

# CO<sub>2</sub> TRANSPORT AND DELIVERY: STATUS UPDATE ON OFFSHORE OIL AND GAS INFRASTRUCTURE RE-USE

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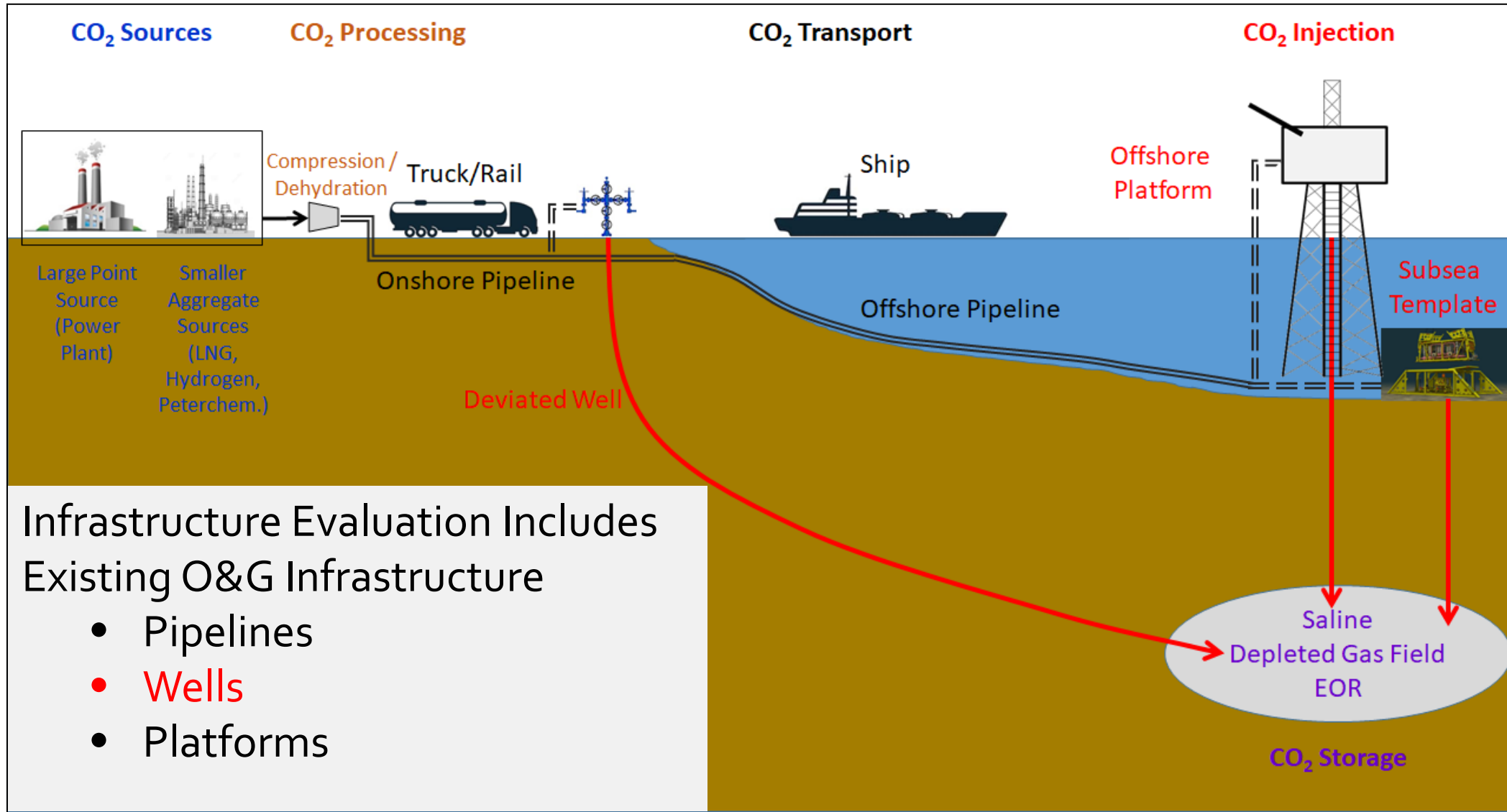
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# Task 5: Infrastructure, Operations, & Permitting

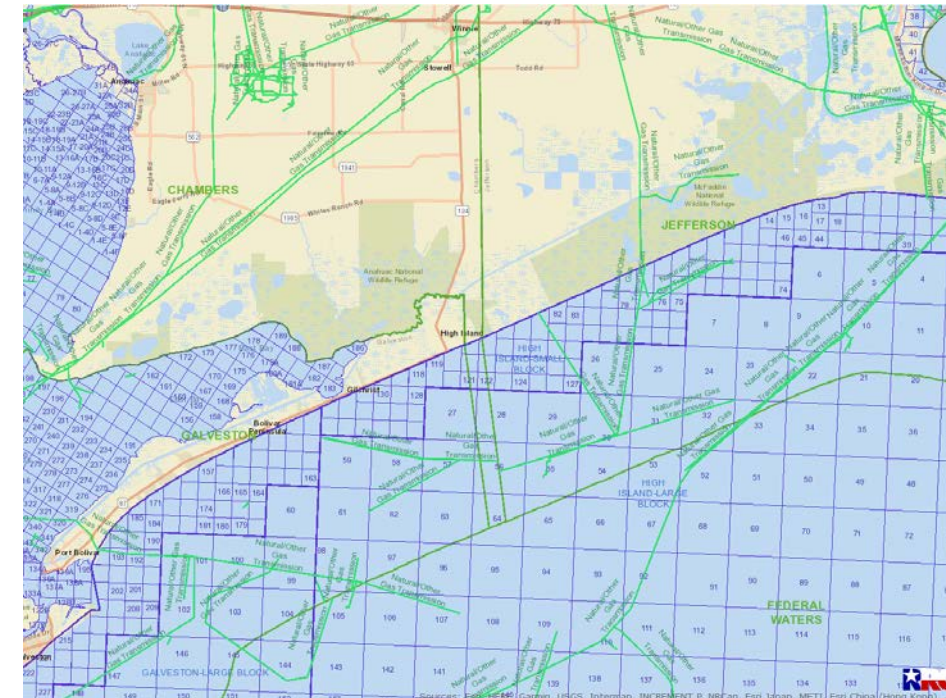


# Wells



# Scope & Status of Well Review

- Understand type & quality of data
- Develop process to assess/screen data
  - Wellbore status, completion date, well integrity reports
- Apply screening criteria to analog sites
  - HI-10L and HI-24L
- Developed well re-use evaluation “memo”



# Data Sources

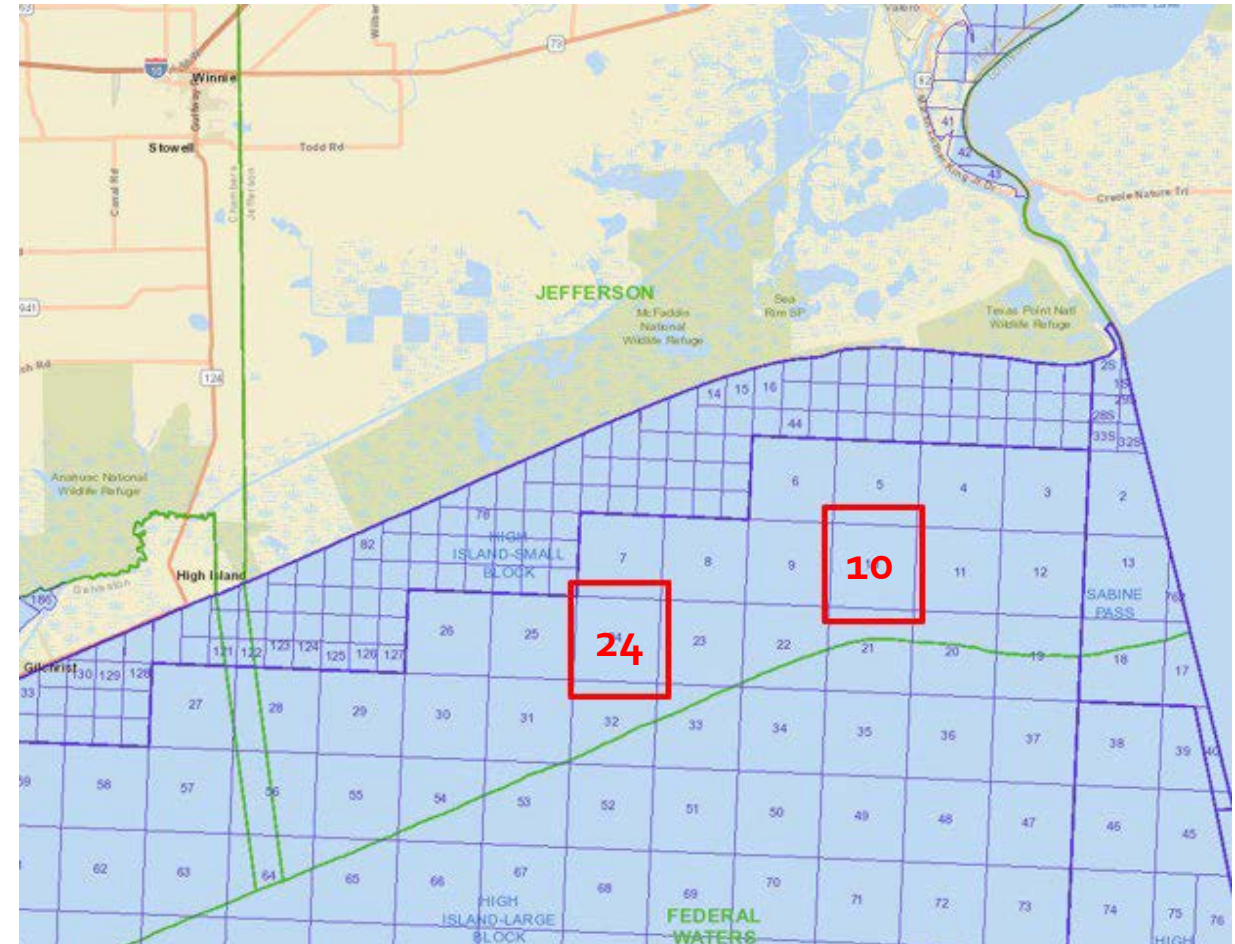
## Texas Railroad Commission (Public)

- GIS map of O&G assets
- Oil and Gas Records Query
- Wells tracked by API number
  - API = 10 digit number

## Subscription Databases (via UT BEG)

- IHS Enerdeq: Summary info. per well
- IHS Petra: State and federal waters
- Lexco OWL7: specific to GoM federal waters; source of info = BOEM, BSEE
- Wells tracked by UWI number
  - UWI = 14 digits; allows for tracking of individual wellbore for a single surface location
- Includes access to well integrity reports

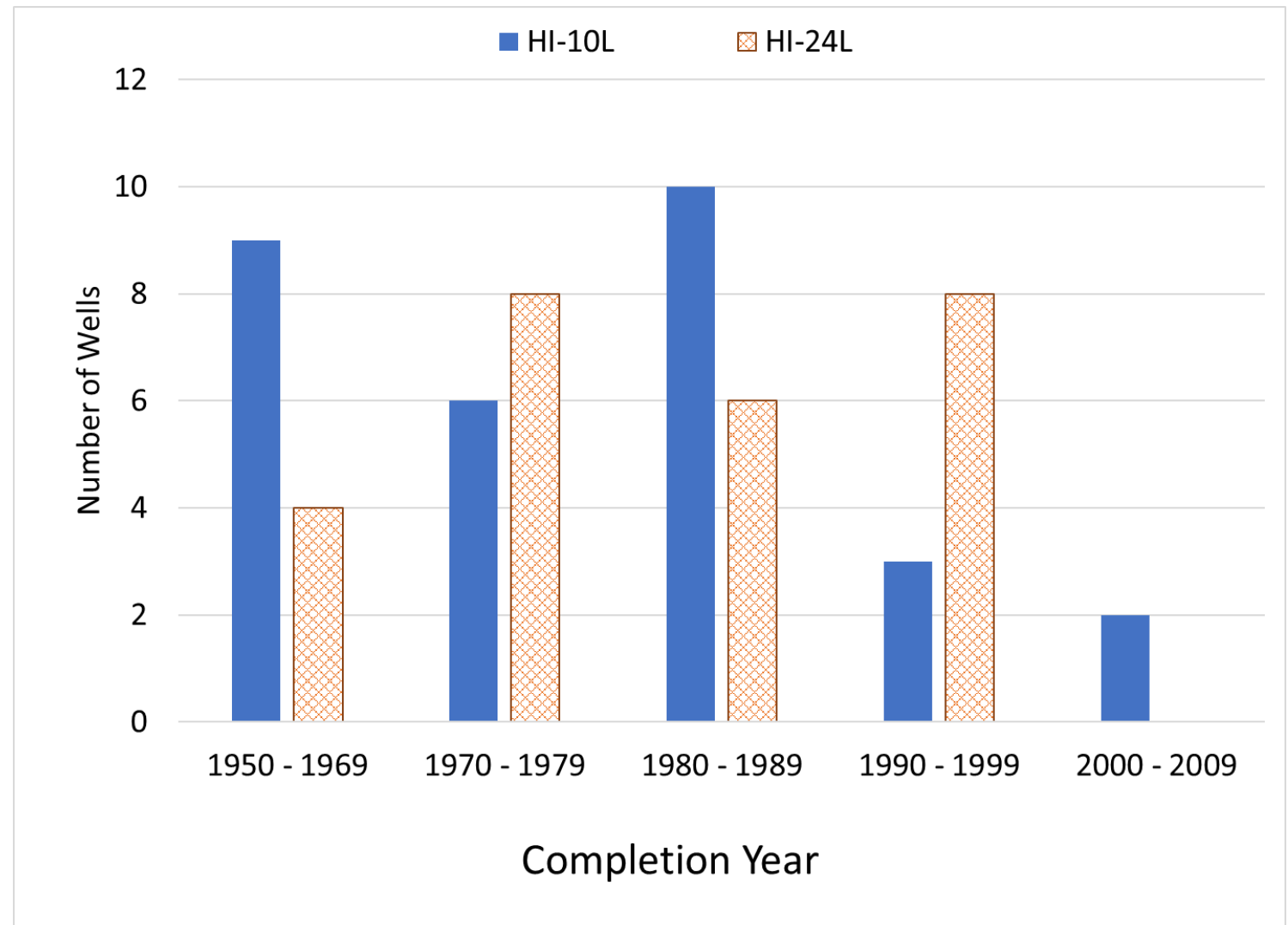
# Regions of Review: HI-10L & HI-24L





# Wells – Age Distribution

- All wells > 20 years old
- < 1970 = “Old” well-construction methods
- Age distribution in these blocks loosely matches broader O&G infrastructure trends





# Wells – Wellbore Status

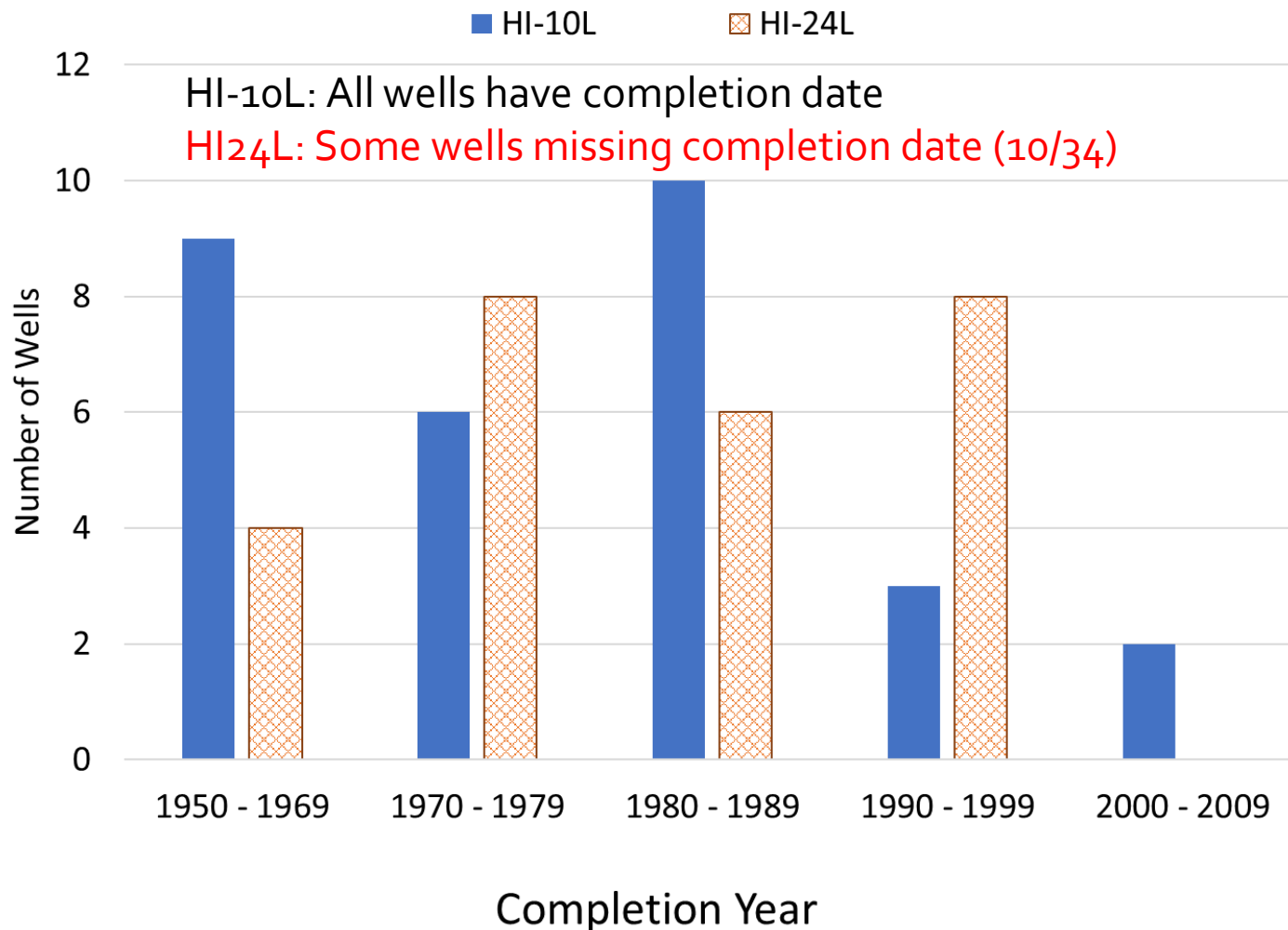
- TX RRC Terminology:
  - Active
  - Plugged
  - Inactive wells – unplugged well with no activity for > 12 months
    - Compliant/Non-compliant: w/ Section 14(b)(2) extension deadline for plugging
    - Orphaned: inactive > 12 mo & operator's organization report delinquent > 12 mo

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- TX RRC Terminology:
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    - Compliant/Non-compliant: w/ Section 14(b)(2) extension deadline for plugging
    - Orphaned: inactive > 12 mo & operator's organization report delinquent > 12 mo
- Beware loose & inexact terminology
  - “Abandoned”:
    - RRC: Purposefully plugged and abandoned
    - Colloquially: May refer to non-compliant well that has not been properly plugged
  - “Dry hole” (non-producing well):
    - RRC: Also indicates plugged
    - Colloquially: No association with plugging status

# Wells – Wellbore Status

	HI-10L	HI-24L
<b>Number of UWIs/APIs</b>	34	39
<b>Wellbore status</b>		
<b>Plugged</b>	<b>29</b>	<b>16</b>
Permitted/ Cancelled	4	3
Unknown Status	1	2
<b>Active: Producing</b>	<b>0</b>	<b>1</b>
Inactive: Temp Abandoned	0	1
<b>Inactive: Orphan</b>	<b>0</b>	<b>16</b>

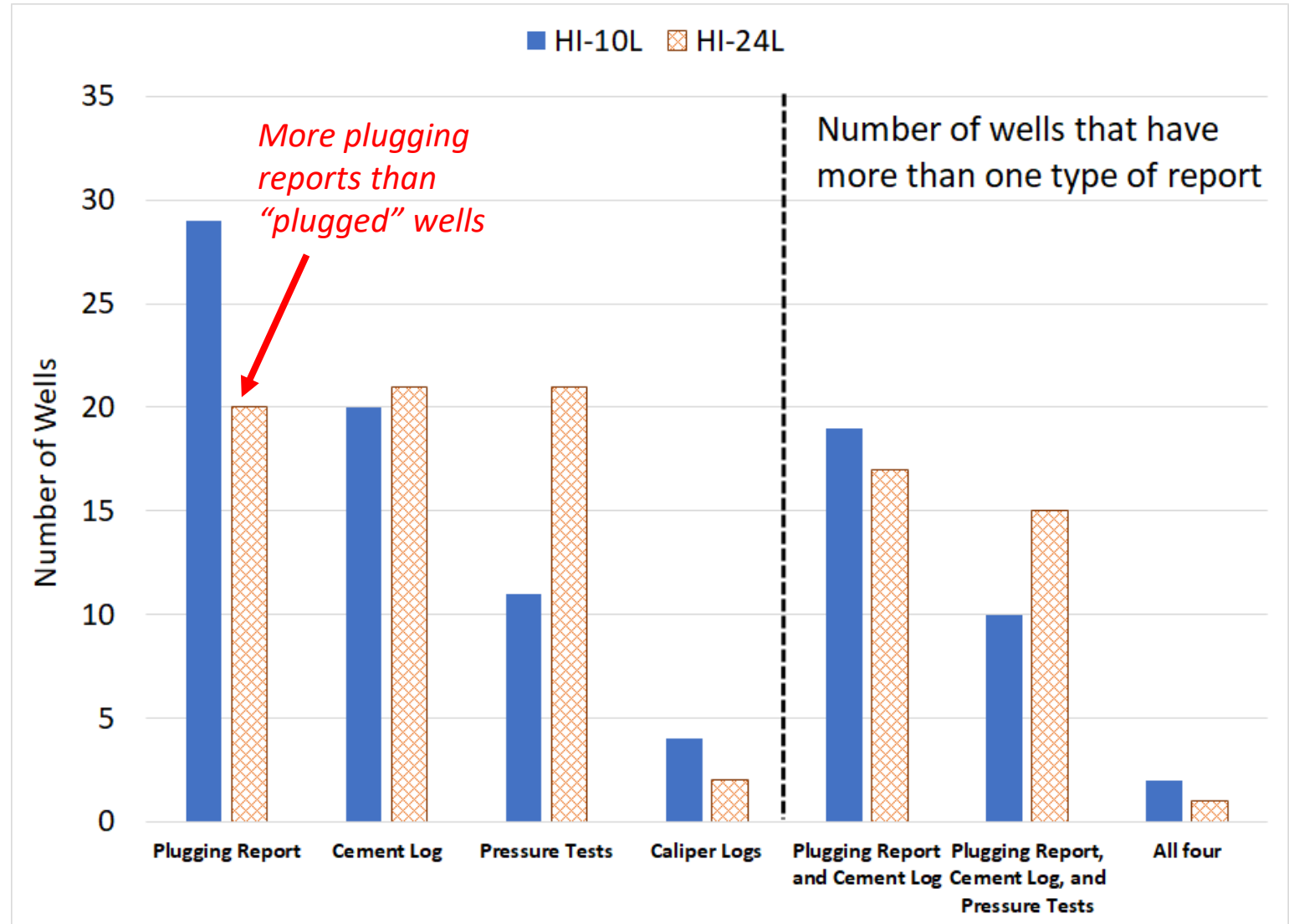






# Wells – Integrity Reports

- Critical reports for assessing well condition
- Only 3 wells have all 4 reports

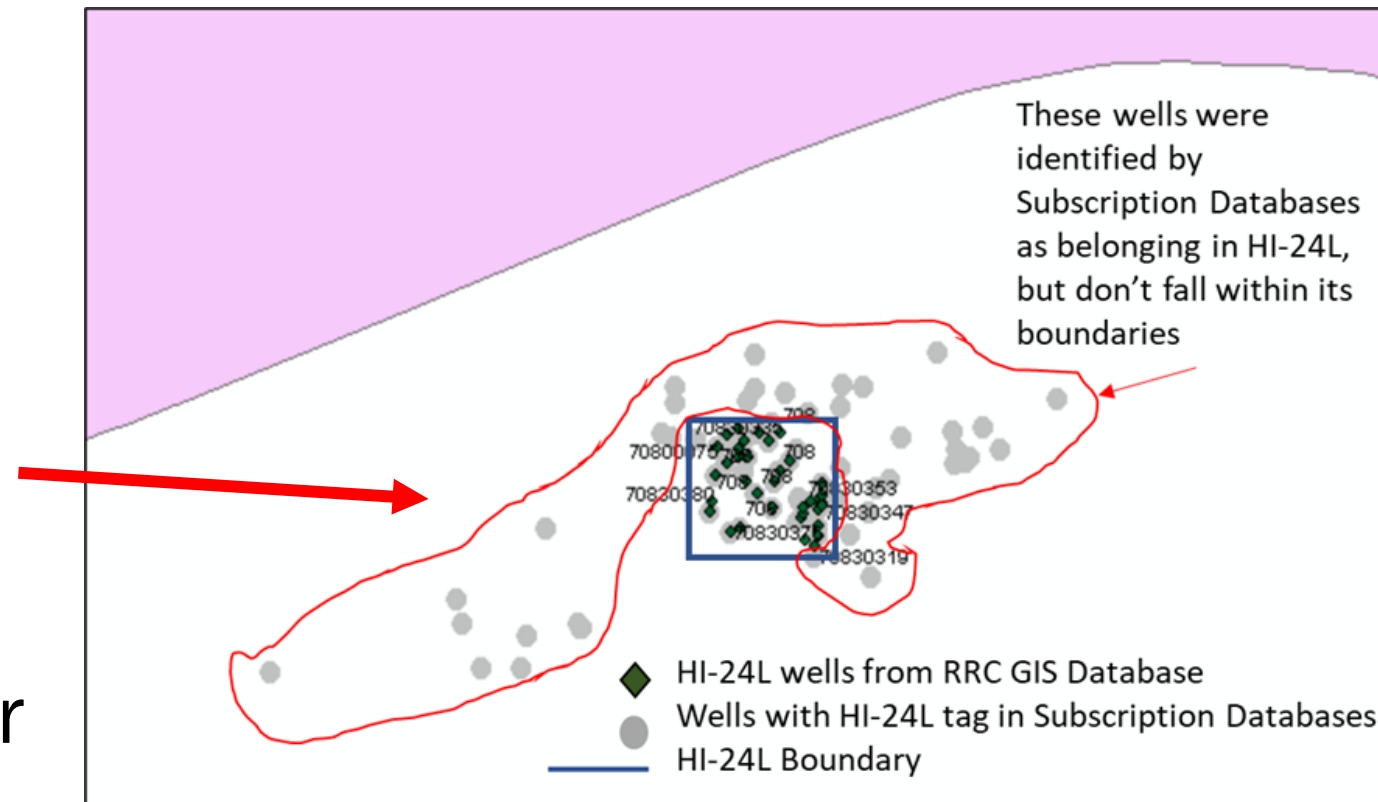


# Analog Site Summary

- Re-use opportunity or risk for leakage?
  - Wells in HI-10L and HI-24L are > 20 years old
  - Orphaned wells can be substantial (~40% of wells in HI-24L)
  - Of 73 wells in this analysis, only 3 wells had all 4 key reports (plugging, cement logs, pressure tests, caliper logs)
- Publicly available well records are incomplete & inconsistent
  - Non-trivial effort to assess wells beyond a cursory level
  - Project developer will need access to owner's records

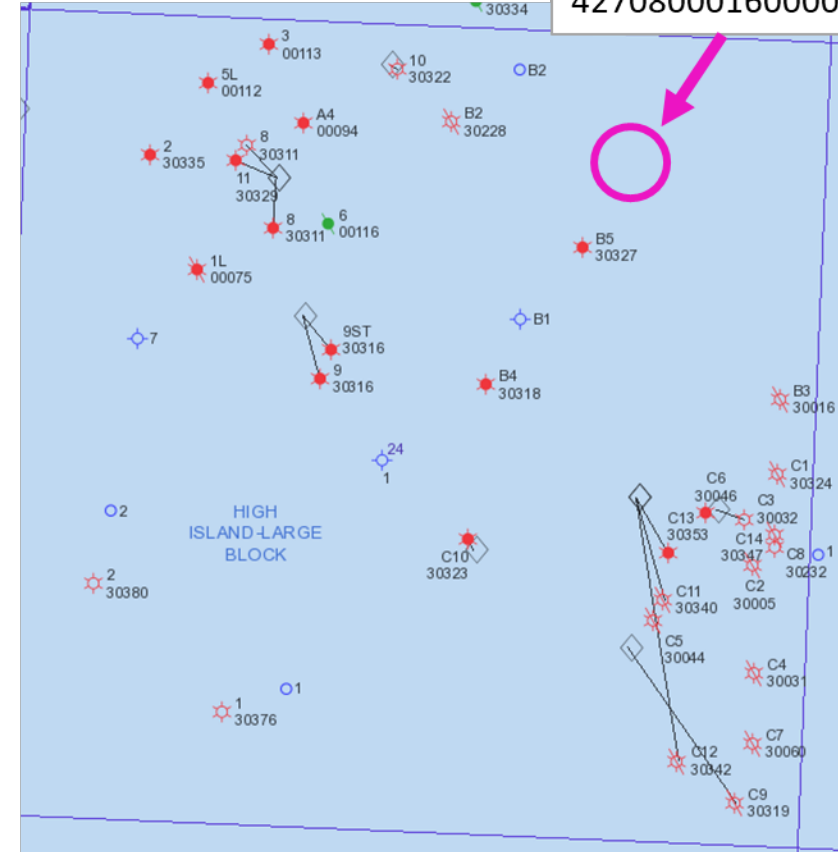
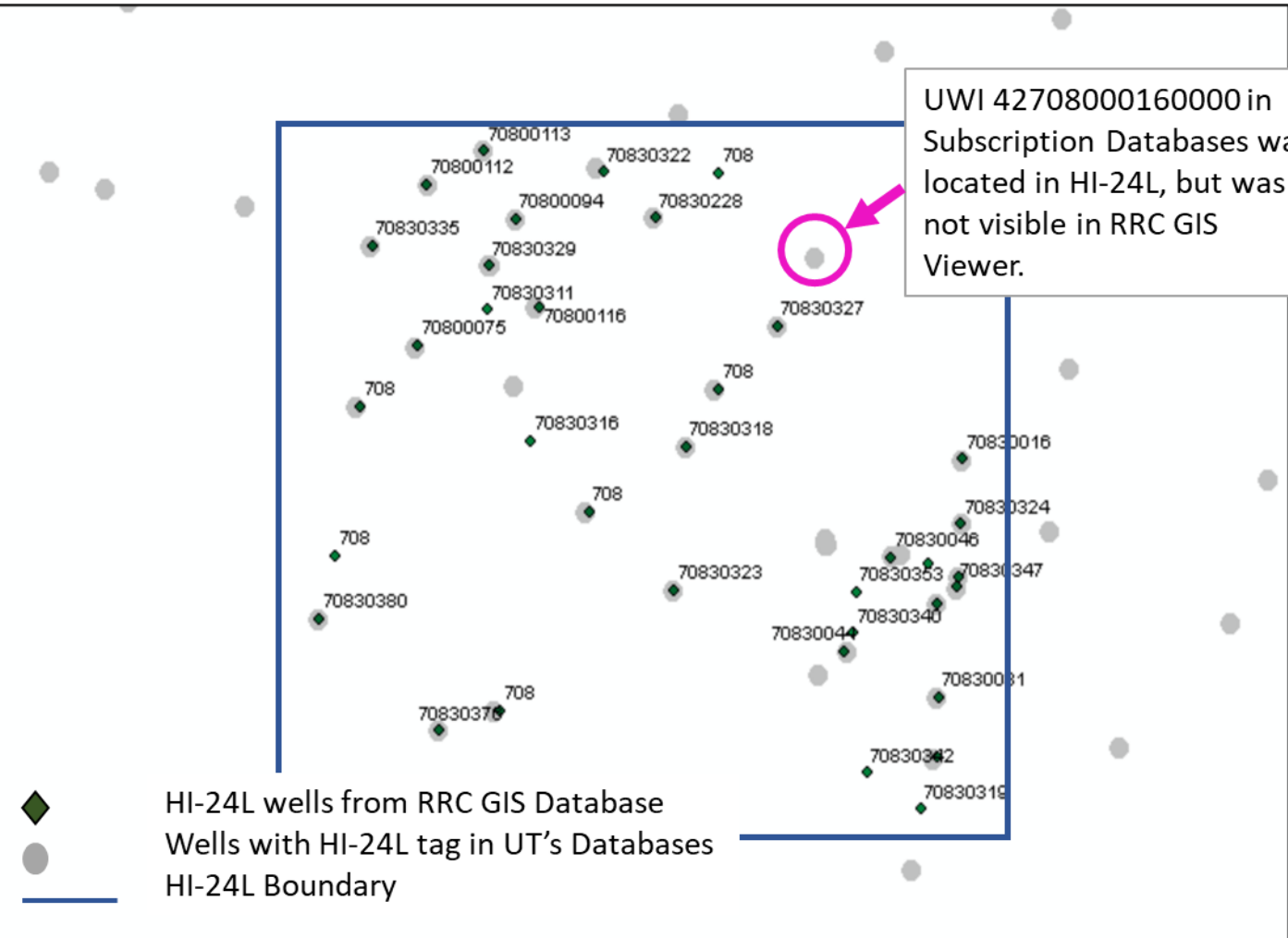
# Data Challenges – Inconsistency b/t Sources

- Well numbering systems are different (API vs. UWI)
- Old wells in RRC do not have a full API number
- Subscription database tags wells not physically located in leasing block
- Some Subscription database wells are not in RRC GIS Viewer search (next slide)



# Data Challenges – Inconsistency b/t Sources

GIS Viewer does not indicate any features in vicinity of UWI 42708000160000

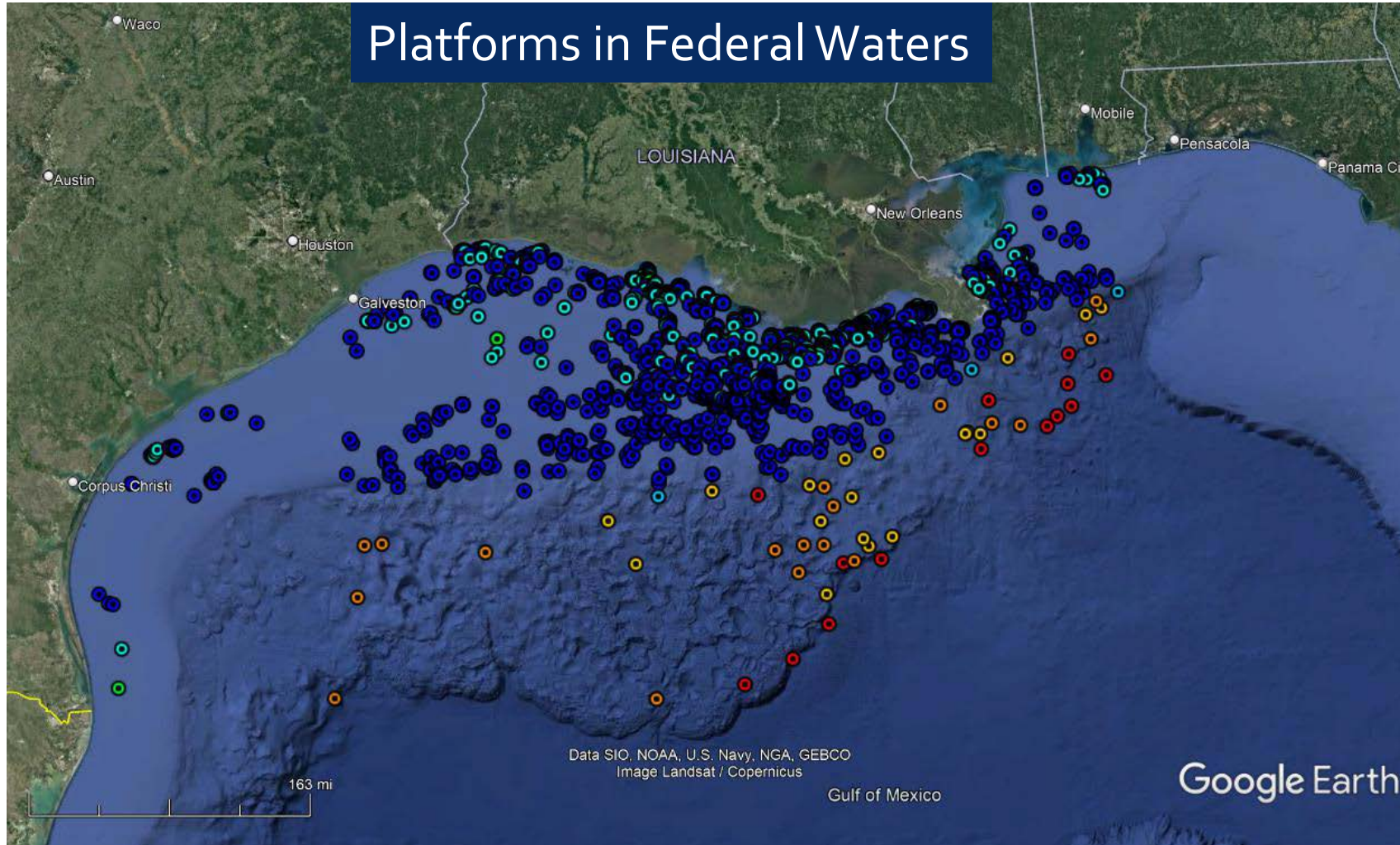




# Synergy with Other DOE/Federal Efforts

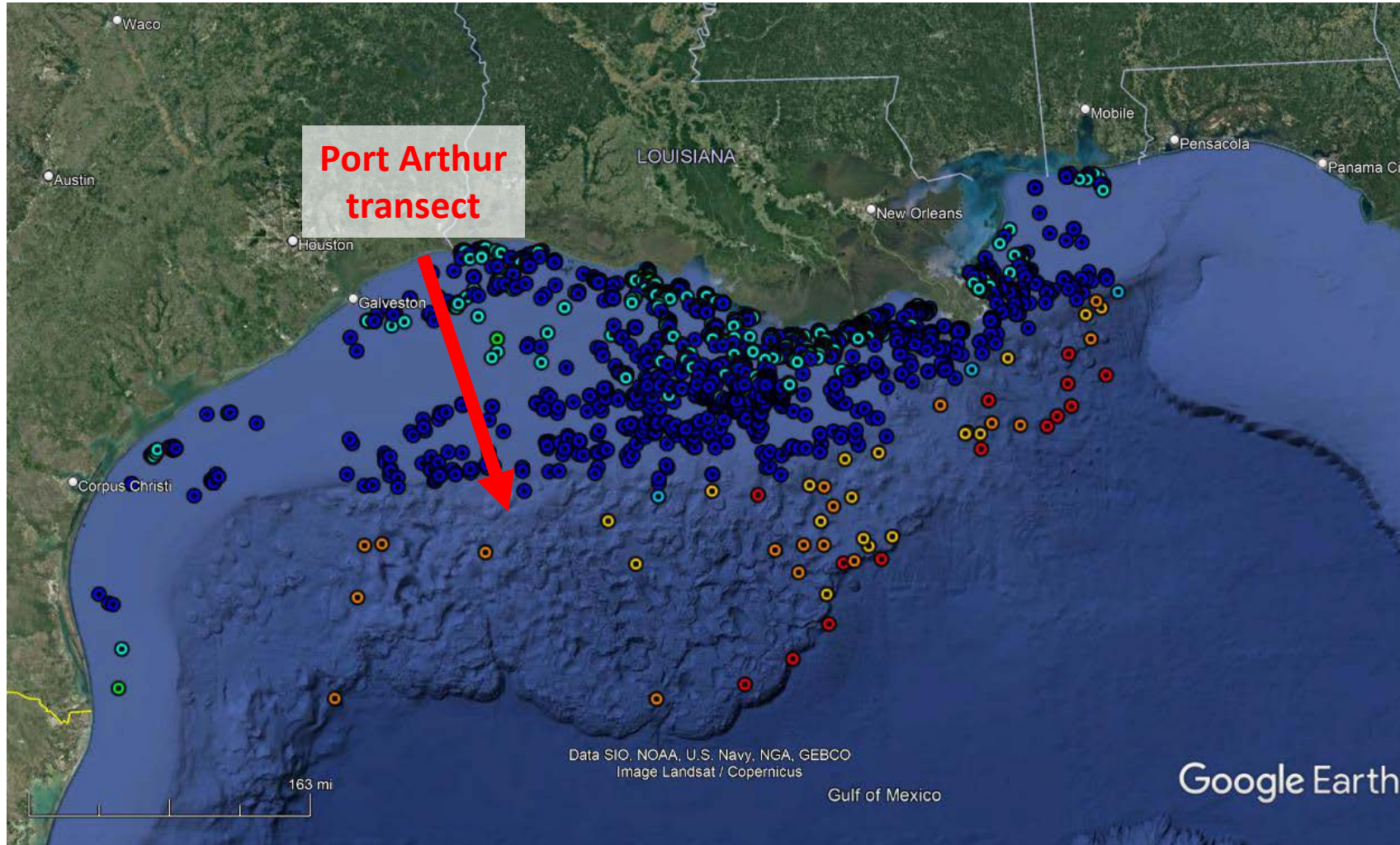
- DOE Workshop: Undocumented Orphaned Wells
  - DOE focused on unknown wells (up to 800,000 undocumented wells)
  - DOI focused on known orphaned wells (up to 130,000 wells)
- Federal interest in repurposing these orphaned wells to offset costs
- Common themes with GoMCarb:
  - Inconsistent well terminology between sources, states, etc.
  - Basic well information difficult to find, may be proprietary
  - No single best source of information – no national database (in the works?)
- Onshore can be much more challenging due to age/# of wells

# Ongoing/Future Work: “Transect” Analysis



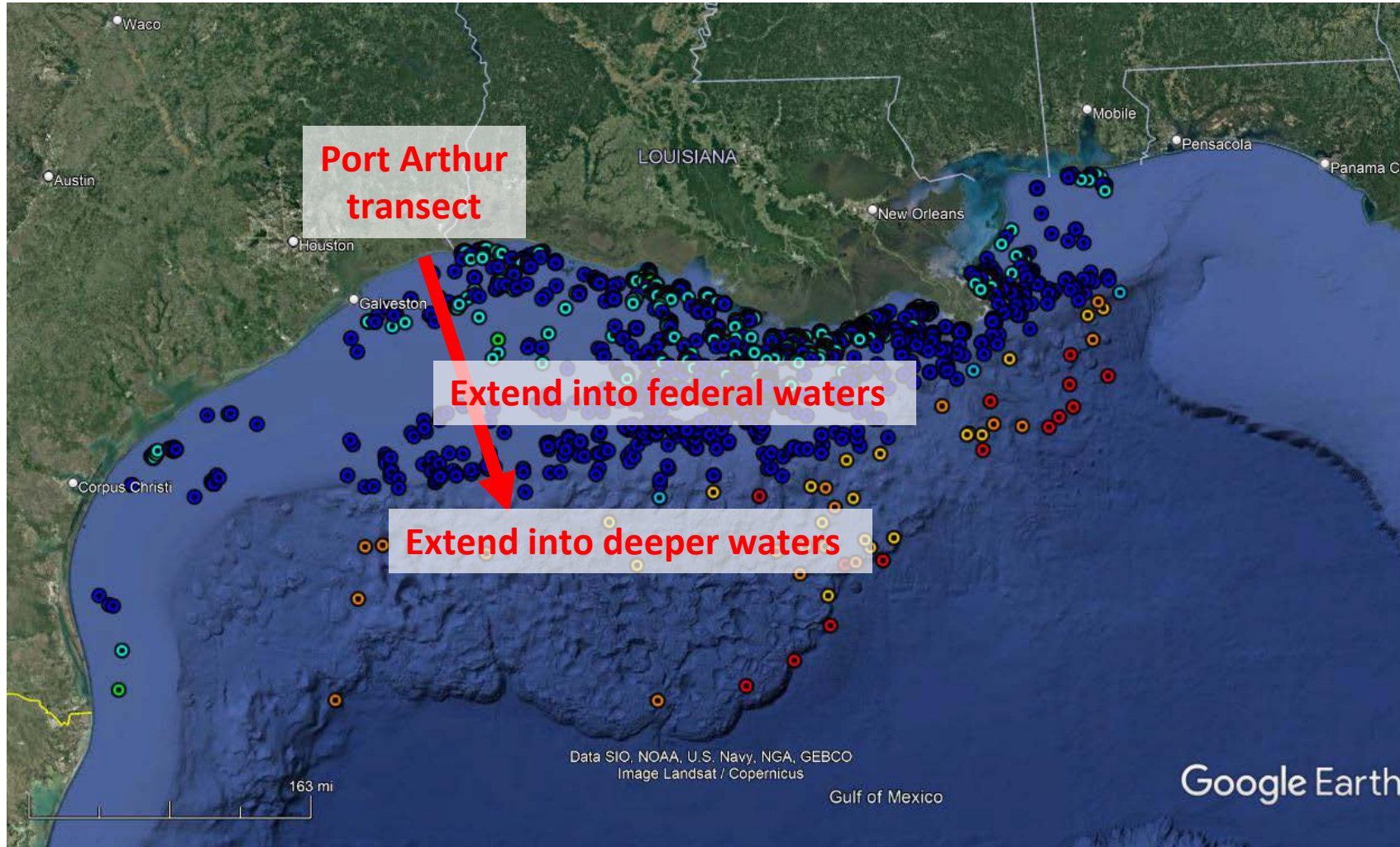


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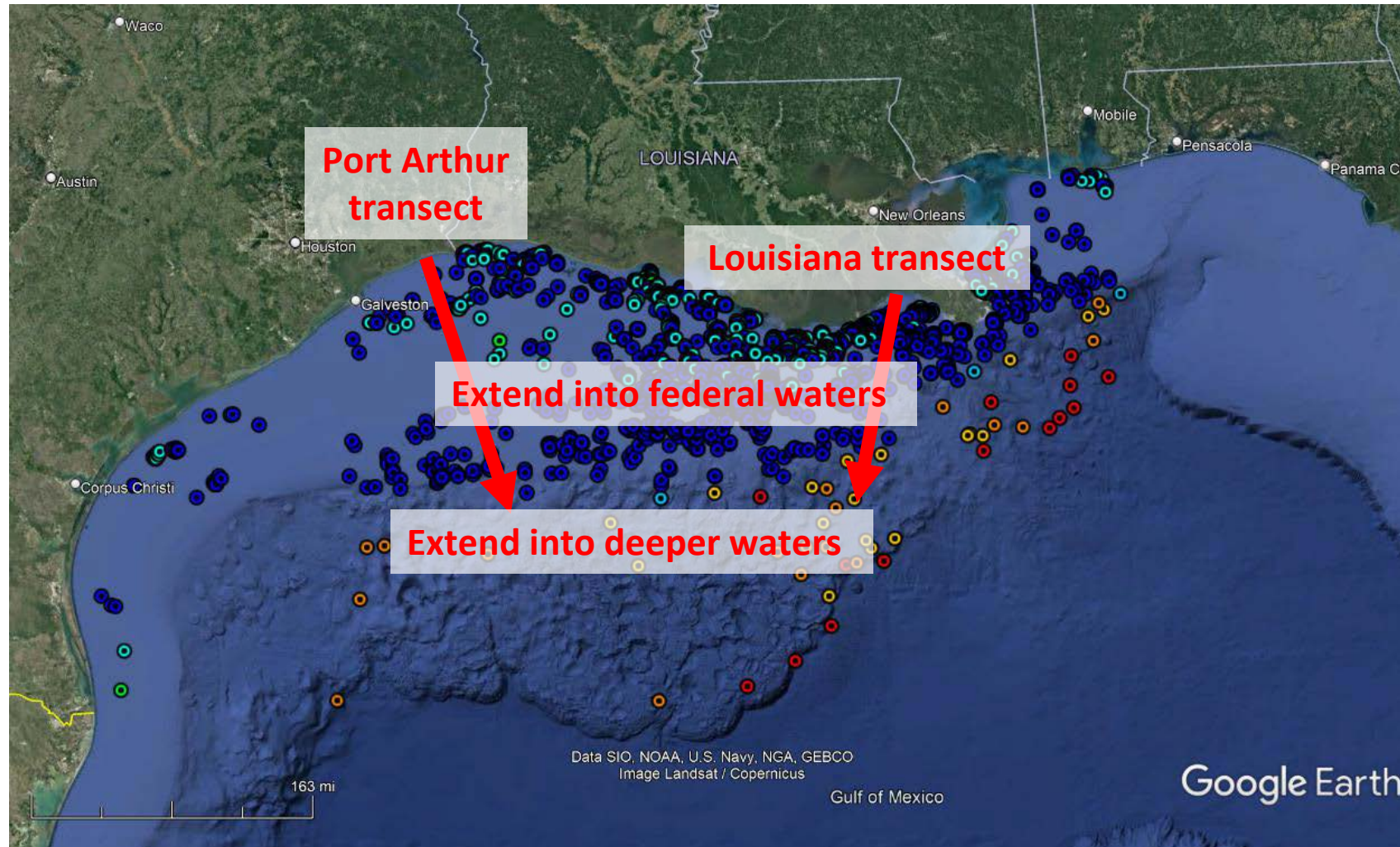


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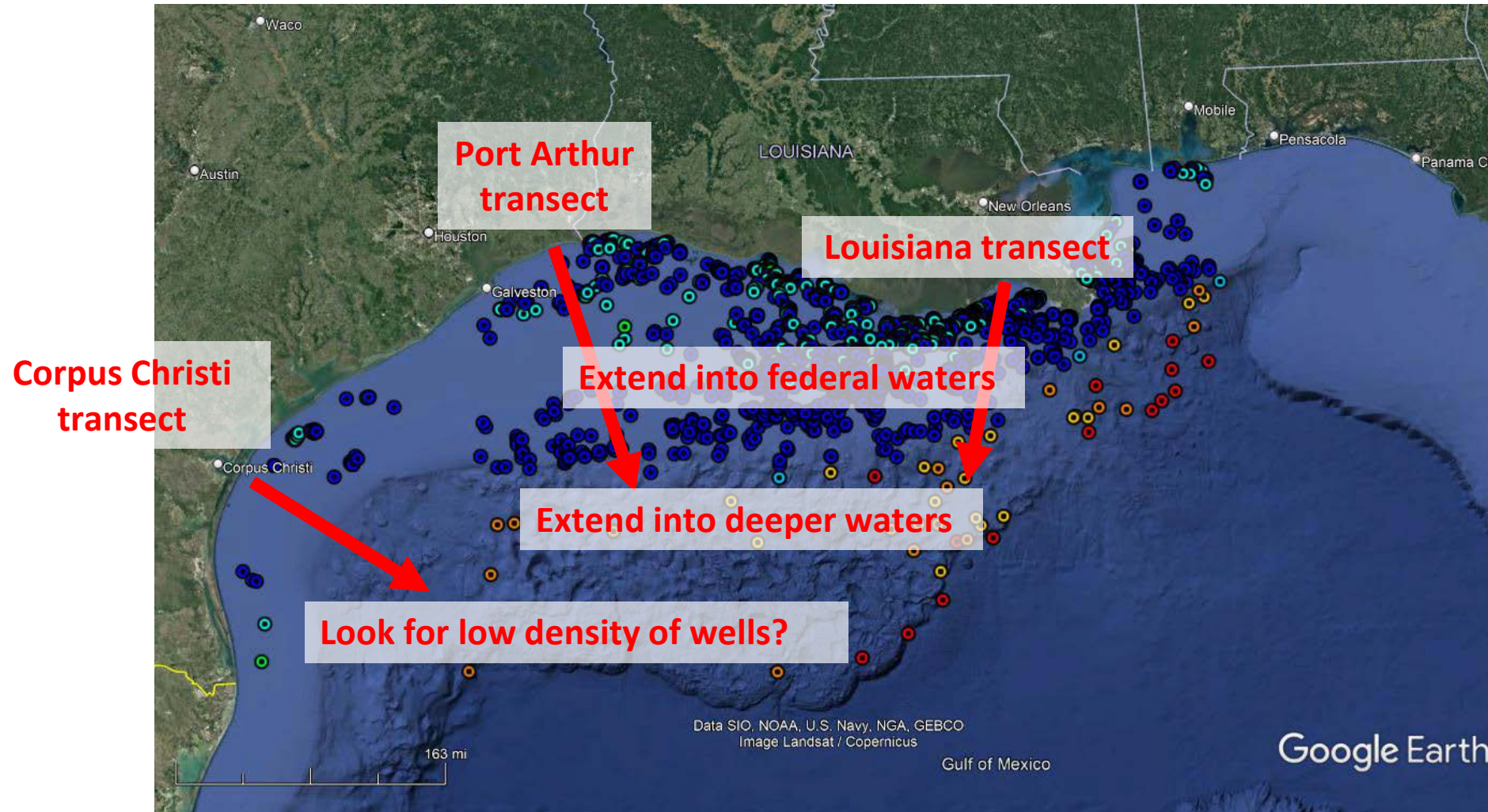


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# Ongoing/Future Work: “Transect” Analysis



# Pipelines

# Pipeline Re-Use: Past Work Review

- **High-level screening**
- Identified specific pipelines for more detailed review
  - Included direct engagement with pipeline owners/operators
- Developed re-use workflow
  - Identified major steps required for re-use
  - Attempted to assess cost of these steps
- Developed a pipeline re-use assessment “memo” summarizing work

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<b>Total</b>	20,274	
<b>Service Status (Inactive/Active)</b>	11,195	5,568
<b>8” or larger</b>	2,335	1,676
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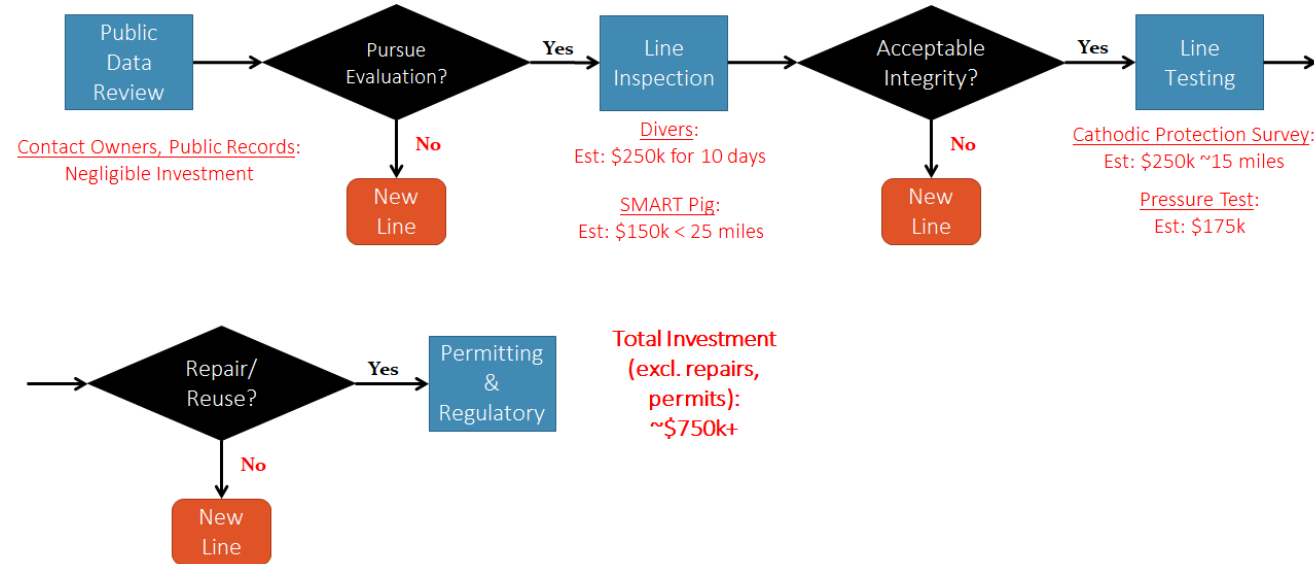
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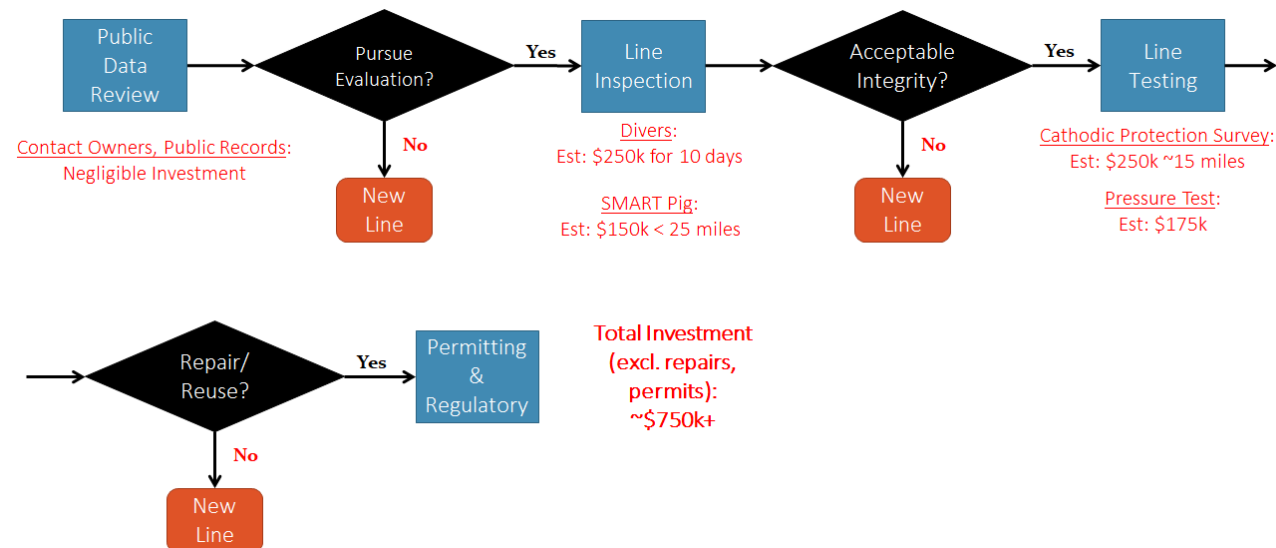


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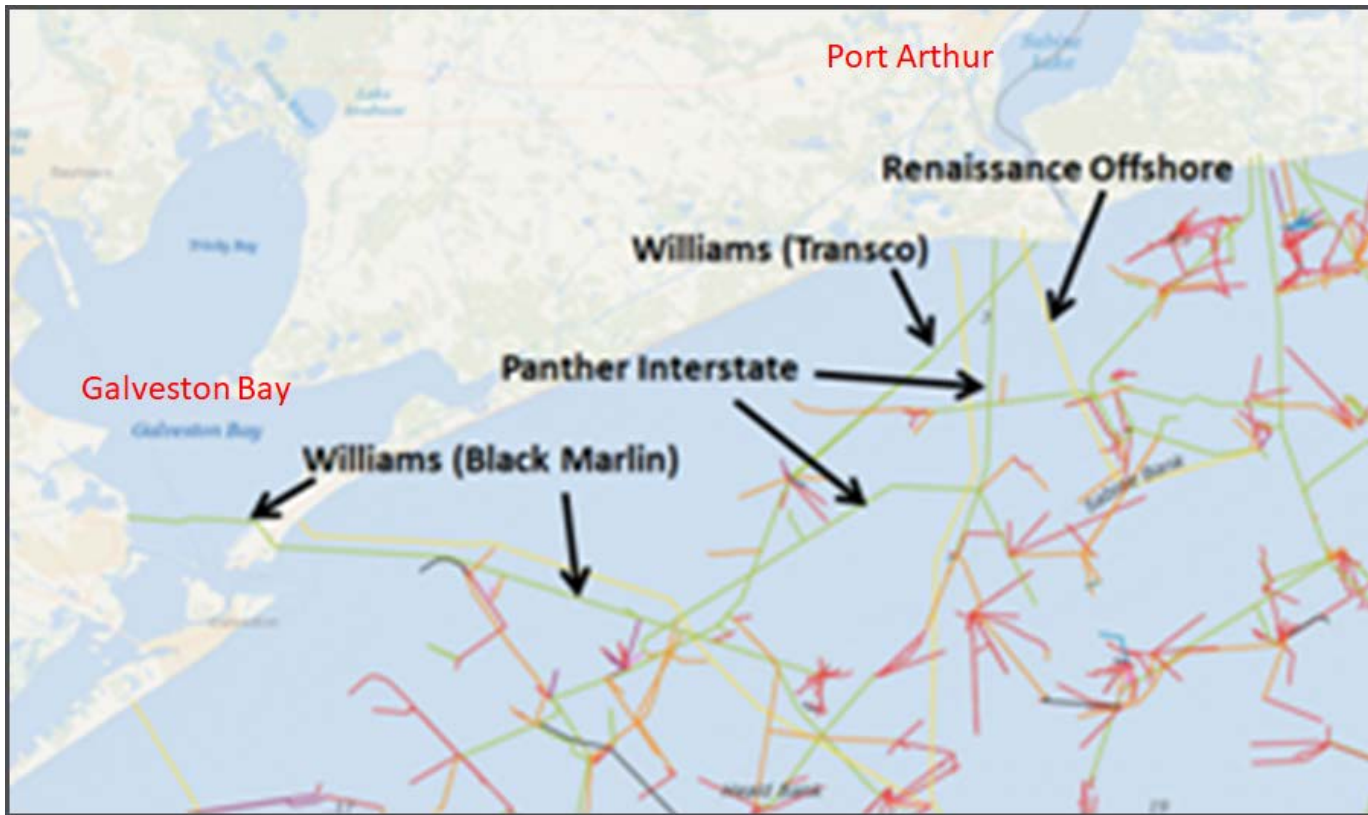
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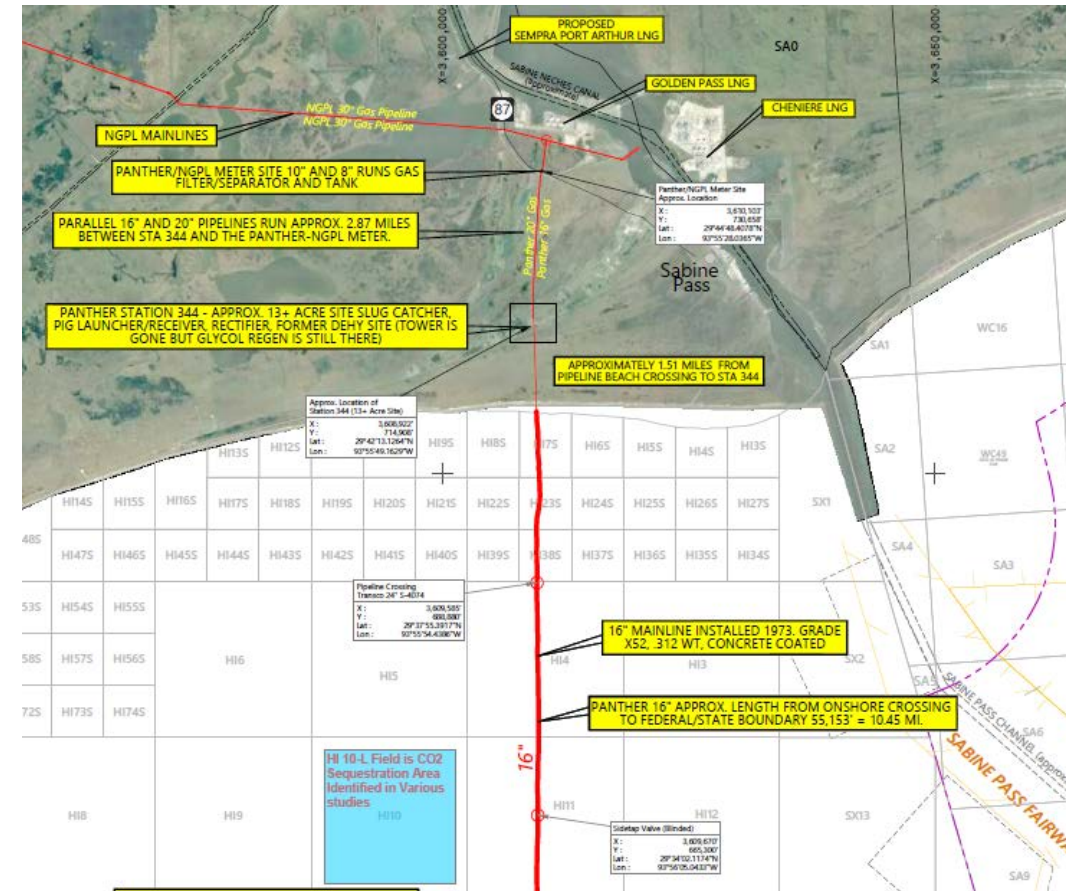
# Pipeline Re-Use: Case Study Evaluation

- Priority candidates from screening to perform a “deeper” dive
- High-level technoeconomic assessment of re-use
  - Comparison to new Class 900
  - Hydraulic Evaluation (transport phase, pressure/velocity limitations, environmental conditions, capacity, offshore recompression requirements)
  - Other considerations (shore crossing, useful life, pipeline records)
- Broader objectives:
  - Not intended to represent a “project”
  - “Pilot” test the re-use workflow – are we missing key steps?
  - Identify/assess specific re-use challenges or benefits

# Pipeline Re-Use: Case Study Evaluation

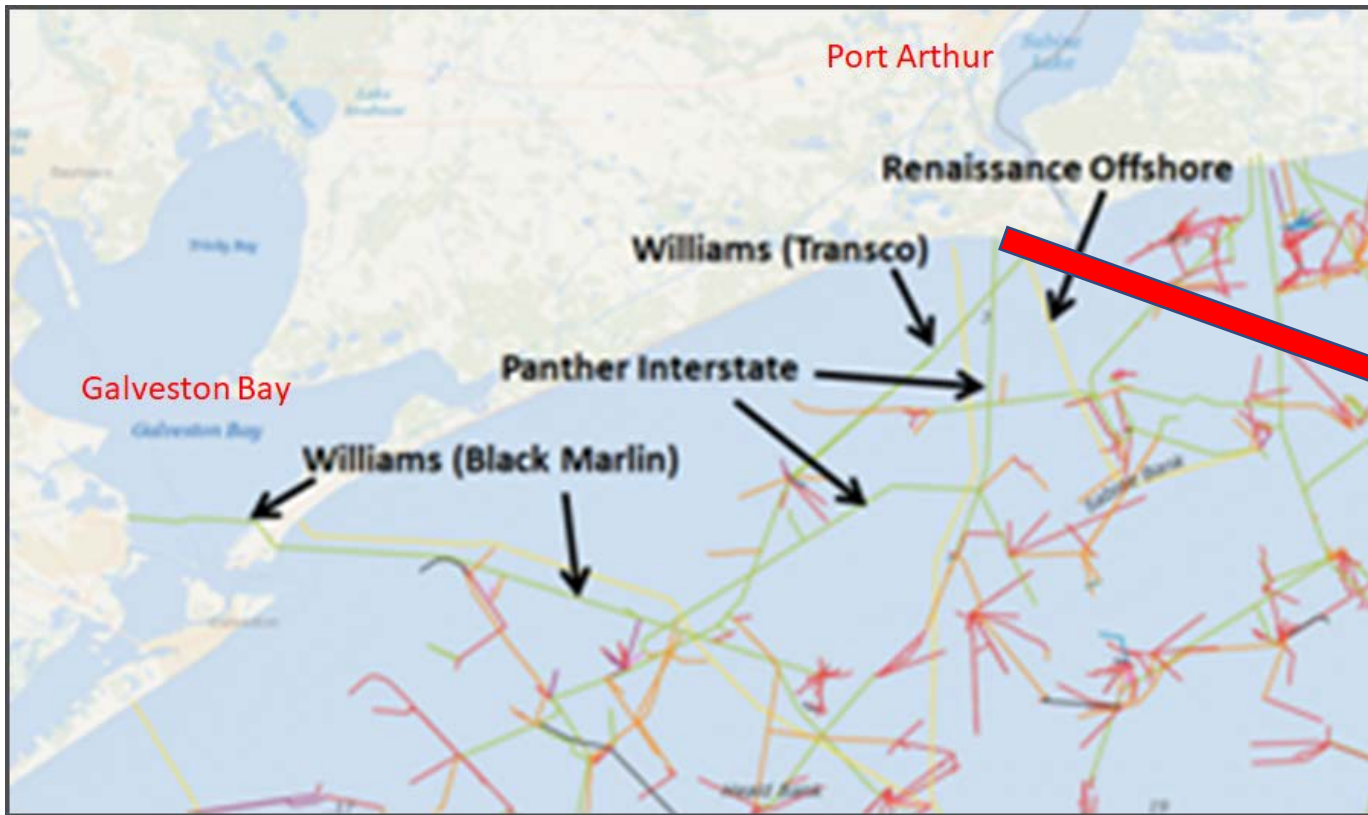


From Panther Companies website (Used with permission):  
[Maps \(panthercompanies.com\)](https://panthercompanies.com)

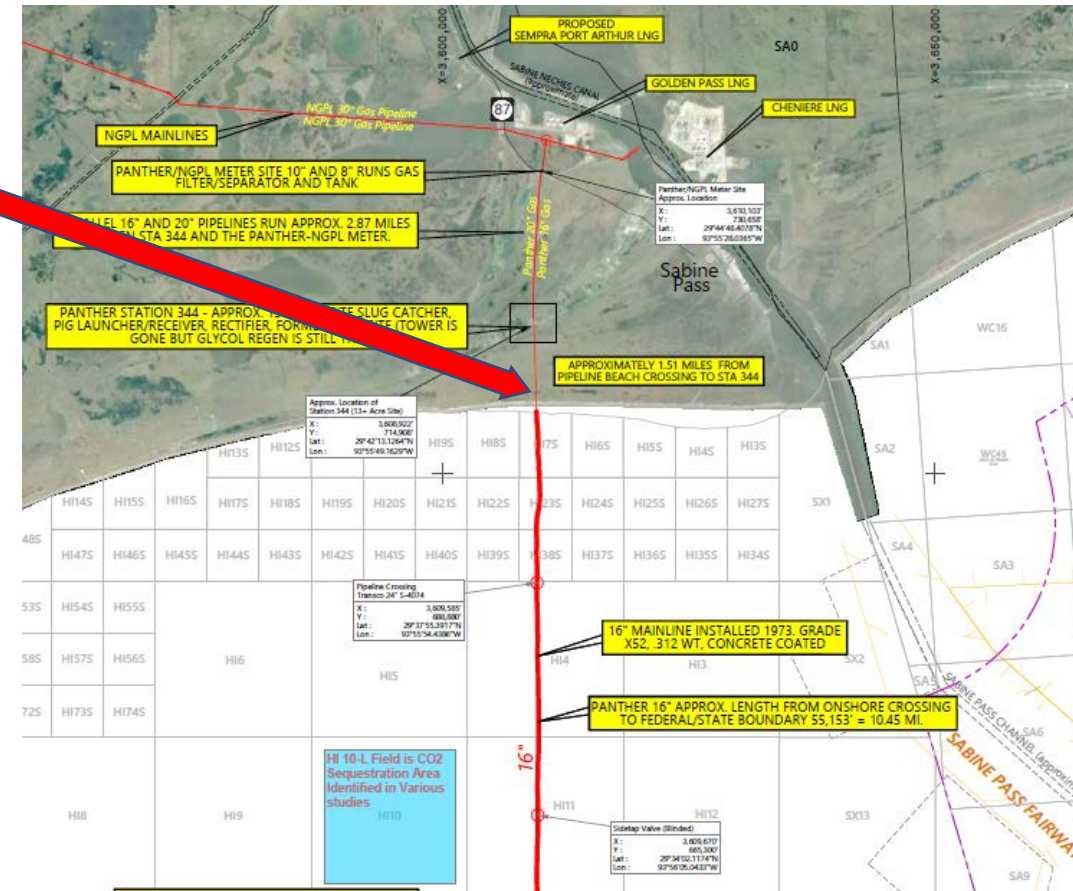




# Pipeline Re-Use: Case Study Evaluation



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# Platforms

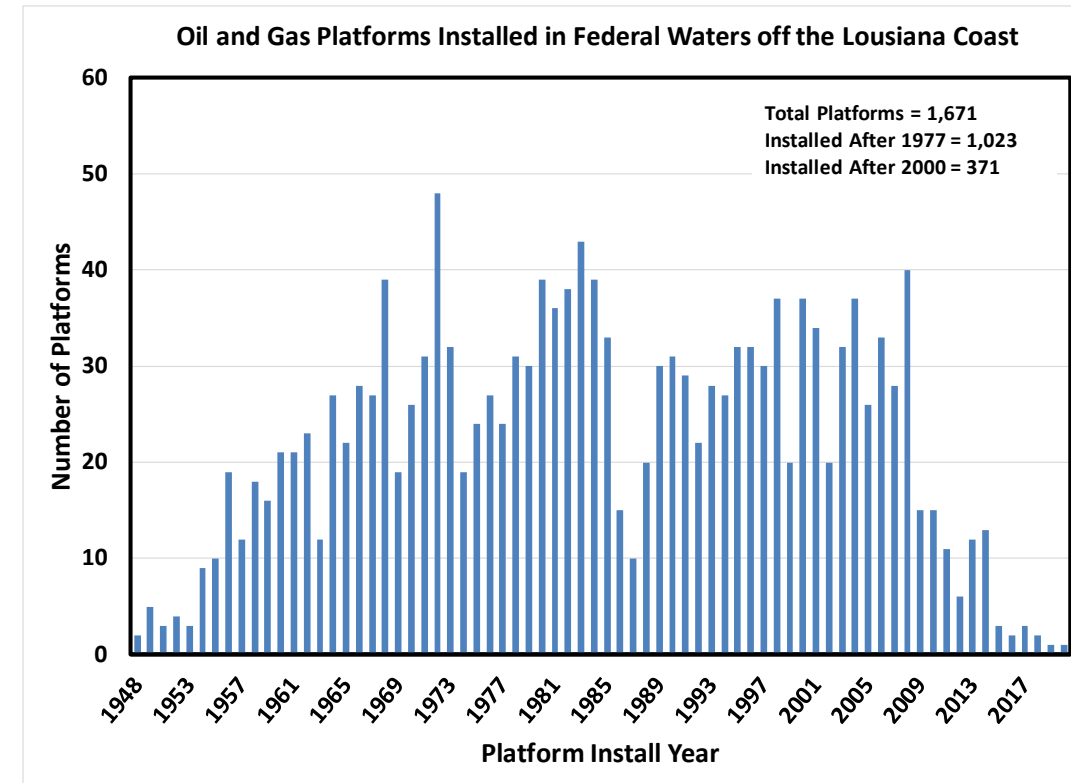
# Platform Re-Use Overview

- Repurposing platforms for CO<sub>2</sub> storage = offset cost of decommissioning idled platforms (“win-win”)
- High-Level platform re-use criteria
  - Location/proximity to preferred injection site
  - Age/general condition of platform
  - Space on platform
  - Regulatory/legal considerations
    - How does liability/decommissioning responsibility transfer?
- Platform re-use unlikely to be a project driver
  - Reservoir, pipeline, and in some cases, wells will be prioritized ahead of platforms



# Platforms

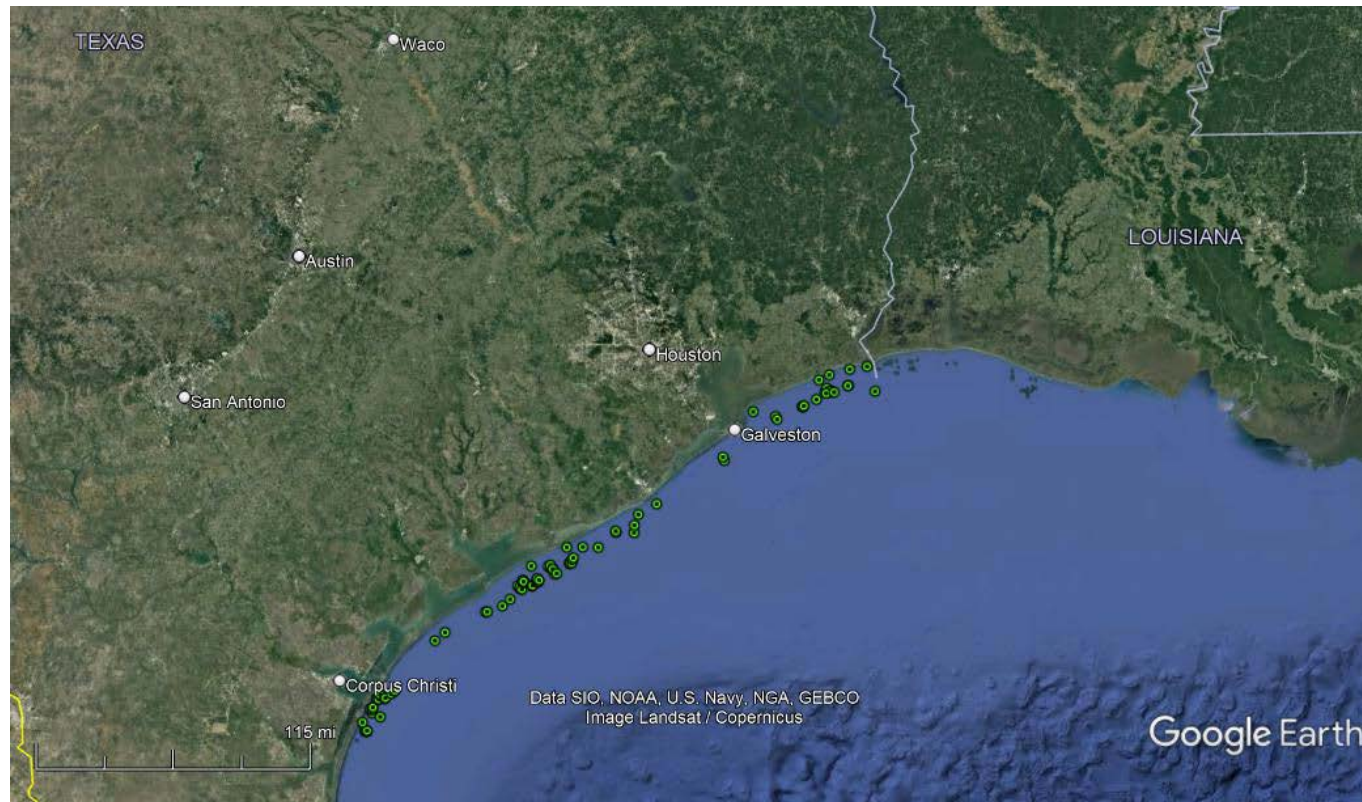
- Texas State Waters:
  - 95% of platforms (of 89 total) in Texas state waters are inactive
  - Minimal detailed data available (no age, water depth, inspection records)
- Federal Waters:
  - 1,807 platforms offshore TX (136) & LA (1,671)
  - High-level data available (incl. inspection reports in some cases)
- Age:
  - SME: Beyond 30 years, structural integrity risk rises significantly
  - Platforms built after implementation of specific standards represent better candidates
    - API RP 2A 9<sup>th</sup> Ed (1977): “100-year return period conditions”
    - MMS – From 1988 on, enhanced inspection requirements
- Critical information such as structural integrity, topsides space, etc. requires contact with operators





# Platforms – Mapping & Case Studies

## Texas State Waters



# Platforms – Mapping & Case Studies

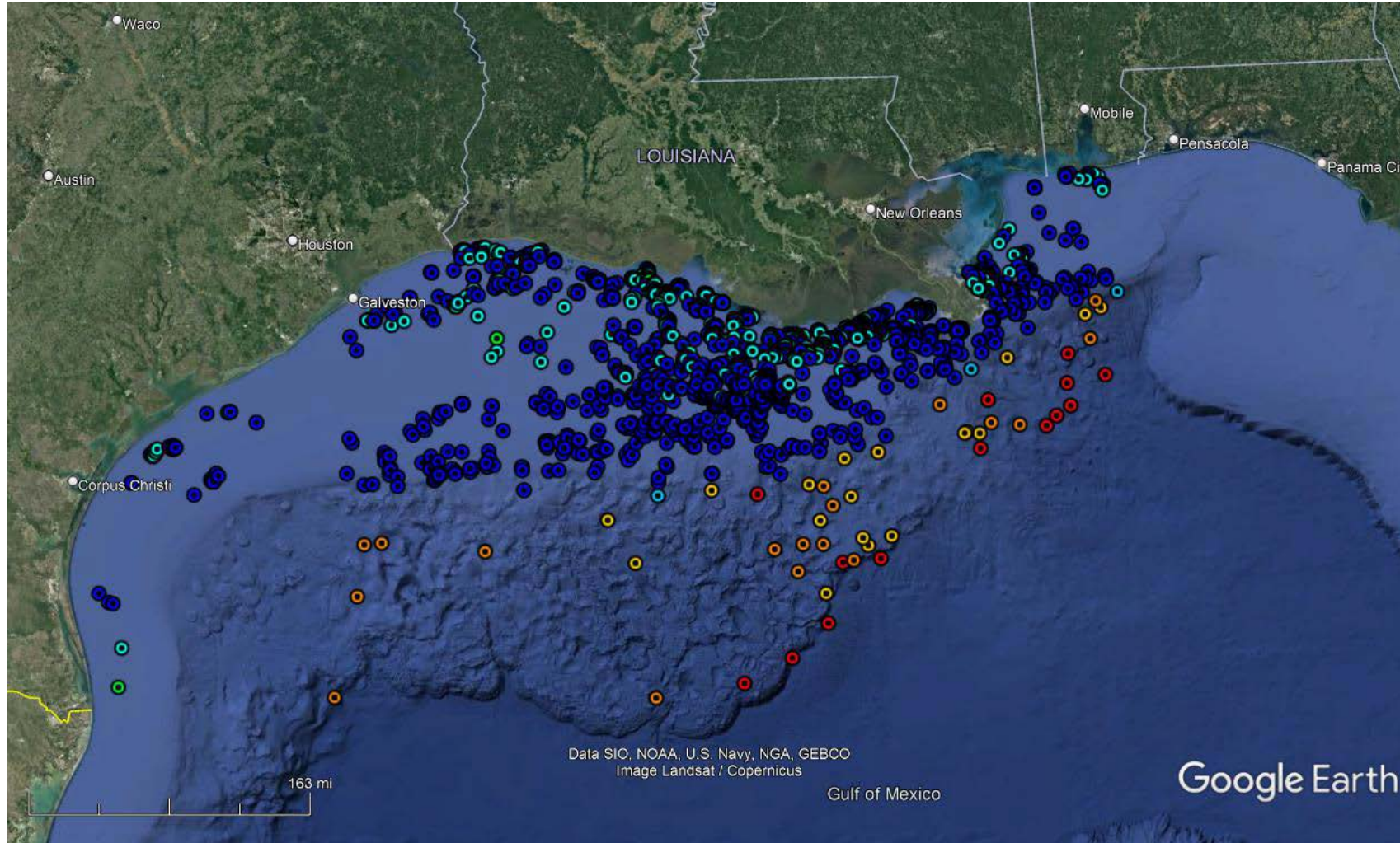
## Texas State Waters





# Platforms – Mapping & Case Studies

## Federal Waters



- 75% of platforms are fixed platforms
- Tend to be in shallower waters, but older
- **More discussion on Thursday**

# Conclusions



# Summary

- Pipelines:
  - Scale of pipeline re-use opportunity limited by size and pressure rating
  - Re-use vs. new is not binary
    - Incremental Capacity: Pair existing with new (reduce total investment)
    - “Phased” Investment: Start-up with existing, build-out new (flexibility)
  - Existing right-of-way, existing routes have inherent value
- Wells:
  - Quality of records and condition of wells represent a risk to CCS projects
  - Opportunities for re-use will be case specific, risk for leakage will be general
- Platforms:
  - Limited stock of “newer” platforms
  - Cost to retrofit vs. new platform is case-specific
- Engineering studies = drive specific decisions on assets
- Decommissioning “best practices” not always followed. **Urgency to identify assets before abandonment.**

# Thank You

## □ Acknowledgements:

- Darrell Davis (Consultant) led efforts for pipeline and platform screening
  - [davisdw58@hotmail.com](mailto:davisdw58@hotmail.com)
  - UT BEG for data analysis support
- Trimeric Corporation  
[www.trimeric.com](http://www.trimeric.com)
- Darshan Sachde  
[darshan.sachde@trimeric.com](mailto:darshan.sachde@trimeric.com)

# Backup Slides

# GoMCarb Ongoing Work

- Case Studies:
  - Pipeline Re-use Case Study (Class 600 vs. Class 900 new)
  - Platforms: What can we learn from data available, what additional data is needed (workflow), and what would it cost to get that data?
- Wells:
  - Review select subsets of data throughout GoMCarb region – are there any generalizations or new considerations?
- Continue engagement with stakeholders to identify the infrastructure questions that are still unanswered



# Existing Well Assessment “Workflow”

- Verify well integrity for wells within the reservoir
  - Records review to assess potential for leakage: age, well abandonment method, well completion activities, cement type, well type
  - Wellbore evaluation to confirm downhole status: casing condition, cement location, joint locations
- Remediate to address well integrity problems
  - Depends upon whether re-using or plugging
- Future Work: Refine with input from experts

# Pipeline Re-Use: Incentives

- Existing Pipelines: ~20k in federal water (+ more in state waters)
- New Pipeline Costs
  - Offshore Lines: ~2 – 3x cost of onshore “equivalent”
  - MAJOR CAVEATS
    - Data comparing on- and offshore is almost exclusively for NG lines
    - Large range in costs - highly project and route-specific
- Hidden risks/costs of new pipelines
  - Shore crossing through env. sensitive/challenging geography
  - Routing risks (right of way, new regulatory requirements vs. existing lines)

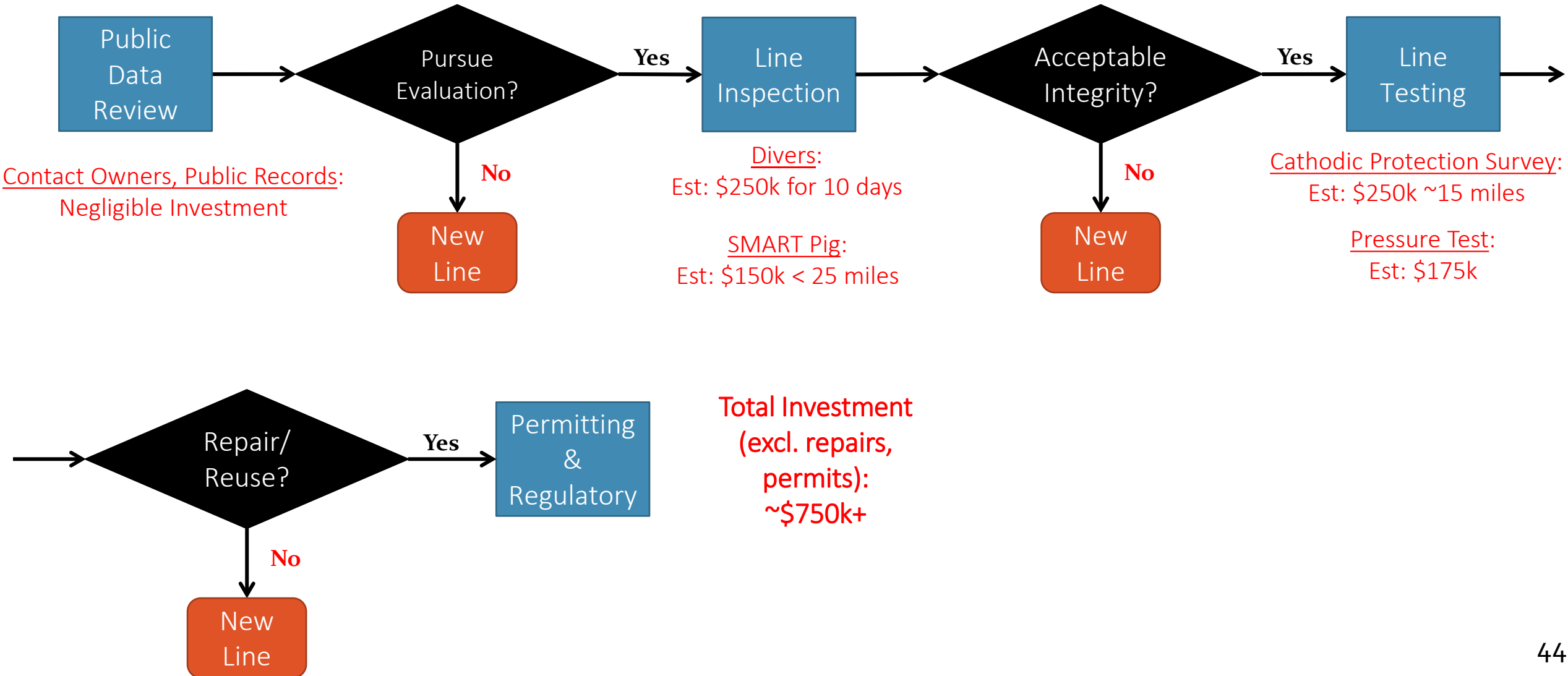
# Pipeline Re-Use: Challenges

- Pressure Rating
  - ANSI Class 600 (working P = 1,480 psig @100 F)
  - ANSI Class 900 (working P = 2,220 psig @100 F)
  - Actual pressure rating of an existing line?
- Age
  - Pipeline broker – Up to 85 years usable life
  - Older lines = higher risks (**especially out of service lines**)
- Condition of Line
  - Corrosion, repairs, thickness
  - Existing records (or lack thereof) represent essential data
- **Key Issue: Incentives & feasibility are not always aligned for re-use**

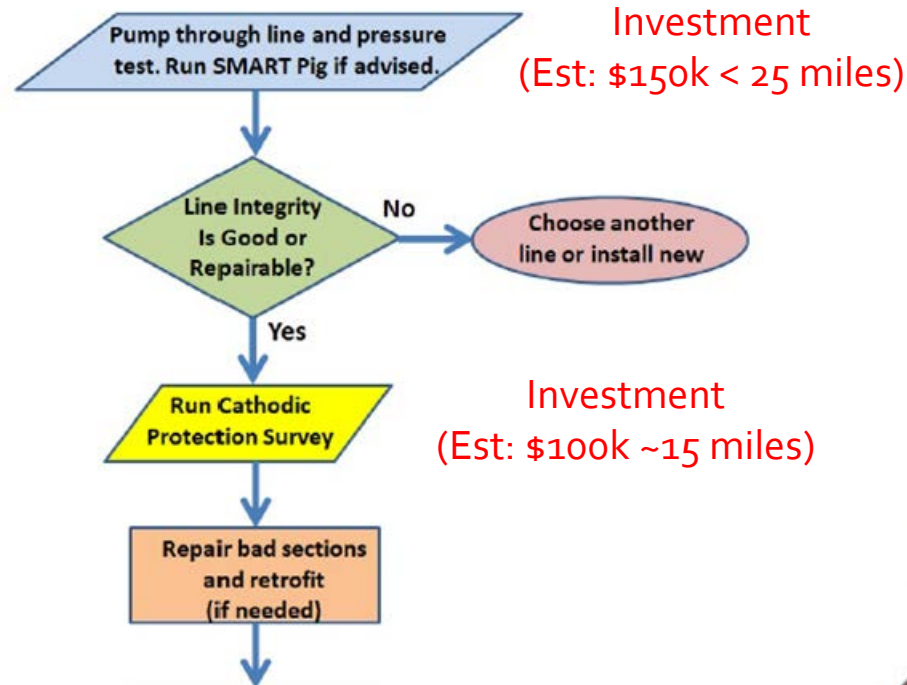
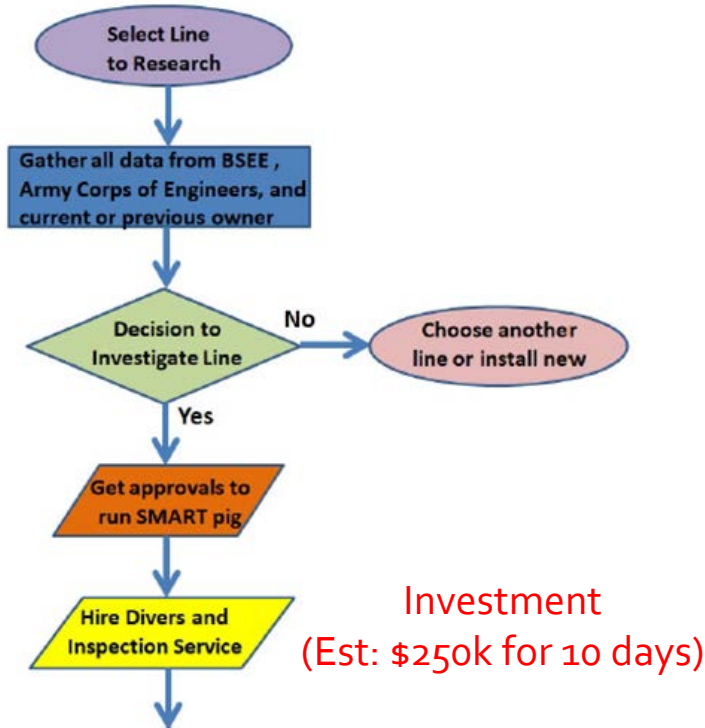
Case	Inlet Pressure (psig)	CO <sub>2</sub> Flow (Mt/yr)
New Class 900	2,000	~3.2
Existing Class 600	1,400	~1.8

- 8", 5-mile pipeline
- P<sub>Outlet</sub> > 1,200 psig (CO<sub>2</sub> always above P<sub>Critical</sub>)

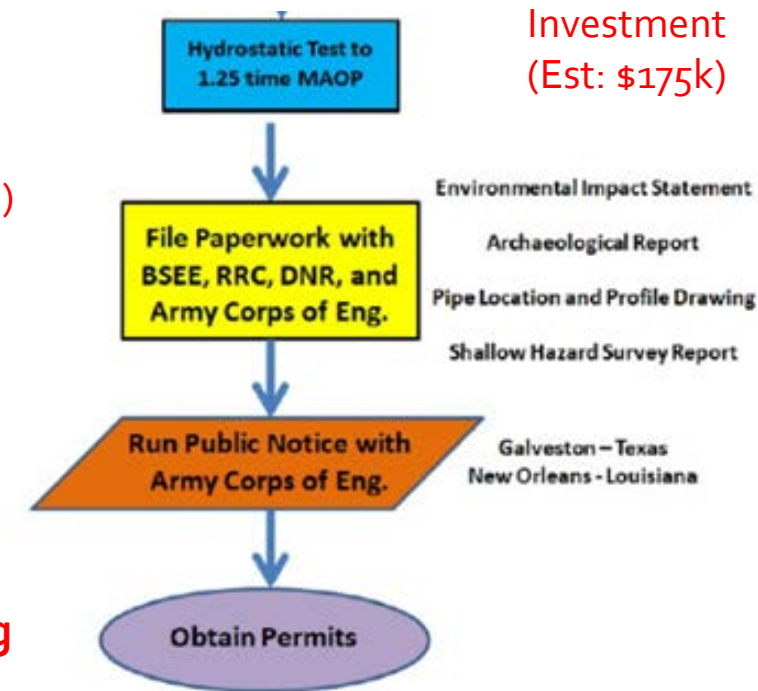
# Pipeline Re-use Workflow





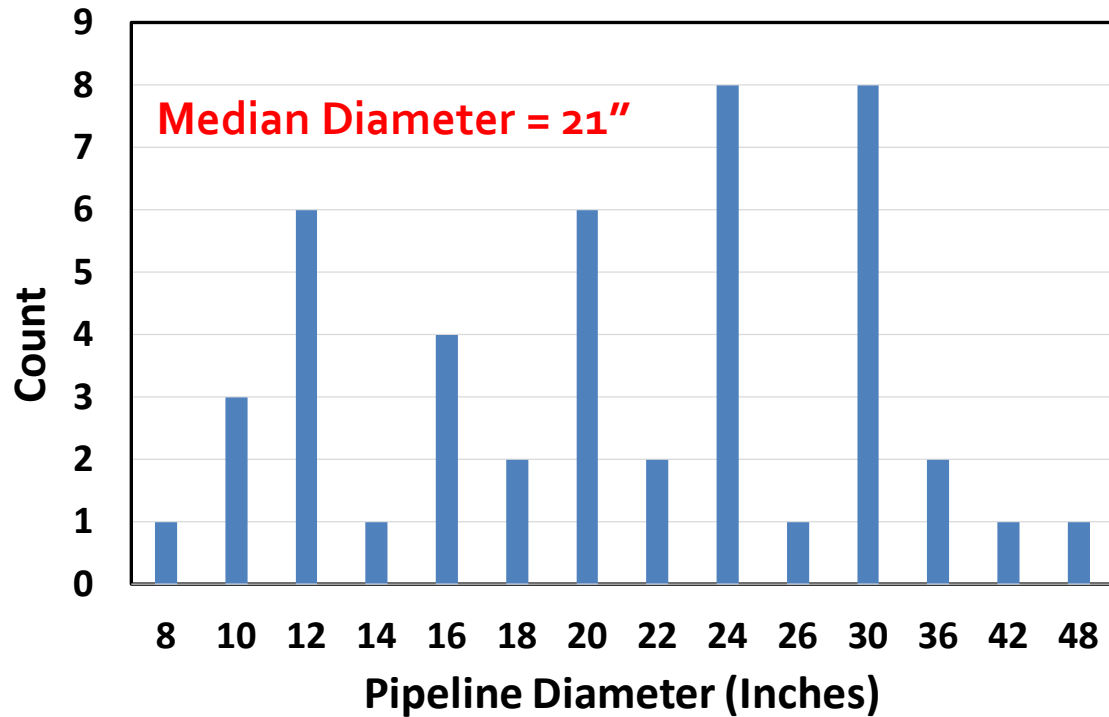


**Total Investment (Excluding repairs)**  
(Est: ~\$750k)



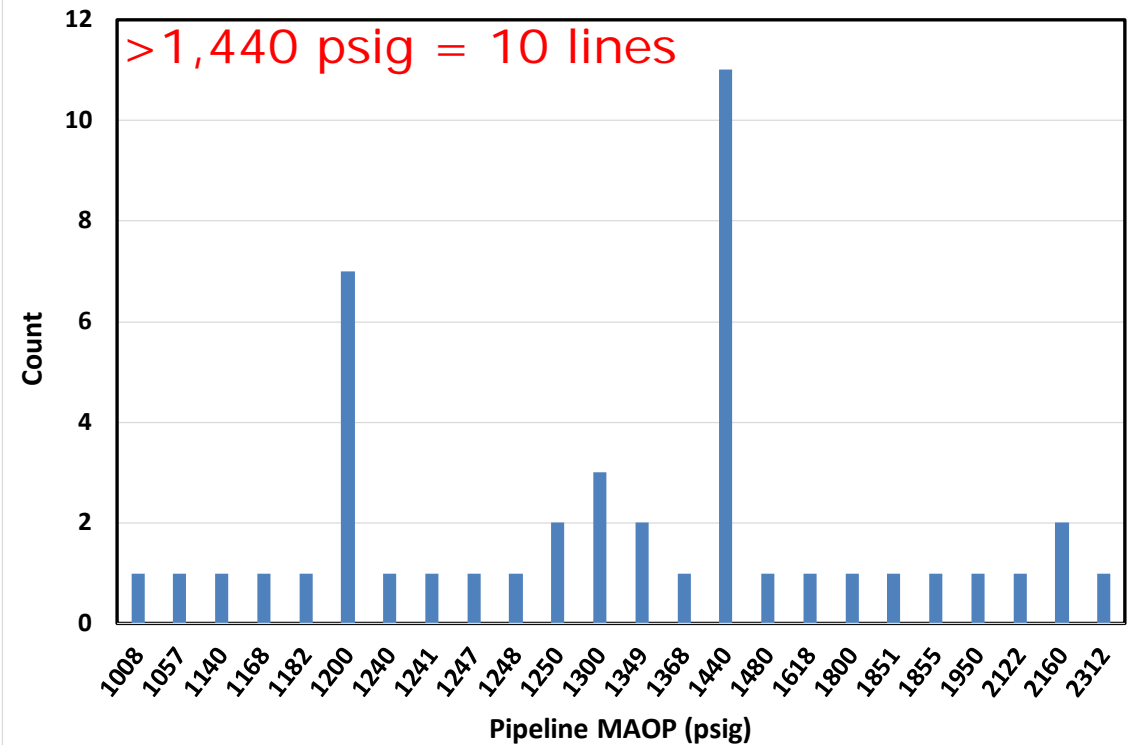
# Pipeline Screening Results – Federal Active Lines

Pipeline Size Distribution - Active Lines



Note: Out of Service Median Size = 16"

Pipeline Pressure Distribution - Active Lines



Note: Out of Service Lines > 1,440 psig = 0

# Pipeline Screening Results – Federal Out of Service

- **Limited stock of large pipelines**
  - ~23% ≥ 8 inches
  - 41% of this subset are 8” lines
- **Class 600 pipelines are most common**
  - 61% of all pipelines at least 1440 psig
- **Nearly half of pipelines meeting size and pressure screen are active**
  - Recent (last 10 years) common practice: fill abandoned lines w/ uninhibited seawater.
- **Less than half (46%) of lines meet the age criteria (< 40 years)**

<b>FEDERAL WATERS</b>	<b>Number of Segments</b>
<b>Total</b>	20,274
<b>8” or larger</b>	4,614
<b>Max Operating Pressure &gt; 1000 psig</b>	3,875
<b>Not in Service</b>	1,927
<b>&gt; 2 miles long</b>	951
<b>Water Depth &lt; 100’</b>	520
<b>In Service 1980 or later</b>	355
<b>Key Segments*</b>	11

\*Key Segments = Come onshore & terminate near state waters offshore

# Pipeline Screening Results – Federal Active Lines

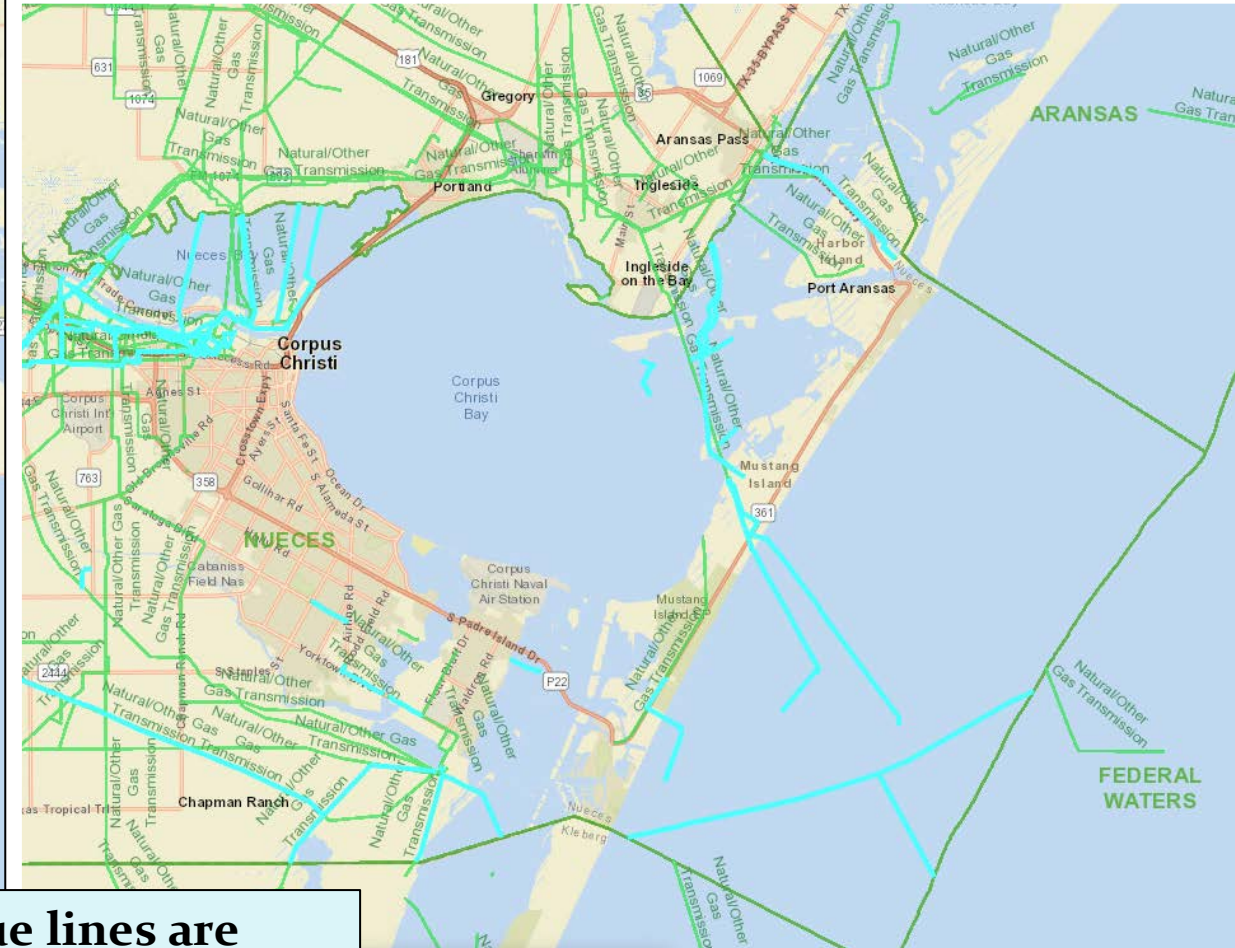
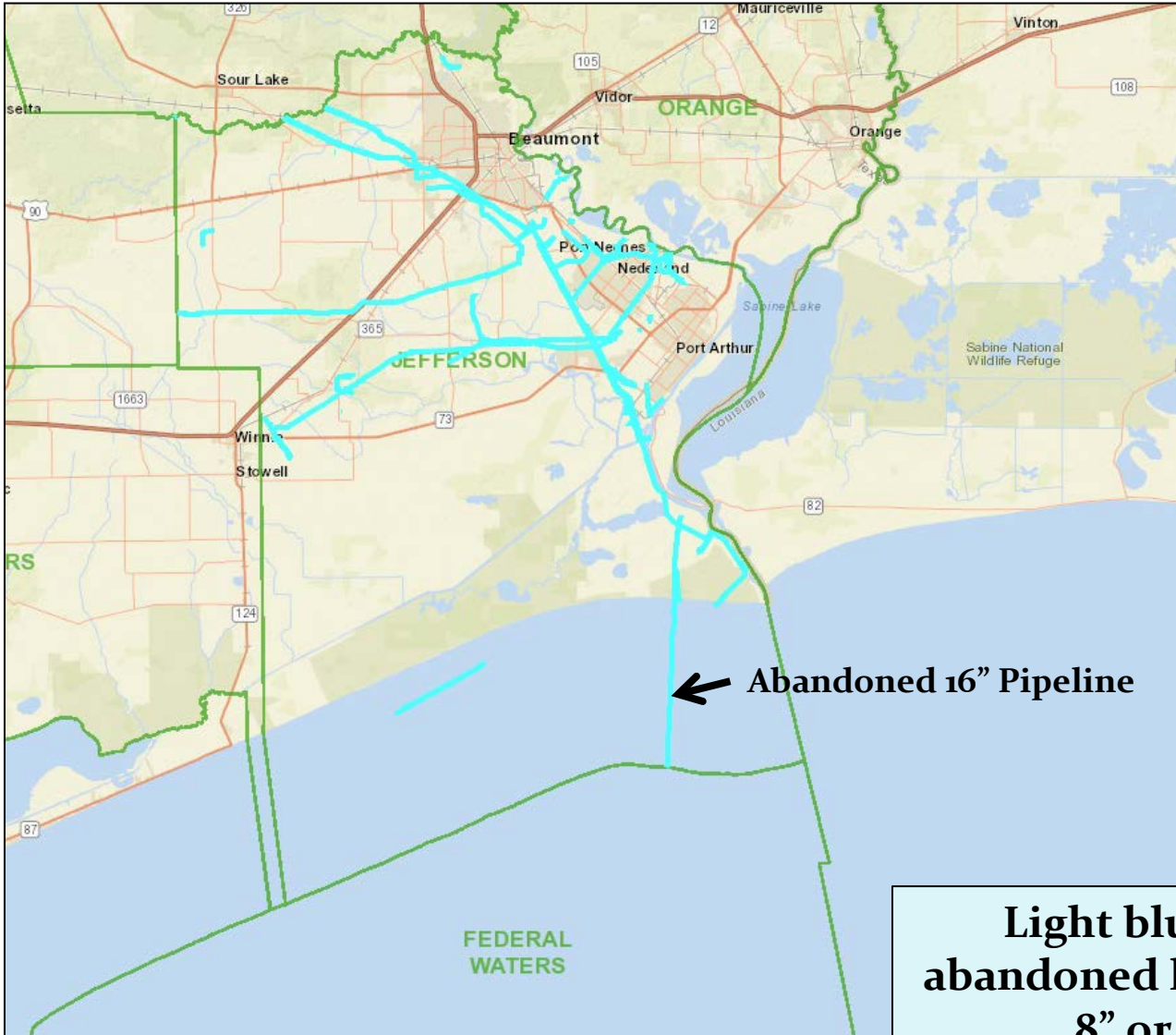
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# Pipeline Opportunity: Texas State Waters

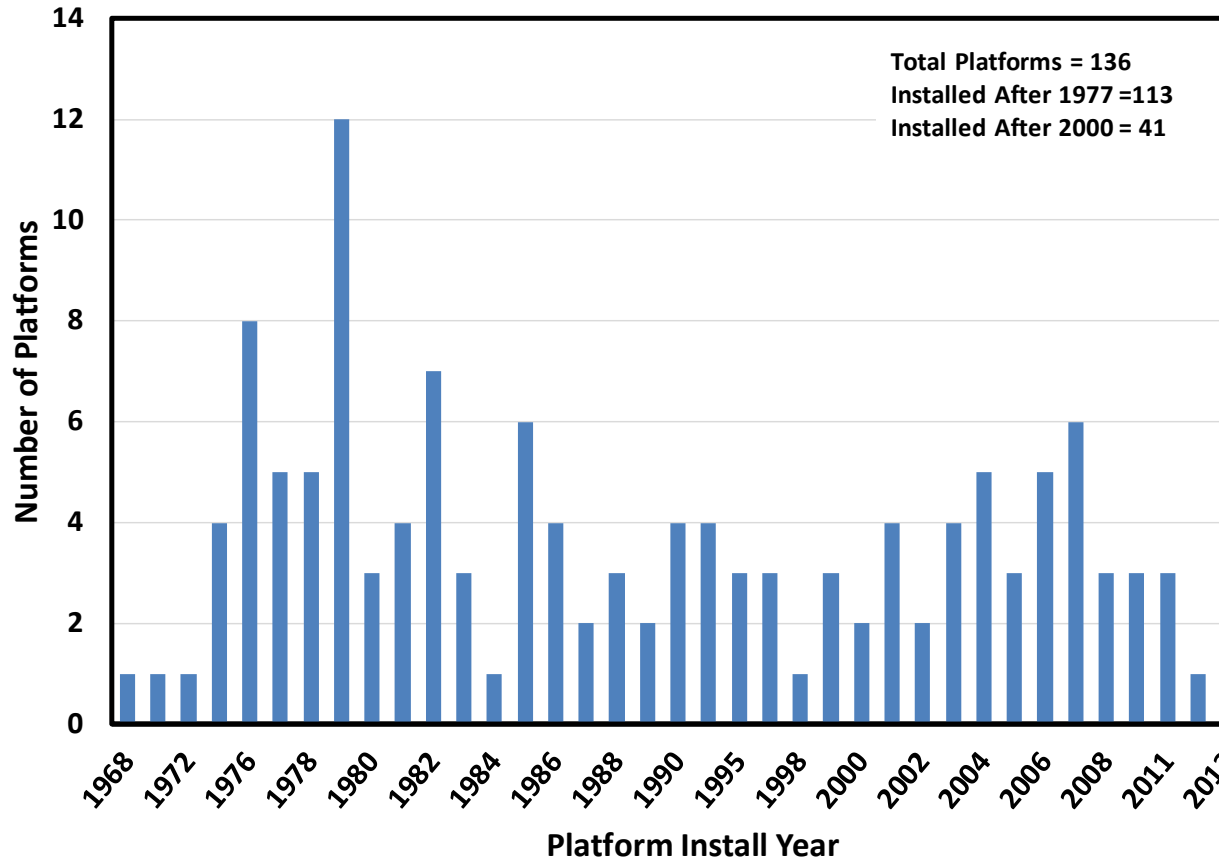


Light blue lines are abandoned lines which are 8" or greater

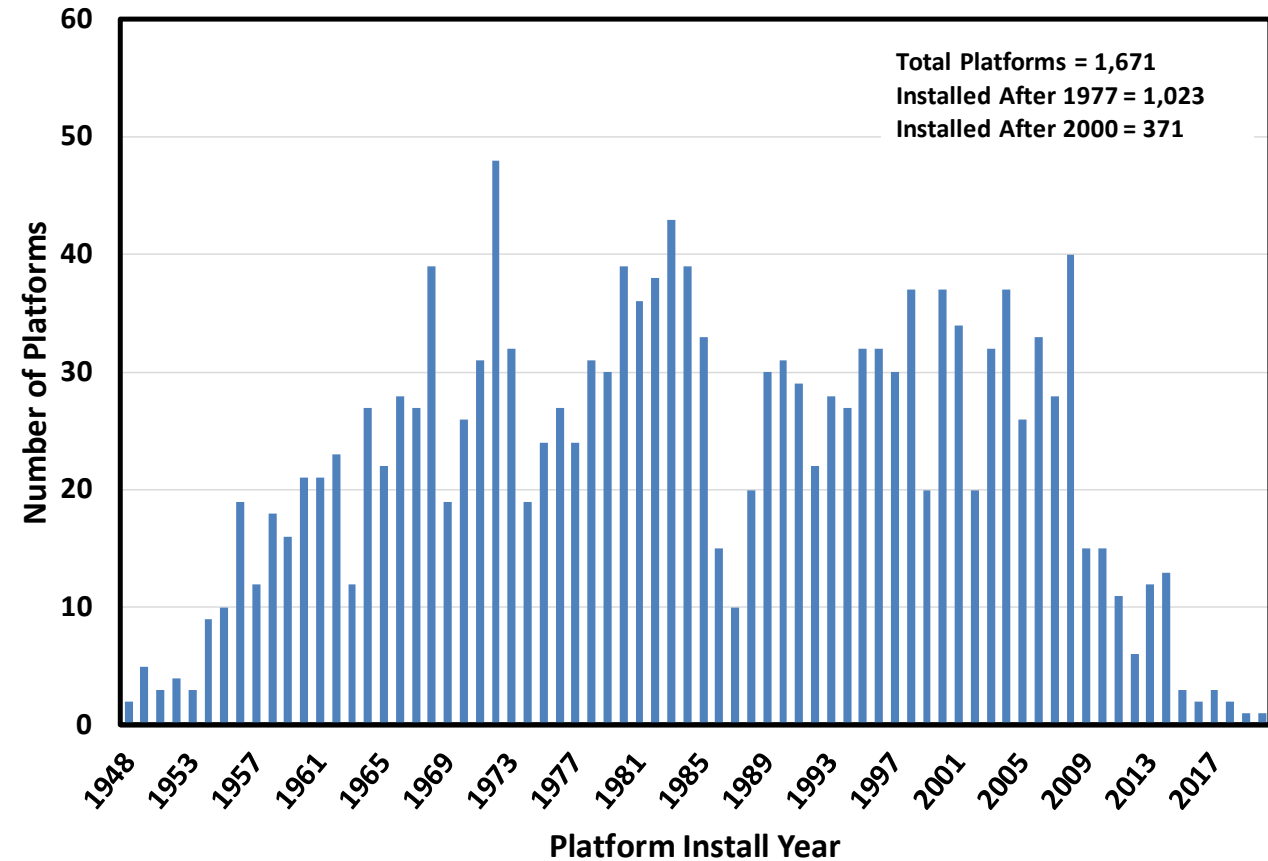
Source: Prepared by Darrell Davis for Trimeric Corporation

# Platforms – Federal Waters

Oil and Gas Platforms Installed in Federal Waters off of the Texas Coast



Oil and Gas Platforms Installed in Federal Waters off the Louisiana Coast



# Platforms – CO<sub>2</sub> Topsides Requirements

- General Equipment: Valving, instrumentation, filters, pig receivers, piping manifold, heaters
- Drill new CO<sub>2</sub> injection wells
  - Weight of a drilling rig or need a separate jack-up rig for drilling
  - Need open slots for injections wells or re-use existing wells
- Booster compression/pumping (in some cases)
  - Additional topsides weight, space, power requirements
- Materials compatibility:
  - Supercritical CO<sub>2</sub> is a solvent, P, T considerations
- **Do cost-savings of re-purposing vs. new-build hold up after modifications?**
- More detailed engineering studies will be needed to:
  - Assess the integrity and useful life of specific platforms
  - Assess modifications to the topsides for CO<sub>2</sub> injection
  - Understand the cost of a new platform