ASSET INTEGRITY MANAGEMENT WITHIN THE COASTAL ZONE

PHMSA Public Meeting, November 17, 2017

TOPICS FOR DISCUSSION

- What is the “coastal zone”?
- Why are coastal and riverine processes so different?
- What data sources are available?
- How is Phillips 66 evaluating coastal threats?

WHAT IS THE COASTAL ZONE?

Defined by distinctive:

- Geology
- Topographic elevation
- Soils and subsidence
- Predicted sea level rise
- Potential for storm surge and waves
- Biology, botany, vegetation

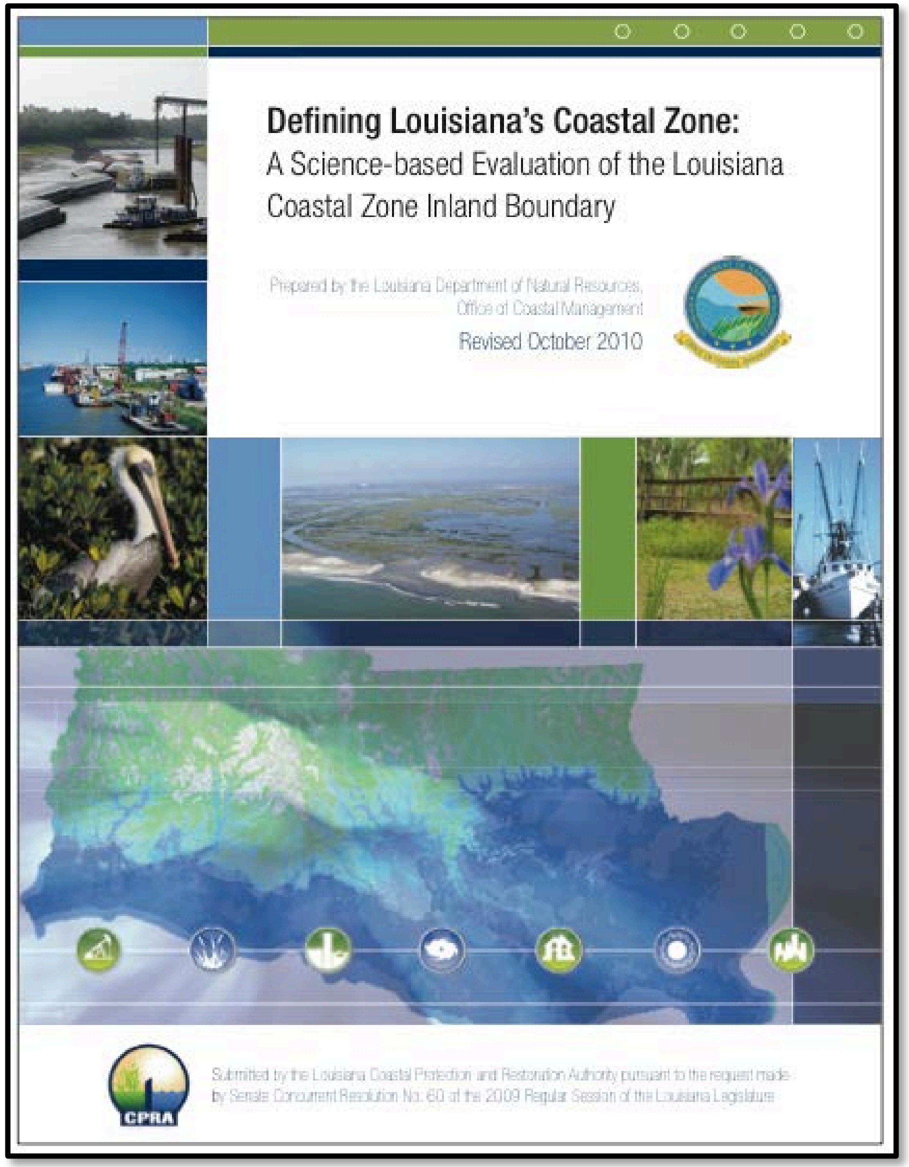
Thus, it has a specific set of *physical threats* and *environmental consequences*.

WHAT IS THE COASTAL ZONE?

The extent and importance of the coastal zone varies geographically across the U.S.

Some states have legislated their own regulatory definition; this may be used in the future to prescribe rules and guidance.

Example: Louisiana state legislature has passed HCR #143.



EXISTING AWARENESS WITHIN INDUSTRY

API guidance in RP 1133

Operators are inventorying and evaluating coastal assets

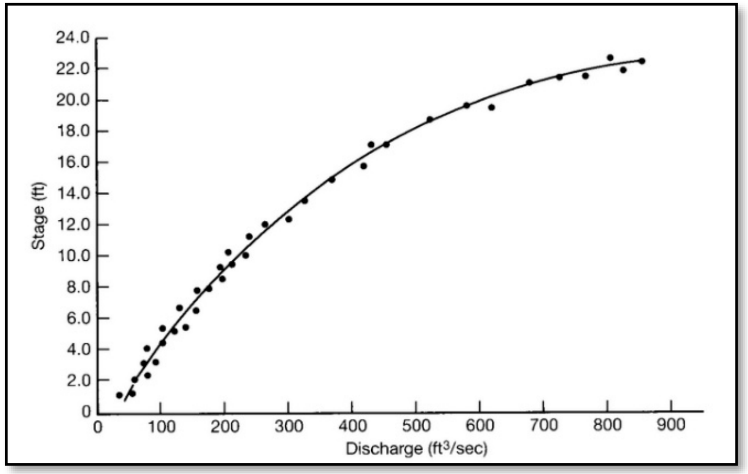
A methodical process can identify potential exposure and appropriate mitigation

Within the coastal zone, there may also be threats from inland riverine forces

RIVERINE VS COASTAL DYNAMICS

RIVERS

- Water crossing location well known
- Long history of data available
- Gravity driven flow downstream
- Well established physical explanation (S_o, R, P, n)
- Strong correlation between stage and velocity



Predictable

COASTAL

- Sparse data available
- Multiple flow directions
- Variability of storm parameters for single return period
- Water velocity and waves are highly sensitive to hurricane track and speed
- Poor correlation between water level to velocity
- While some pipelines are under bays and estuaries, others are on land; thus are not normally considered a water crossing
- Storms may scour “land” areas

Complicated

TIME SCALES OF COASTAL THREATS

Per API RP 1133 Guidance:

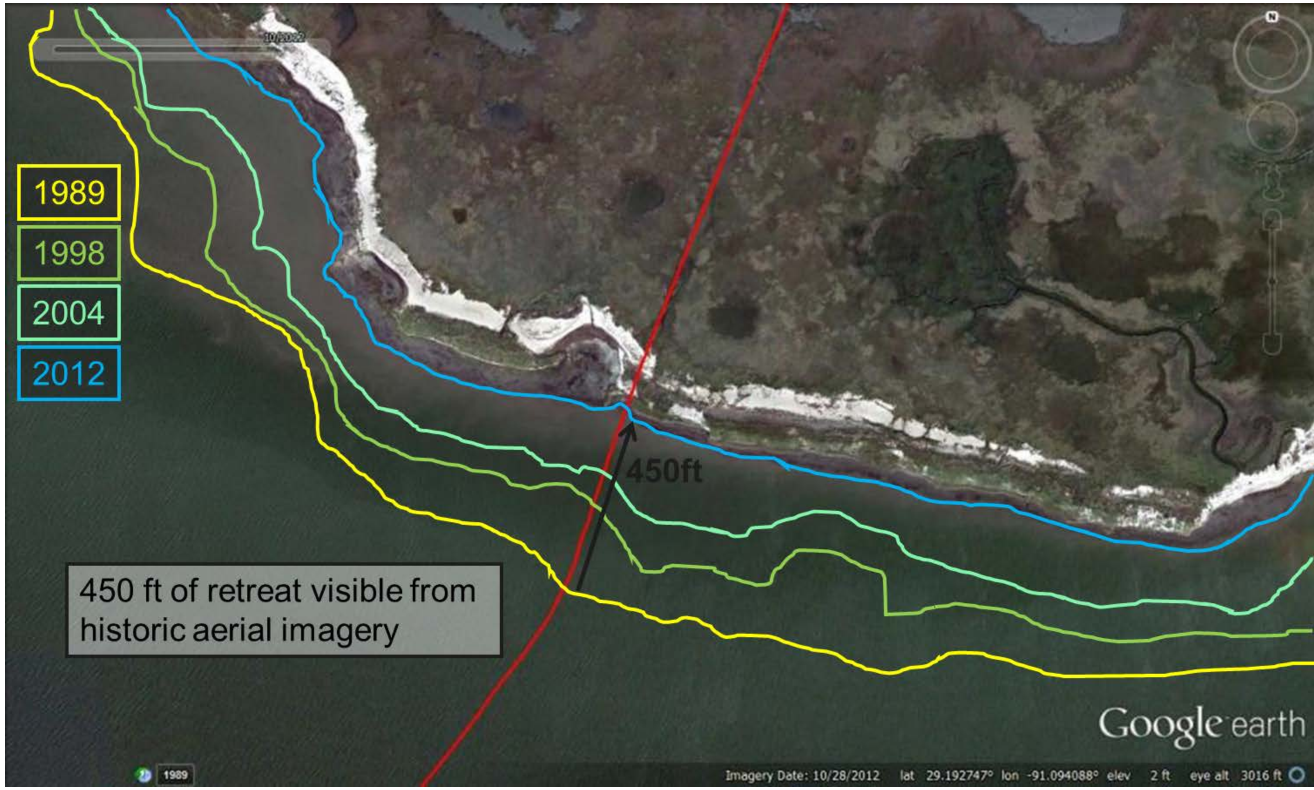
	Threat	Data
SHORT TERM		
Hurricane	Scour from surge / waves	Computer simulation
Third party activities	Dredging, coastal projects	Communications with local agencies + Damage Prevention
LONG TERM		
Site specific erosion	Erosion from tides	Field observations, historical trends
Coast wide retreat	Subsidence, SLR, vegetation changes	Geomorphic model

TIME SCALES OF COASTAL THREATS

SHORT TERM

Erosion beneath elevated coastal structure from single storm event (Hurricane Ike, Galveston, TX; 2008).

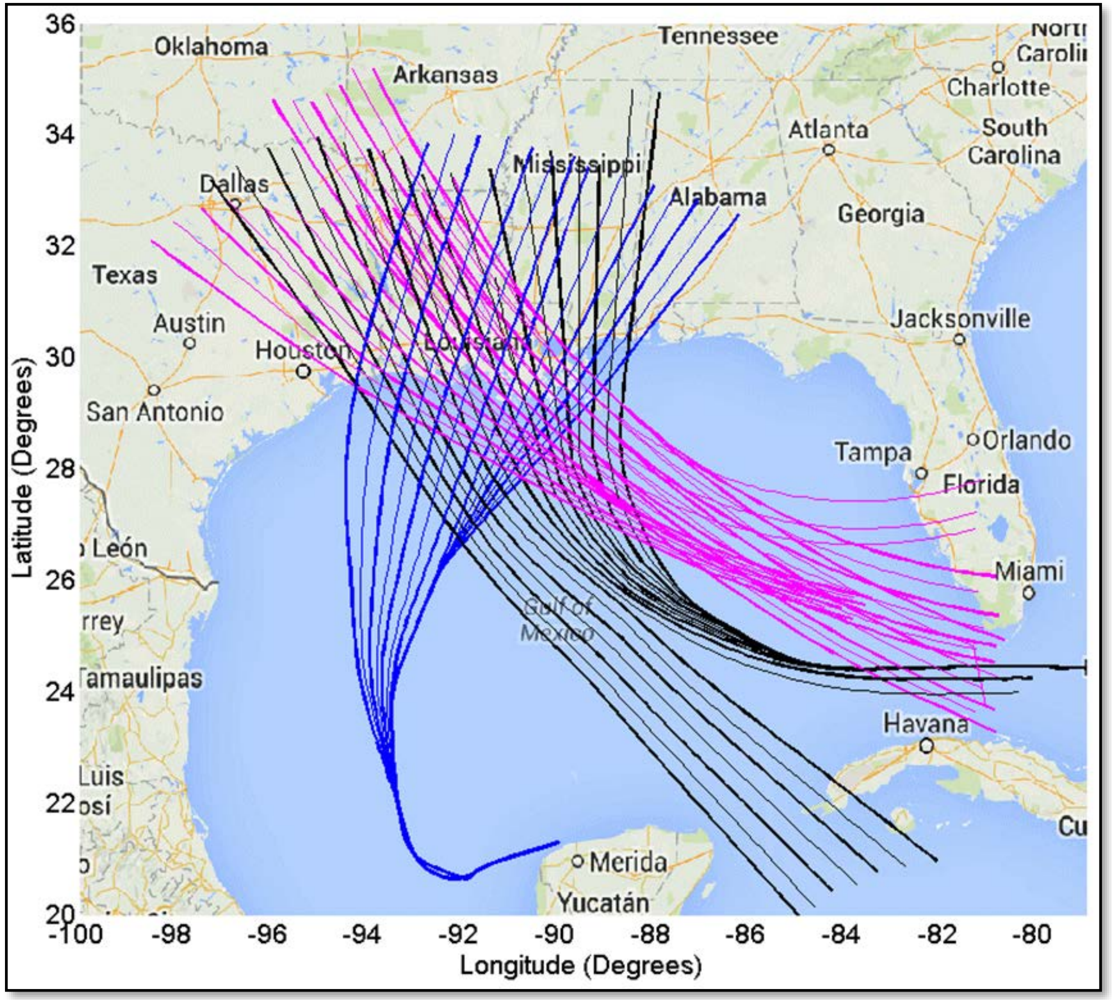
LONG TERM

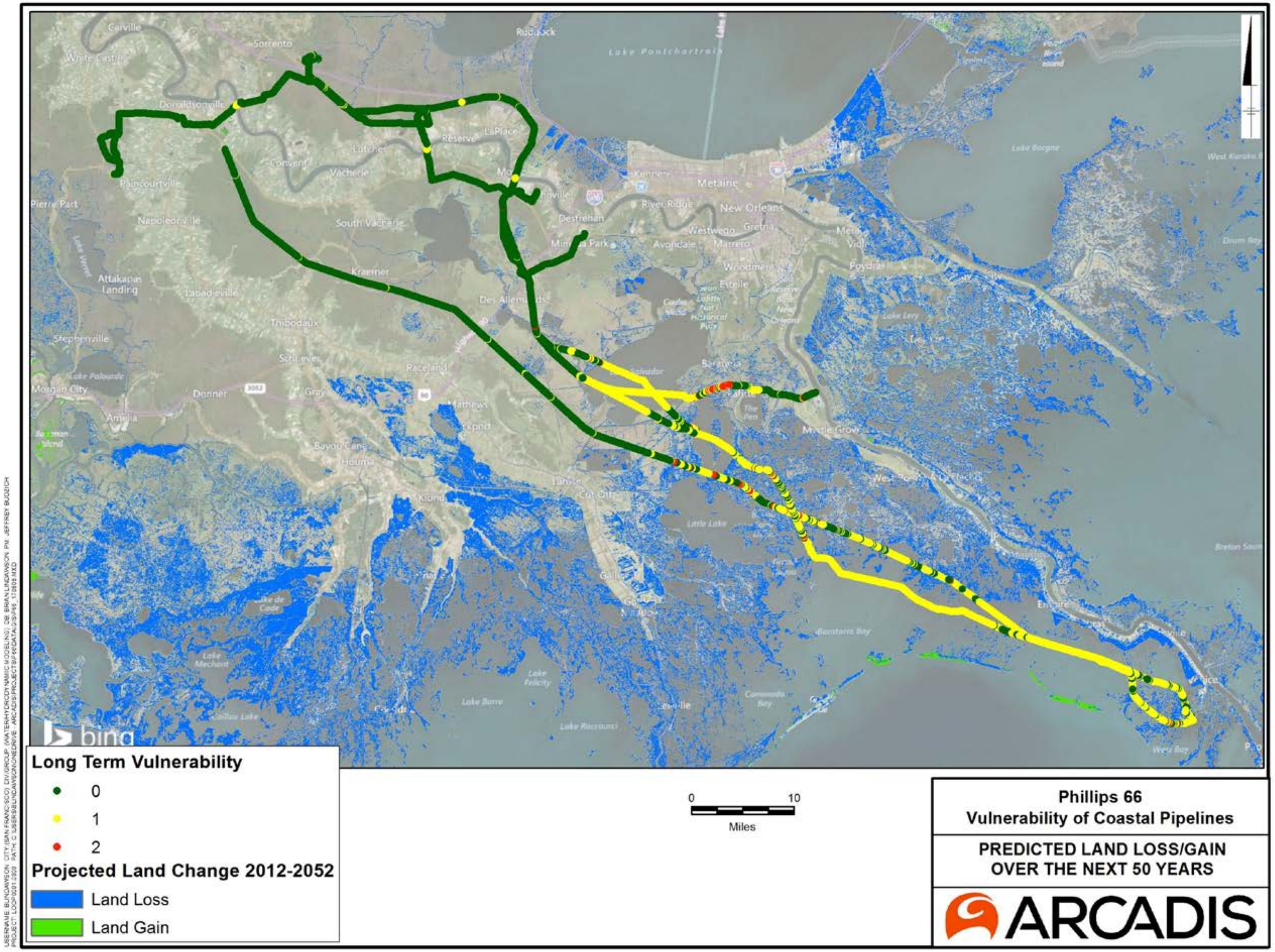


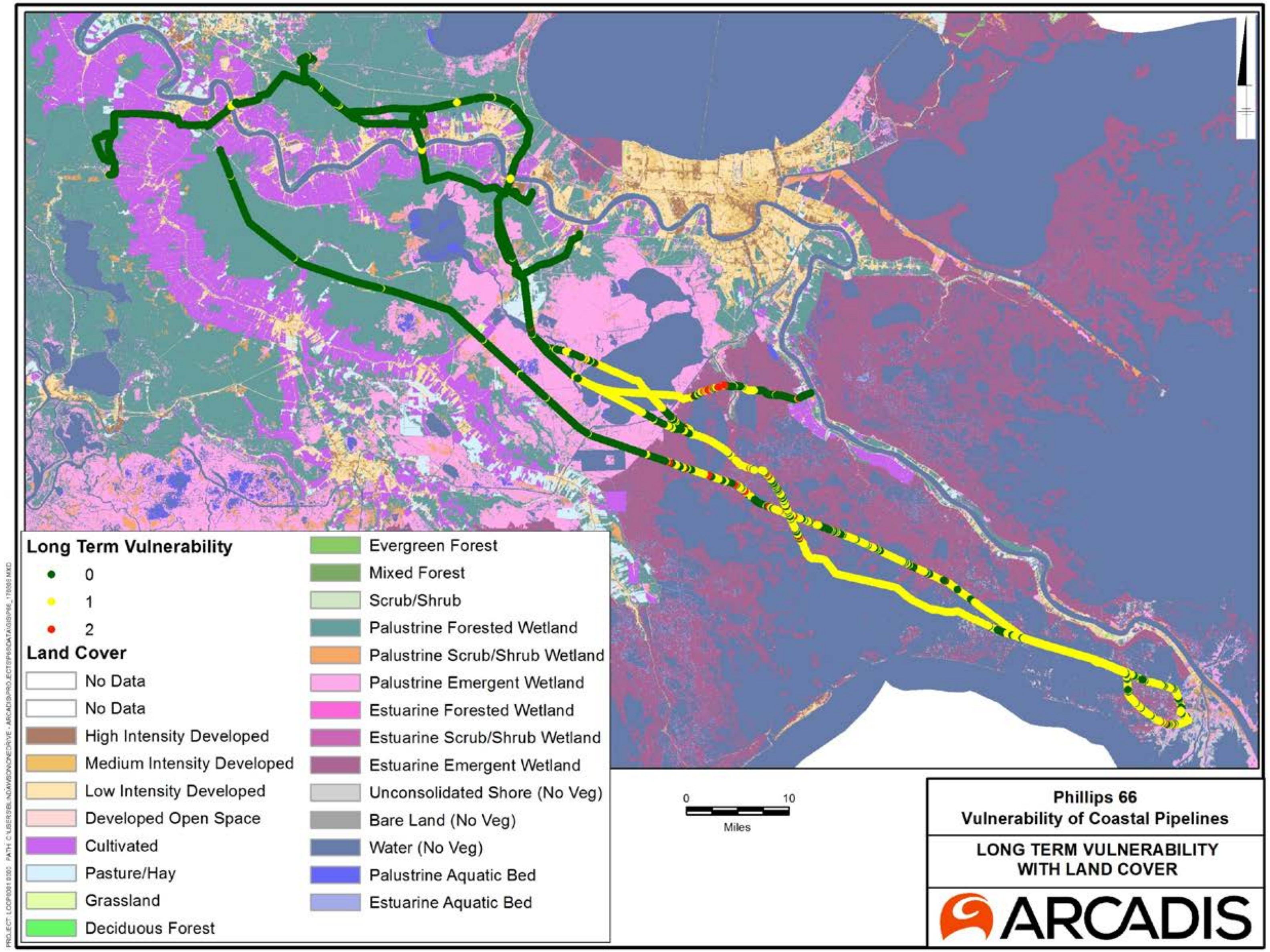
Coastal retreat occurring in Gulf of Mexico. Visible retreat of 450 ft over past 25 years (Louisiana).

COASTAL DATA SETS AVAILABLE

- Some historical data exists
- Make use of existing data layers
    - Land cover
    - Historical erosion
    - Geomorphic forecasts
    - Sediment data
    - Frequency of vessel traffic
    - Regionally specific HCA
- Supplement with simulations
    - Extent and magnitude of storm surge
    - Wave forces




Long Term Vulnerability
0
1
2
Projected Land Change 2012-2052
Land Loss
Land Gain
0
10
Miles
Phillips 66
Vulnerability of Coastal Pipelines
PREDICTED LAND LOSS/GAIN
OVER THE NEXT 50 YEARS
ARCADIS
bing


Long Term Vulnerability
0
1
2
Land Cover
No Data
No Data
High Intensity Developed
Medium Intensity Developed
Low Intensity Developed
Developed Open Space
Cultivated
Pasture/Hay
Grassland
Deciduous Forest
Evergreen Forest
Mixed Forest
Scrub/Shrub
Palustrine Forested Wetland
Palustrine Scrub/Shrub Wetland
Palustrine Emergent Wetland
Estuarine Forested Wetland
Estuarine Scrub/Shrub Wetland
Estuarine Emergent Wetland
Unconsolidated Shore (No Veg)
Bare Land (No Veg)
Water (No Veg)
Palustrine Aquatic Bed
Estuarine Aquatic Bed
0
10
Miles
Phillips 66
Vulnerability of Coastal Pipelines
LONG TERM VULNERABILITY
WITH LAND COVER
ARCADIS

SHIP WAKE

- Coastal regions often encounter large vessel traffic
- Transverse stern wake can be quite large
- Wake can be amplified from bathymetric gradients (at edge of shipping lane)
- Can cause continual erosion, over wash, and liquefaction of fine sediments
- Important contributor to long term vulnerability

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COASTAL ASSET INTEGRITY PROGRAM

SCREENING APPROACH

- Goal is not to predict “failure”, rather assess potential “vulnerability”

- Although there are multiple failure mechanisms:
  - Vortex Induced Vibrations (VIVs)
  - Wave induced oscillation
  - Third party impact
  - Ship wake
  - Debris
  - Unsupported span length
  - Other

If a pipeline remains buried, it is relatively protected and safe.

ARCADIS Design & Consultancy for natural and built assets

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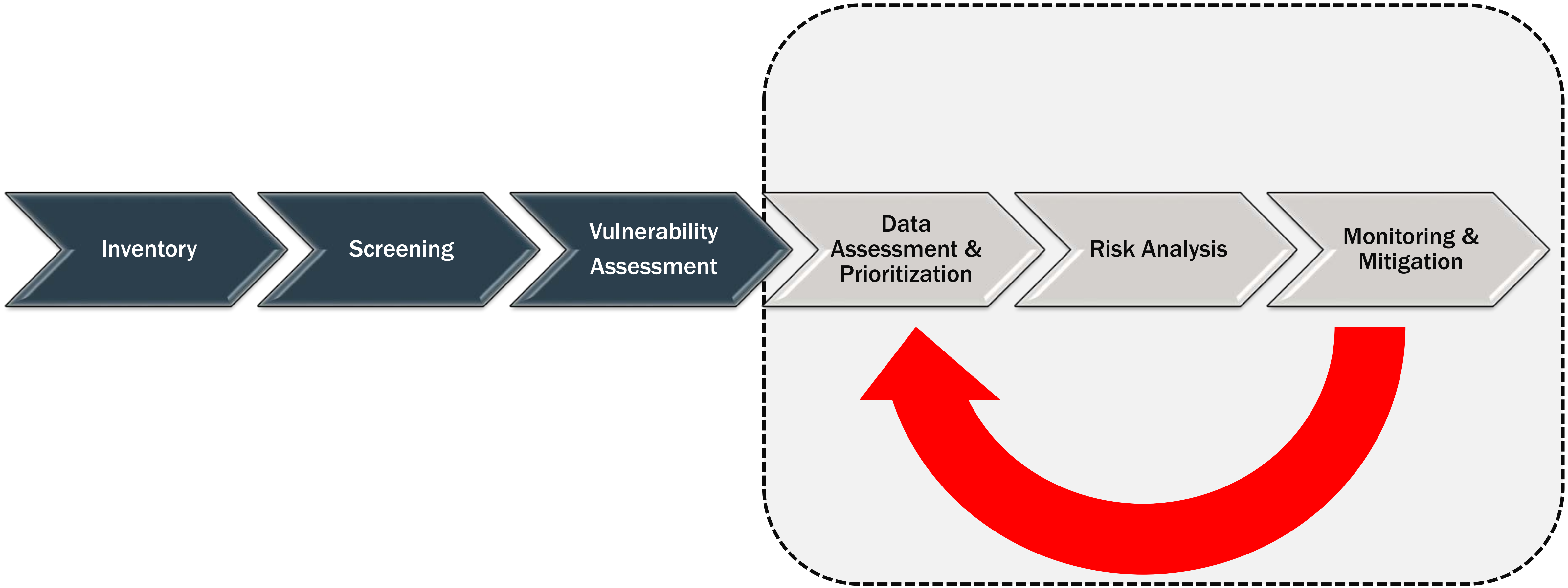
SCREENING APPROACH



Goal = Proactive instead of Reactive

SPATIAL IDENTIFICATION OF VULNERABILITIES

Example of Phillips 66 Coastal Pipeline Vulnerability Assessment

VULNERABILITY SCORECARD

- Partition pipeline network into 500 ft. segments
- Summarize contributions to vulnerability from
  - Scour (episodic threat)
  - Vegetation, land loss and ship wake (duration-based threat)
- Compute scour potential and compare to depth of cover.
- Identify areas prone to coastline erosion

Segment Data			Short Term Factors					Long Term Factors				
Segment ID	Depth of Cover	Survey Date	10 yr	50 yr	100 yr	Field Observation	Short Term Score	No Vegetation	Land Loss	Historical Incident Data	Known Exposure/Span	Long Term Score
1	3.5	11/1/2013	1	1	1	1	4	1	1	1	1	4
2	3.8	11/1/2013	0	1	1	1	3	0	1	1	1	3
3	4	11/1/2013	1	1	1	0	3	0	0	1	1	2
4	3	1/1/1900	0	0	1	1	2	0	0	0	1	1
5	3	1/1/1900	0	1	1	0	2	0	0	0	0	0
6	3	1/1/1900	0	0	0	1	1	0	0	0	0	0
7	3	1/1/1900	0	0	0	0	0	0	0	0	0	0

Example of Phillips 66 Coastal Pipeline Vulnerability Assessment

SUMMARY

- Proactive methodology to preemptively identify vulnerabilities.
- Generate a comprehensive baseline for long term coastal monitoring.
- Identify what mitigation actions to perform to minimize the most risk.
- Prioritize surveys and maintenance budget.
- Maintain records to preserve institutional knowledge despite employee turnover.
- Goal - Avoid exposures and shutdowns.

DAMAGE PREVENTION - MARINE VESSEL ENCROACHMENT PROGRAM

- Monitoring trajectories and current location of marine vessel traffic through PortVision.
  - Prevent vessels from being setup or idling over P66 lines
  - Collecting data for risk assessment and asset integrity
- AMIC (Asset Monitoring Integrity Center) of Oceaneering monitoring River Parish coastal assets.
  - Alerts are analyzed by maritime experts to determine risk posed to the pipeline
  - Maritime experts have the ability to contact the marine vessel to communicate awareness of pipeline presence.