ARCADIS Design & Consultancy for natural and built assets

THE NEW ROI

Return on Investigation from *Smart* Characterization Methods

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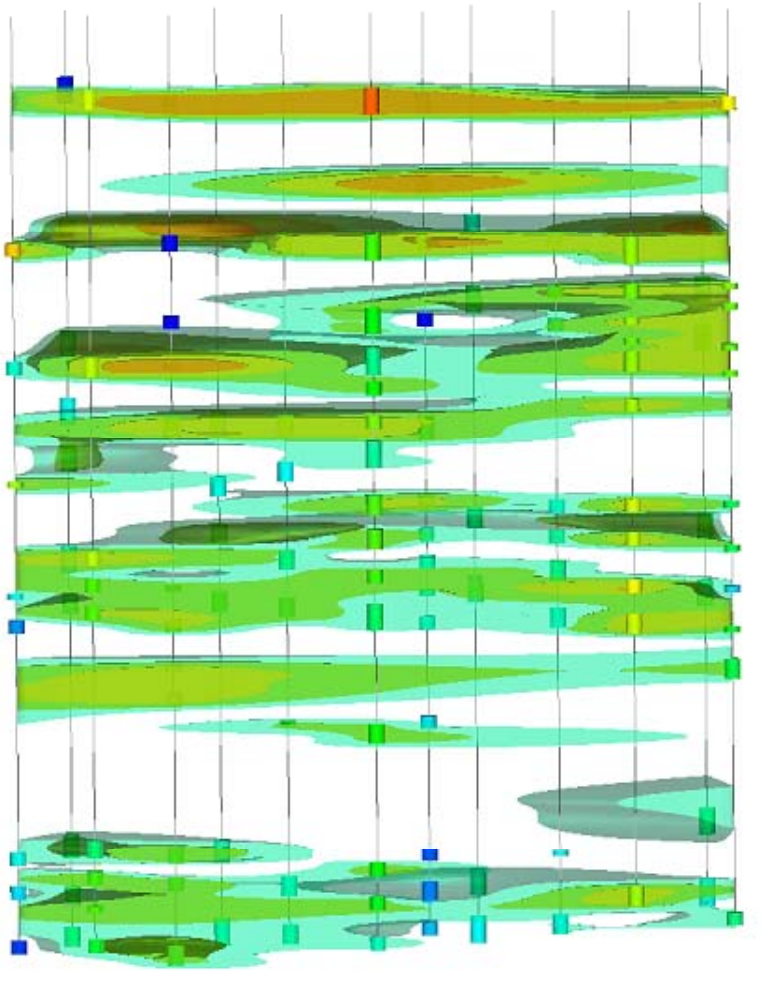
December 2, 2015

FRTR General Meeting

Site Characterization for Effective Remediation

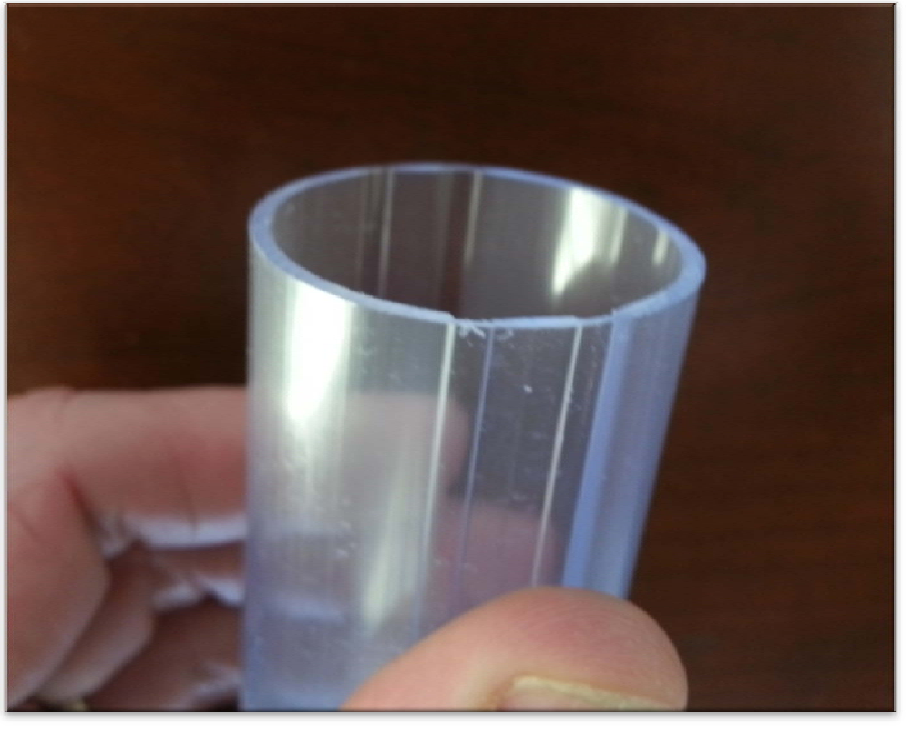
Agenda

- Health and Safety Moment
- Return on Investigation
  - Exit Ramp Strategies
  - Smart Characterization
  - Flux-Based CSMs



Health and Safety Innovation

Zipliner



http://www.geoprobe.com/Newsletters/march_2014_winner.html

ARCADIS Design & Consultancy for natural and built assets

Zipliner

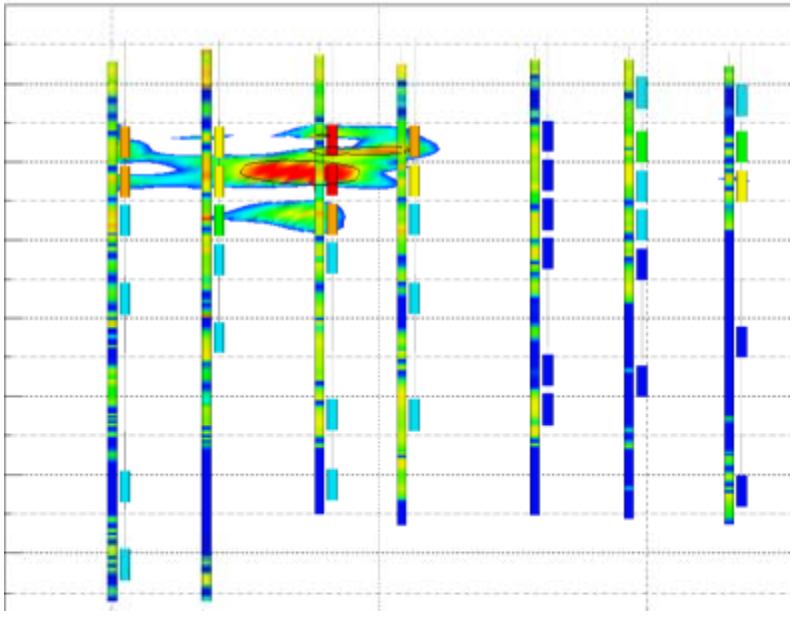
FEATURES

- Operates with drill tooling similar to standard liners.
- Designed to fit with AMS Power-Probe and the Geoprobe Systems direct push technologies.
- The ZipTool is the safest opening tool for soil sampling sleeves.
- Similar durability as standard liners.

The ROI of Smart Characterization

Full slurry wall → Smart characterization → Focused pumping

90% of relative flux in 10% of cross-section



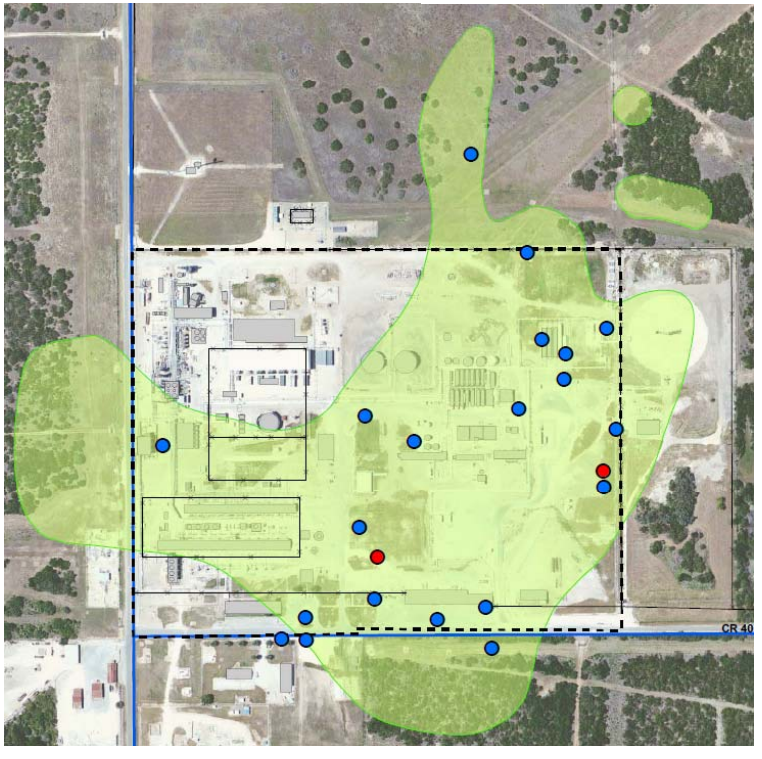
Return on Investigation

Client avoided spending > $5M on slurry wall

LNAPL recovery (> 25 acres)

Smart characterization

LNAPL removal not required



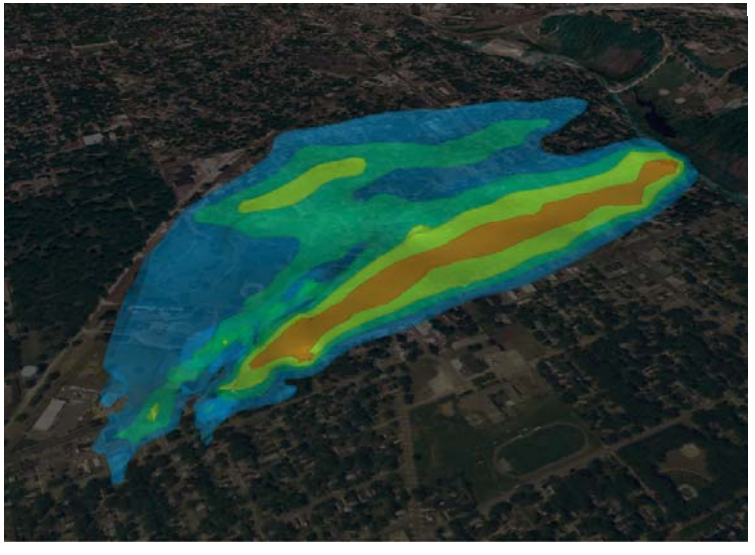
Return on Investigation

Client avoided spending $4 - $5M on active LNAPL recovery

Unknown plume extent

Smart characterization

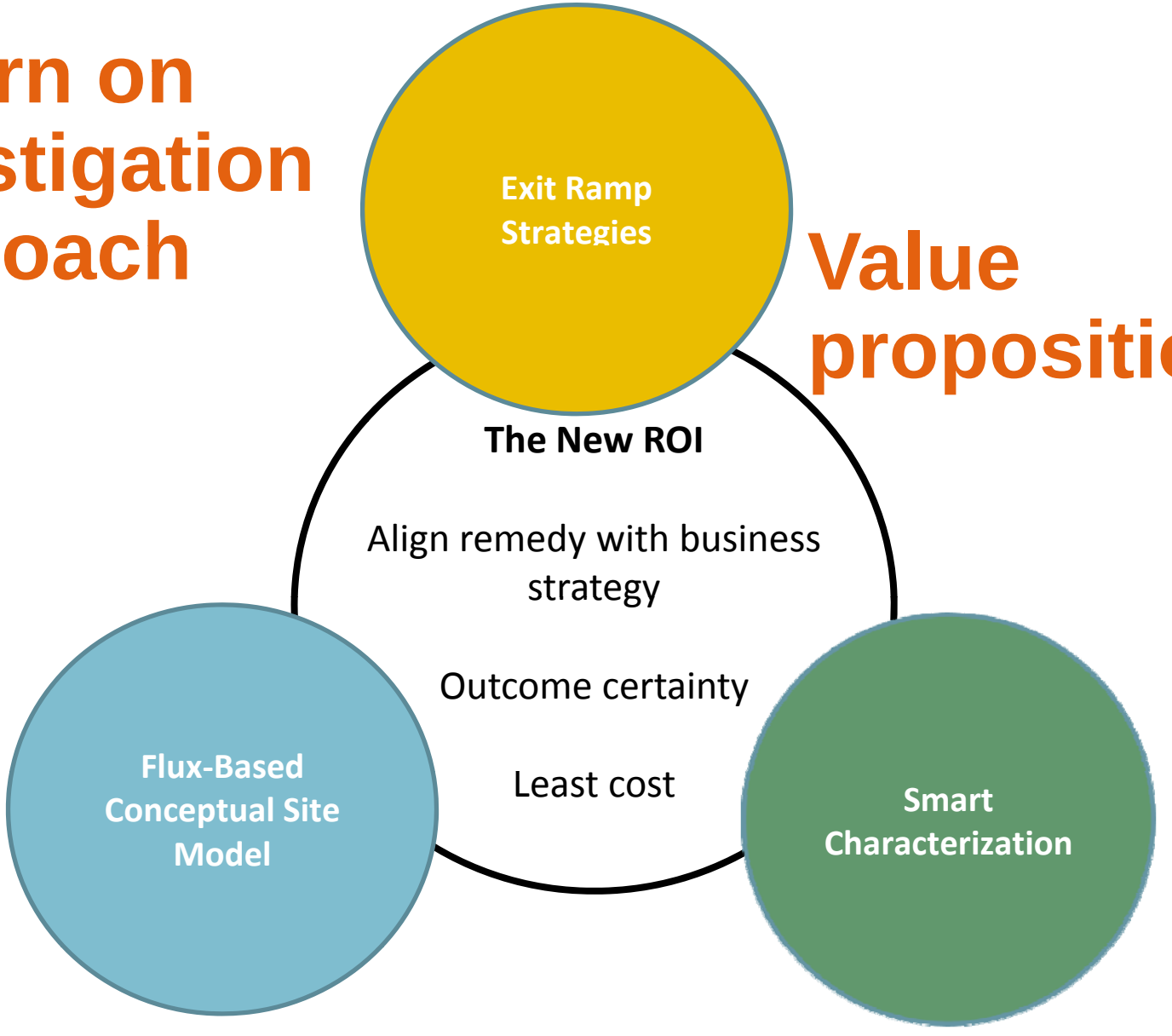
1-mile long, 10 PPM VOC plume



Return on Investigation

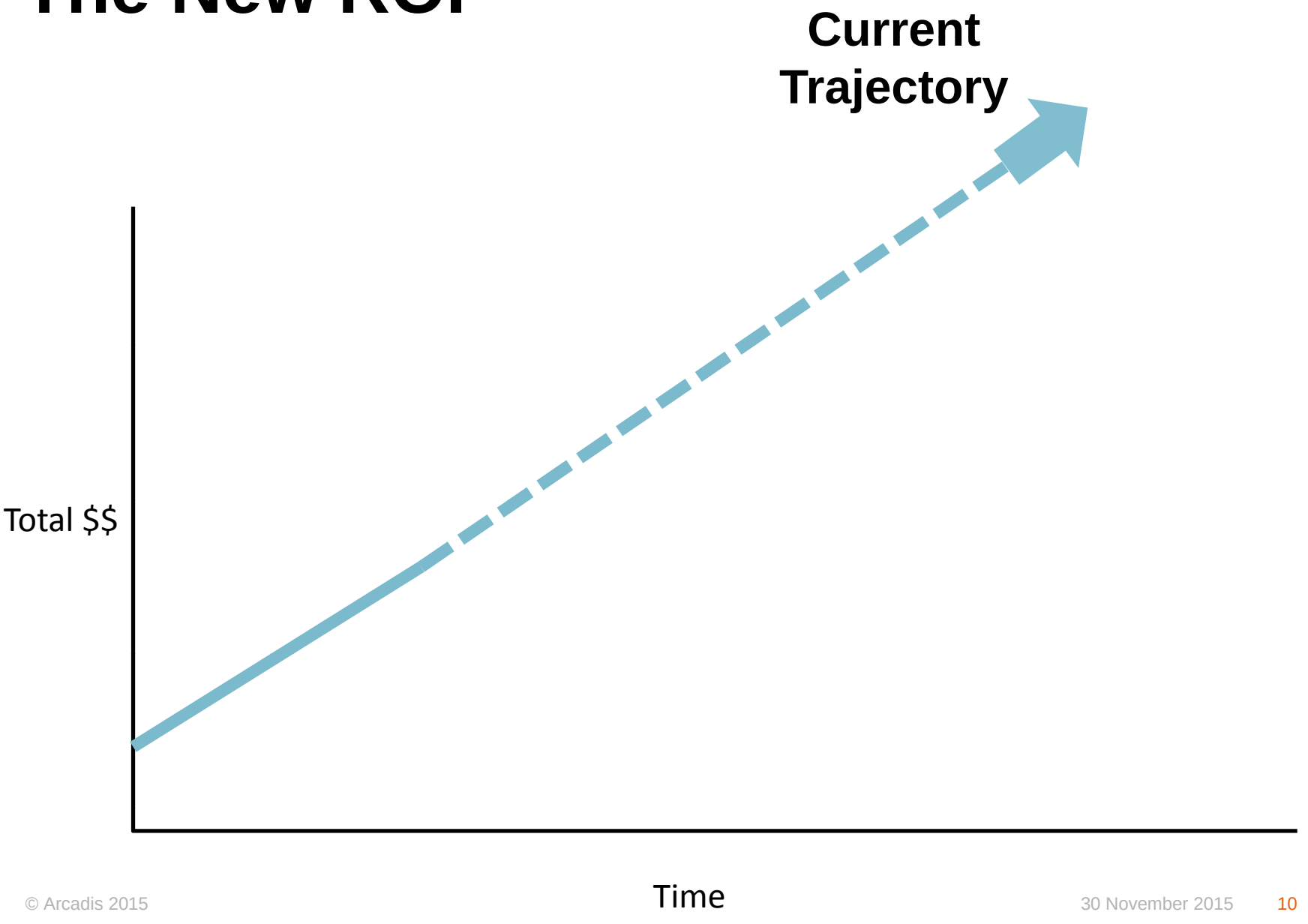
No active remediation required

Return on Investigation Approach

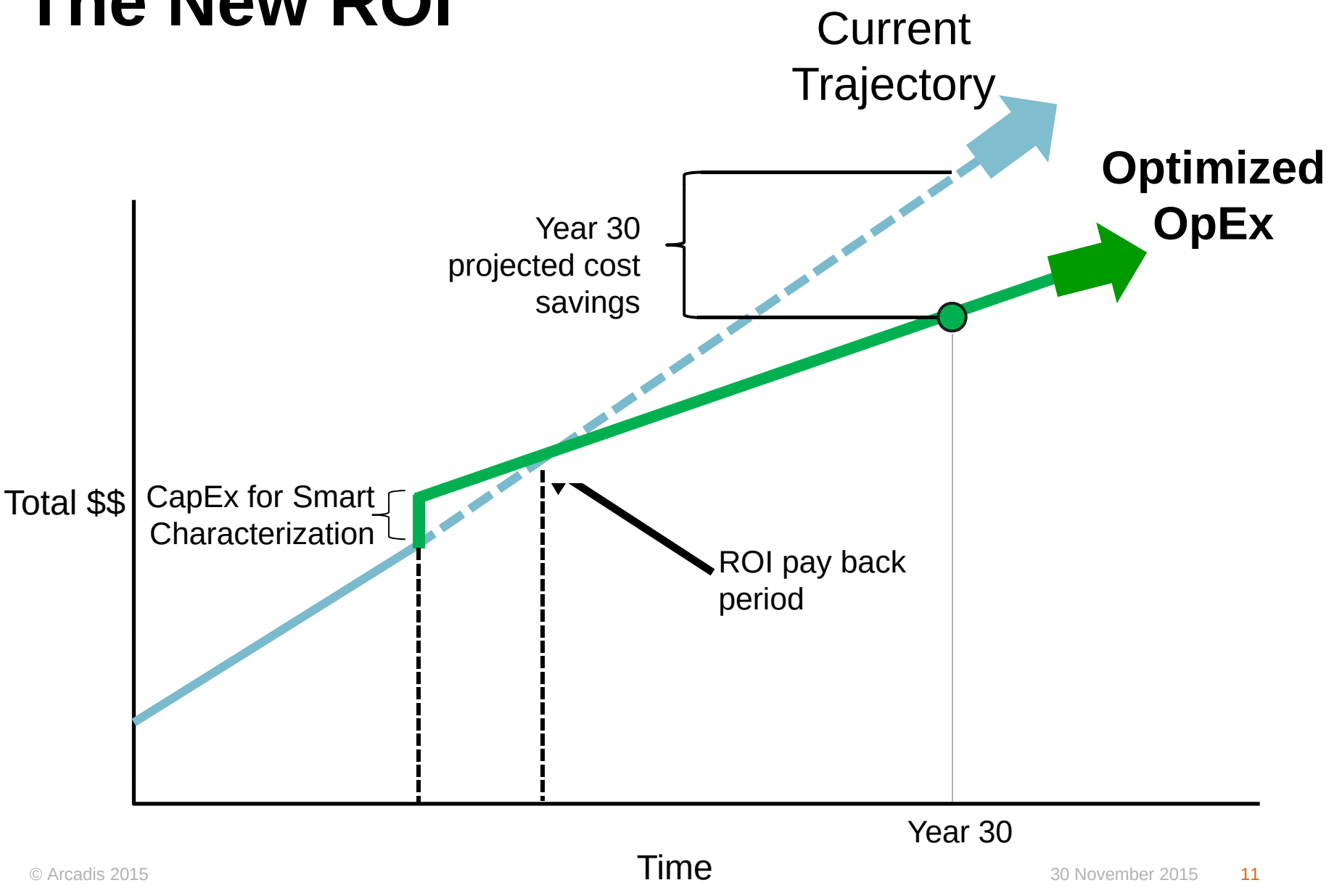


Value proposition

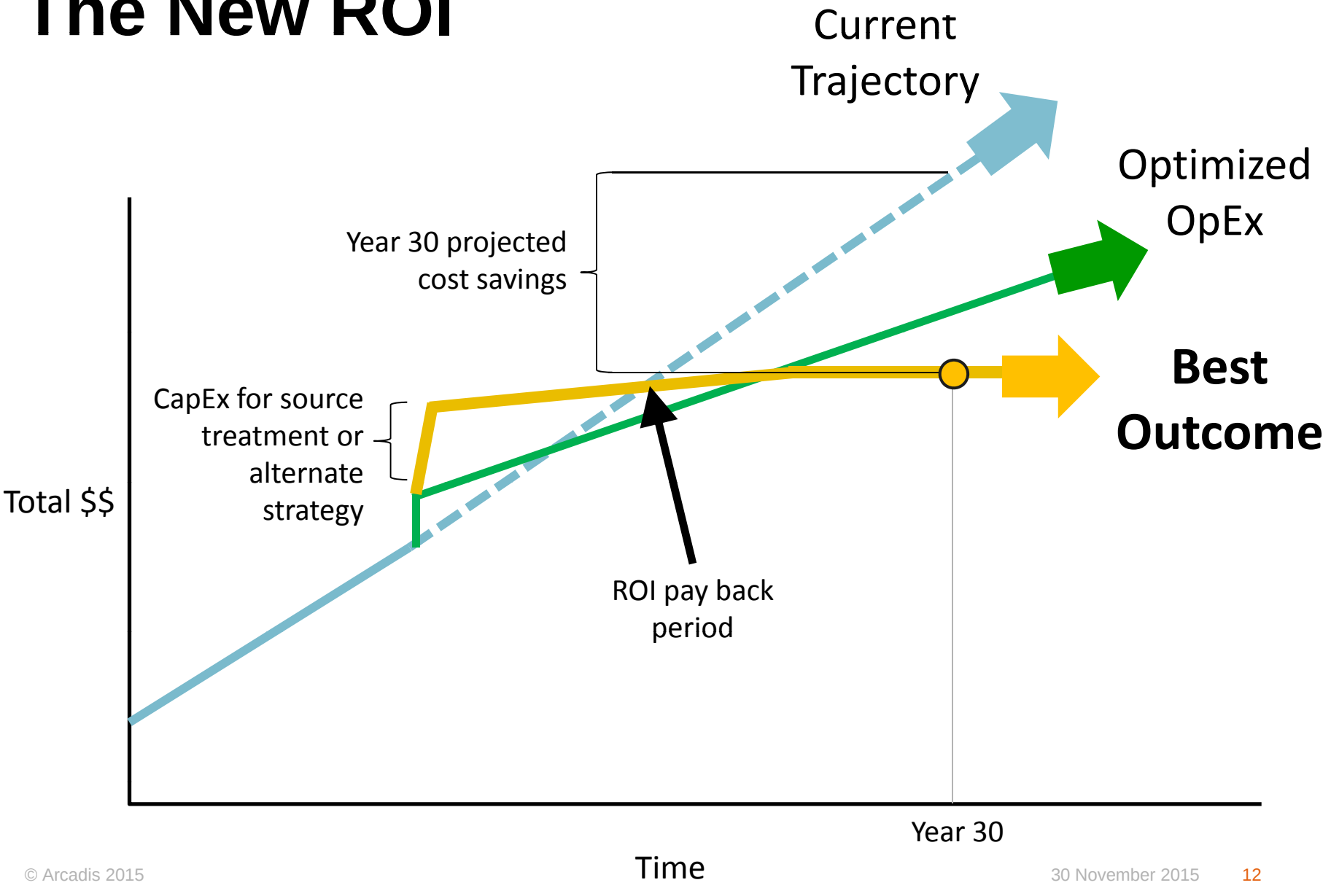
The New ROI



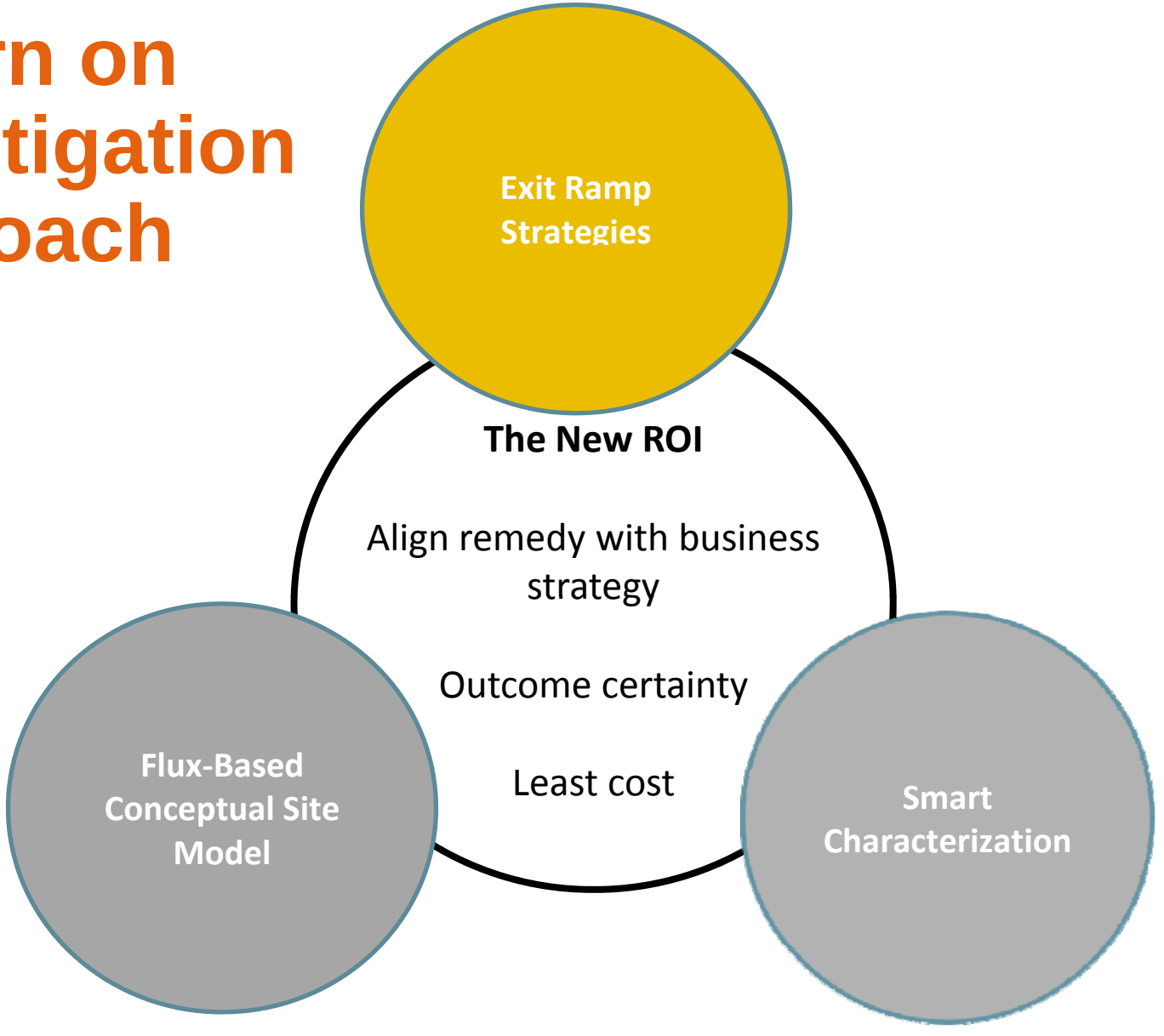
The New ROI

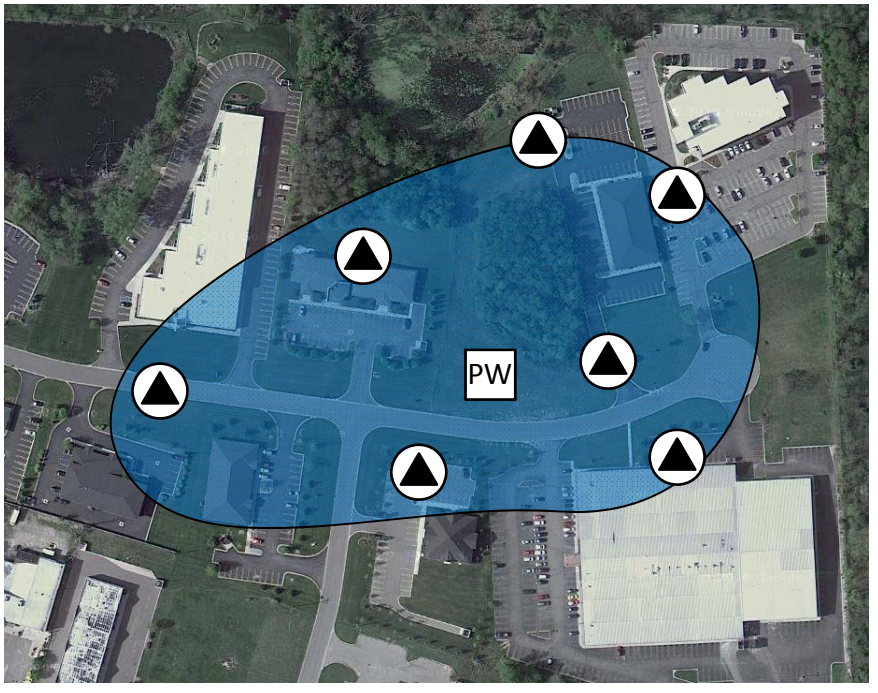

Current
Trajectory
Optimized
OpEx
Year 30
projected cost
savings
Total $$
CapEx for Smart
Characterization
ROI pay back
period
Year 30
Time

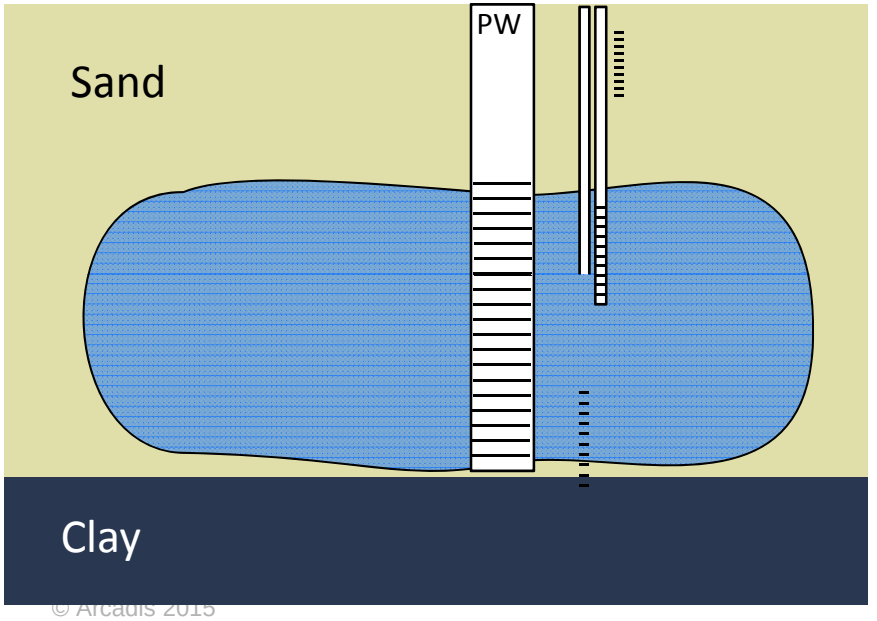
The New ROI



Return on Investigation Approach







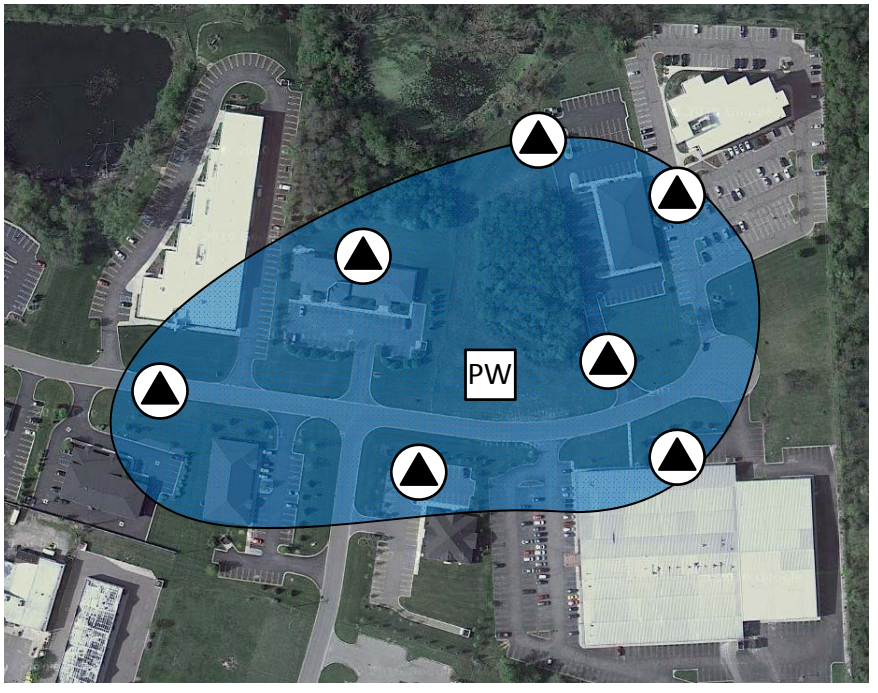
Background

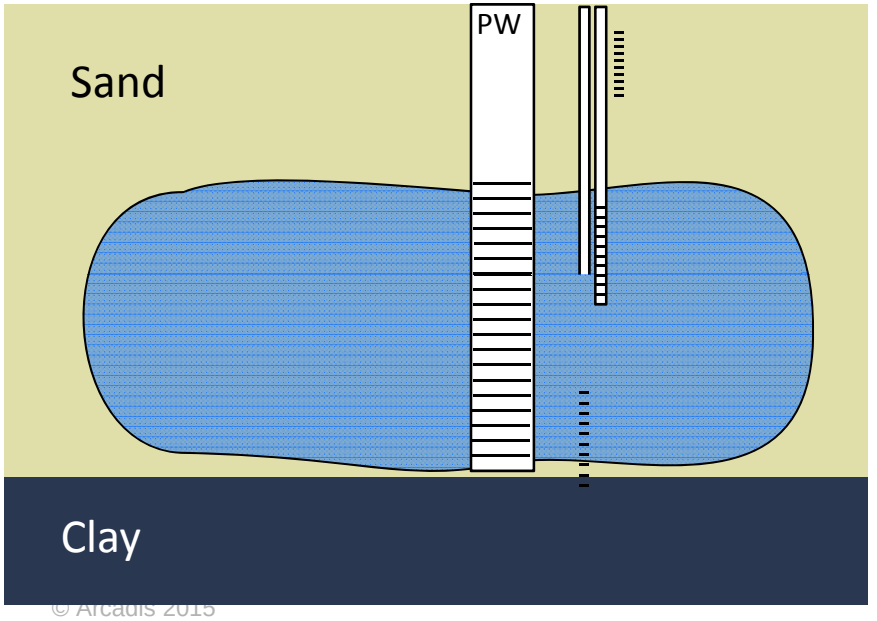
Diffuse VOC plume

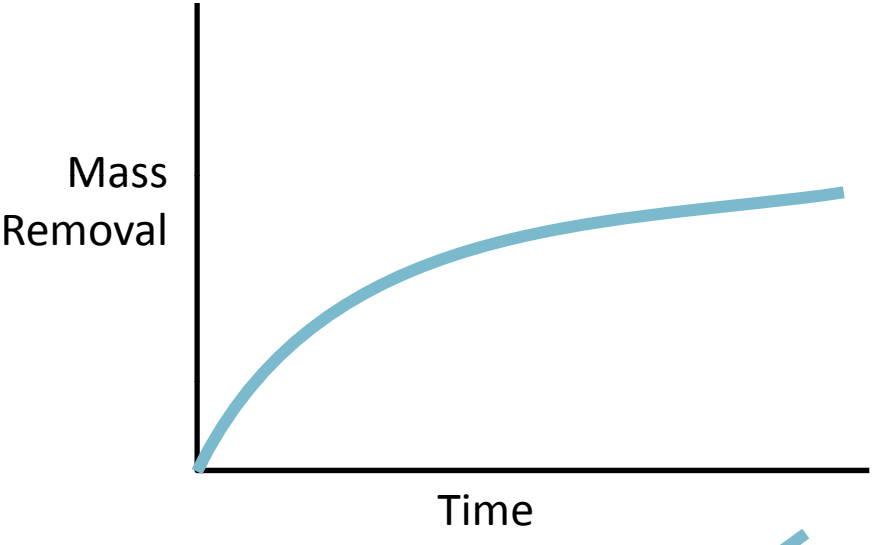
Characterized with monitoring wells

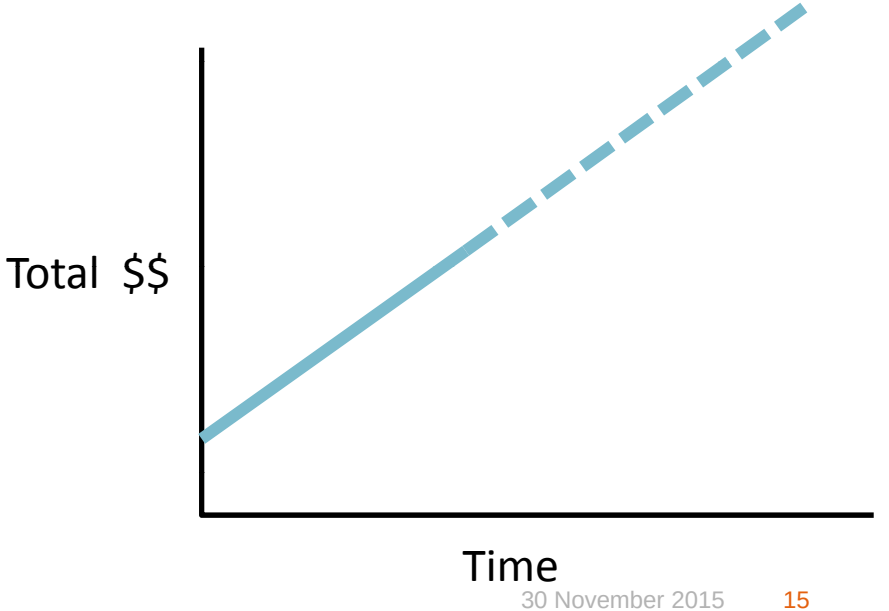
20 years of P&T

The Problem

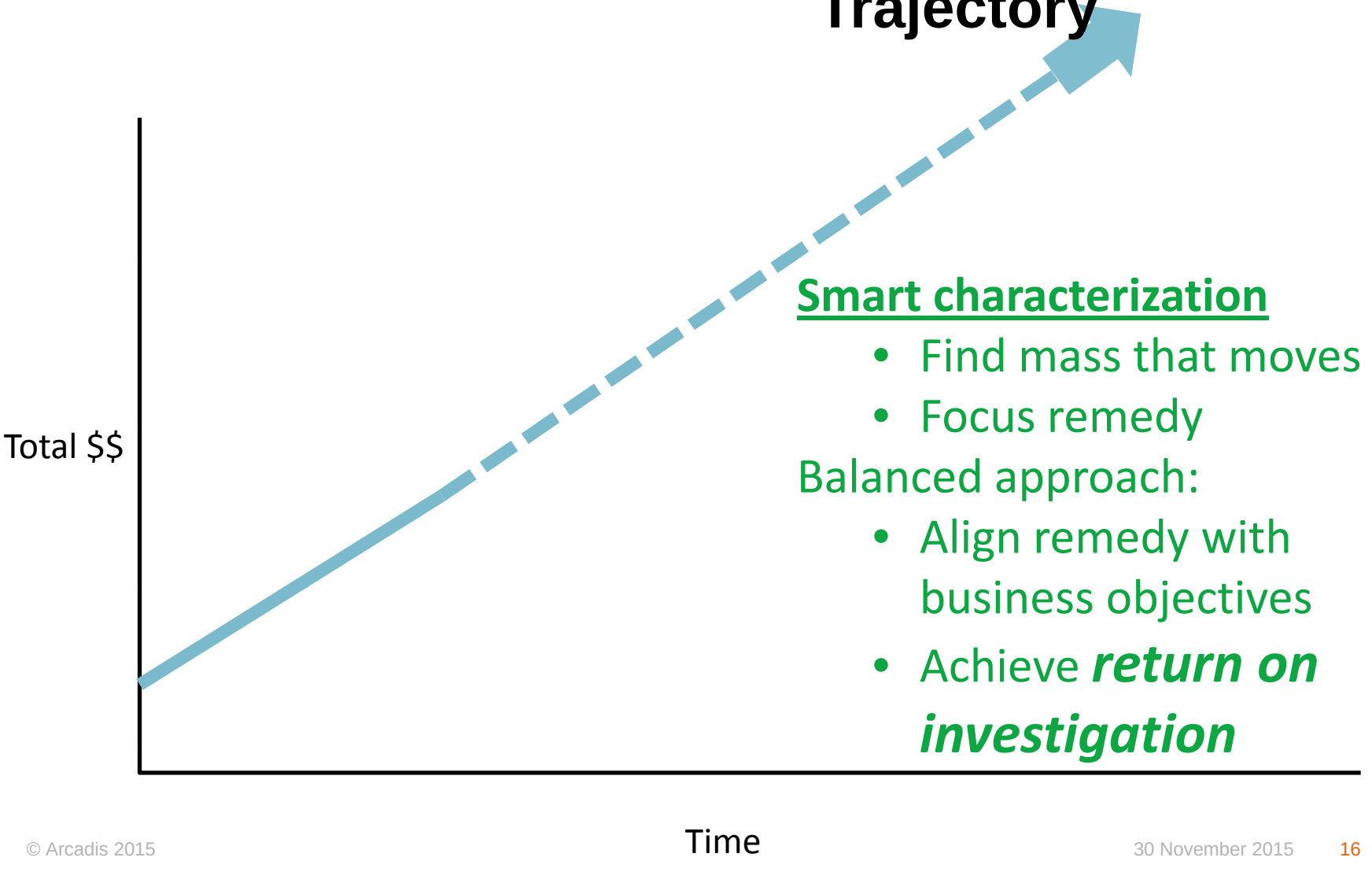








The New ROI



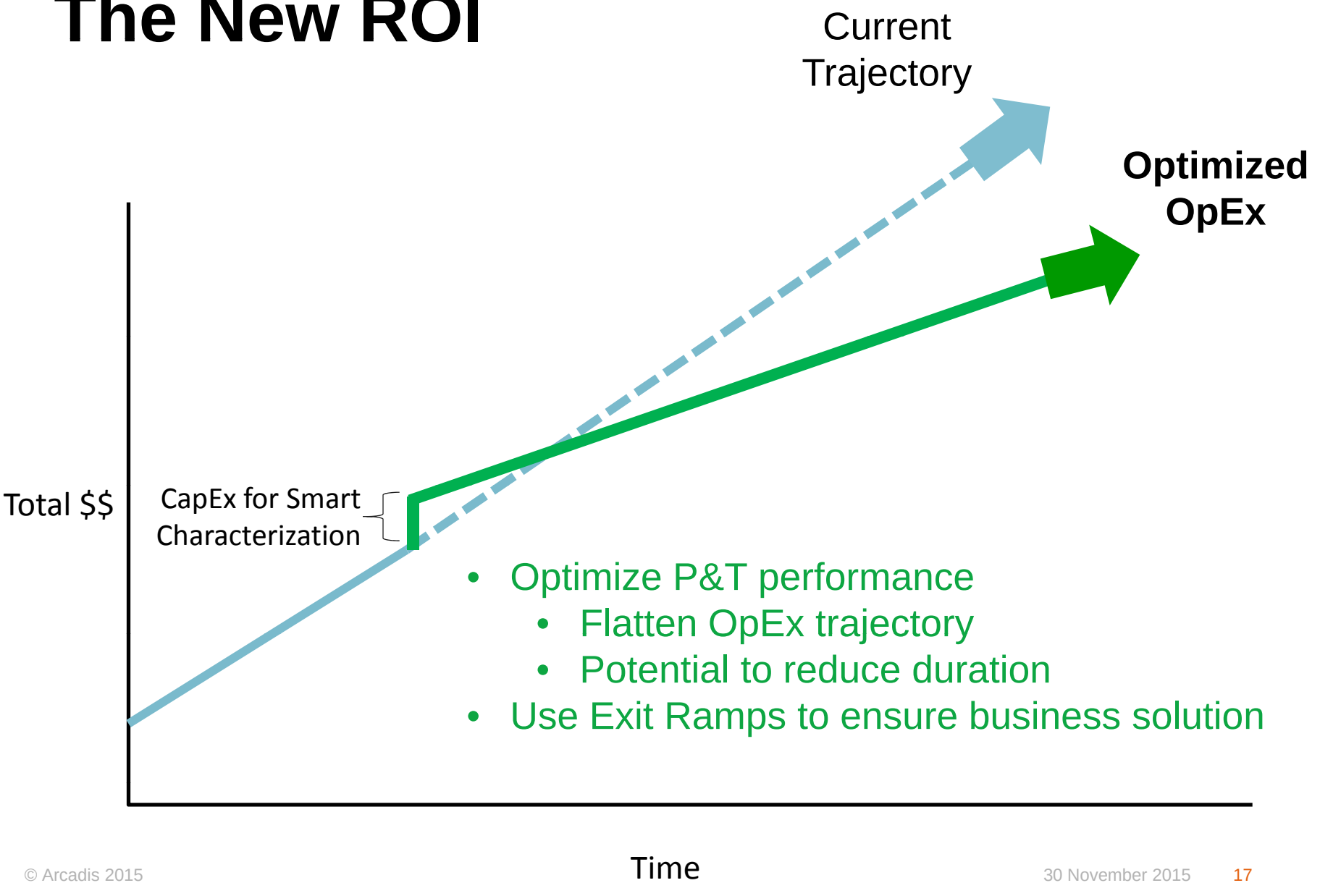
Smart characterization

- Find mass that moves
- Focus remedy

Balanced approach:

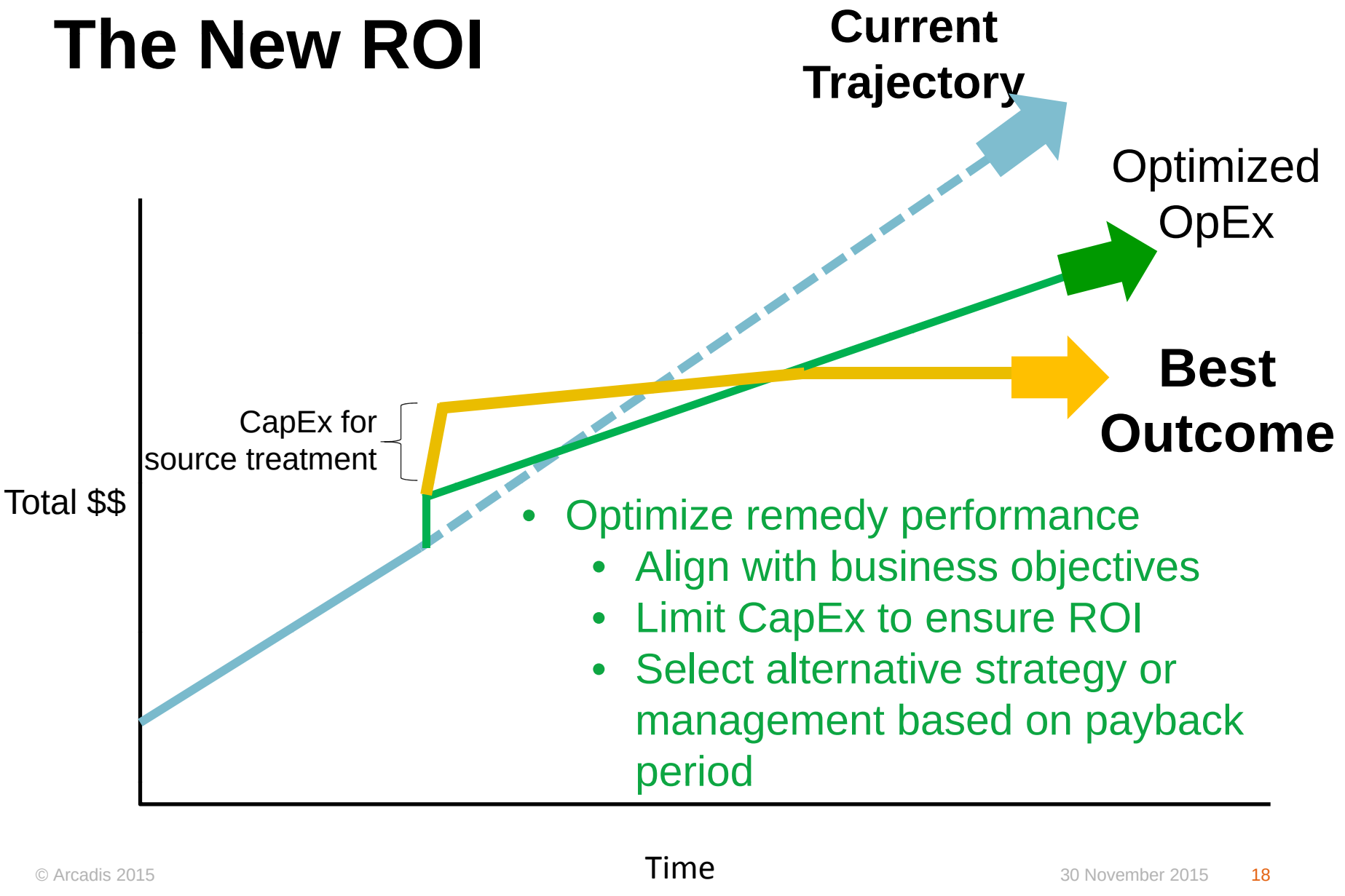
- Align remedy with business objectives
- Achieve ***return on investigation***

The New ROI

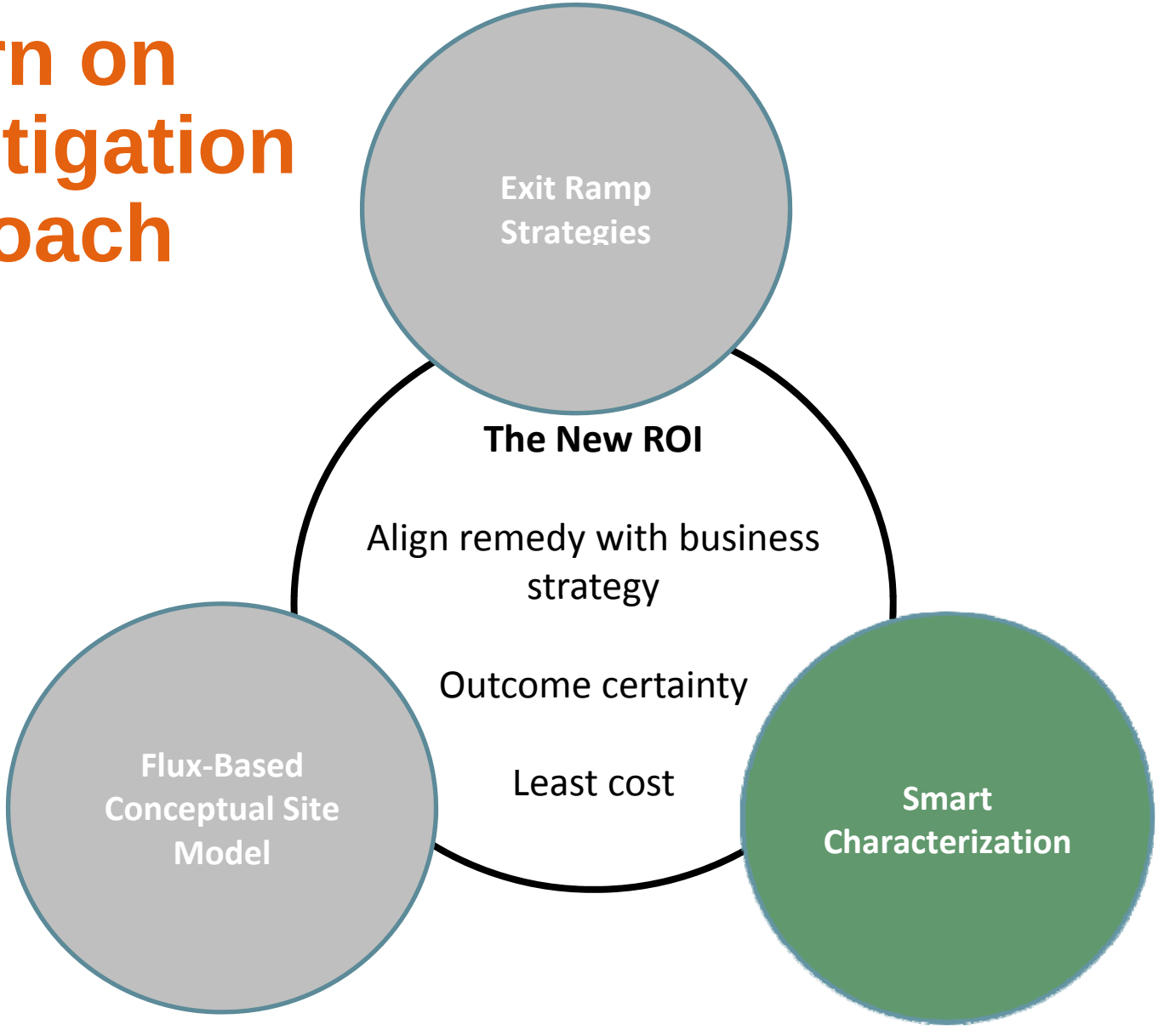


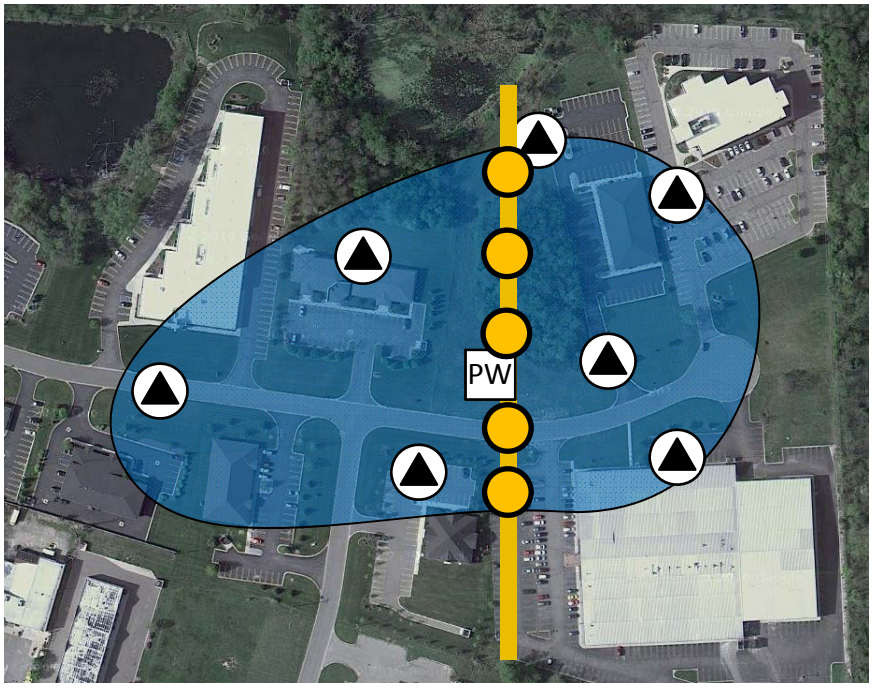
- Optimize P&T performance
  - Flatten OpEx trajectory
  - Potential to reduce duration
- Use Exit Ramps to ensure business solution

The New ROI



Return on Investigation Approach



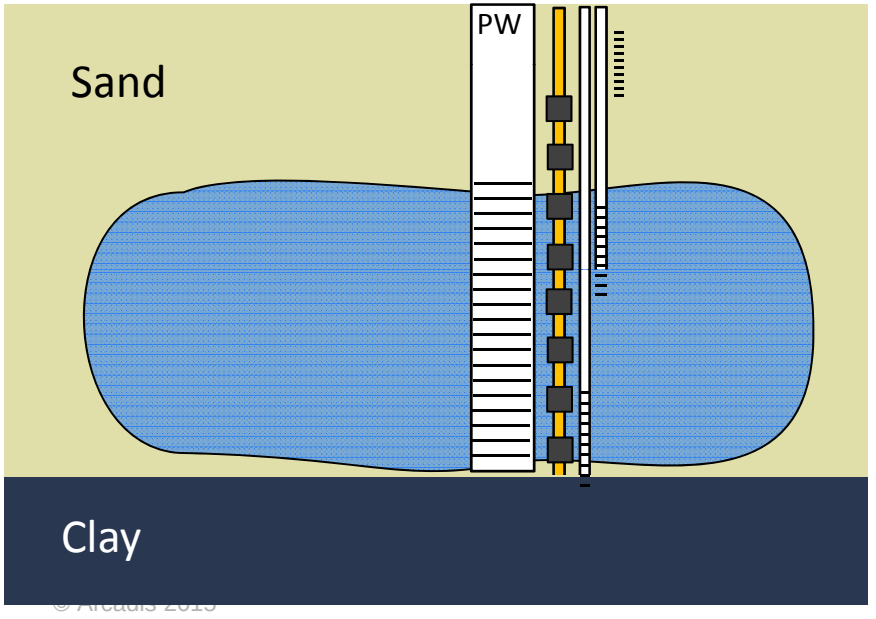


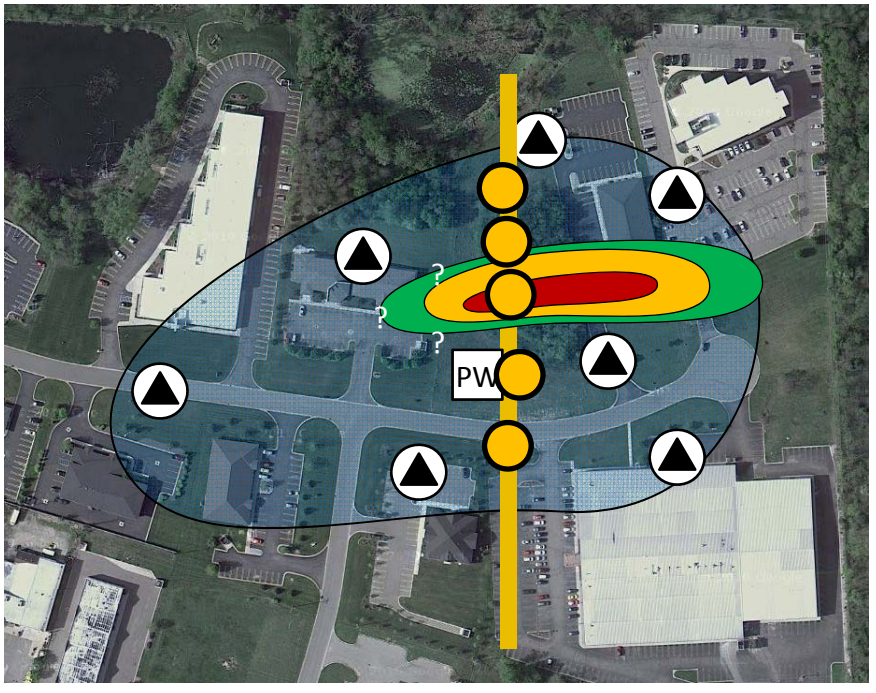
Exit Ramp$_1$ – Can P&T be optimized?

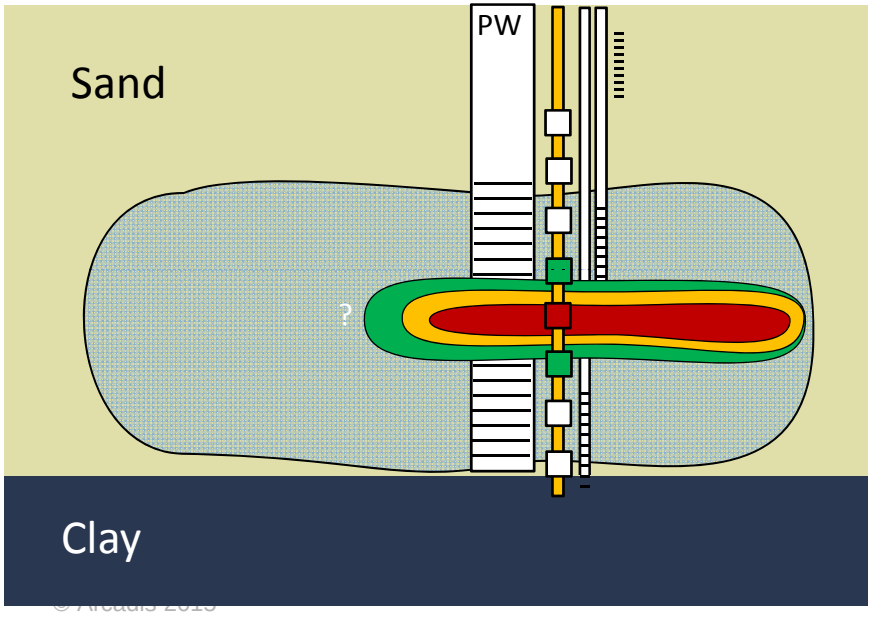
$50K investment

Goal:

- Optimize P&T
- Reduce OpEx
- Reduce duration & increase mass removal







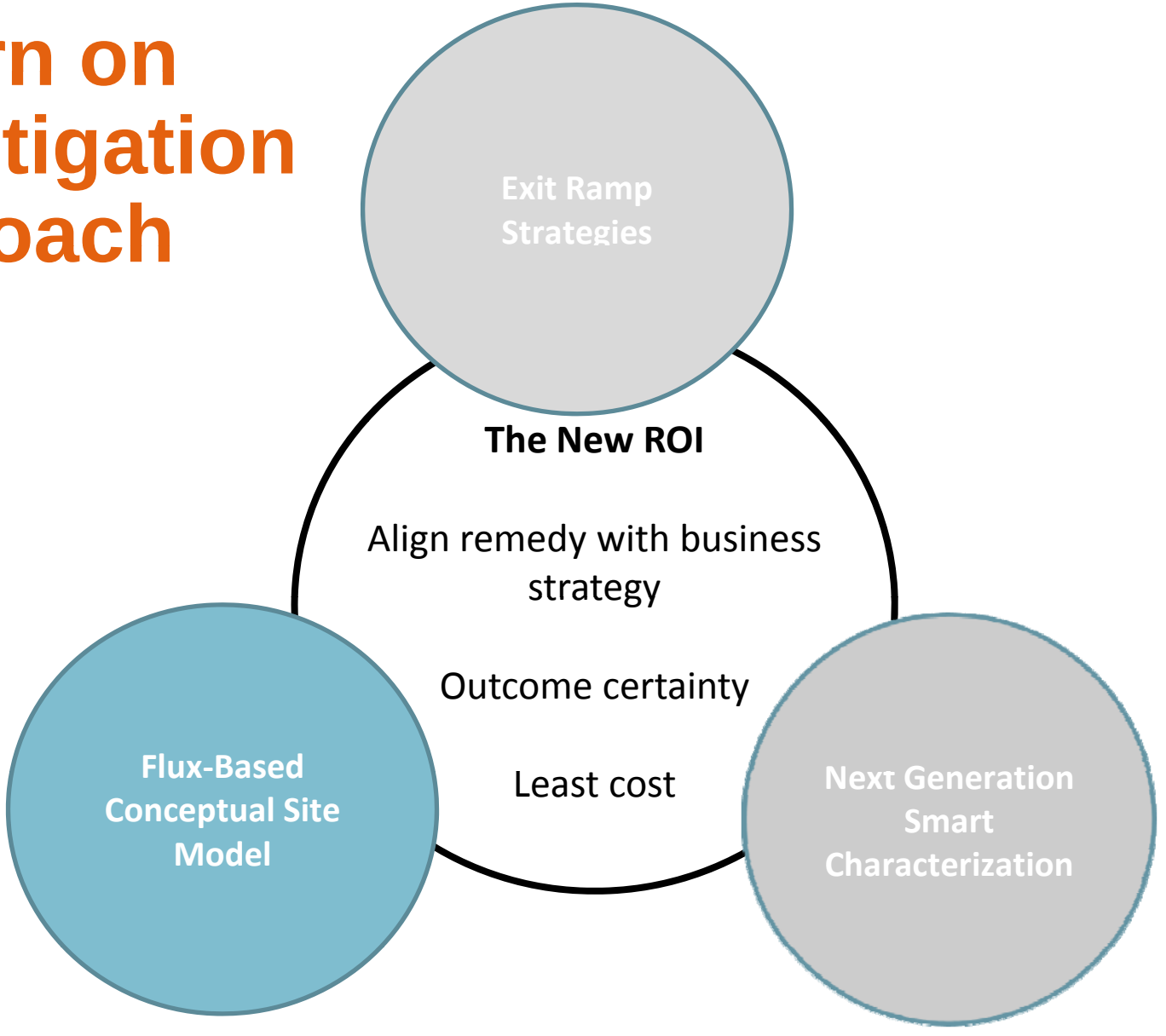
Exit Ramp 1

Result: Flux transect

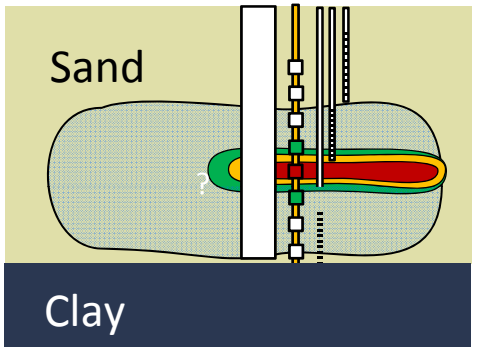
- Plume is concentrated
- Pumping can be optimized
- Change cost and performance curve

Why is plume concentrated?

Return on Investigation Approach



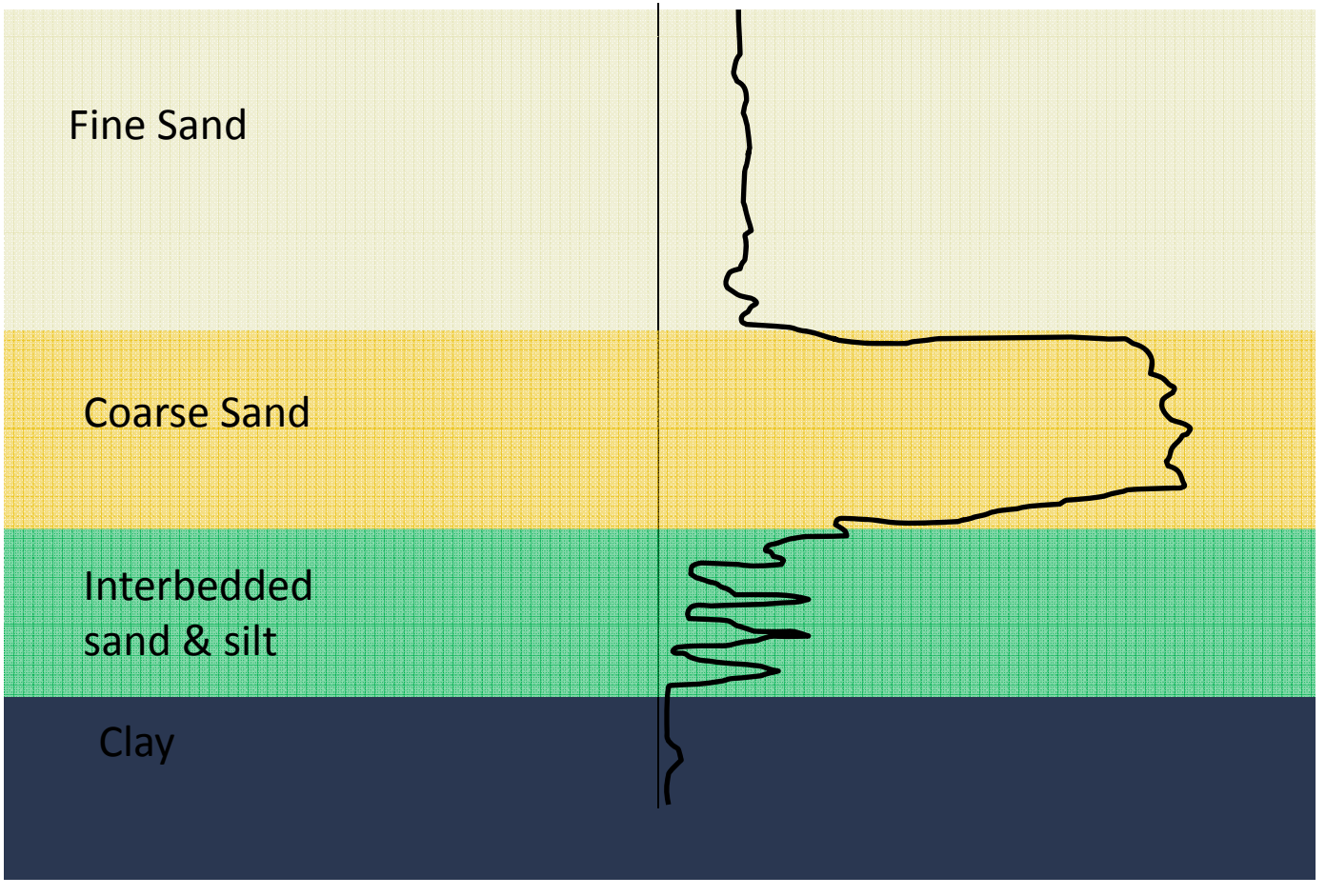
Stratigraphic Flux



Find the flux

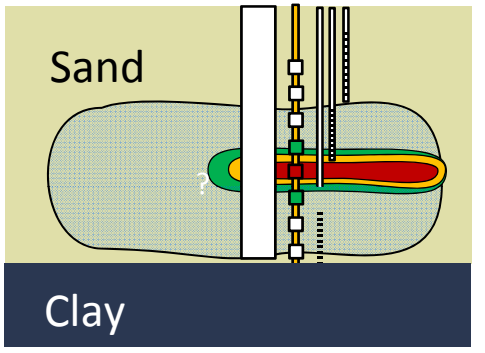
HPT
Relative permeability

0.1 1.0 10 100



> 90% of **flow** is in coarse sand zone

Stratigraphic Flux



Find the flux

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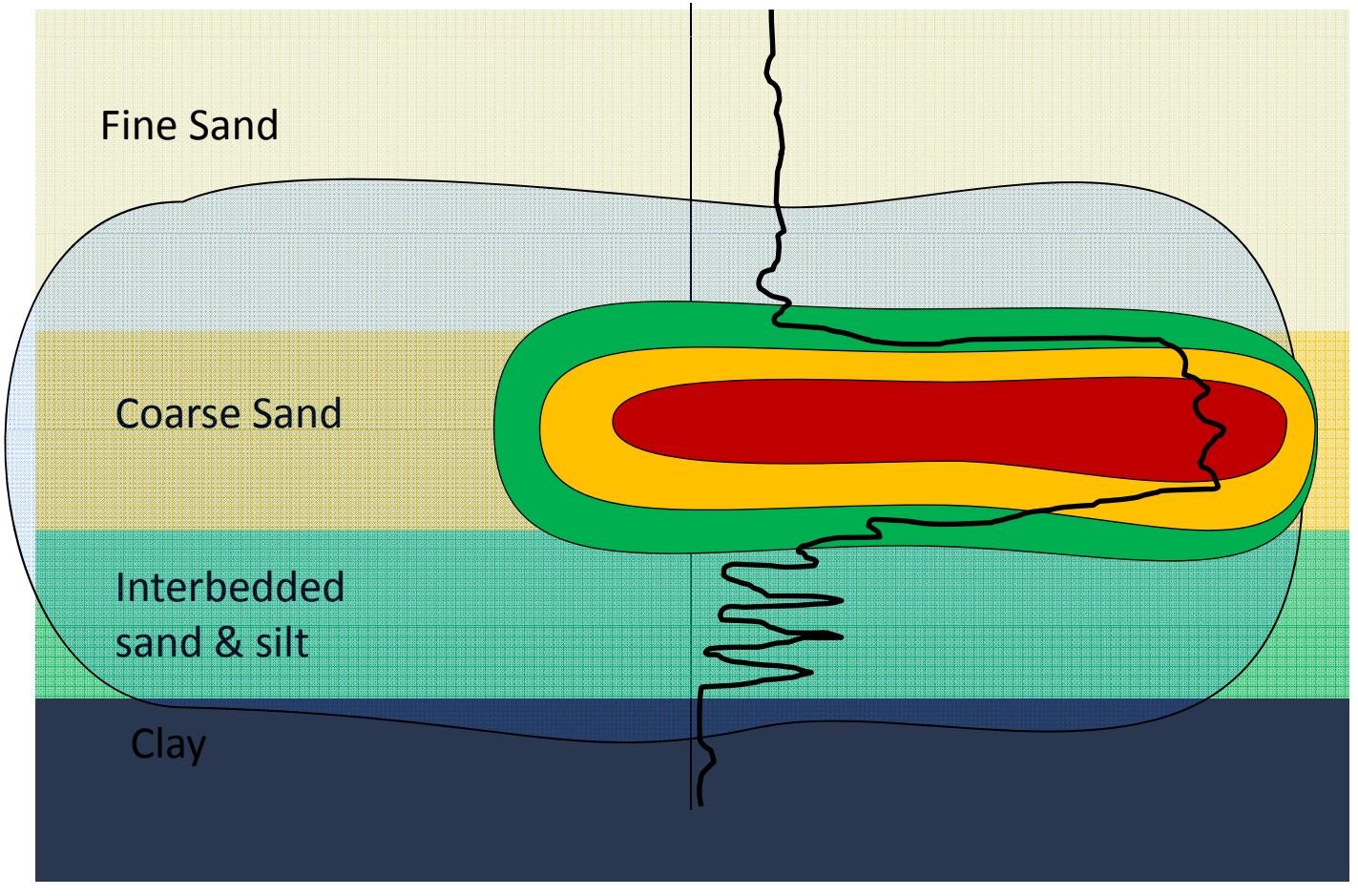

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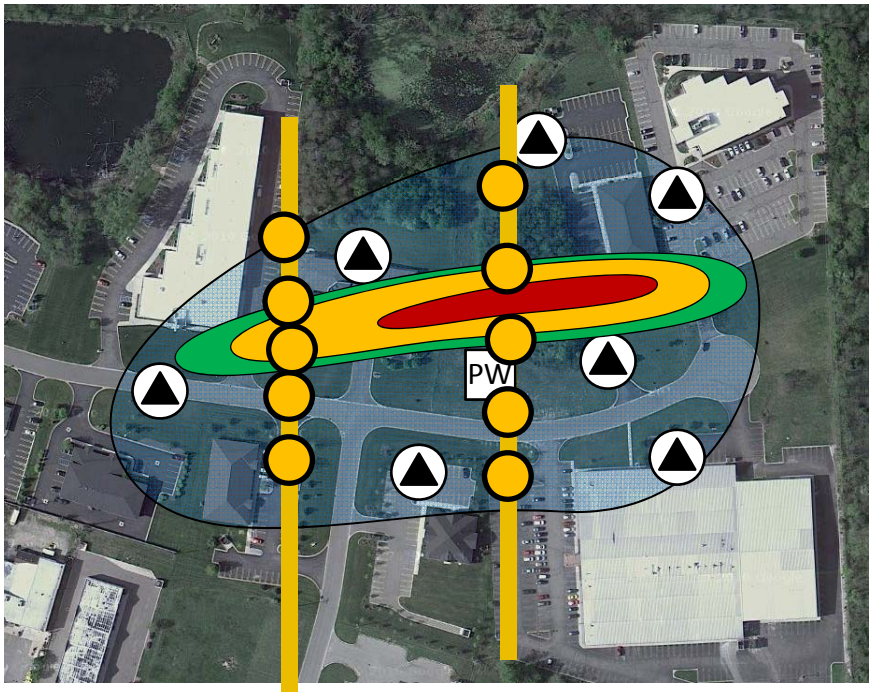
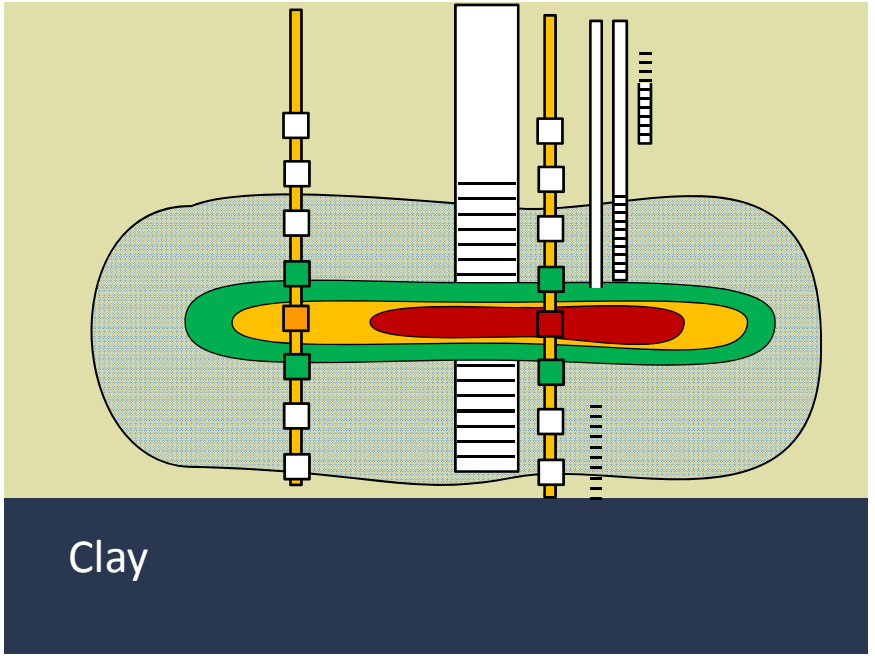
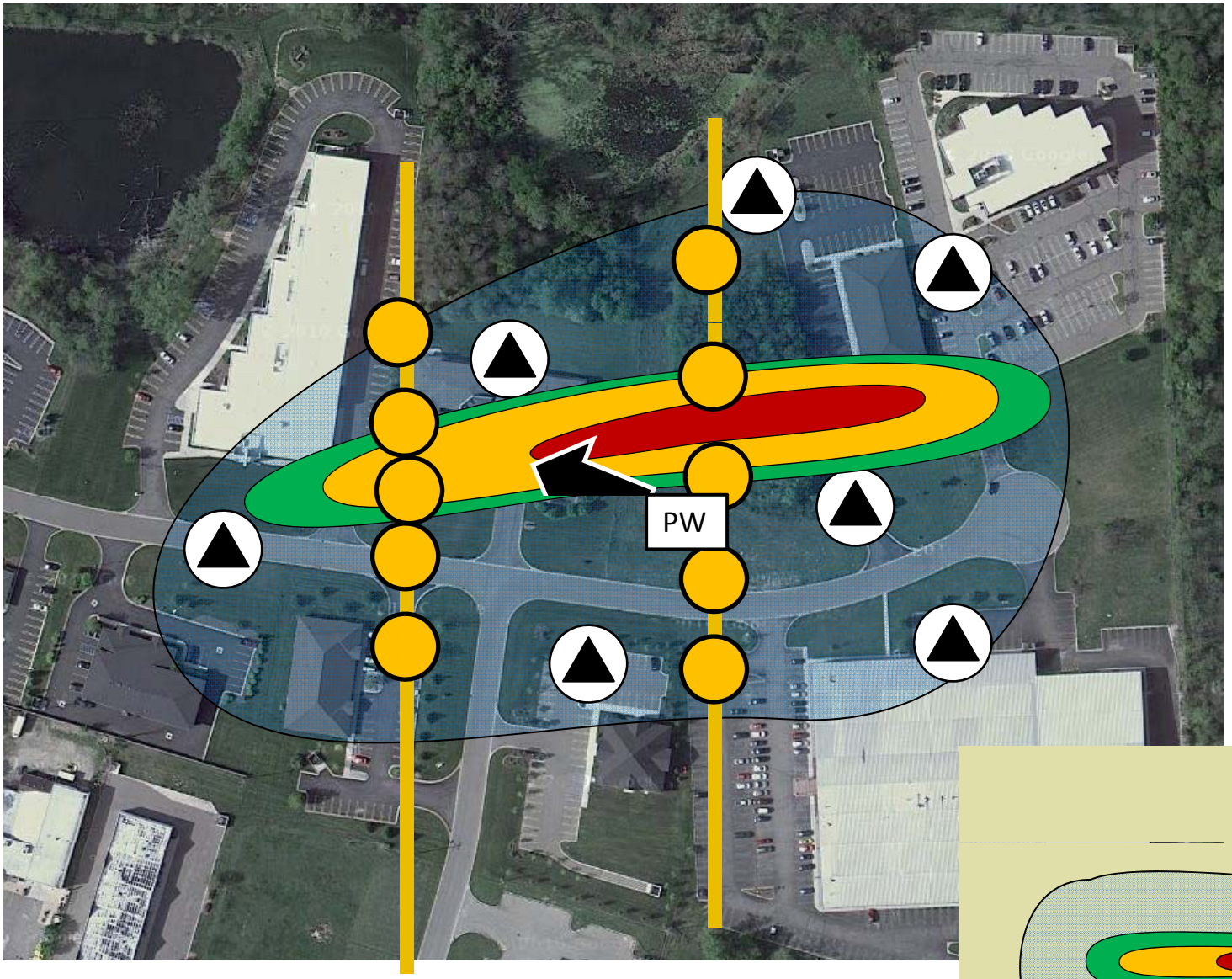
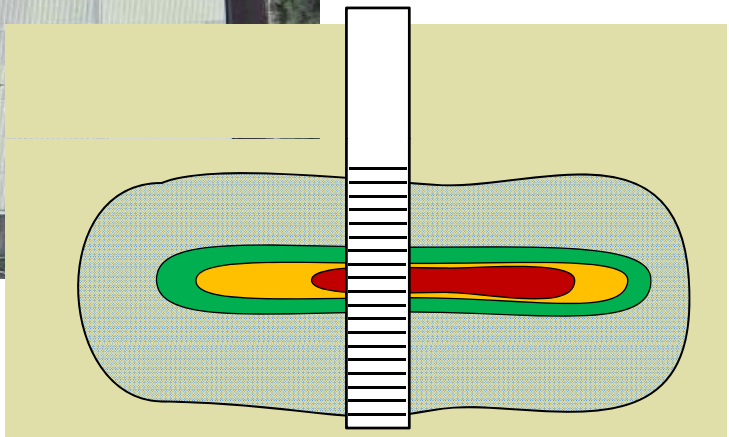




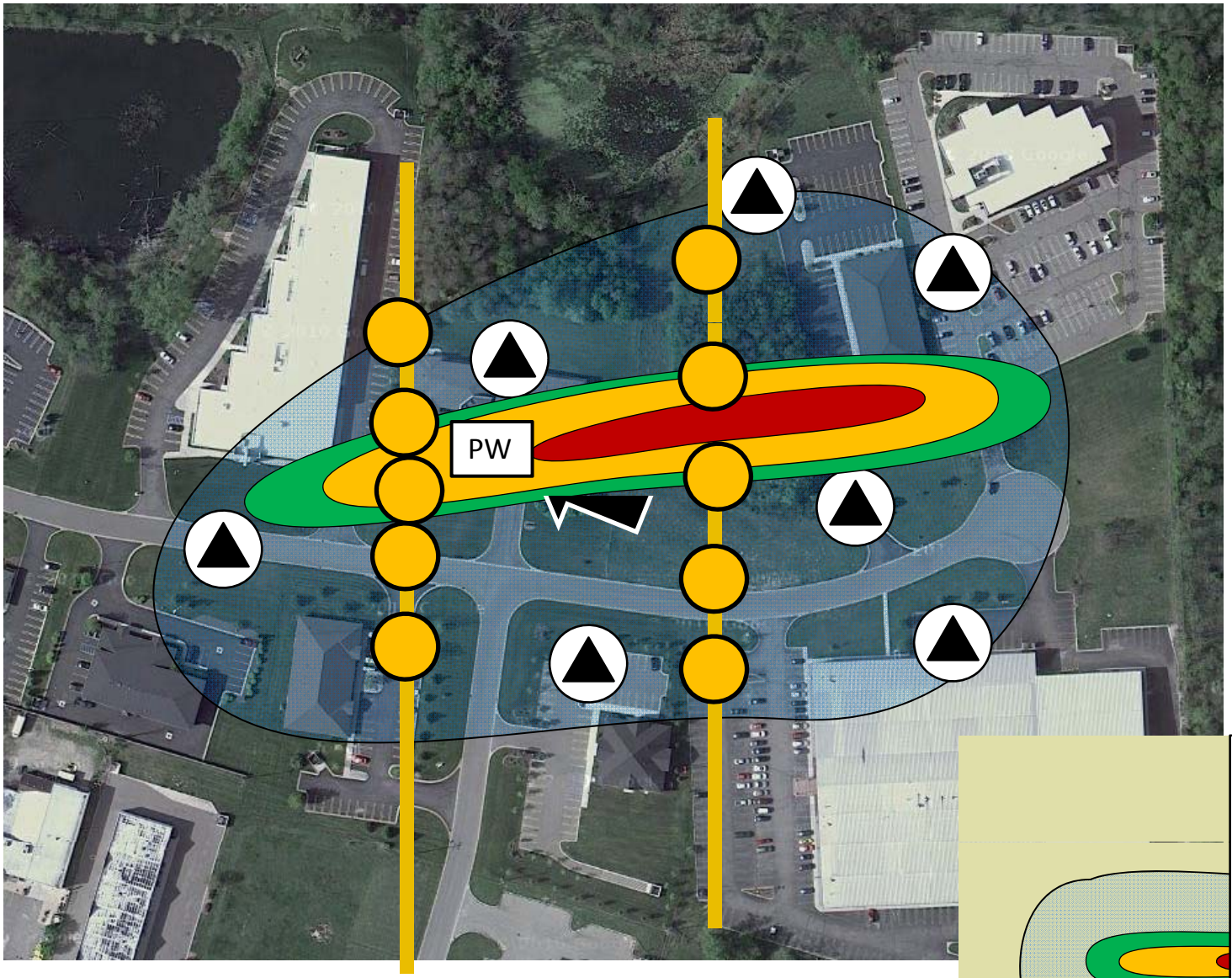
Exit Ramp 2 - OpEx Optimization

- Consider ROI payback on CapEx
- Verify plume geometry

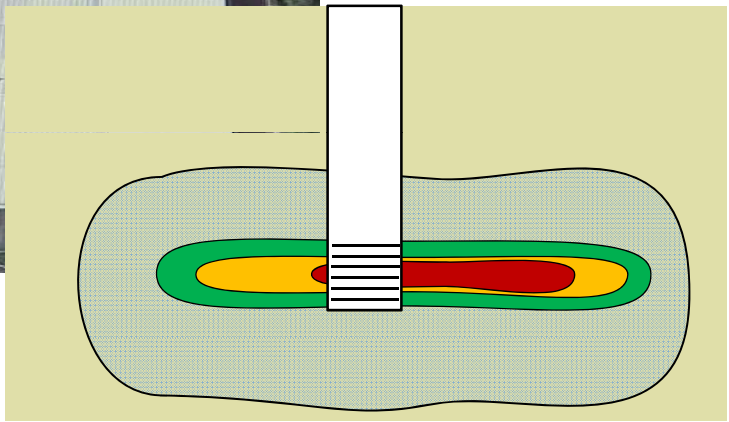




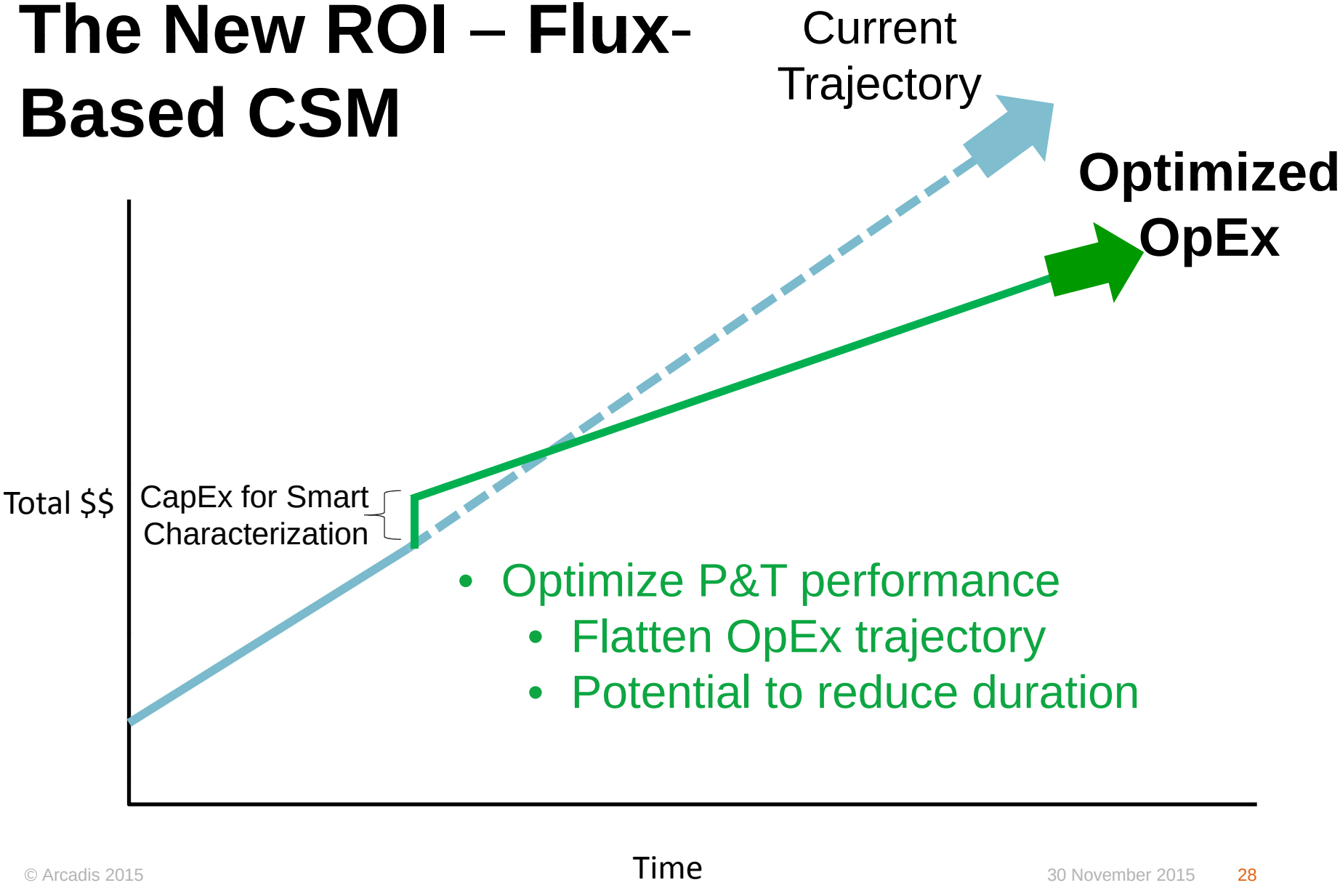
Focus pumping on flux…



Optimize OpEx, enhance mass recovery with less flow

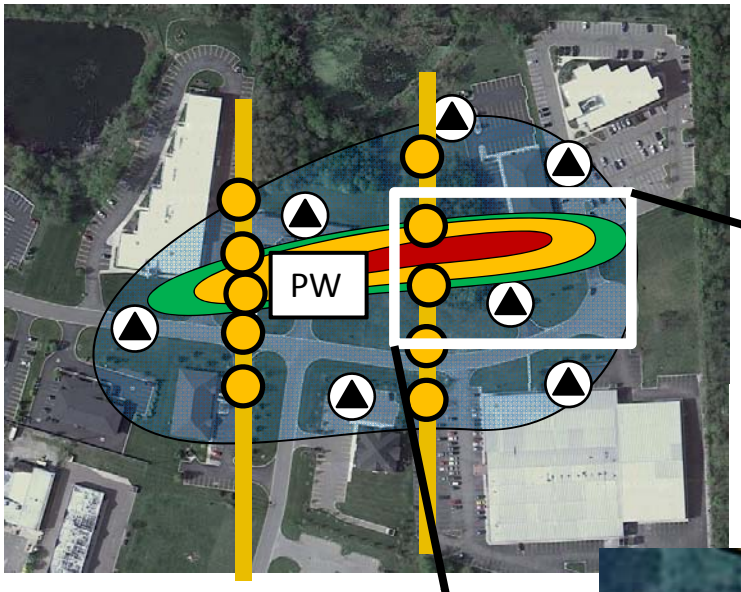


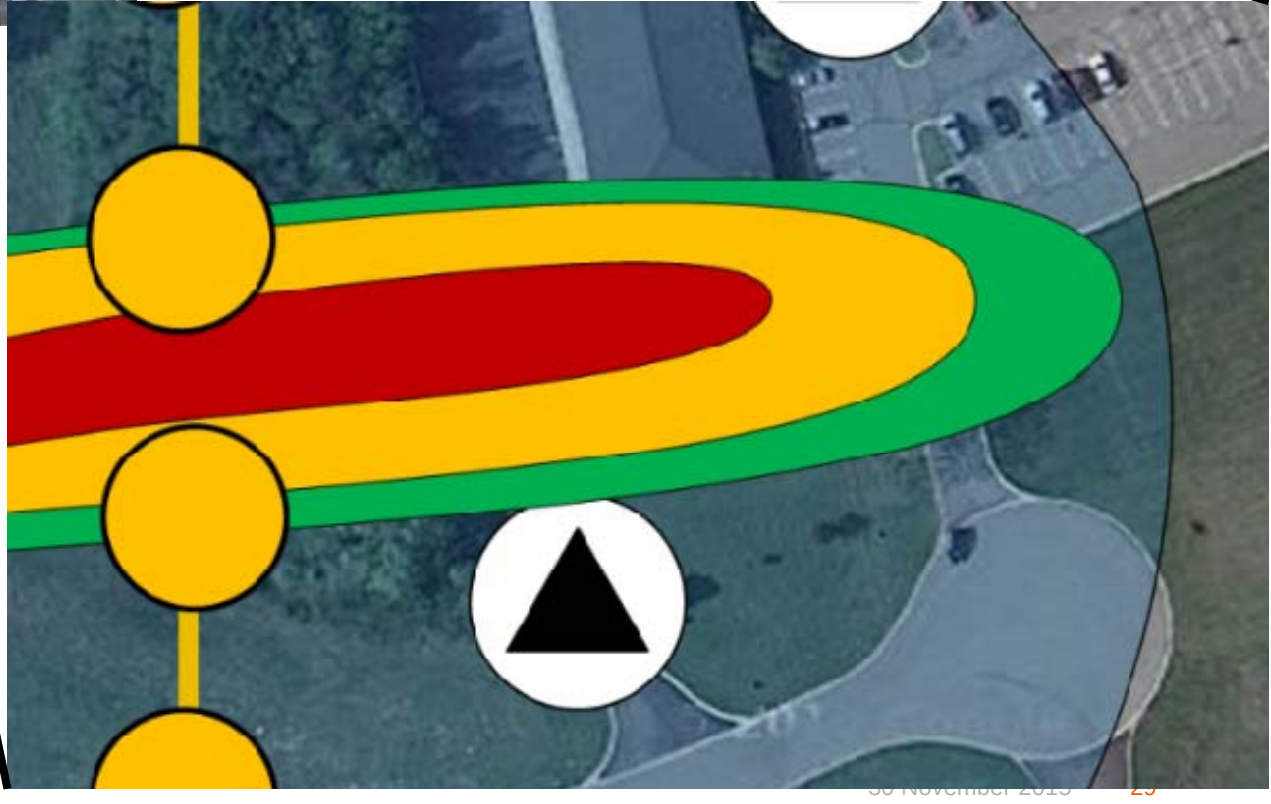
The New ROI – Flux-Based CSM



- Optimize P&T performance
  - Flatten OpEx trajectory
  - Potential to reduce duration

Outcome Certainty





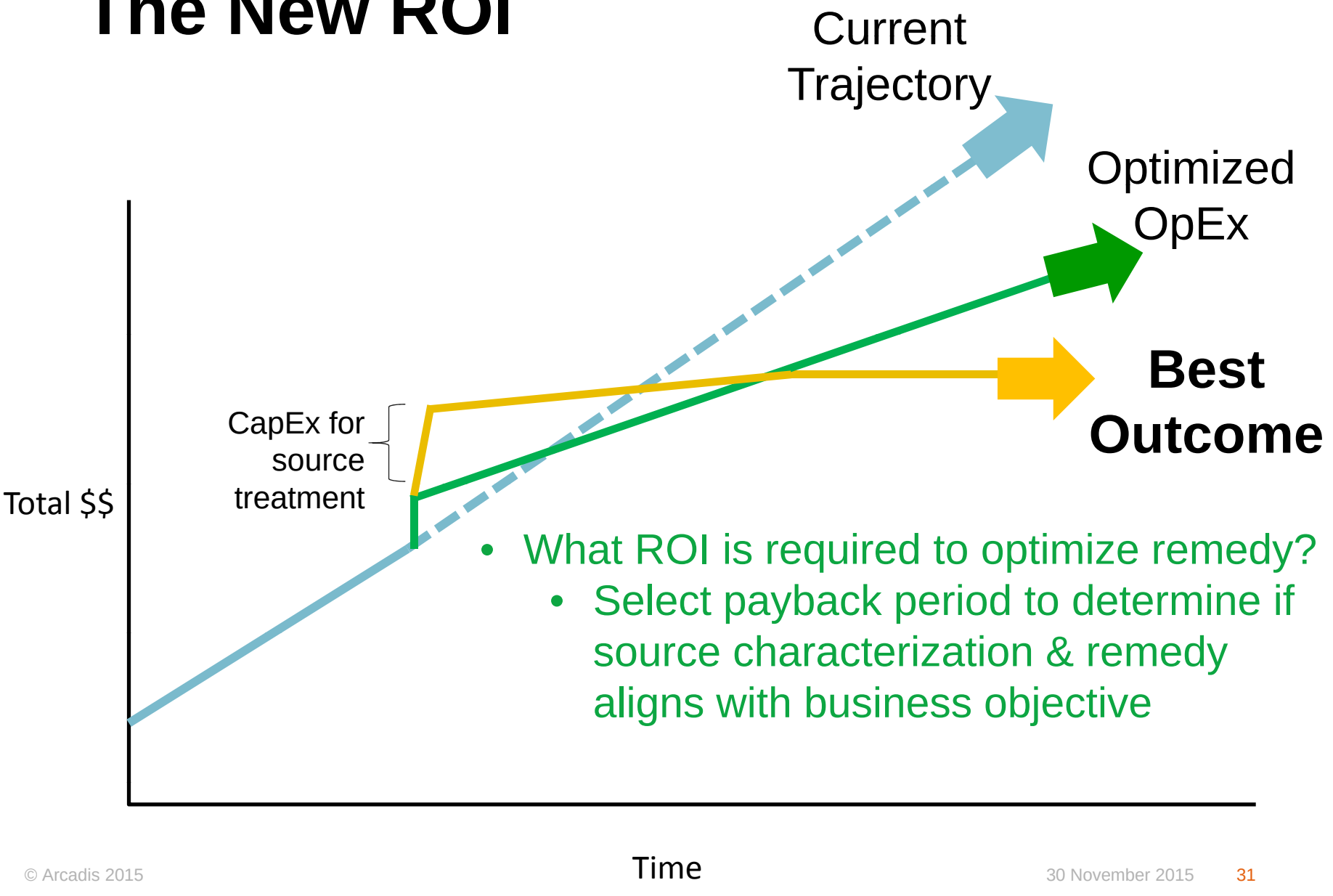
Duration of P&T Or opportunity for optimized remedy depends on source

Calibrating ROI Expectations

- Remedy decisions dependent on more than least total cost

- Align the remedy to meet expectations that match your business needs in short- and long-term

The New ROI

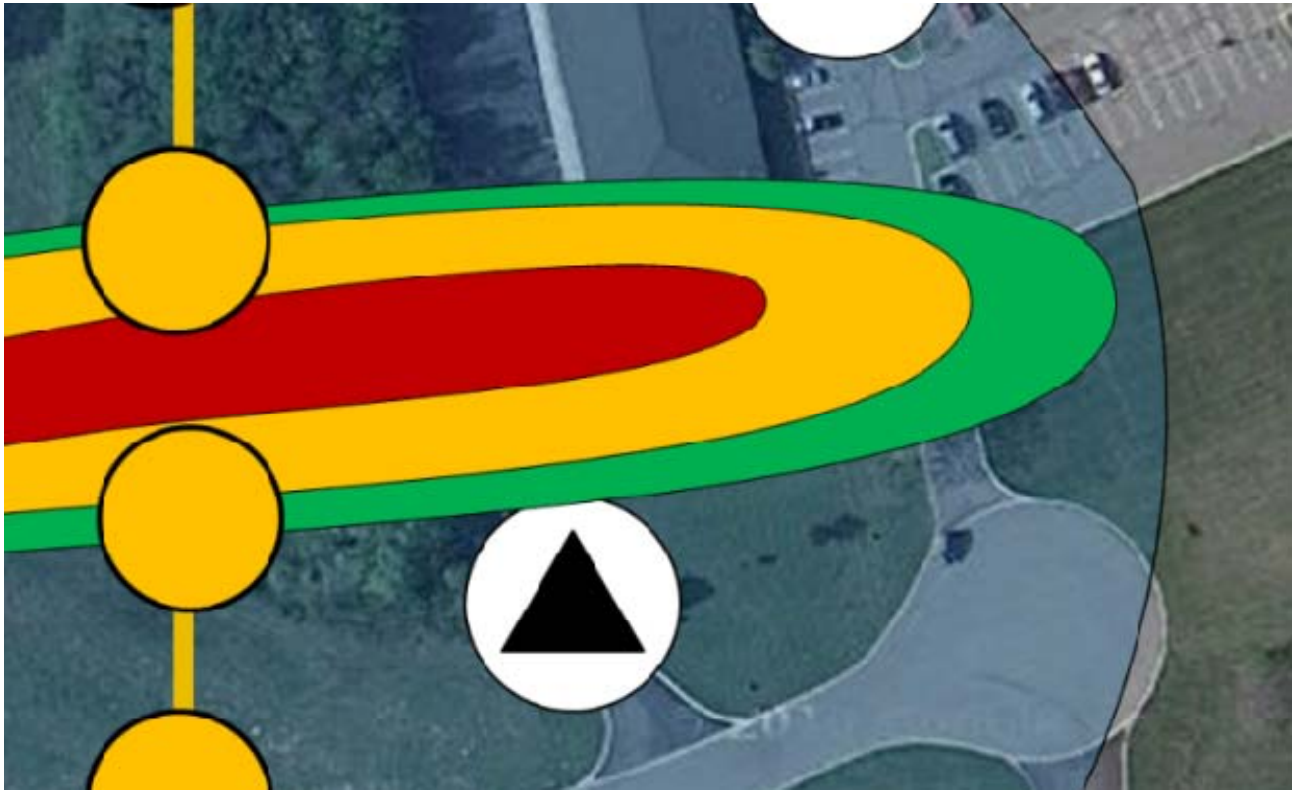


- What ROI is required to optimize remedy?
  - Select payback period to determine if source characterization & remedy aligns with business objective

Source Treatment – Exit Ramp

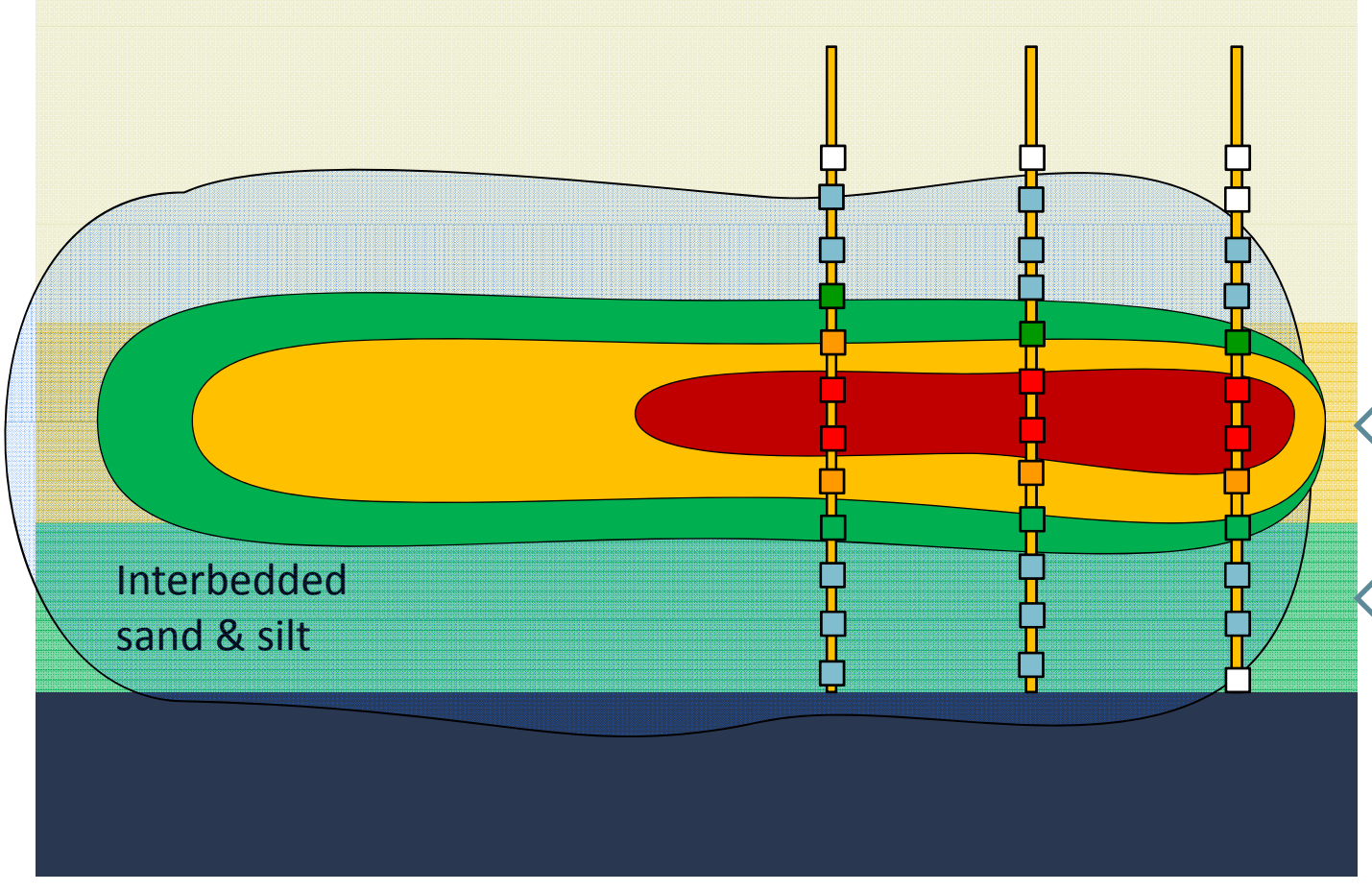
Flux-Based Source Evaluation

- Mass distribution relative to transport and storage zones dictate technologies, endpoint, and cost



Is Smart source characterization worth the effort?

Flux-based source evaluation – Transport zone

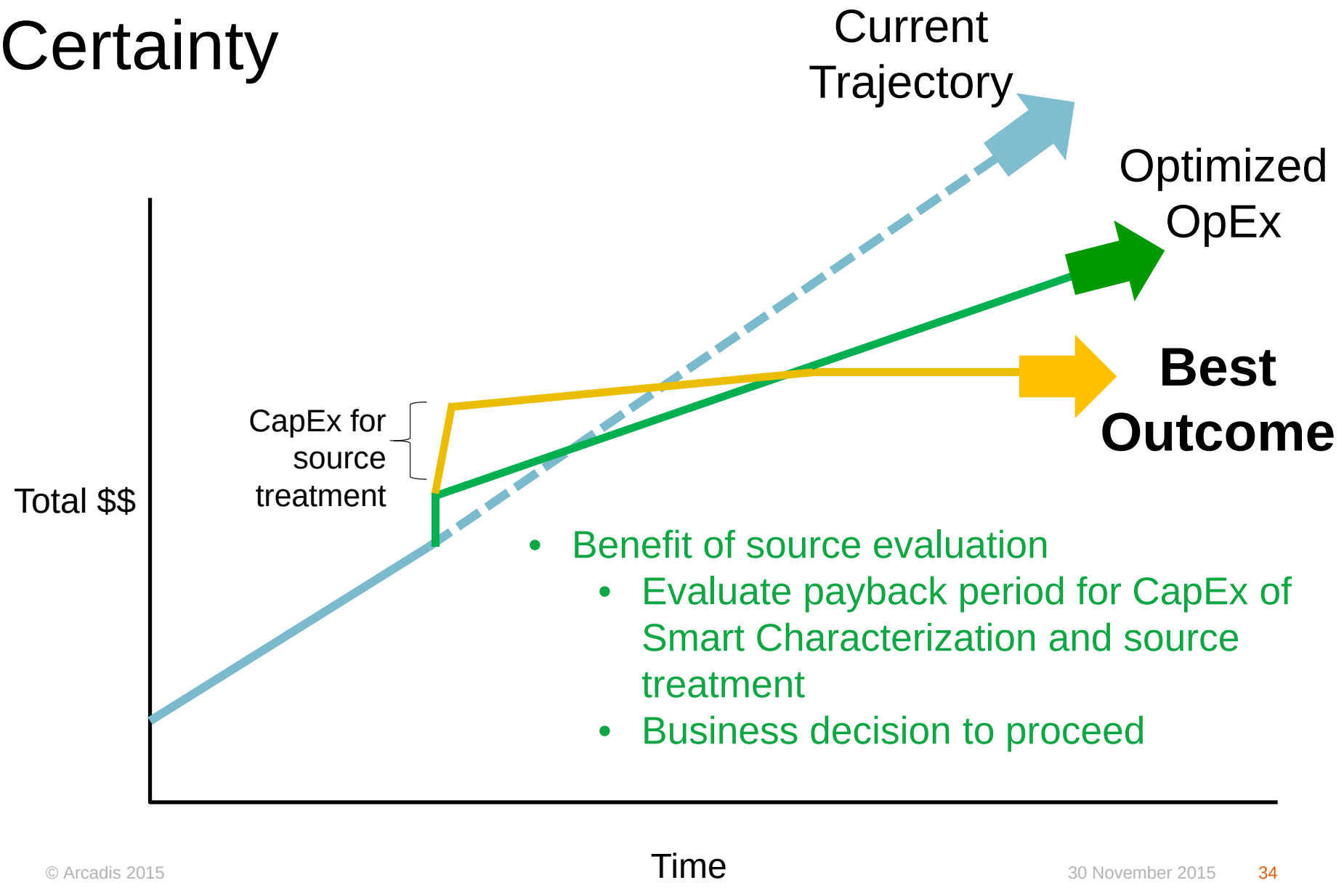


>90% of flux in coarse sand zone

<u>Limited</u> mass in difficult to treat storage zone

Size is key cost factor

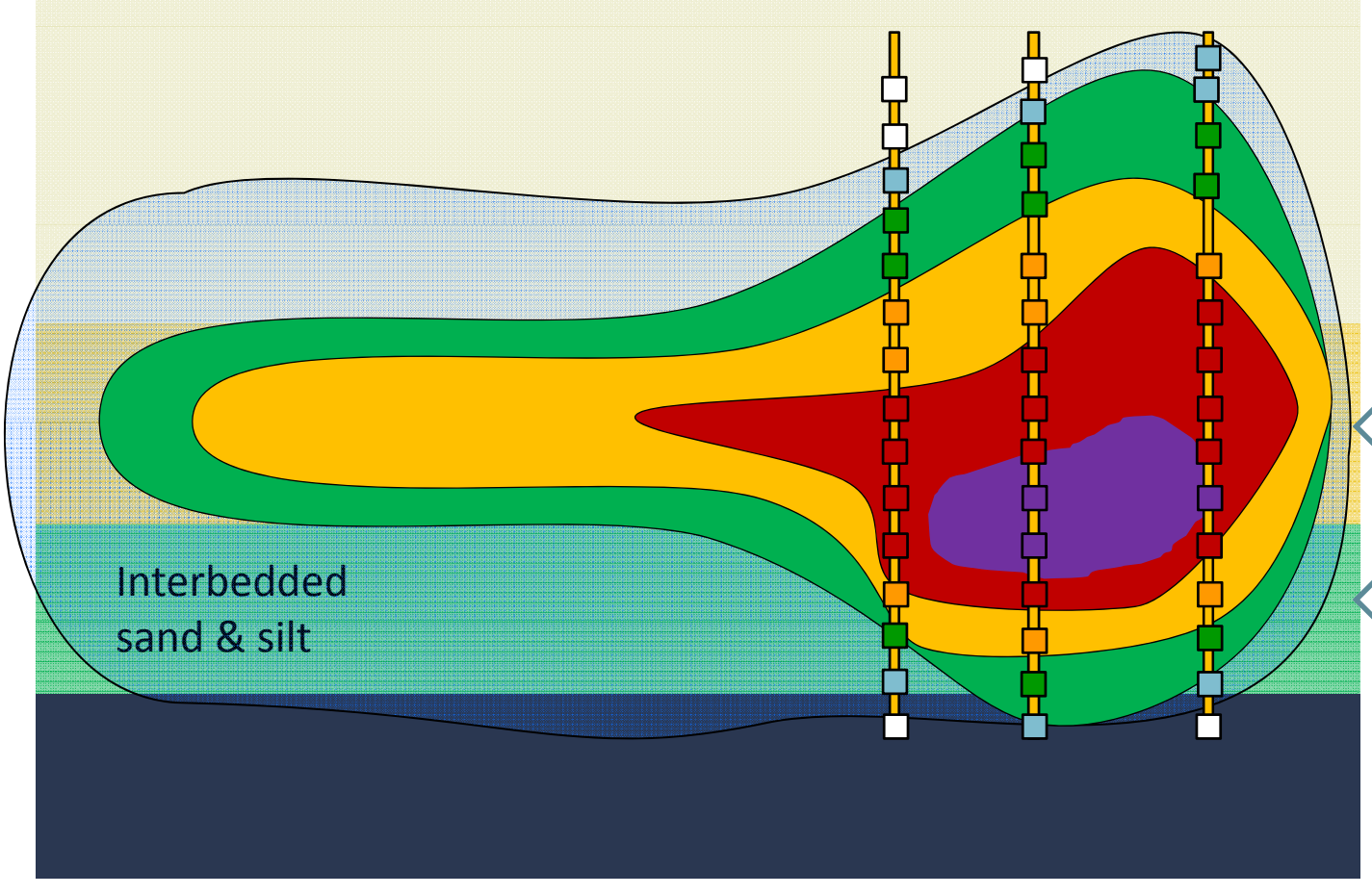
The New ROI - Outcome Certainty



- Benefit of source evaluation
  - Evaluate payback period for CapEx of Smart Characterization and source treatment
  - Business decision to proceed

Flux-based source evaluation – storage zone source

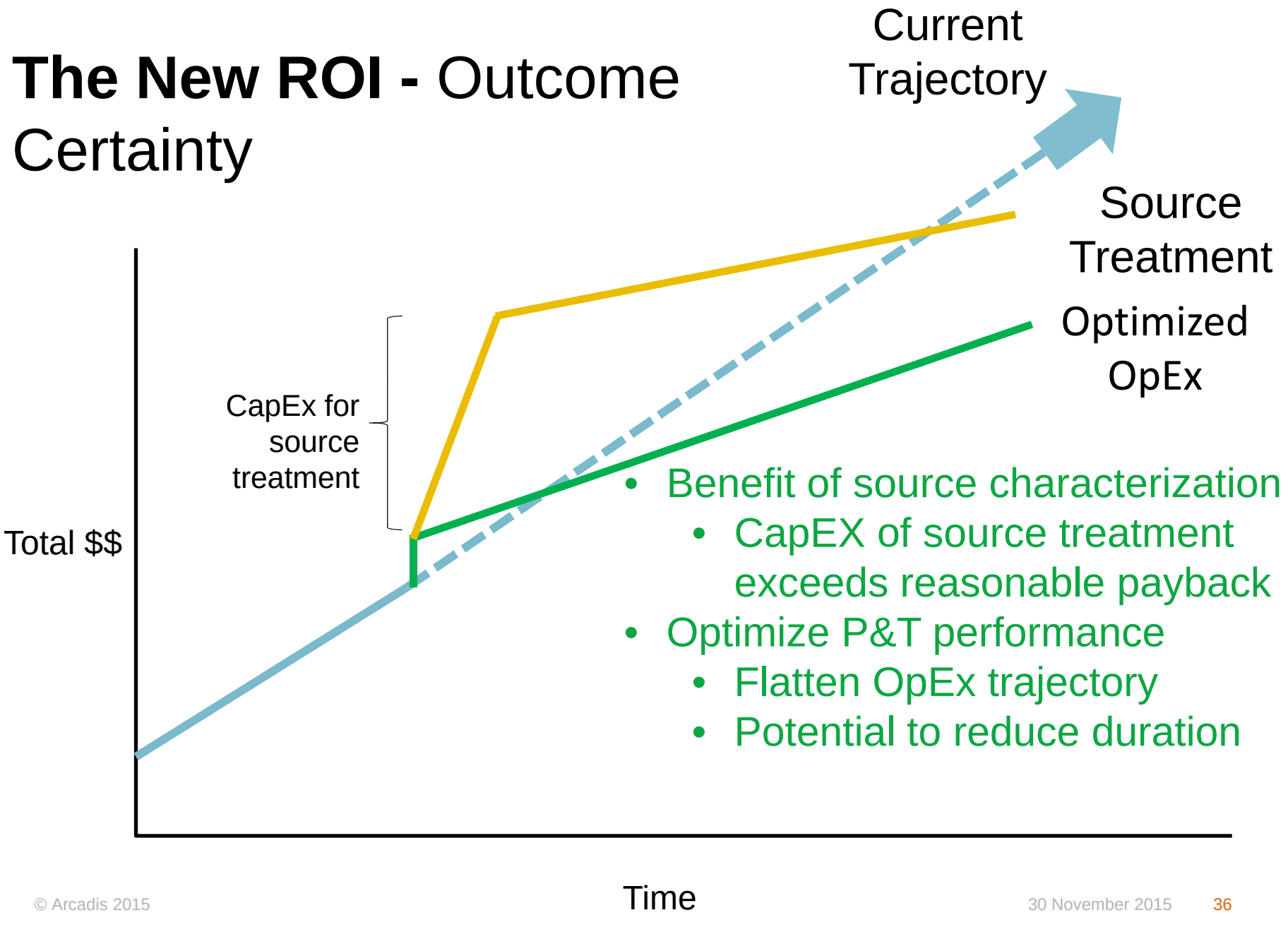
Treatment approach is key cost factor



>90% of flux in coarse sand zone

<u>Significant</u> mass in difficult to treat storage zone

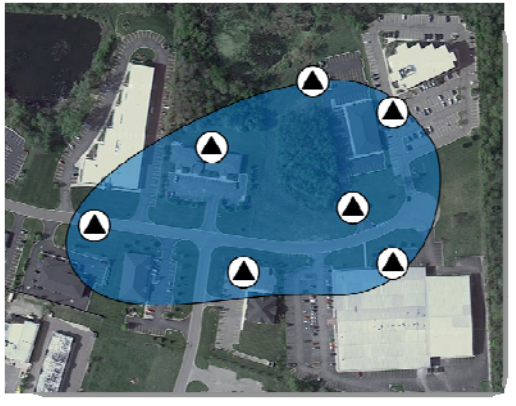
The New ROI - Outcome Certainty



- Benefit of source characterization
  - CapEX of source treatment exceeds reasonable payback
- Optimize P&T performance
  - Flatten OpEx trajectory
  - Potential to reduce duration

For new sites, do it right the first time:

CONVENTIONAL

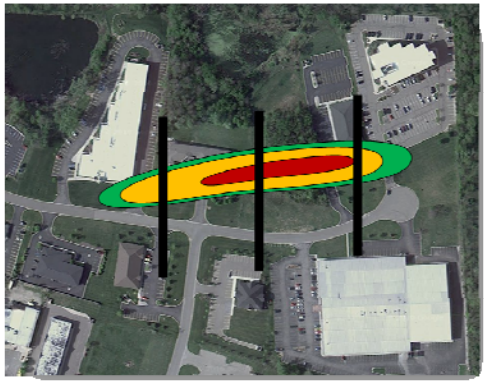


Investigation
- **Years** of effort
- **Dozens** of reports & work plans

Remediation
- **Long-term, ineffective remedy**
- **Poor outcome certainty**

V
S.

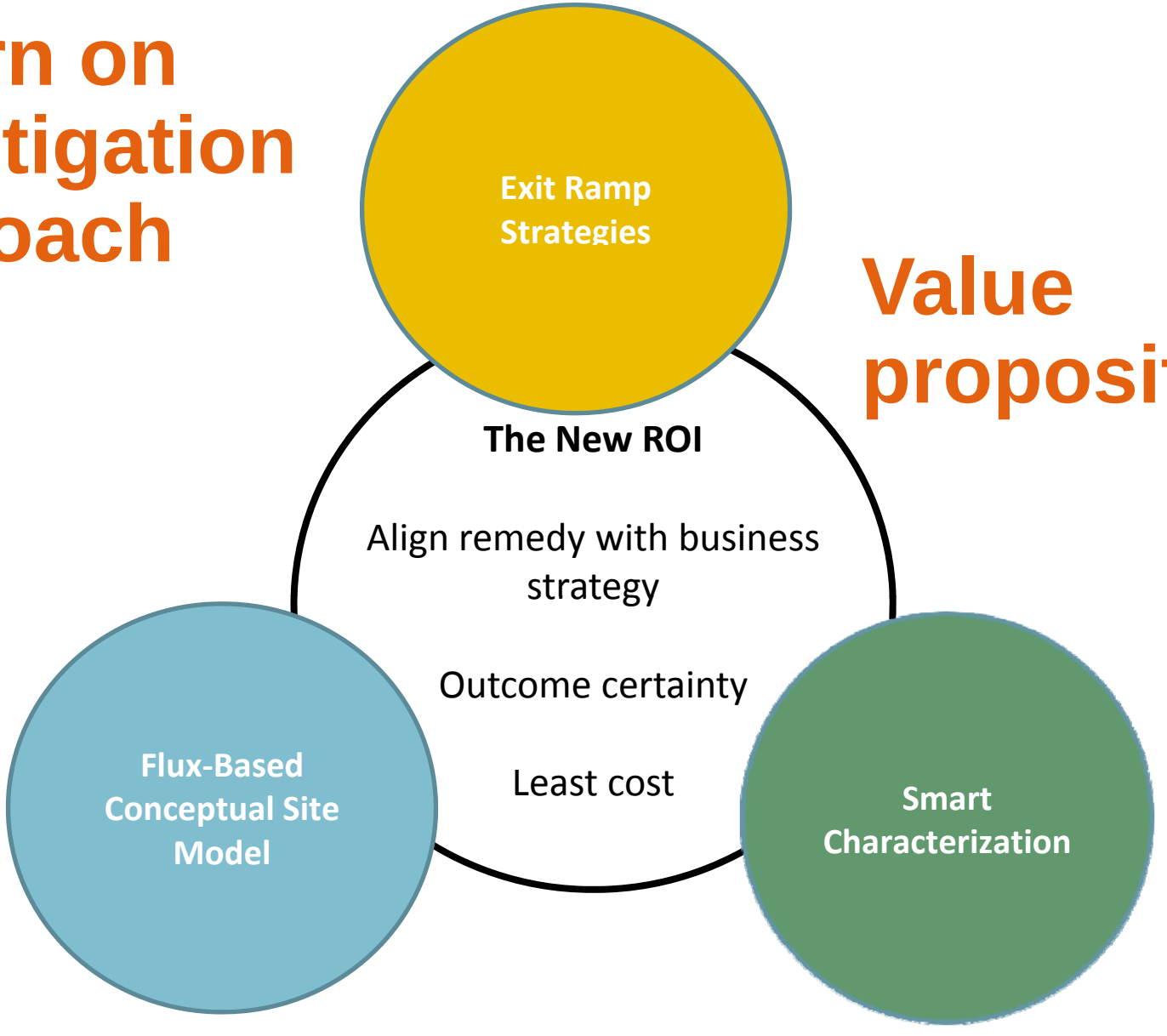
SMART CHARACTERIZATION



Investigation
- **Weeks** of effort using real-time methods
- **ONE** report & work plan

Remediation
- **Focused, cost-effective remedy**
- **Outcome certainty with opportunity to match business objectives**

Return on Investigation Approach



Value proposition

Questions?

Contacts

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