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UPSIDE

Upstream Pipeline Safety, Inspection, and DEtection

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Study Team

- Joint team CSU & UT Arlington
- CSU
  - PI: Zimmerle
  - Administrative lead: Kristine Bennett
  - Lead scientist: Stuart Riddick
  - Research assistant: Kevan Cameron
  - Graduate students: Fancy Cheptonui
- UTA
  - Co-PI: Kathleen Smits
  - Post Doc: Younki Cho
  - Graduate Students: Michelle Schwartz, Nate Steadman, Shanru Tian, Navodi Jayarathne

UPSIDE Project Objectives

- Funded by
  - *The Mark Martinez and Joey Irwin Memorial Public Projects Fund*
  - Colorado Oil and Gas Conservation Commission (COGCC)
- Focus on upstream pipeline leaks
  - Flowlines – well to well pad
  - Gathering lines – well pad to compressor station
- **Objectives:**
  - Investigate and document current leak detection practices for flow and gathering lines
  - Investigate the effect of heavier hydrocarbons
  - Improve understanding of performance of existing/emerging leak detection methods
  - Develop recommendations for flow and gathering line monitoring

Rationale

- Currently
  - No simple method to estimate leakage rate from pipelines
  - Advanced instrumentation may not be readily available for routine field applications
  - … and advanced instrumentation requires sophisticated measurement processes

- Proposed approach
  - Relatively easy to calculate
  - Based on easily measured field parameters that industry is (mostly) already taking
  - Estimate well enough to gauge level of concern
  - Applicable to wide range of subsurface conditions and surface conditions

Overall Plan

Tasks

1. Leak Characterization → METEC test bed experiments
   - Characterize the size and concentration of the plume, in 3D, above a leak using high-precision methane analyzers
2. Variability in leak characteristics caused by gas composition → METEC
   - map out the divergence between C3+ hydrocarbons and C1-C2 hydrocarbons in a METEC testbed
3. Field Validation experiments → temporary field testbeds
   - Methods as in (2) + industry's conventional leak detection survey using established protocols,
4. Solution testing → field *or* METEC test beds
   - Test no more than four technologies, including industry-standard methods
   - Develop assessment tools and/or guidance on acceptance of new methods

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Methane Emissions Technology Evaluation Center

Major Facilities

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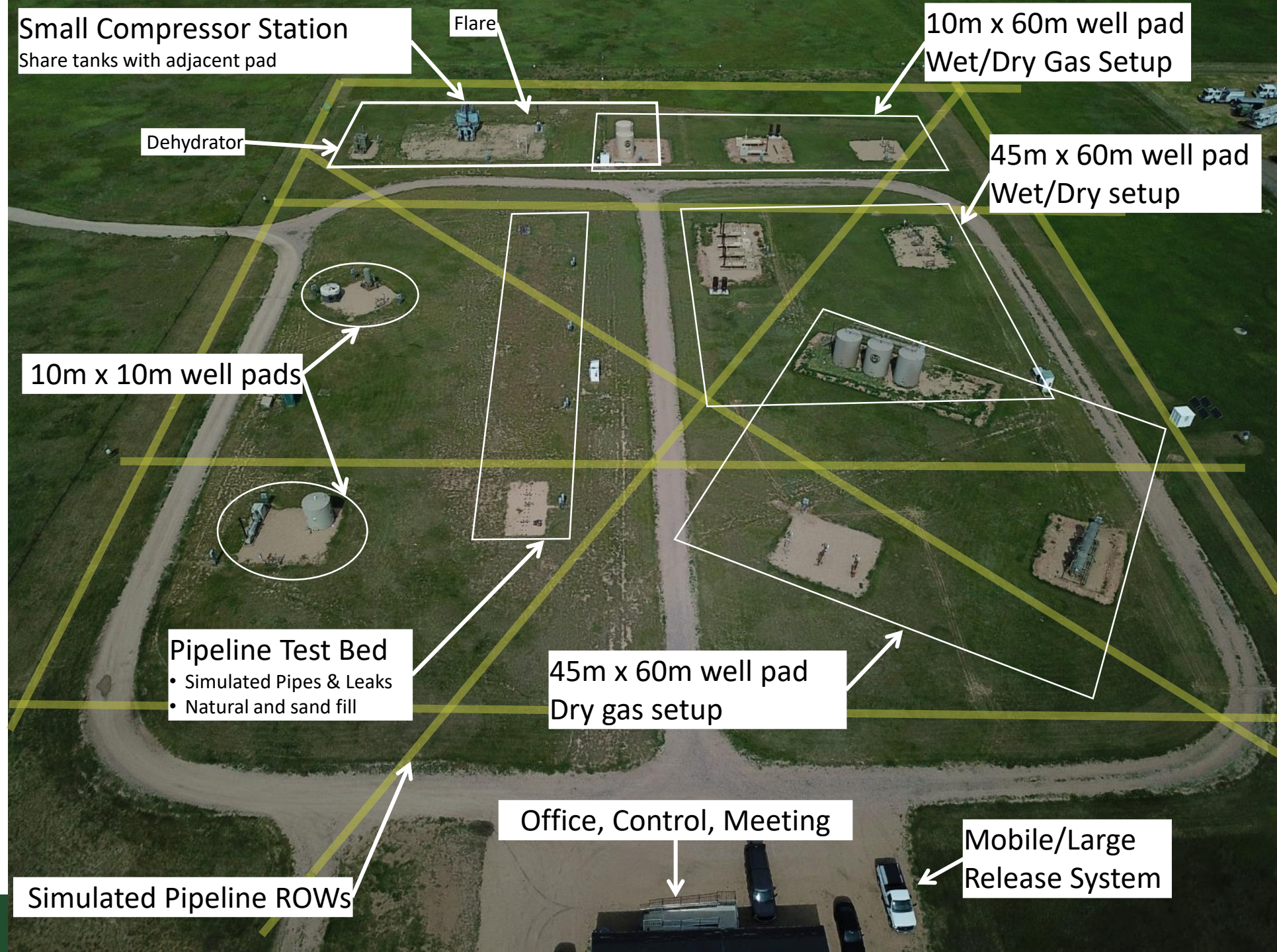
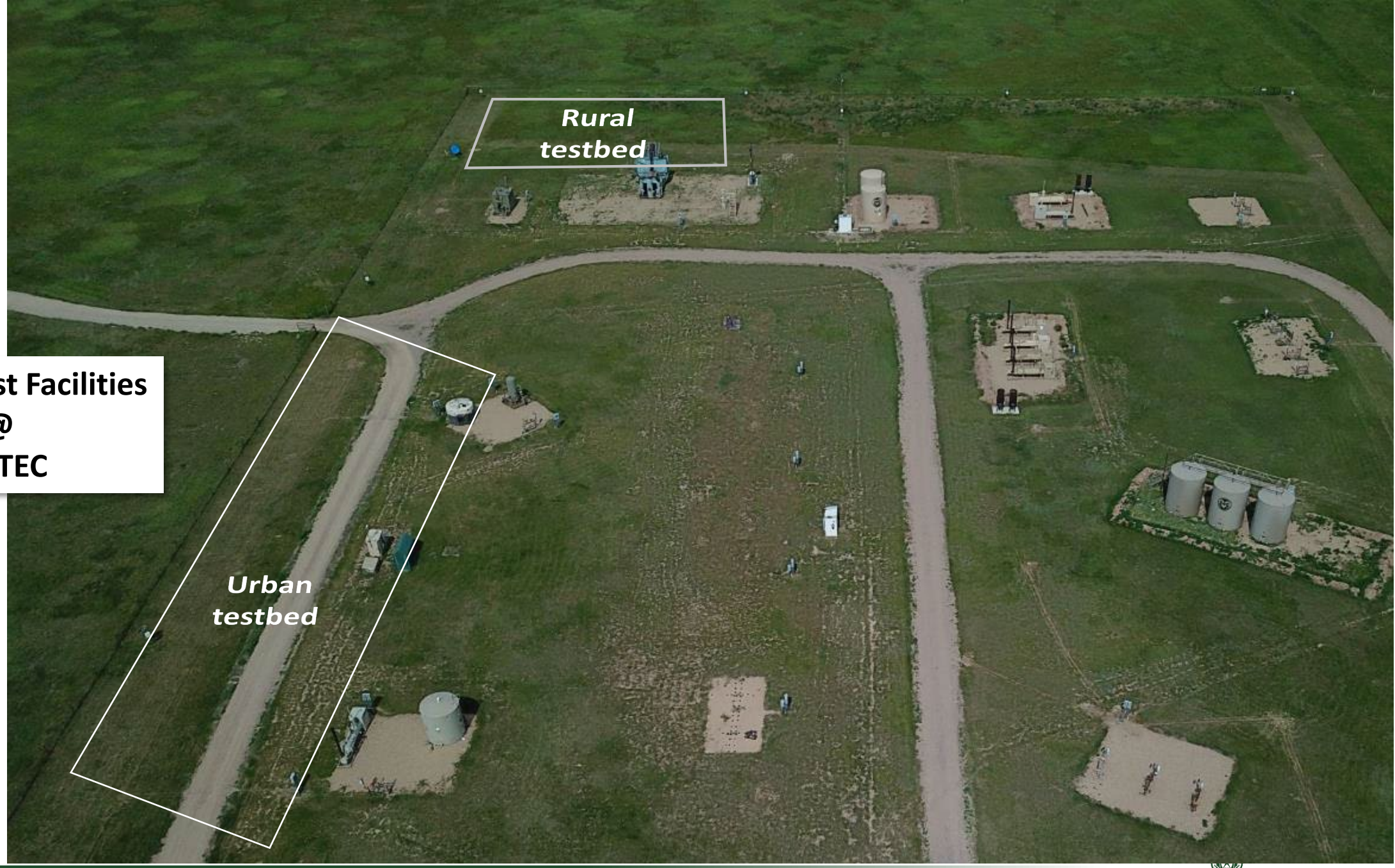
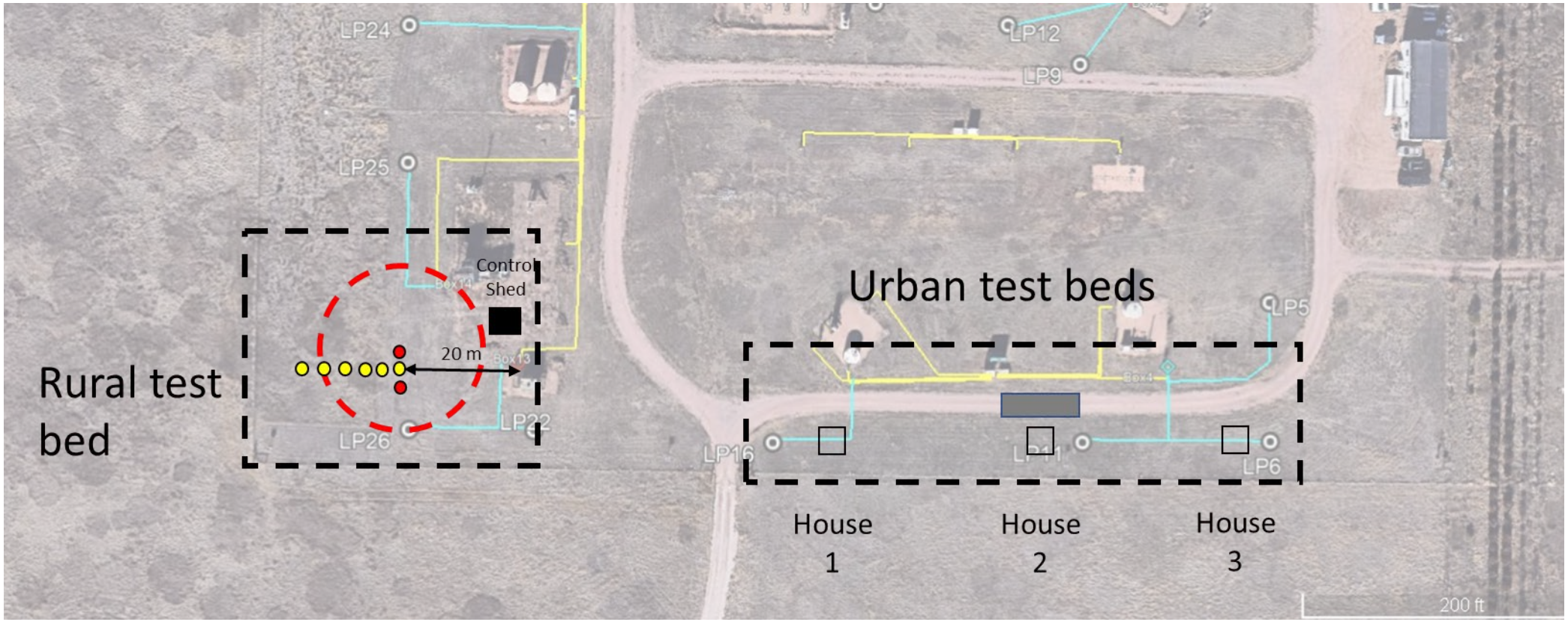
arpa·e CHANGING WHAT'S POSSIBLE



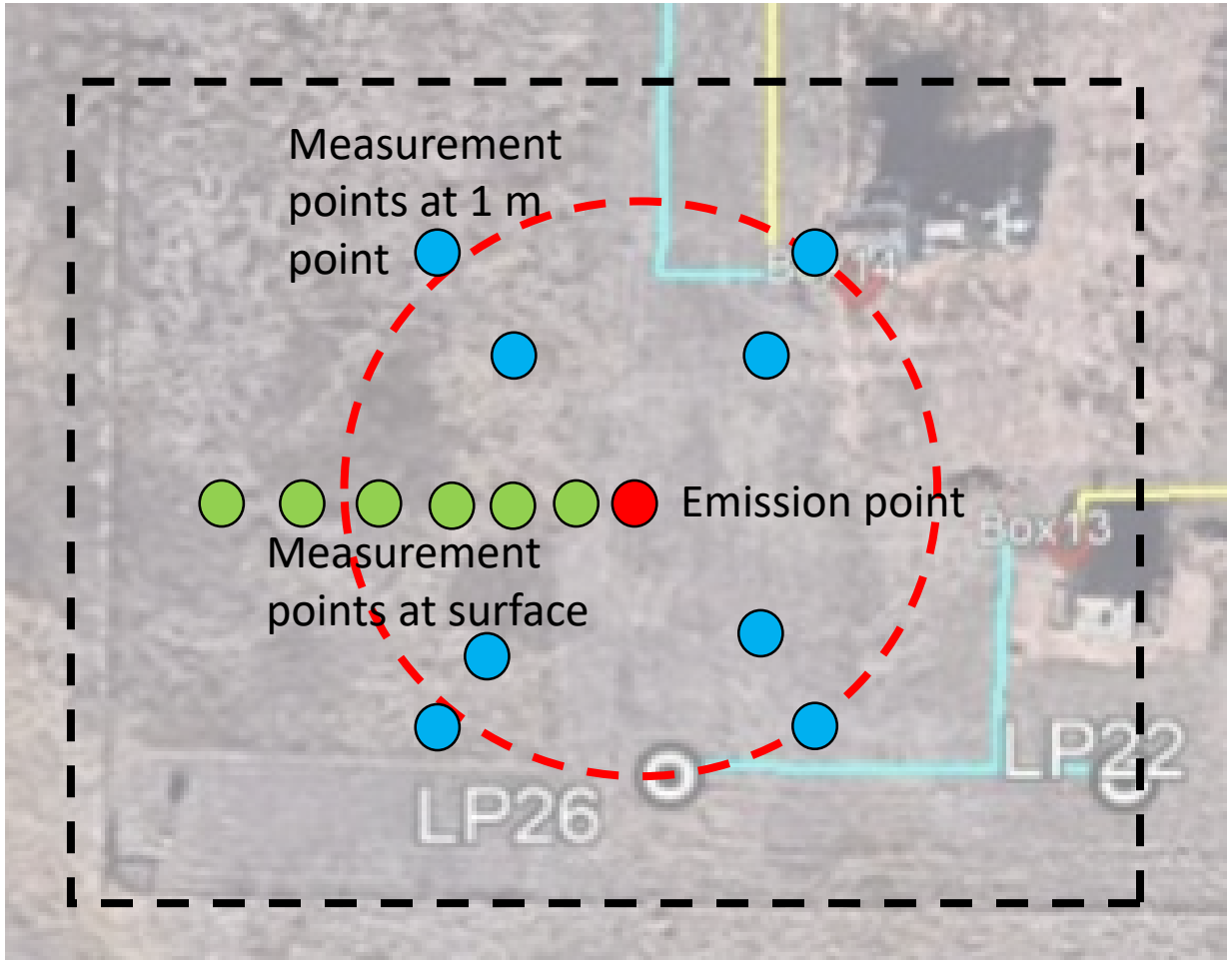
UPSIDE Test Facilities @ METEC



New METEC Testbeds



METEC R-PLUME Rural test bed
Measuring above surface



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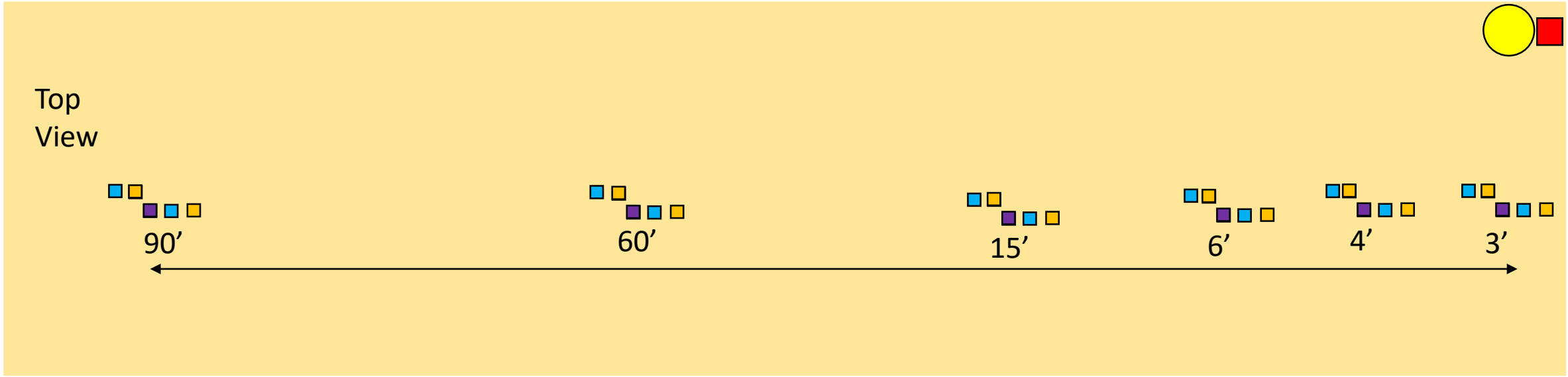
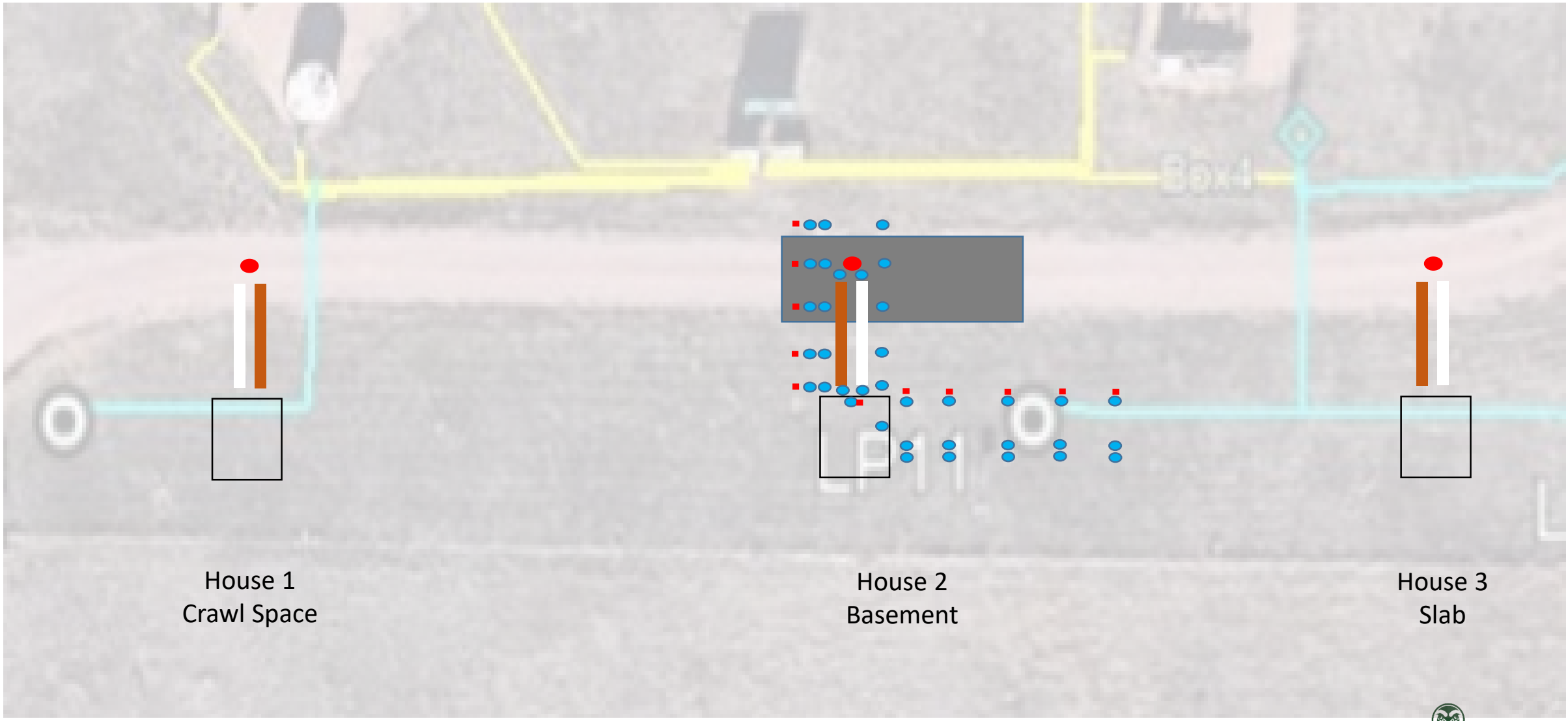
METEC R-PLUME Rural test bed
Measuring below surface



- CH_4 sensor at 1’
- CH_4 sensor at 3’
- CH_4 sensor at 5’
- Emission point at 3’ and 6’

Urban Testbeds

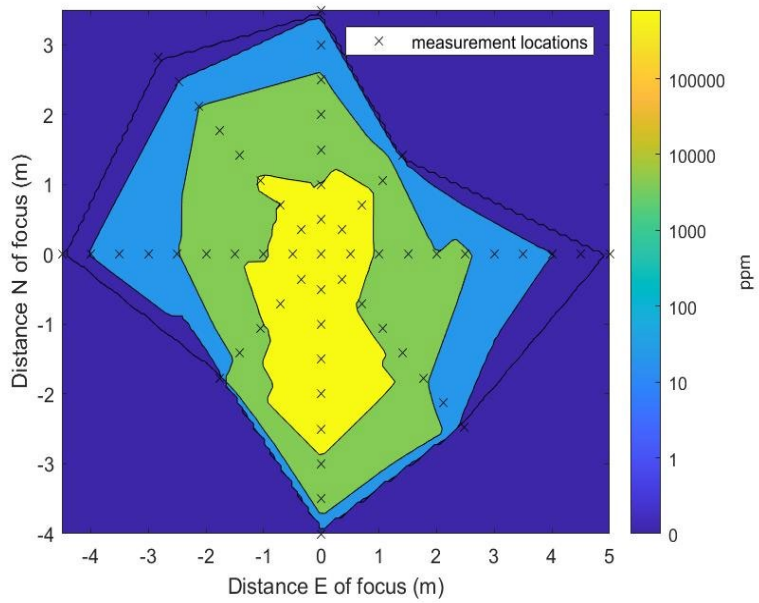


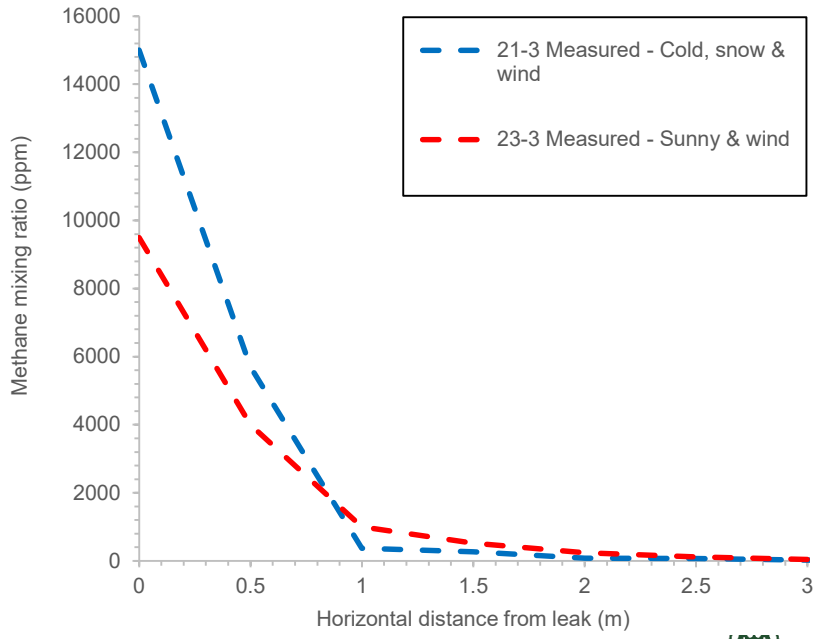
Experimental Approach

- Long term methane releases at the rural and urban testbeds
- Release rates between 4 and 300 SCFH
- Once plume has reached steady state measure time-varying:
  - Above surface plume
  - Surface concentration
  - Below surface concentrations
- Repeat experiments varying the:
  - Environmental conditions
    - Meteorology
    - Soil moisture
  - Depth of release
  - Gas composition

Working hypothesis

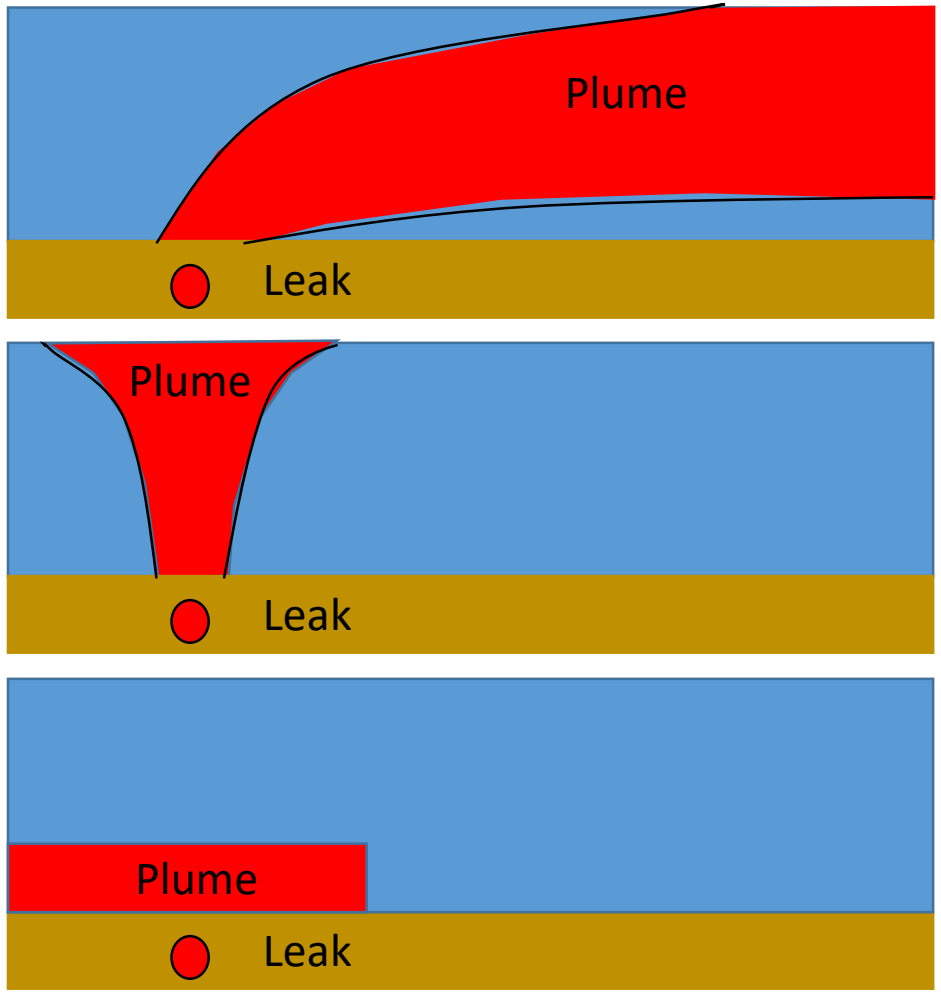
- Flow and gathering lines are generally located in rural areas
- Leveraging previous work on M&M project we know surface concentrations, and hence surface emission, change with environmental conditions.
  - ESCAPE model
- This will affect the probability of detection for a given leak detection solution





Detection probability in atmospheric conditions

- In windy conditions (sunny and dull)
  - Gas will move quickly from the surface.
  - Surface concentrations are smaller
  - Plume more difficult to detect
- In sunny, low-wind conditions
  - Gas will move vertically
  - Surface concentrations are larger
- In dull, low-wind conditions
  - Gas is trapped at the surface.
  - Surface concentrations are much larger
  - Locating the plume could be difficult



Review of leak detection solutions

- Perform literature study to identify the MQL and quantification range of several leak detecting solutions
- Methods will include industry standard practices, such as walking surveys with gas sniffers
- We expect to test no more than four technologies during this project
- Establish an unbiased selection criterion to test detection methods and technologies
- Identify, with industry partners, which technologies would be most interesting to test

UPSIDE Advisory Board

- Industry
  - ConEd, SoCalGas, PG&E, Western Midstream, DCP Midstream
- First responders:
  - Poudre Fire District, White Plains NY Fire District
  - Department of Transportation, Colorado Oil and Gas Conservation Commission (COGCC)
- Regulators:
  - PHMSA

Thank You

Contact

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