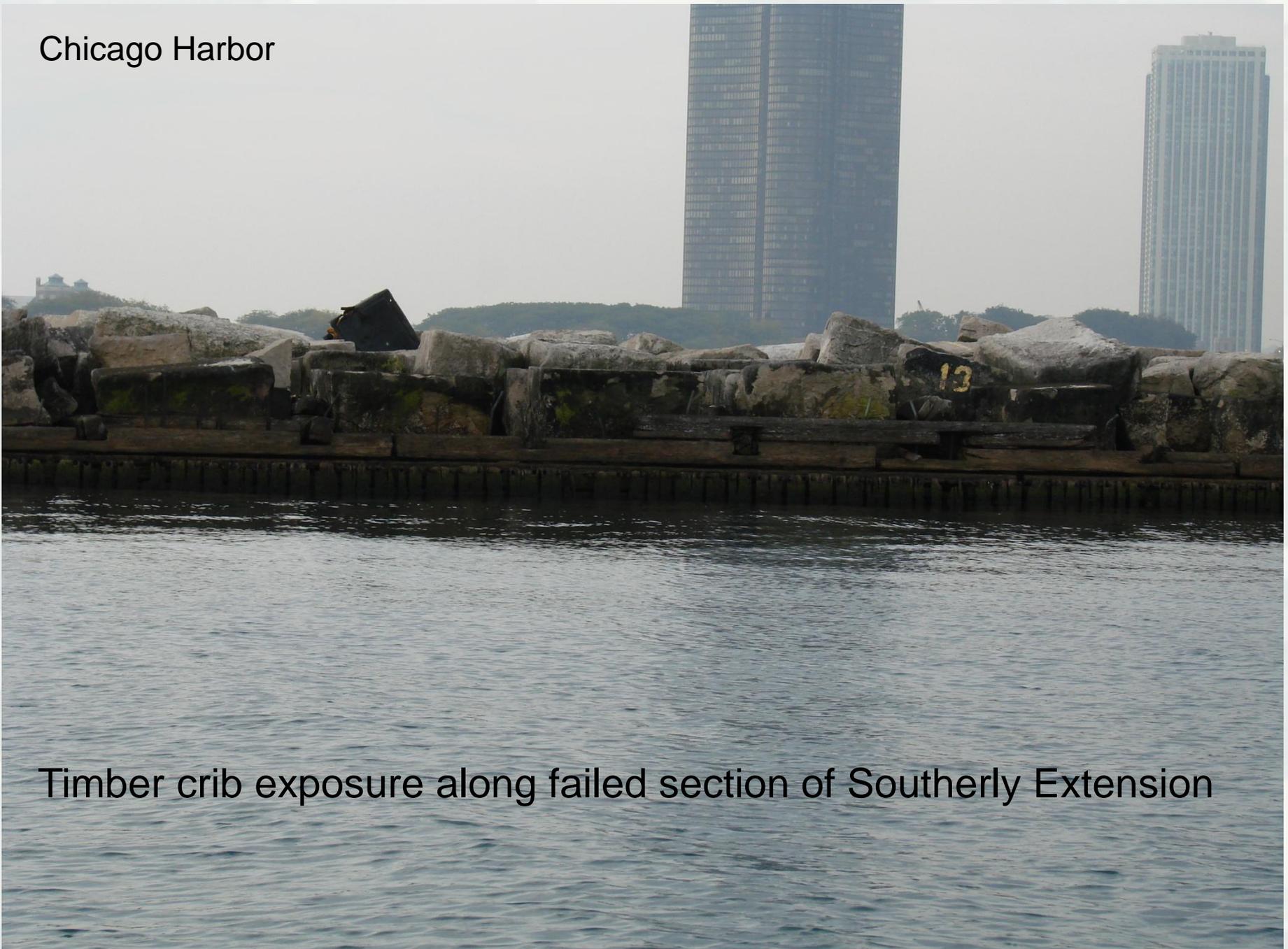


# Chicago Harbor

Significant timber crib exposure  
along the Southerly Extension



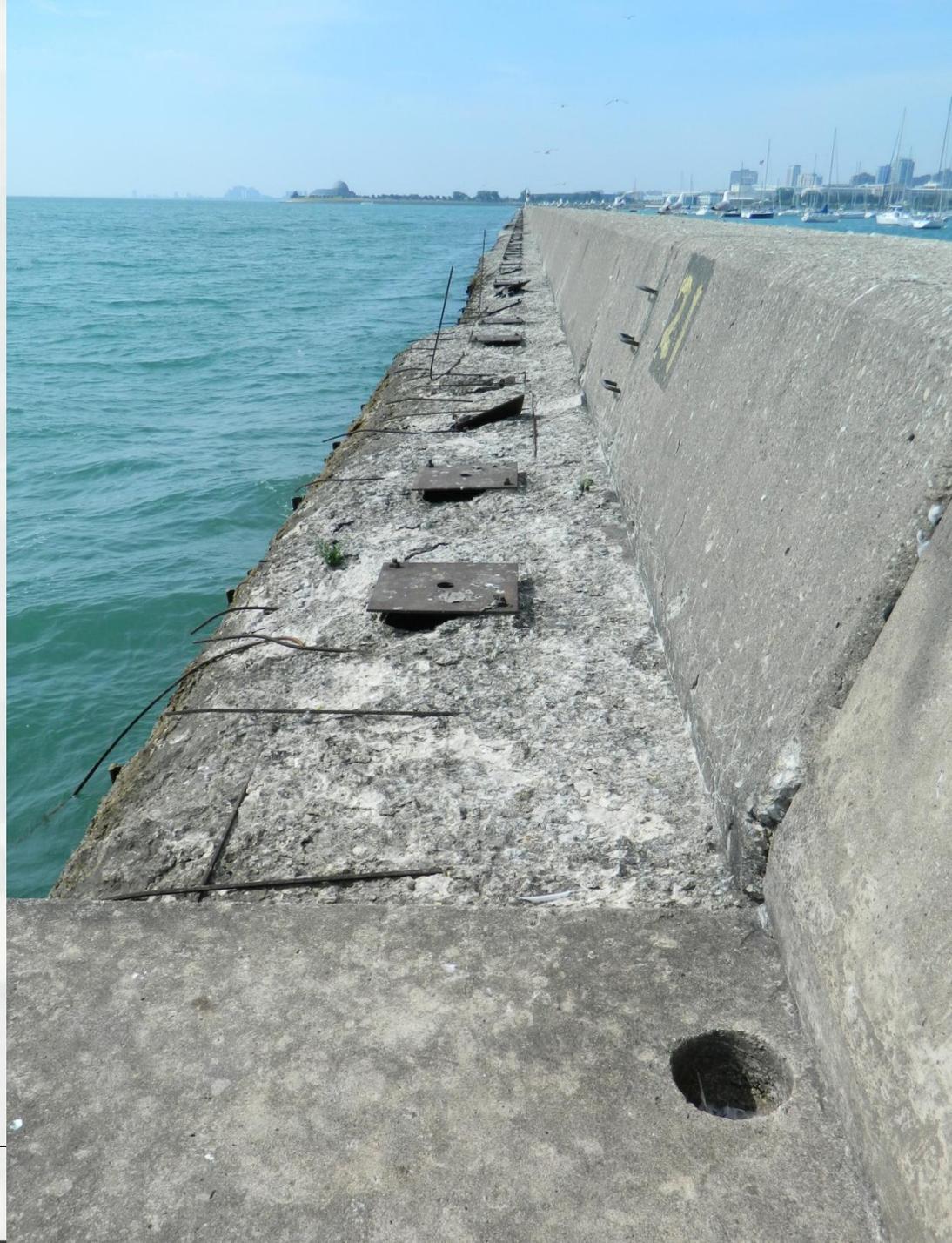
# Chicago Harbor



Timber crib exposure along failed section of Southerly Extension

# Chicago Harbor

Extreme spalling and considerable exposure of rebar along Inner Breakwater



# Chicago Harbor:

Overall rating of 'D', Portion of Exterior Breakwater rated 'F'  
\$26.3M estimated cost to upgrade D rated structures to an acceptable level of risk (Level B)

## Infrastructure:

1. James W. Jardine Water Purification Plant
2. Chicago Harbor Lock Control House
3. Chicago Marine Safety Station
4. Gateway Park and Fountain
5. Milton Lee Olive Park
6. Lake Point Towers
7. DuSable Harbor
8. Columbia Yacht Club Clubship
9. Monroe Harbor
10. Ohio Street Beach
11. 990 North Lake Shore Drive
12. 900-910 North Lake Shore Drive
13. 860-880 North Lake Shore Drive



Image © 2012 TerraMetrics

# Chicago Harbor:

Overall rating of 'D', Portion of Exterior Breakwater rated 'F'

\$26.3M estimated cost to upgrade D rated structures to an acceptable level of risk (Level B)

## Infrastructure:

- 14. 840 North Lake Shore Drive
- 15. North Lake Shore Drive
- 16. Lake Shore Park
- 17. Northwestern University – School of Law
- 18. Northwestern University – Abbott Hall
- 19. 680 North Lake Shore Drive
- 20. The W Hotel Chicago - Lakeshore
- 21. 600 North Lake Shore Drive
- 22. 540 North Lake Shore Drive
- 23. 530 North Lake Shore Drive
- 24. North Pier Apartment Tower
- 25. The Parkshore
- 26. Harbor Point
- 27. Chicago Yacht Club
- 28. The Chandler
- 29. East Water Place Townhomes



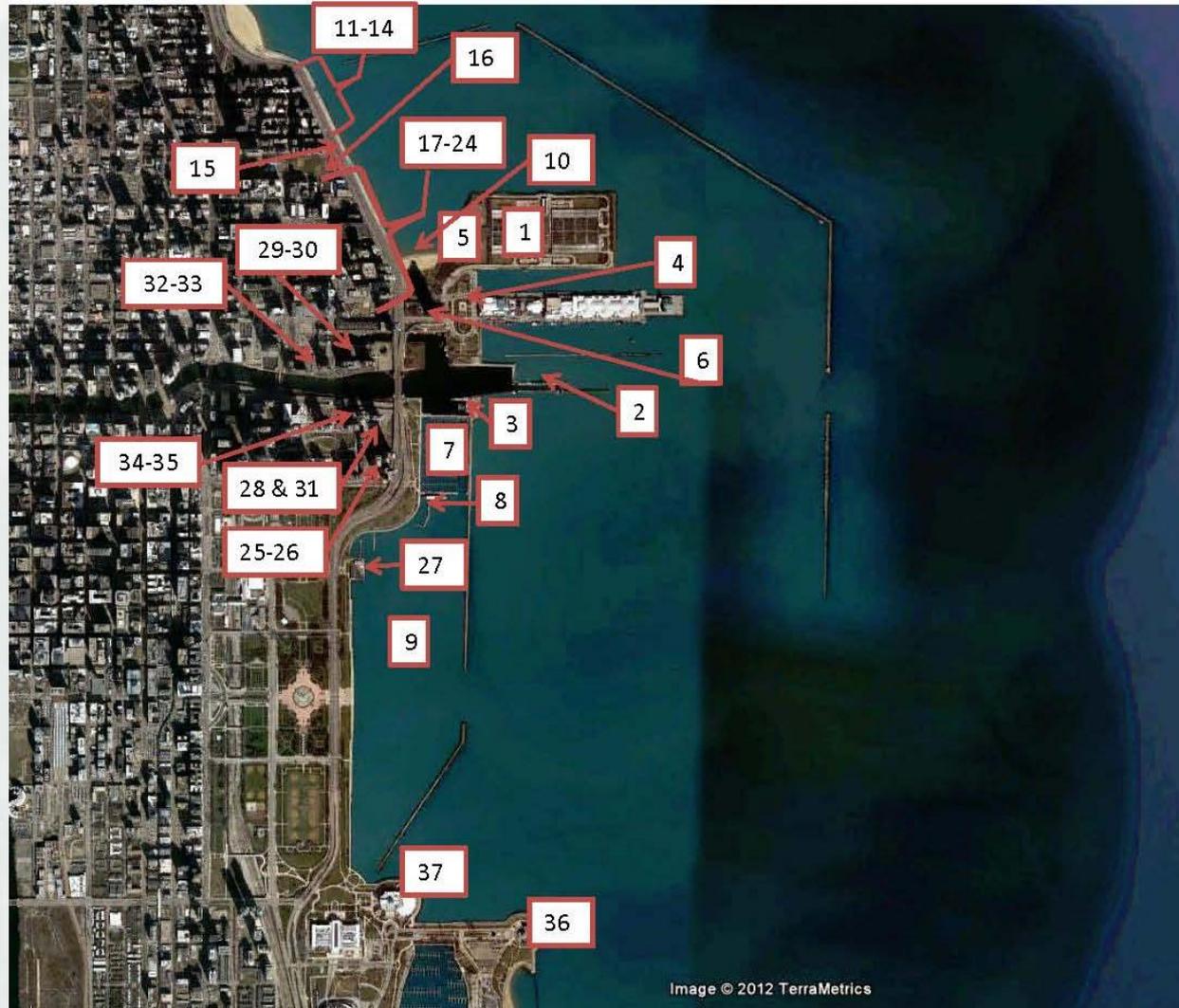
# Chicago Harbor:

Overall rating of 'D', Portion of Exterior Breakwater rated 'F'

\$26.3M estimated cost to upgrade D rated structures to an acceptable level of risk (Level B)

## Infrastructure:

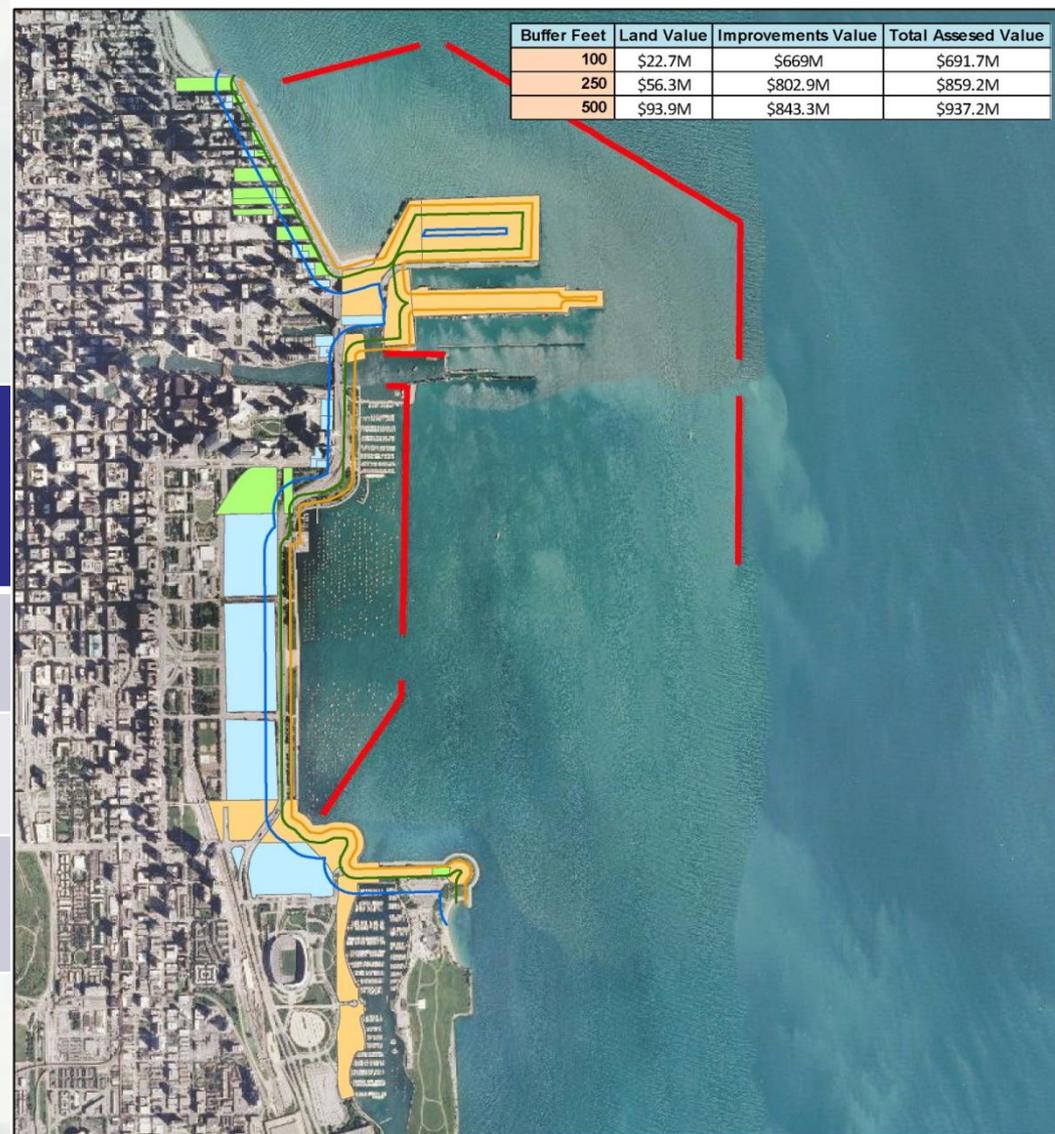
- 30. River View Condominiums
- 31. The Regatta
- 32. Cityfront Place
- 33. Sheraton Chicago Hotel & Towers
- 34. Swissotel Chicago
- 35. 303 East Wacker
- 36. Adler Planetarium & Astronomy Museum
- 37. John G. Shedd Aquarium



# Chicago Harbor:

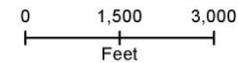
## Potential Impact Areas

Buffer Feet	Land Value	Improv. Value	Total Assessed Value
100	\$22.7M	\$669M	\$691.7M
250	\$56.3M	\$802.9M	\$859.2M
500	\$93.9M	\$843.3M	\$937.2M



- Federal Structure
- Shoreline\_100\_ft\_buffer
- Shoreline\_250\_ft\_buffer
- Shoreline\_500\_ft\_buffer
- Parcels\_100\_ft\_buffer
- Parcels\_250\_ft\_buffer
- Parcels\_500\_ft\_buffer

**CHICAGO HARBOR**  
Chicago, IL



Imagery Source- NAIP 2011



# What Can Be Done?

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- Federal Funding
  - ▶ Funding request through the Federal Budget process each fiscal year
    - Contract structural repair
    - Government floating plant repair
- Local Funding
  - ▶ Mechanisms in place to accept local funding
- Transfer to State/Local Entity
  - ▶ Section 216 Process



# Questions?

