Integrity Management Valve Requirements for Transmission Pipelines

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Introduction

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Mr. LaMont has over 20 years experience in pipeline integrity management and regulatory compliance including pipeline safety and environmental programs. Mr. LaMont holds a Master's Degree and his thesis work included stream environmental impact studies.

The study will examine current federal regulatory requirements governing decisions about where and when to install these devices on existing pipelines, including regulatory criteria on factors to be considered and methodologies to be used for making such decisions. Consideration will be given to the treatment of public safety and environmental risks by these methodologies and the treatment of economic, technical, and operational feasibility. The study will identify and assess other potential methodologies for making such installation decisions on existing pipelines. In doing so, the committee will consider ASV, RCV, and EFRD technological capabilities; statutory and procedural limits on federal regulatory authority to require their use; relevant recommendations by the National Transportation Safety Board; and current and proposed regulatory criteria for the installation of ASVs, RCVs, and EFRDs on newly constructed and fully replaced pipelines. The study will take into account issues associated with reliance on manual control valves, including human factors and accessibility concerns. As appropriate, recommendations will be made regarding regulatory or statutory changes that might be considered at the federal and state levels.

Transportation Research Board

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Agenda

- Scope: Gas and Hazardous Liquids Transmission Pipelines
  - Introduction/Review - Integrity Management (IM) Regulations
  - IM Valve Requirements for Gas Pipelines
  - IM Valve Requirements for Hazardous Liquid Pipelines
  - Considerations and Takeaways

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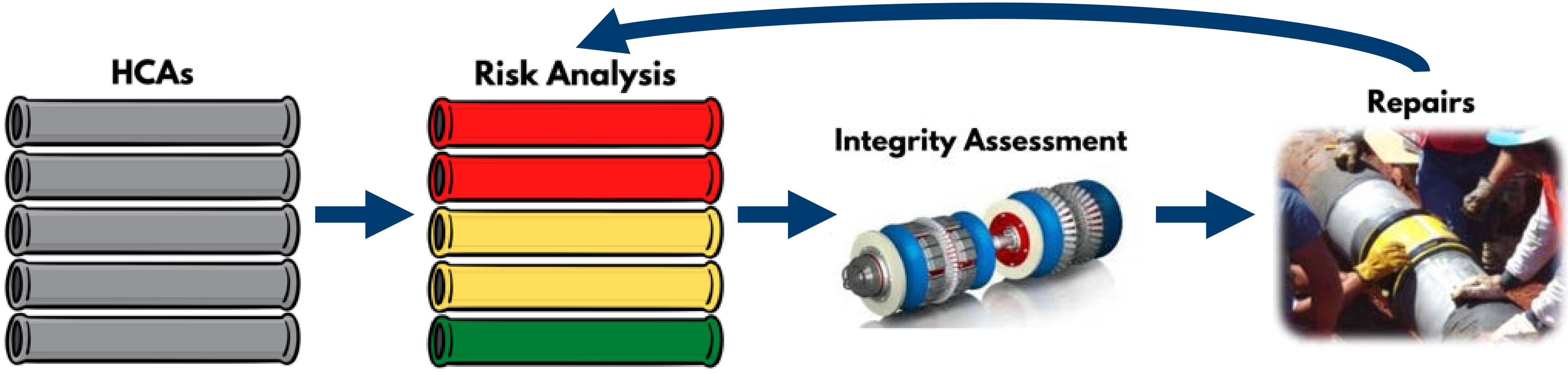
Integrity Management Regulations

- Segment specific factors provide risk picture
  - Threats
  - Consequence
- Regulations drives risk reduction actions

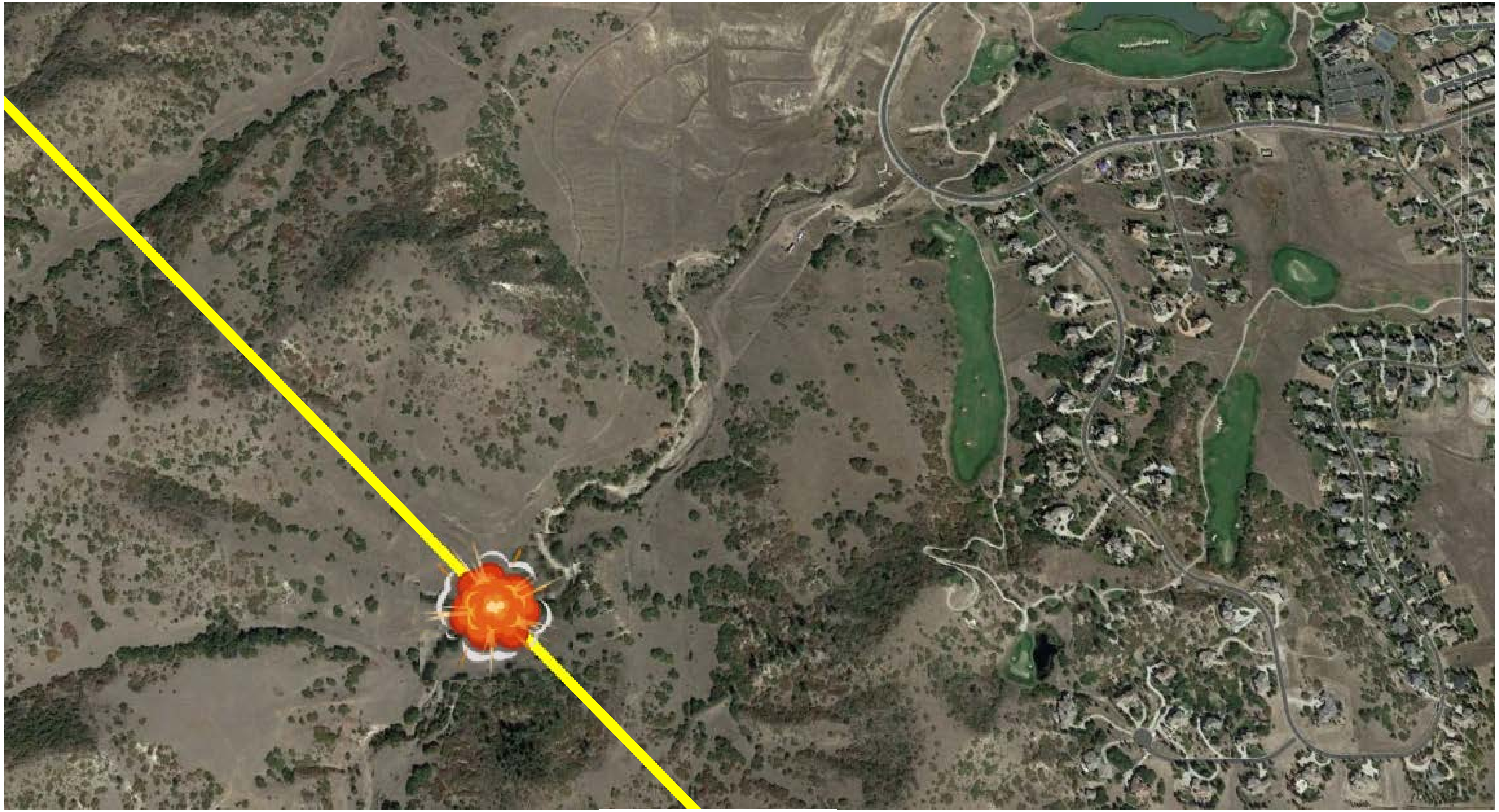
Risk Based Regulations

Integrity Management Life Cycle



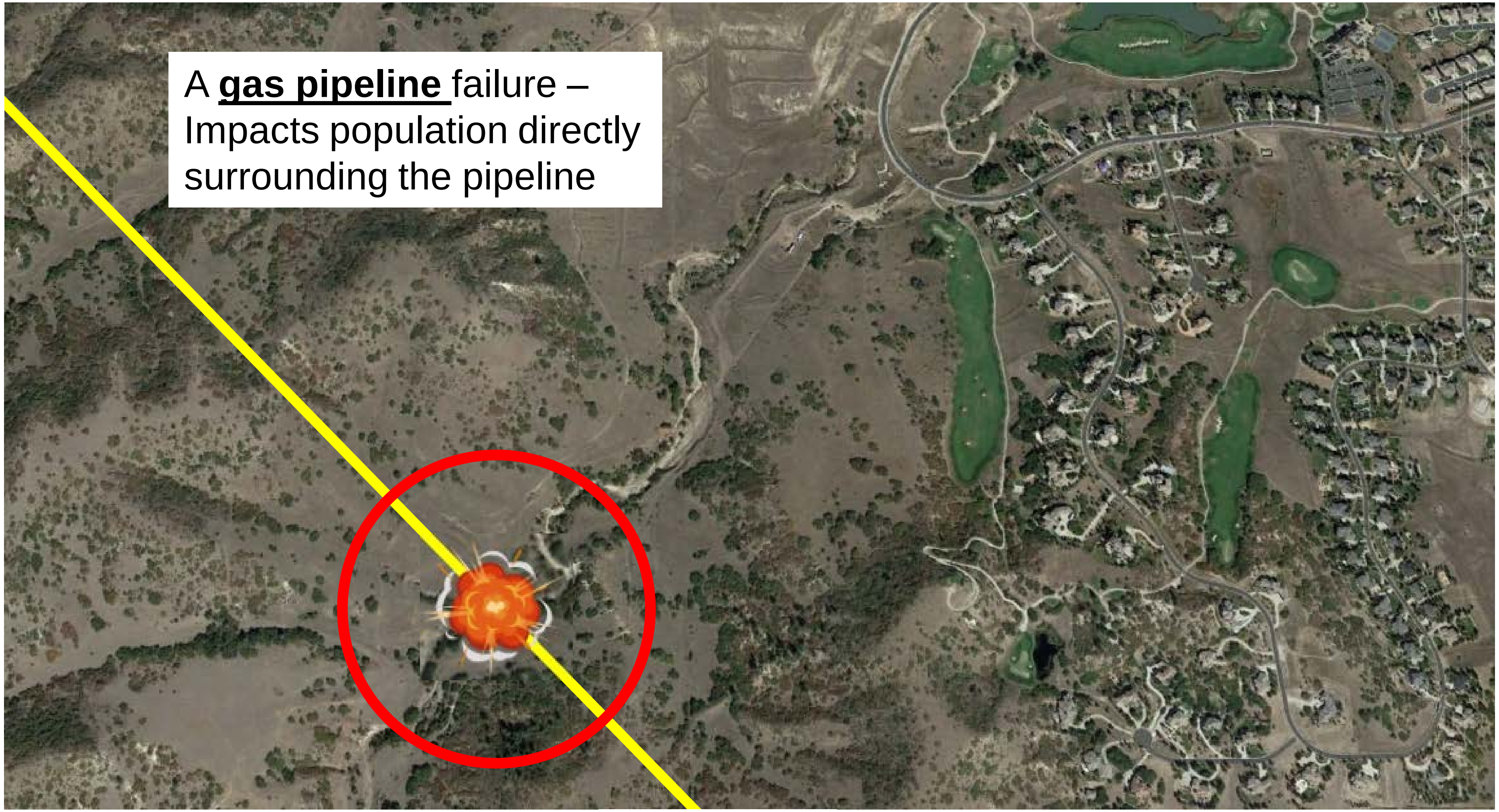
Preventative and Mitigative Measures
- Prevent a Failure
- Mitigate the Consequence

Gas vs Hazardous Liquids High Consequence Areas

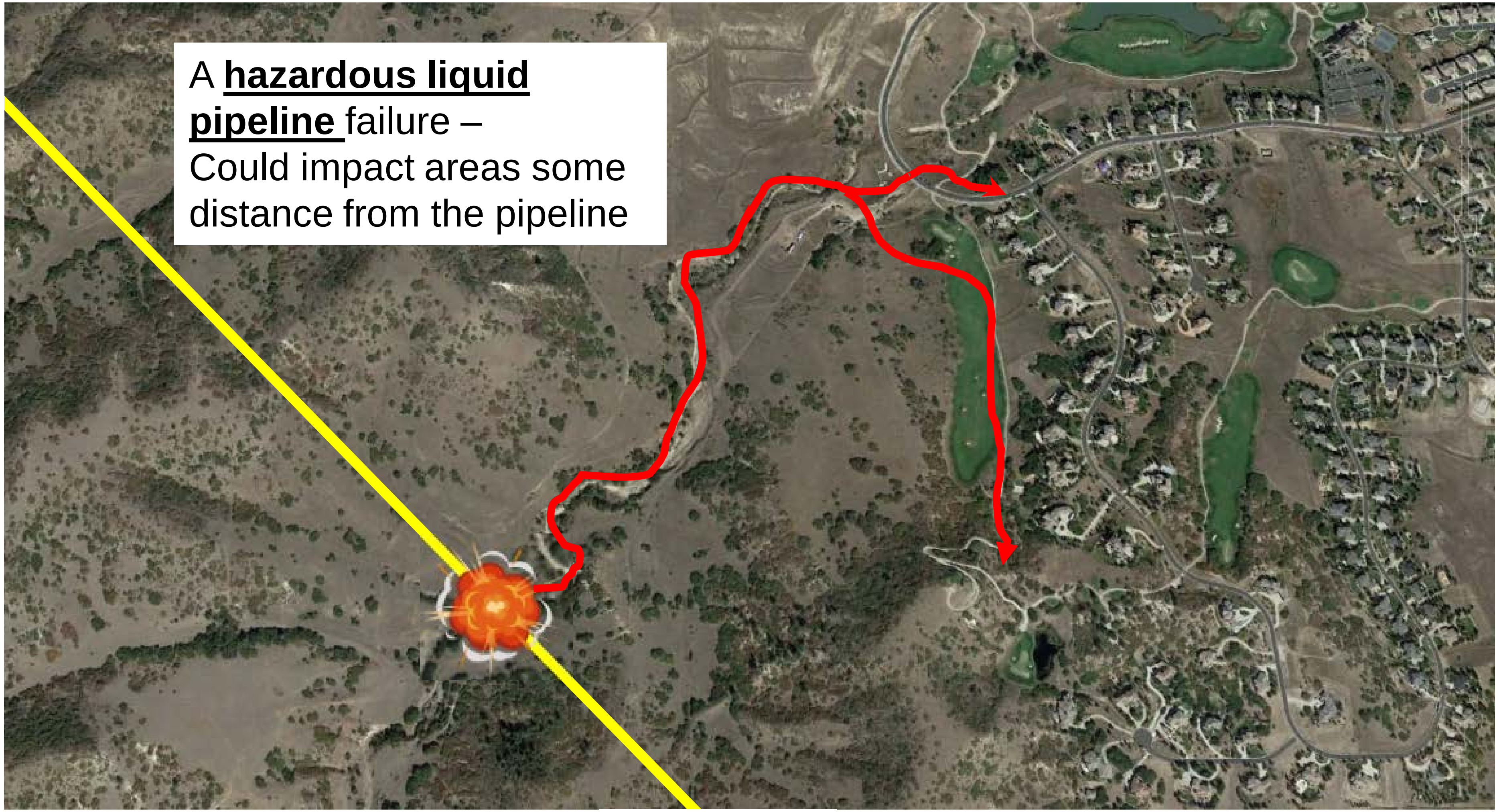


For Educational purposes only - Fictional Pipeline

Gas vs Hazardous Liquids High Consequence Areas



Gas vs Hazardous Liquids High Consequence Areas



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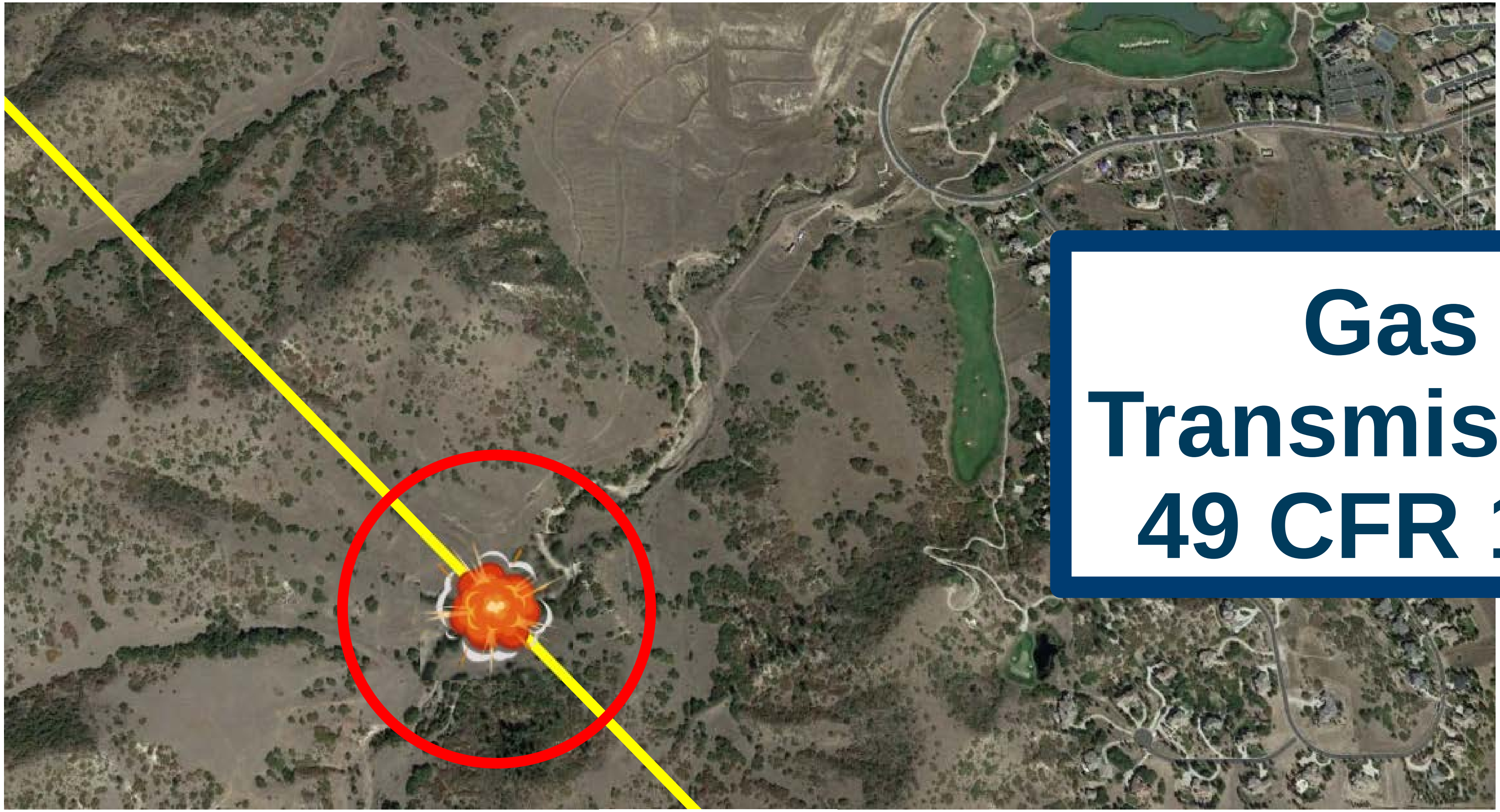


Gas Transmission 49 CFR 192

Gas Transmission Pipelines-
§192, Subpart O, High Consequence Areas

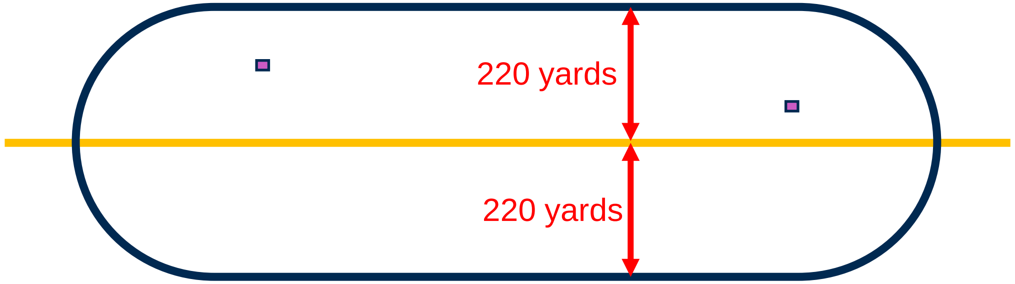
The regulation allows for two methods of determination - Pipeline operators can select either method

	Method 1	Method 2
Impact size determination	Standard 220 yards (660 feet) for all pipe	R = $0.69*\sqrt{pd^2}$ Depends on pipe diameter and operating conditions
What is impacted	Structure count basis And includes well defined outside areas	Specific structure and outdoor area usage
	More Conservative Approach	More Granular Approach

Method 1 – Based on Class Location Units

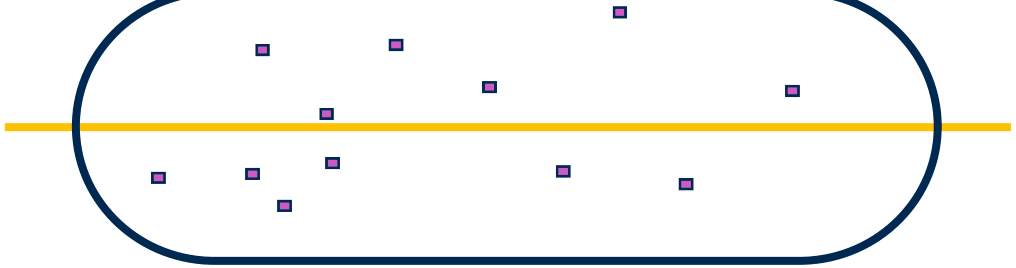
Onshore area that extends 220 yards on either side of the centerline of any continuous 1-mile length of pipeline

Class 1



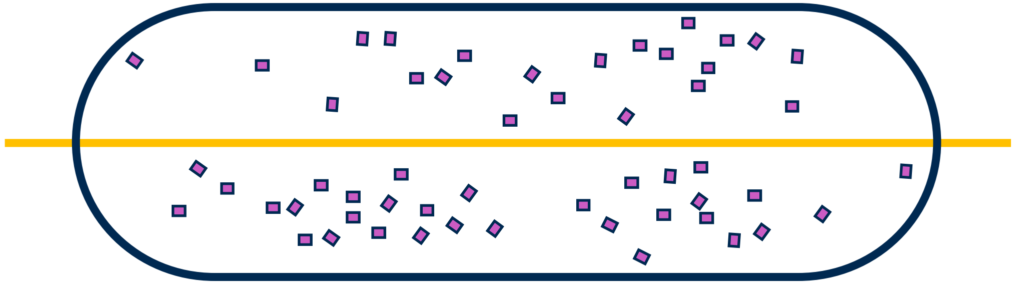
≤ 10 buildings intended for human occupancy

Class 2



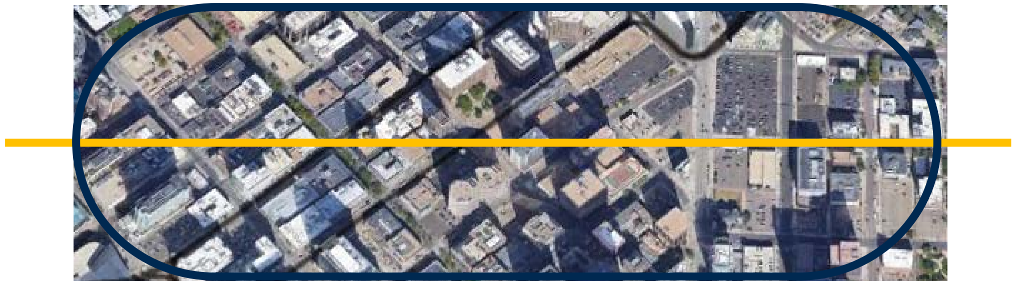
10 < buildings intended for human occupancy < 46

Class 3



≥ 46 buildings intended for human occupancy; or where the pipeline lies within 100 yards of either a building or a small, well-defined outside area

Class 4



Where buildings with four or more stories aboveground are prevalent

Method 2 – Based on Potential Impact Radius

Allows operators to determine pipe specific Potential Impact Radius (PIR) that contains 20 or more buildings intended for human occupancy or an Identified Site

$$R = 0.69^{*}\sqrt{pd^2}$$

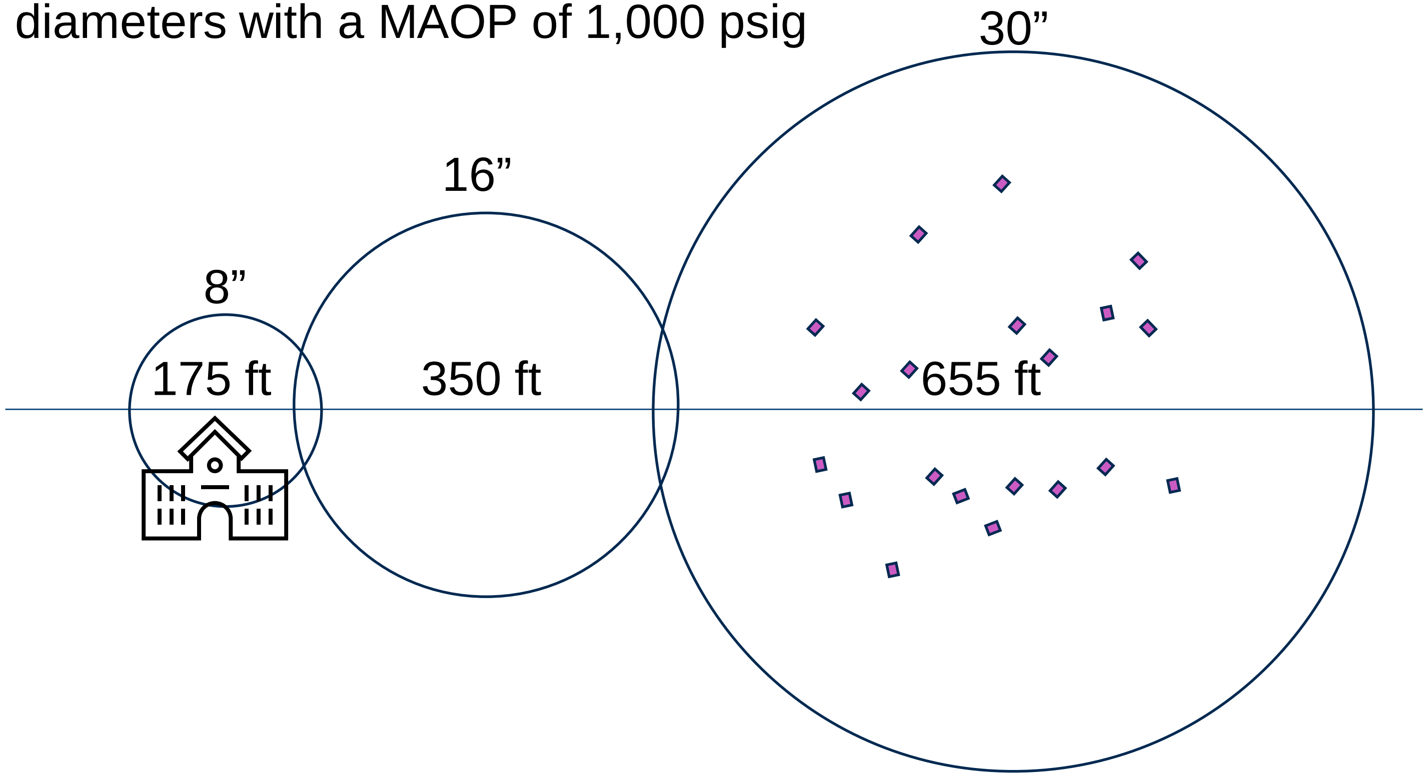
R = PIR (in feet)

p = Maximum Allowable Operating Pressure (MAOP) in pounds per square inch gauge (psig)

d = Nominal Diameter of the pipeline (inches)

**constant applicable to natural gas - Section 3.2 of ASME B31.8S-2001*

Example PIRs for different pipe diameters with a MAOP of 1,000 psig



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Gas Integrity Management - §192.935(a)

For HCA areas operators MUST:

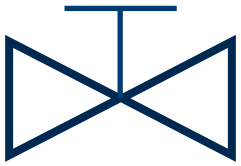
- Develop and implement a risk-based process to identify additional preventative and mitigative measures (P&MMs)

Risk of Failure = **Likelihood Failure** × **Consequence Failure**

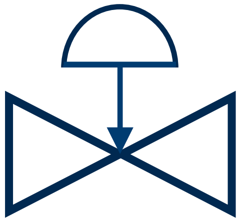
Preventative Measure: Reduces Likelihood

Mitigative Measure: Reduces Consequences

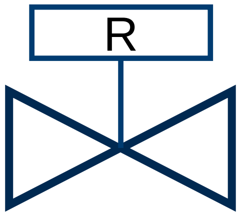
Gas Integrity Management - Automatic Shut-Off Valves or Remote-Control Valves



Manual Valve –
Hand operated valve.
*Not considered an ASV or RCV



Automatic Shut-Off Valve (ASV) –
Valve equipped with actuators to trigger closer automatically based on predetermined criteria



Remote Control Valve (RCV) –
Operated from a remote location
(e.g., control room)

Gas Integrity Management – §192.935(c) ASVs or RCVs

For HCA areas operators MUST:

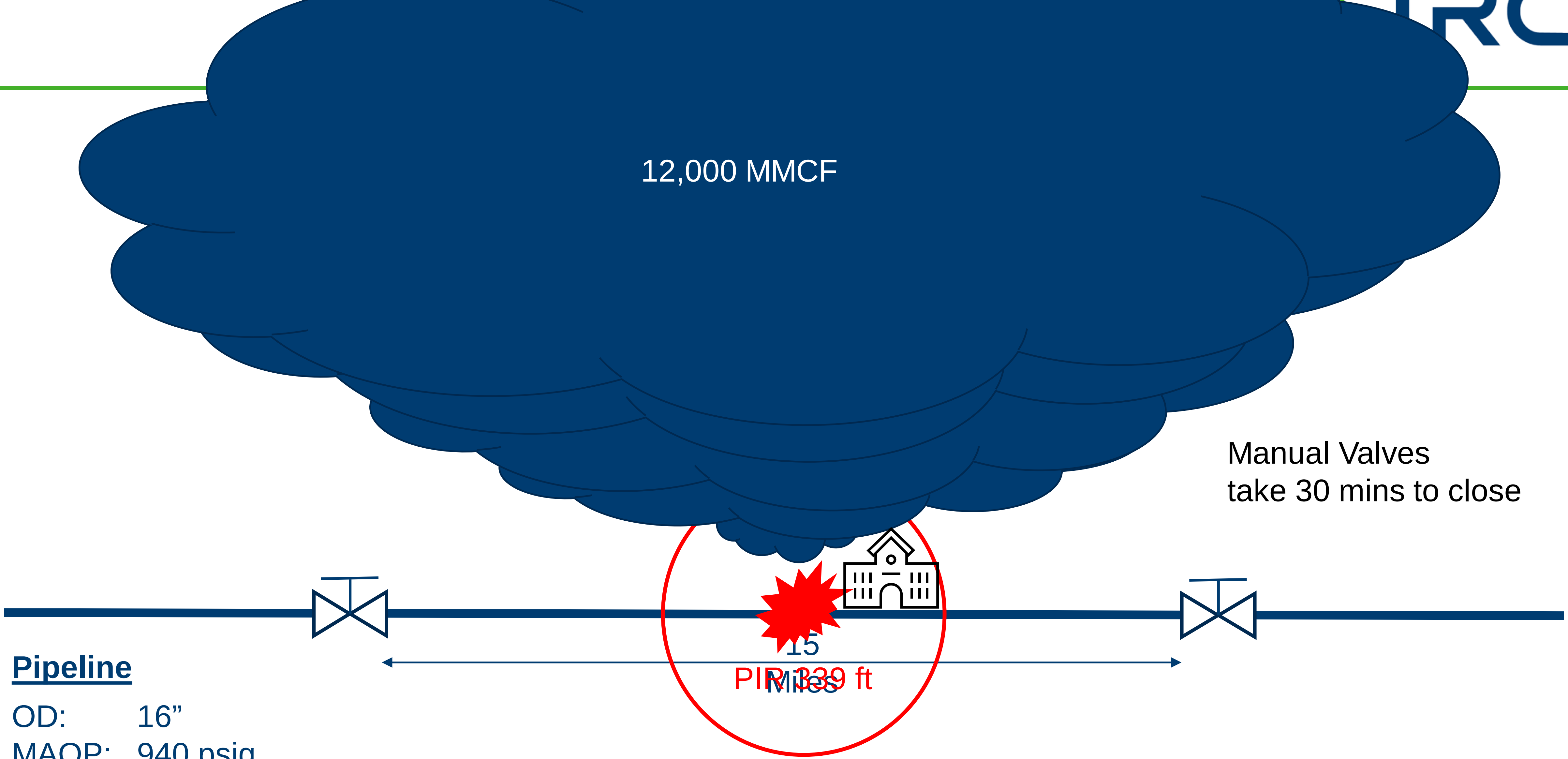
- Use a risk-based process for determining if additional ASVs or RCVs are an efficient means of adding protection to potentially affected HCAs
  - Process must require analysis of the following factors:
    1. swiftness of leak detection and pipe shutdown capabilities
    2. the type of gas being transported
    3. operating pressure
    4. the rate of potential release
    5. pipeline profile
    6. the potential for ignition
    7. location of nearest response personnel
- System-wide or generic studies may be used with appropriate justification

Note: An operator is required to install an ASV or RCV if the operator determines that it would be an efficient means to protect an HCA in the event of a gas release (PHMSA FAQ-86)

Gas Integrity Management – §192.935(c) Modeling Approaches

- Consequence analyses focus entirely on impacts to population
- Typically includes a full rupture (guillotine) with the gas rapidly escaping
- Ignition is assumed with a resulting fireball
- Modeling typically conducted with the application of geospatial platforms and other commercial applications
- Potential release volume includes the following factors:
  - Pipeline diameter
  - Flow rate
  - Time to detect a rupture and shutdown down pumps and close valves
  - Valve types and locations

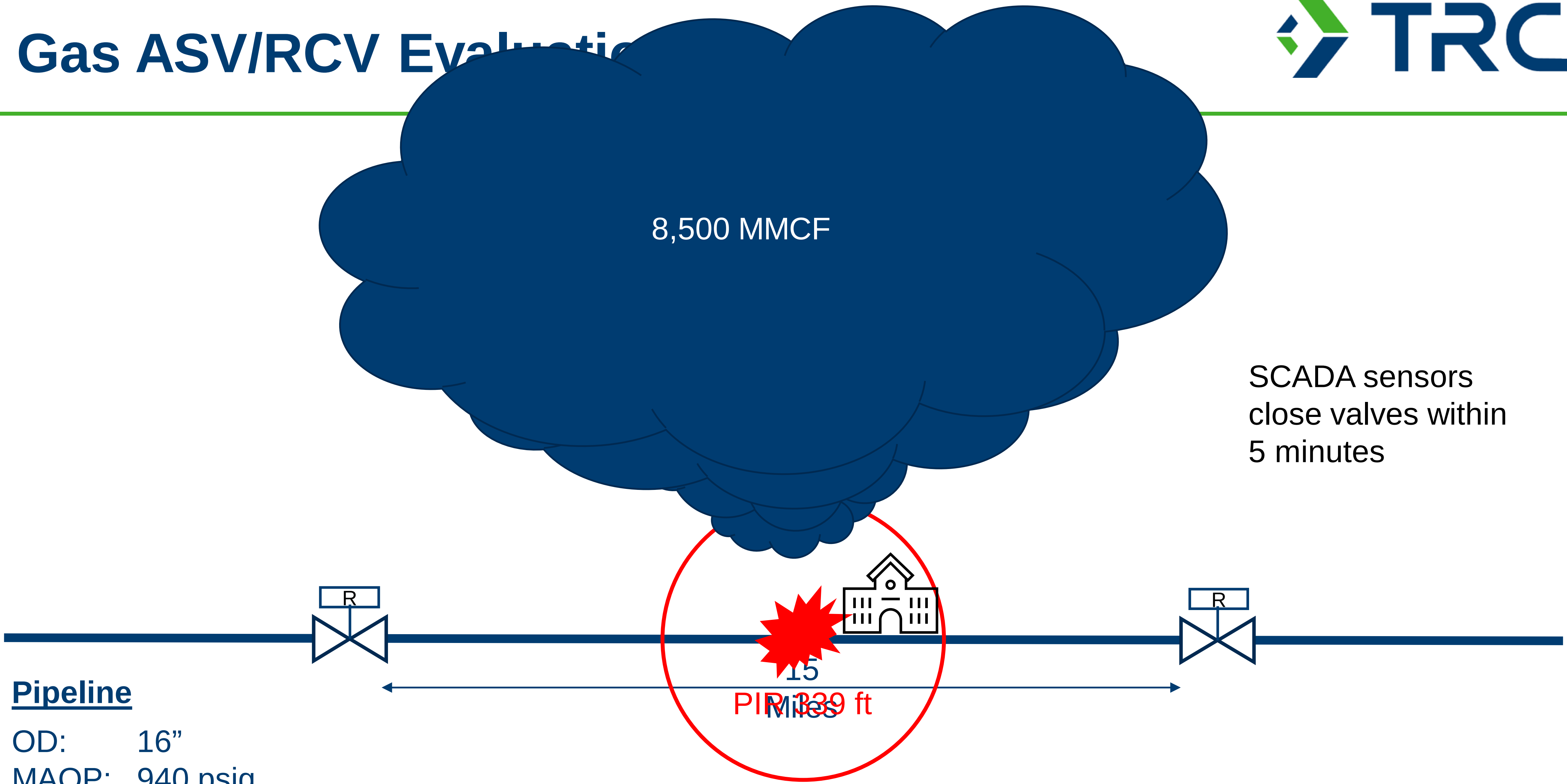
Gas ASV/RCV Evaluatio



Pipeline

OD: 16”
MAOP: 940 psig

Gas ASV/RCV Evaluatio



SCADA sensors close valves within 5 minutes

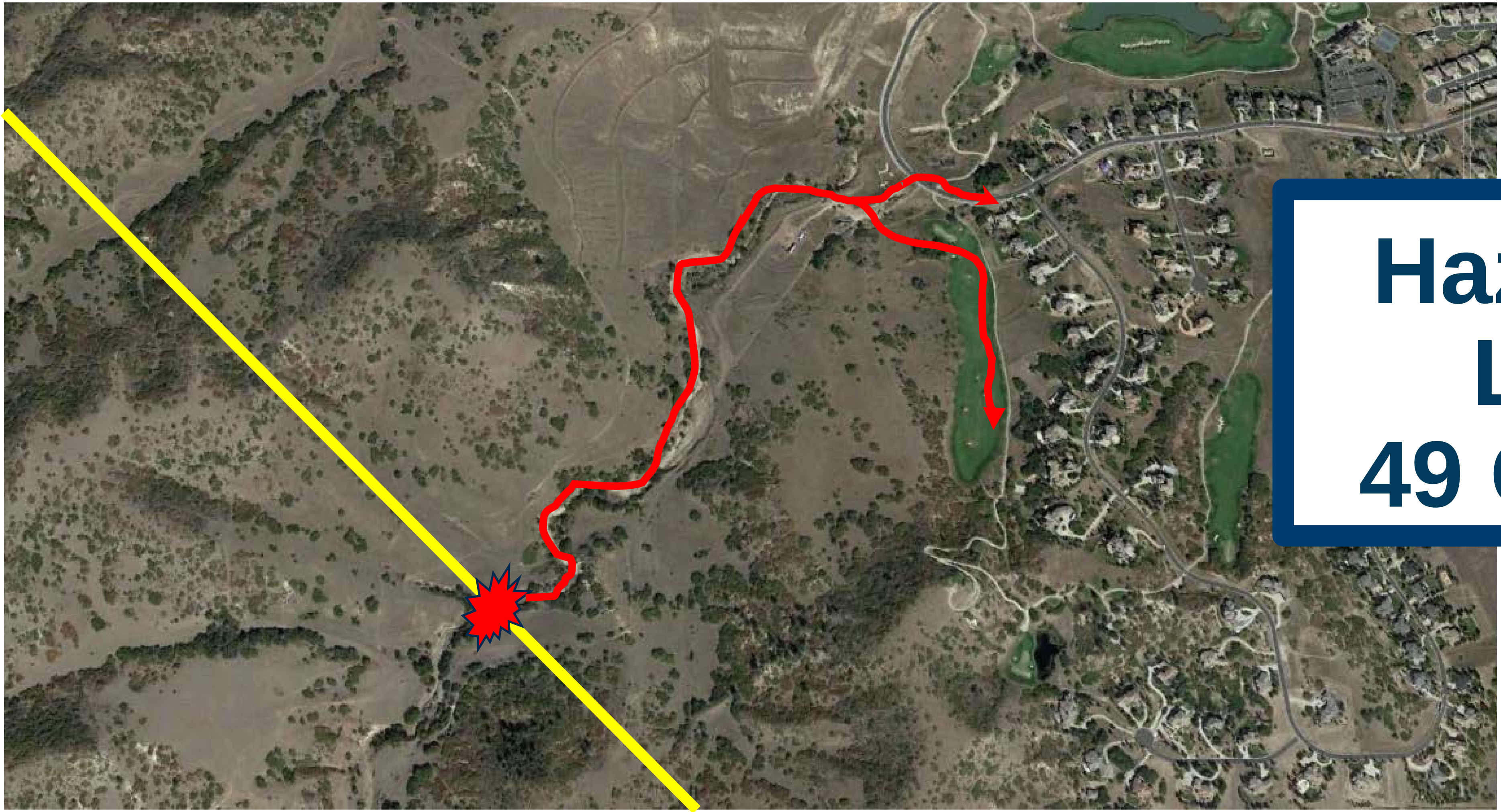
Pipeline

OD: 16”
MAOP: 940 psig

Gas Integrity Management – §192.935(c) Considerations

Impacts	Benefits	Added Risks and Considerations
Human*	• Hazard reduction to public and first responders	• Construction safety risks to company and 3rd party personnel
Environment	• Reduction in volume of gas released to the environment in the event of failure/repair	• Construction and disruption to area (e.g., stormwater runoff) • Leaks from valve assemblies
Pipeline System	• Reduction in volume of gas released upon system repair	• Introduction of threats to current pipeline system (e.g., destabilization of soils)

* Initial population impacts will be immediate and unchanged with valving

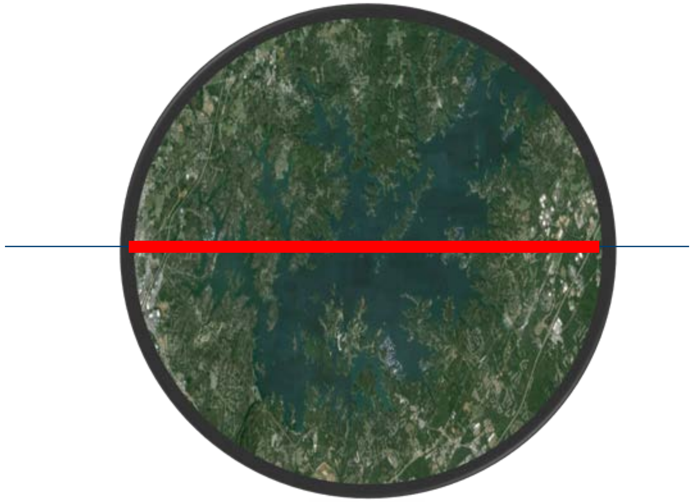


Hazardous Liquid
49 CFR 195

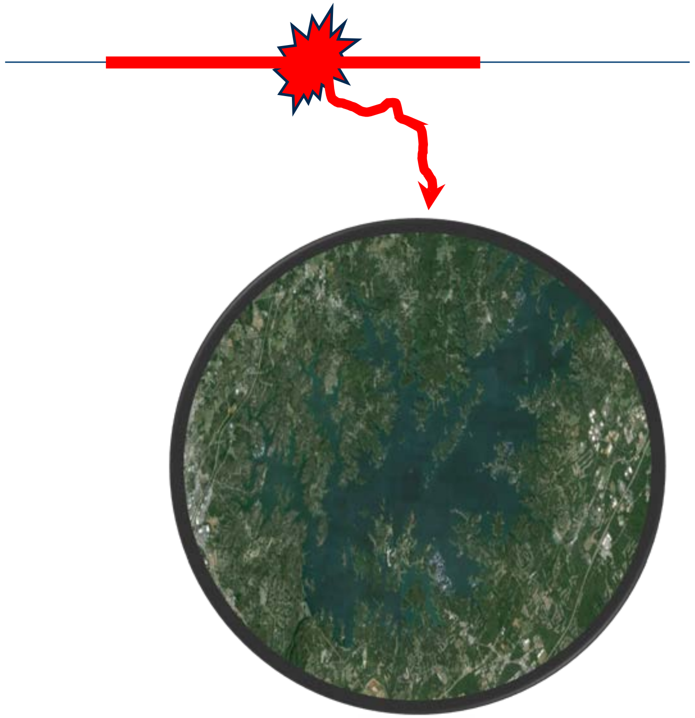
Hazardous Liquids Pipelines –
§195.452 High Consequence Areas

Code Citation	§195.450
National Pipeline Mapping System	High population and other populated areas
	Unusually sensitive areas
	Commercially navigable waterway

Hazardous Liquids Pipelines – §195.452 High Consequence Areas

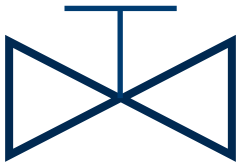


Direct Impact



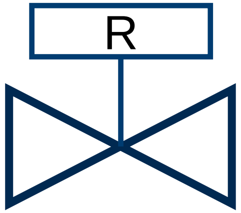
Indirect Impact

Hazardous Liquid Integrity Management – Emergency Flow Restricting Device (EFRD)



Manual Valve –
Hand operated valve.
*Not considered an EFRD

Check Valve – a valve that only flows in a single direction



Remote Control Valve –
Operated from a remote location (e.g., control room)

Hazardous Liquid Integrity Management - §195.452(i)(4) – EFRDs

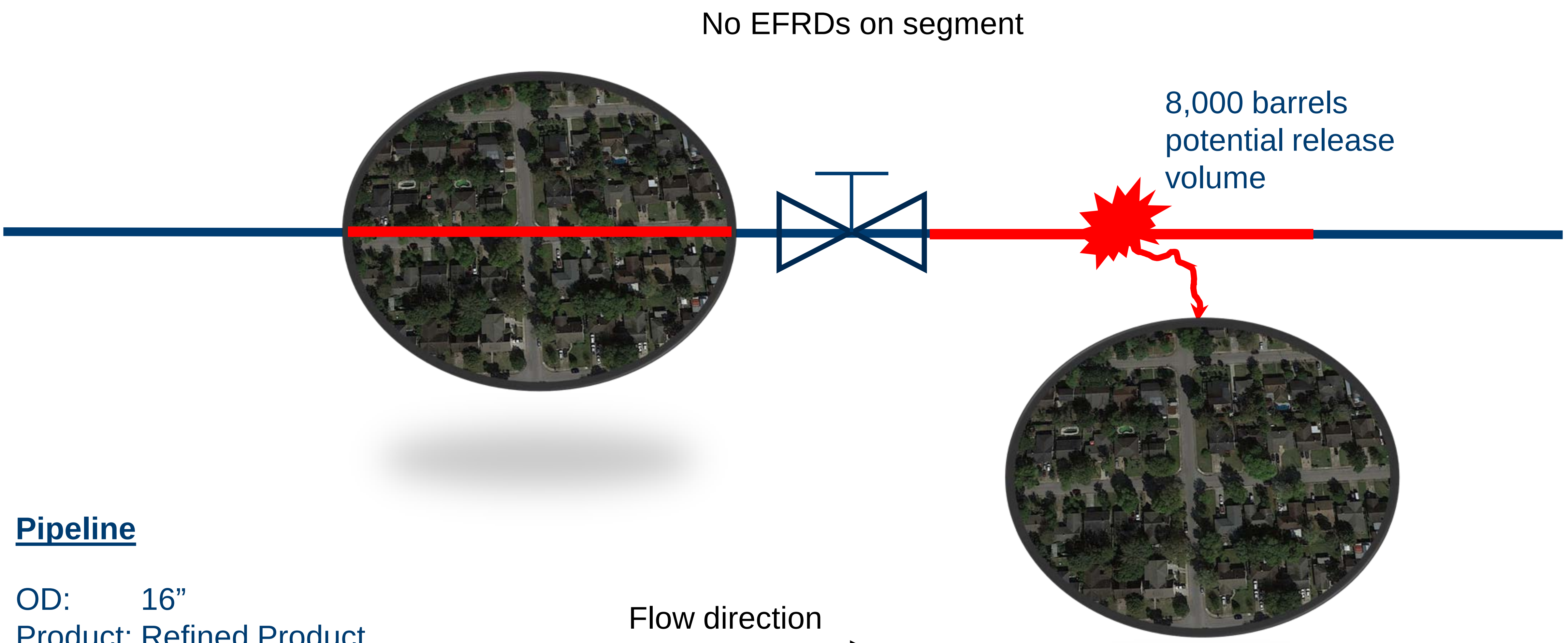
Advanced geospatial modeling capabilities allow for precision analysis accounting for local features such (e.g., storm drains, culverts)

Required considerations:

1. Swiftness of leak detection/pipeline shutdown capabilities
2. Type of commodity carried
3. Rate of potential leakage
4. Volume that can be released
5. **Topography/pipeline profile**
6. Potential for ignition
7. Proximity to power sources
8. Location of nearest response personnel
9. **Specific terrain between the pipeline segment and the high consequence area**
10. Benefits expected by reducing the spill size

Note: If an operator determines that an EFRD is needed, it must install the EFRD

Hazardous Liquid EFRD Evaluations
Base Case – Current state

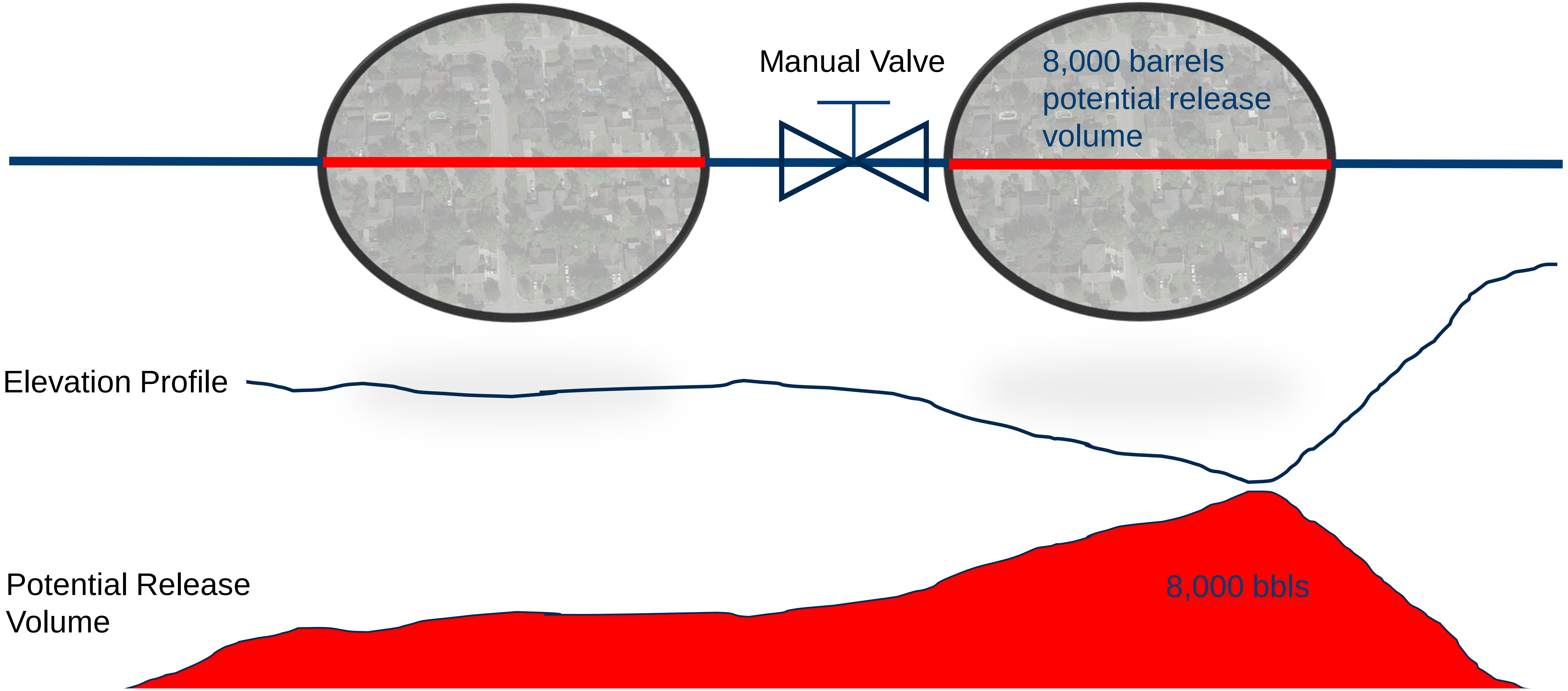


Pipeline

OD: 16”
Product: Refined Product

Flow direction

Hazardous Liquid EFRD Evaluations
Base Case – Current state



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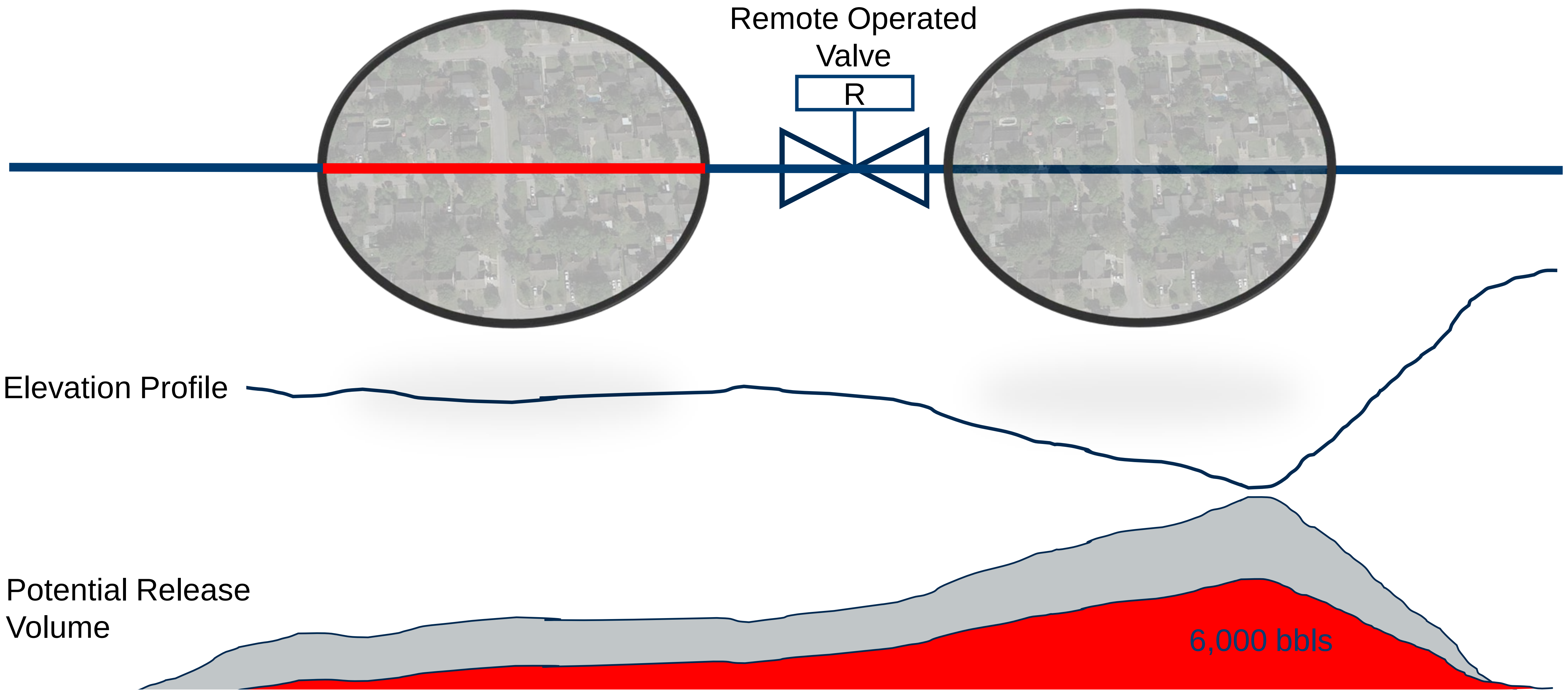
Hazardous Liquid EFRD Evaluations
Scenario 1 – Convert to remote valve



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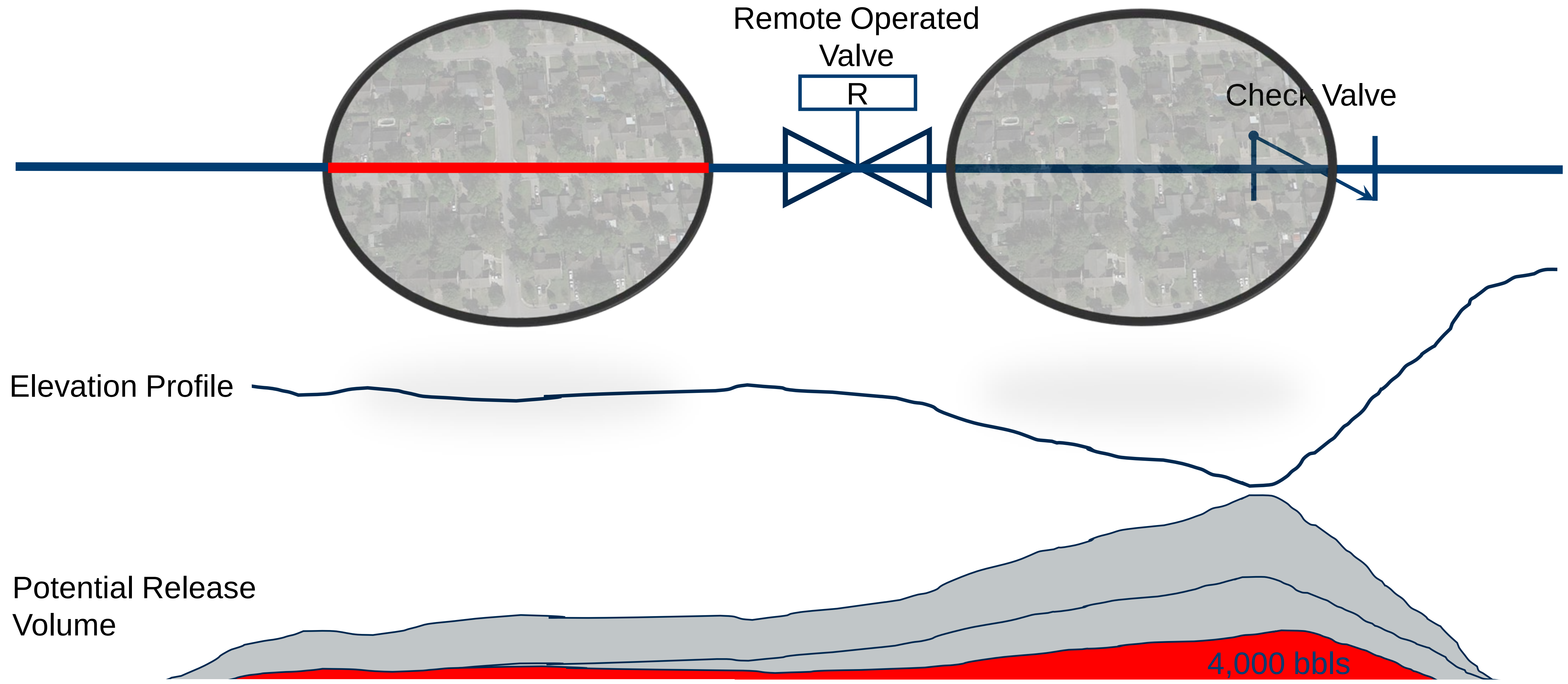
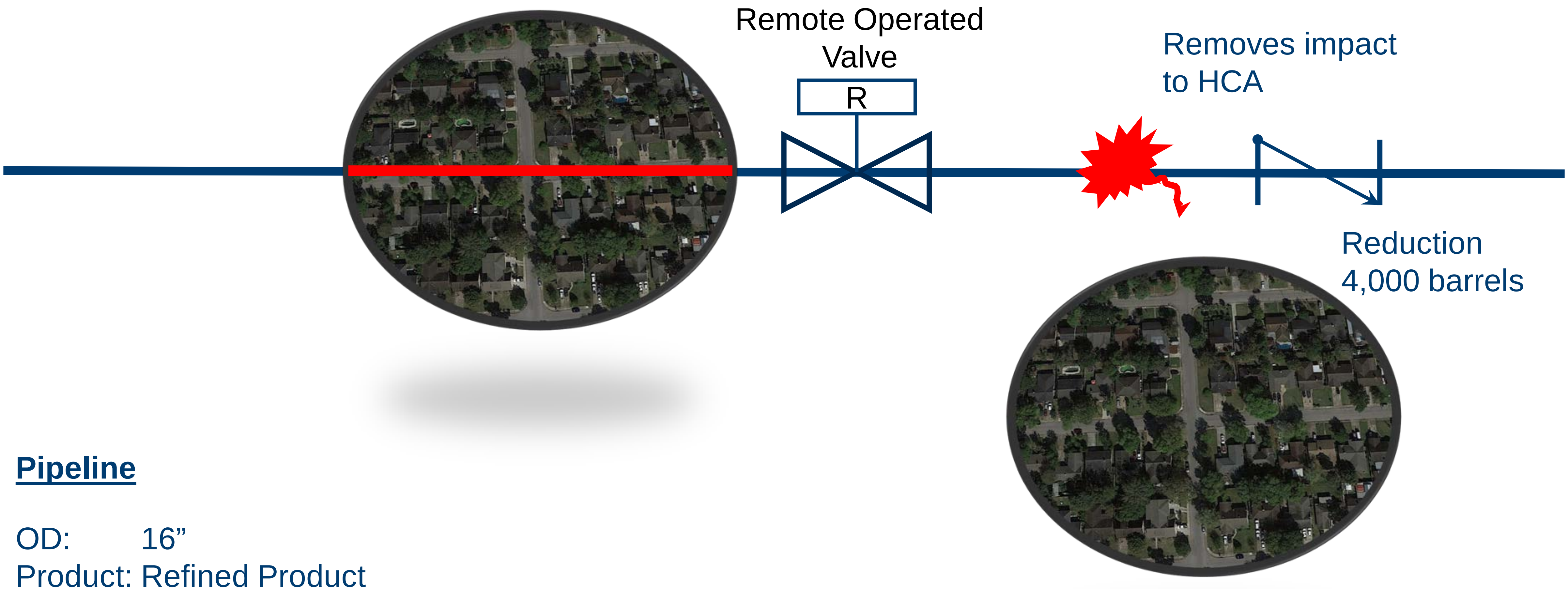
Hazardous Liquid EFRD Evaluations
Scenario 2 – Remote valve with check valve



Hazardous Liquid EFRD Evaluations

Scenario 2 – Remote valve with check valve

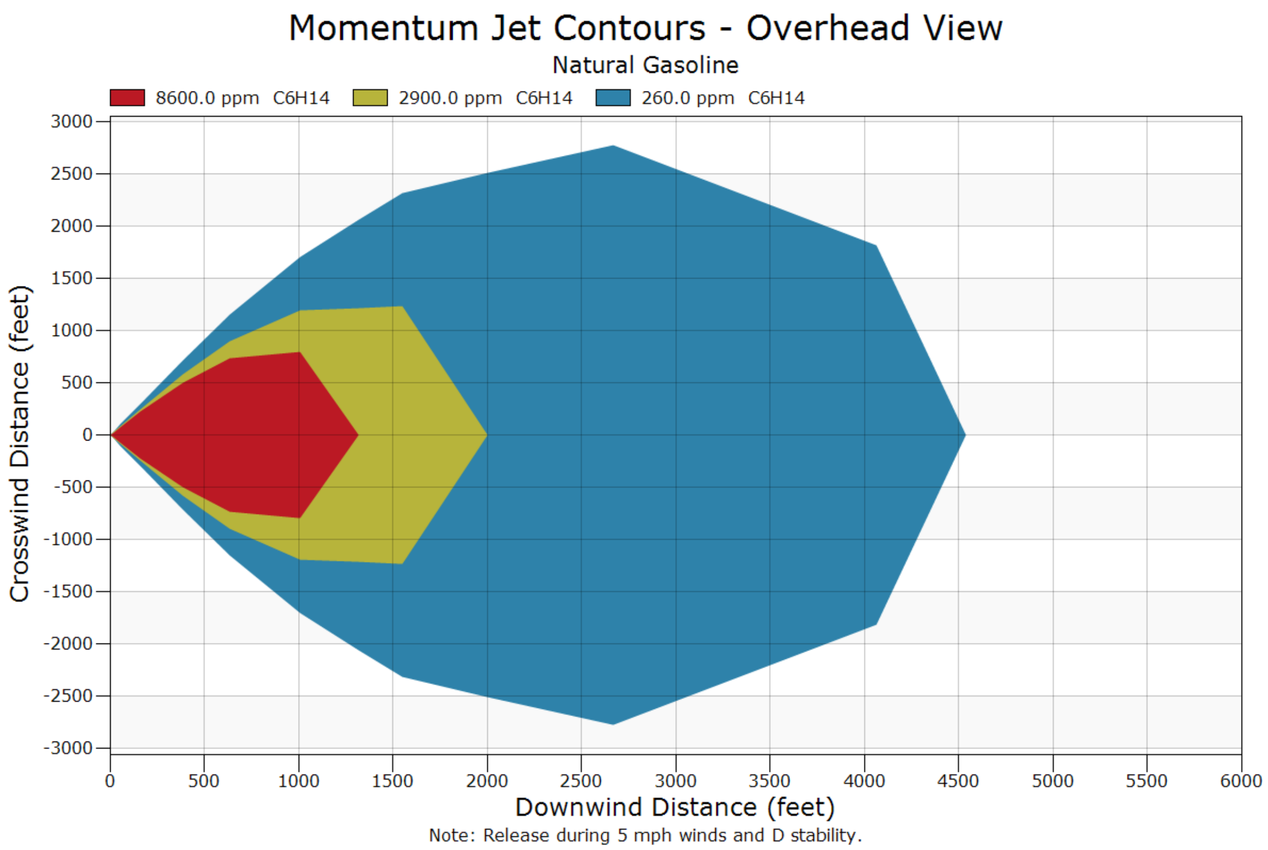


<u>Pipeline</u>

OD: 16”
Product: Refined Product

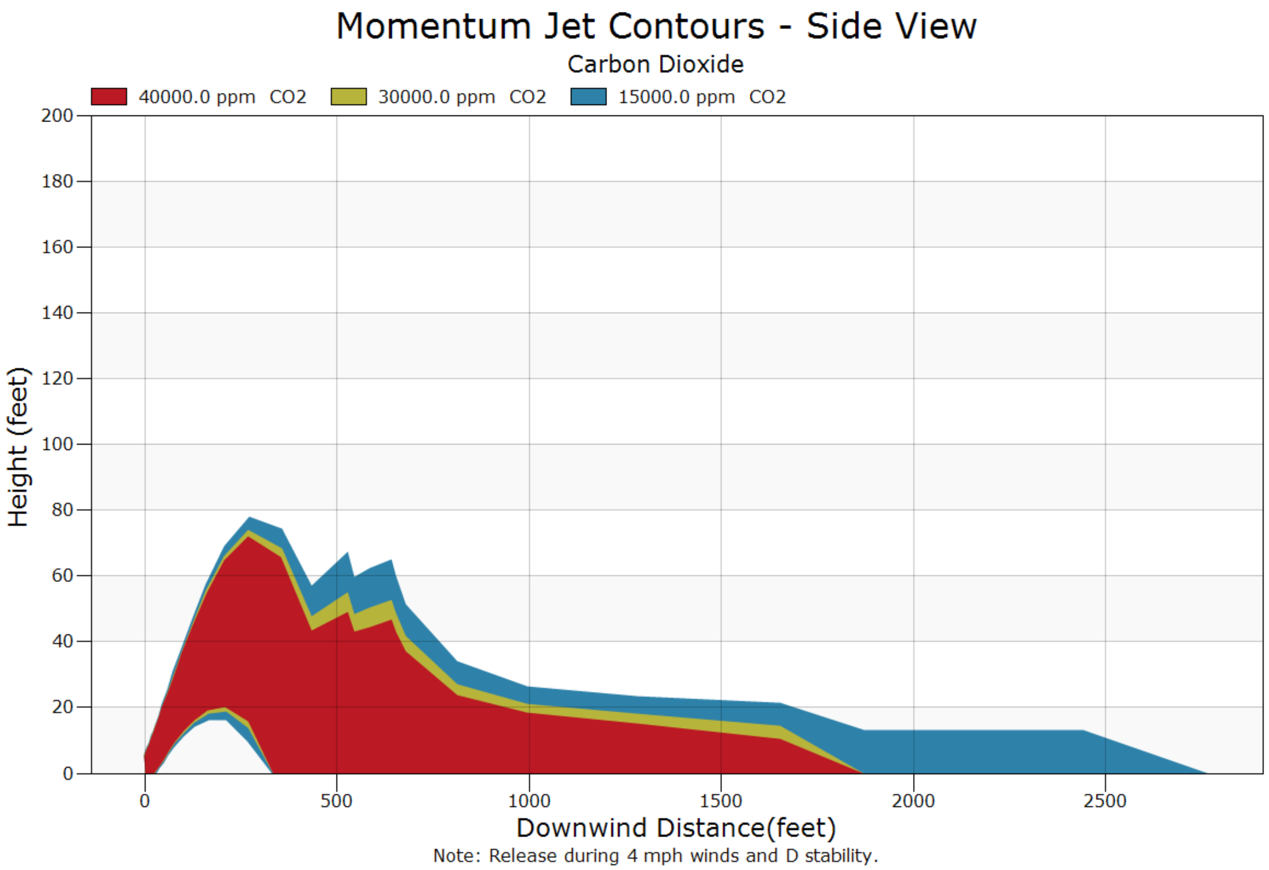
Hazardous Liquid Integrity Management - §195.452(i)(4) – High Volatile Liquids (HVLs)

- HVL examples
  - NGLs
  - Condensate
  - Ethylene
- Ignition/overpressure
- Toxicity/asphyxiation hazards
- Complexities
  - Behaves as a gas when released
  - Some have a liquid phase released
- Requires appropriate modeling techniques to determine potential impacts of a release



Hazardous Liquid Integrity Management - §195.452(i)(4) – CO_2

- CO_2 transported as a liquid in a supercritical or liquid state
  - Behaves as a gas when released, denser than air
  - Asphyxiation hazard when in sufficient concentrations (30,000 to 40,000 ppm)



Hazardous Liquid Integrity Management - §195.452(i)(4) – EFRDs Considerations

Impacts	Benefits	Added Risks and Considerations

Human	• Hazard reduction to public and first responders
	• Protection of water resources
	    • Drinking water
	    • Navigable waterways
		• Construction safety risks to company and 3rd party personnel

Environment	• Emissions reductions for CO_2 and HVL service segments • Reduction in release volume to environmentally sensitive areas, particularly streams, rivers, waterways	• Construction and disruption to area (e.g., stormwater runoff) • Leaks from valve assemblies

Pipeline System	• Reduction in potential lost volume
	• Reduction in worst case discharge
		• Introduction of threats to current pipeline system
		    • Pressure transients (water hammer)
		    • Leaks
		    • Above ground facilities can increase third party and security risks

Takeaways and Conclusions

- Pipeline operators must determine the necessity of additional valves (*RCVs, ASVs, and EFRDs)* through integrity management (IM)
- For natural gas pipelines, initial population impacts are unchanged regardless of valve closure time or location (distance between valves)
- Risk benefit of installation or automation of new or existing valves is shown to be more beneficial to hazardous liquids pipelines
- Pipeline operators should continue use of advanced geospatial consequence and valve analysis tools
- Pipeline operators should continue to implement mitigative measures to reduce the consequence of failure through risk reduction activities (e.g., improved leak detection)
- Installation or automation of valves reduce consequence of a failure under certain scenarios, however, the safety gained may not warrant the additional safety risks

Takeaways and Conclusions

Specific to HVL and CO_2 Pipelines:

- Appropriate modeling techniques must be employed to determine consequence impacts or conduct valve studies
- The use of advanced modeling techniques is critical for dense gases (CO_2) and should incorporate terrain in air dispersion modeling and hazard distance determinations
- During model analysis, selection and evaluation of toxicity threshold valves require careful consideration

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Questions?

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