# Overview of Geologic & Driller's Targets

Pete Clark
CVX ETC D&C DEU DD SME
1 October 2015

# Agenda

- Objective
- Geologic Targets & Modifiers
- Directional Software Target Shapes
- Position Uncertainty Components
- Target Erosion
- Vertical Uncertainty
- Management

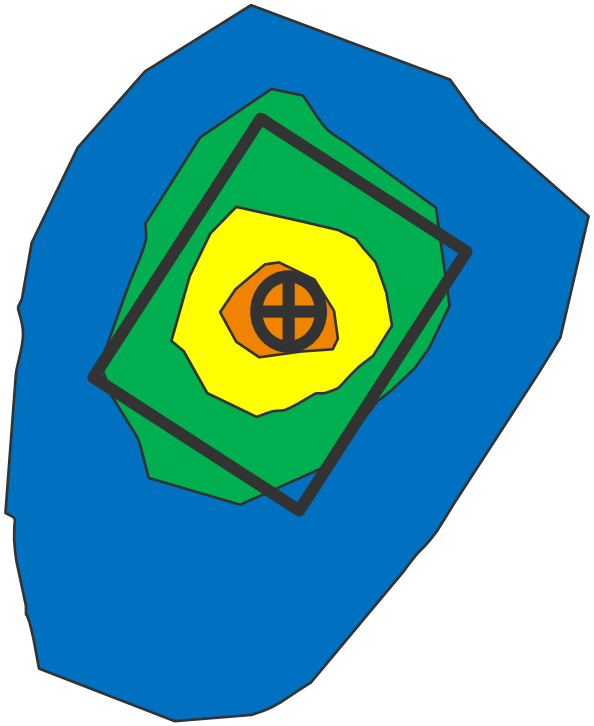
# Objective

- Summarize
  - Target sizing
  - Objective of target sizing
  - Requirements for target sizing
- In order to
  - encourage industry standardization
  - provide an educational resource

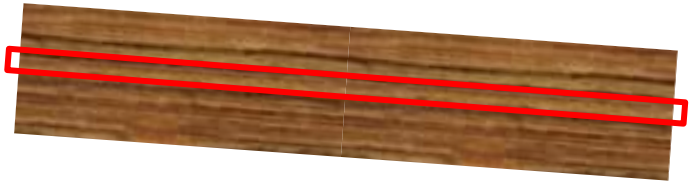
# Geologic Target

- A simplification of the reservoir target that can be used for geometric well-planning

**Location within a reservoir**



**Layer within a sequence**

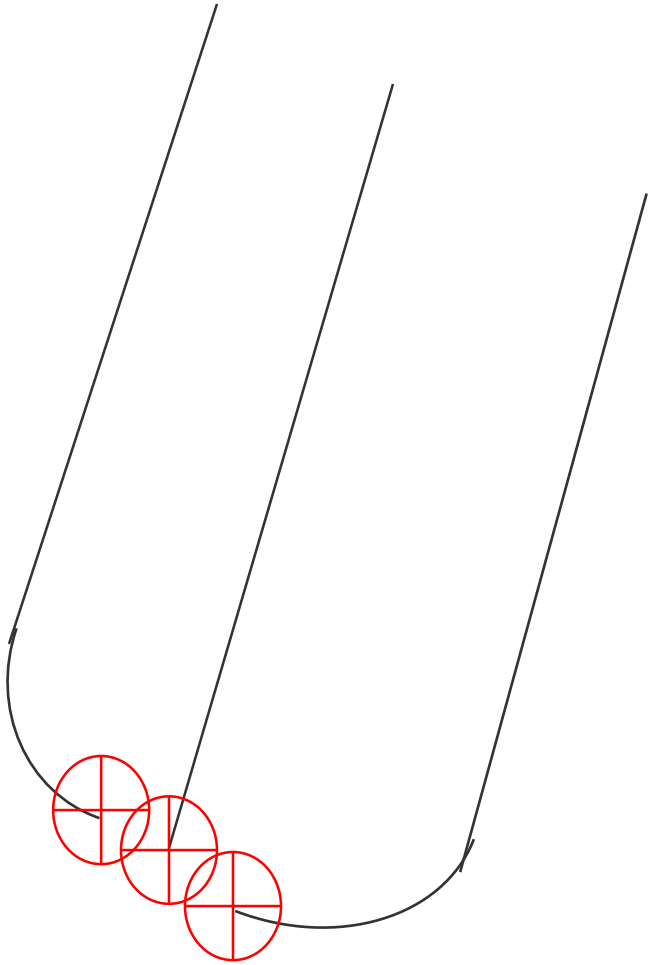


# Geologic Target

- Layer / Lithology
- Location
- Layer / Lithology & Location

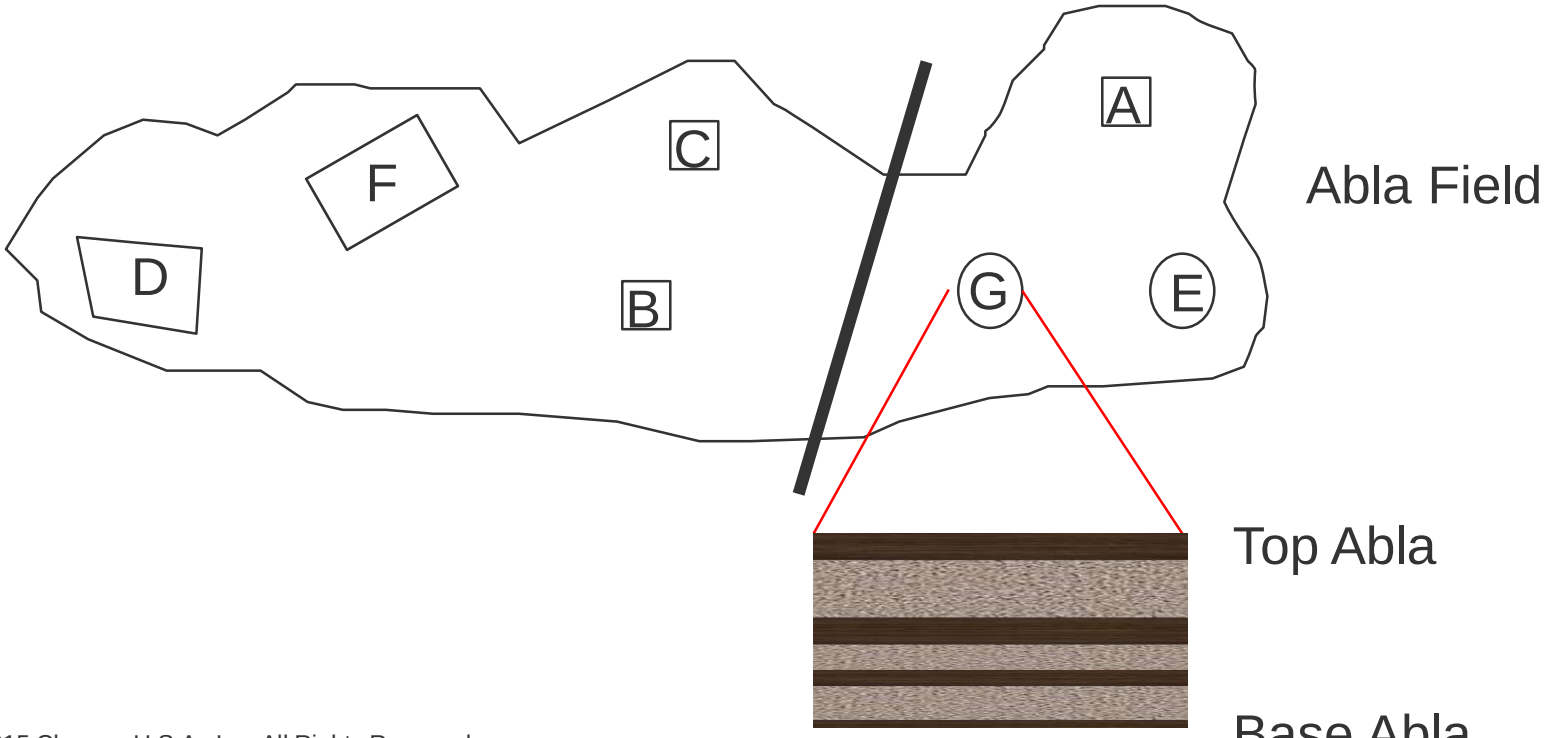
Top Sheepcamp - A

Base Sheepcamp - A



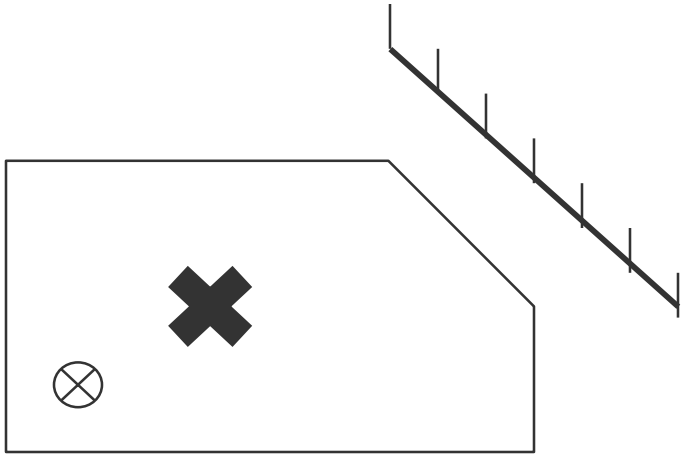
# Geologic Target

- Location
- Layer / Lithology
- Location & Layer / Lithology



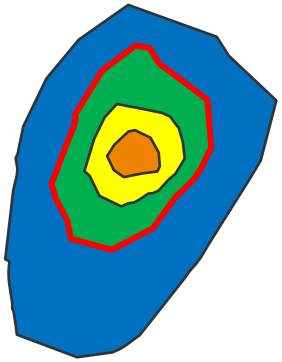
# Geologic Target Modifiers

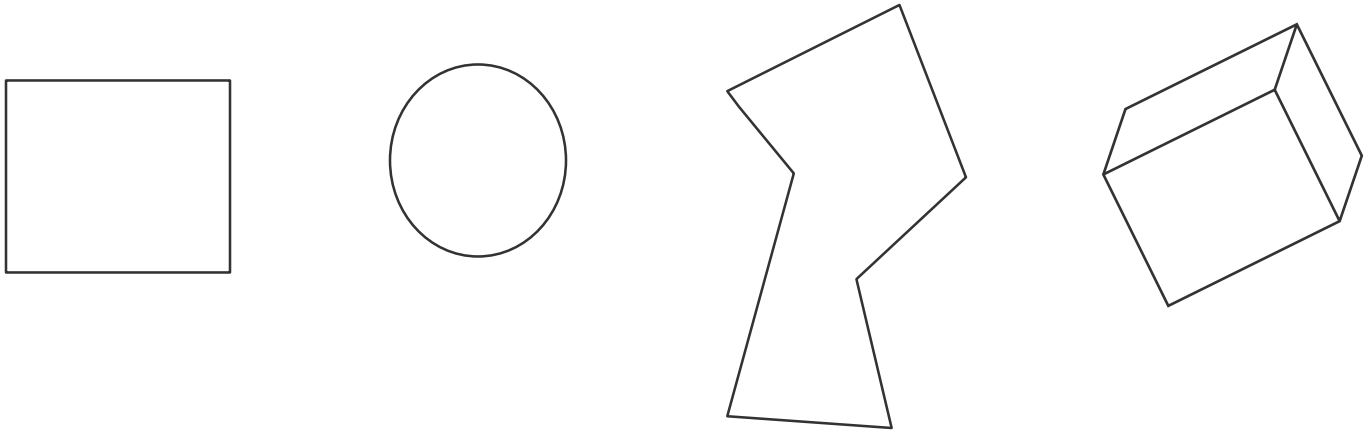
- Geologic Fault
- Lease Boundary
- Offset Well



# Directional Software Target Shapes

- Generally
  - Simplify true geologic target shape into a geometric description
    - Point
    - 2D ; Square, Rectangle, Circle, Ellipse, Polygon (2D)
      - Tilt by dip angle, oriented by strike
    - 3D ; Extrusion (vertically, orthogonally)

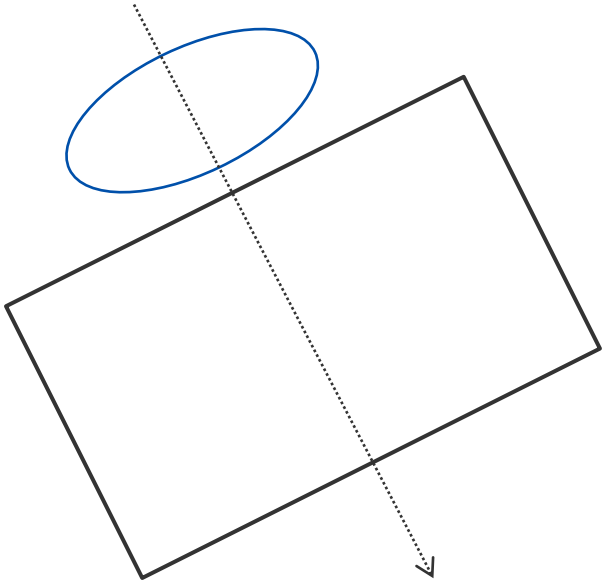




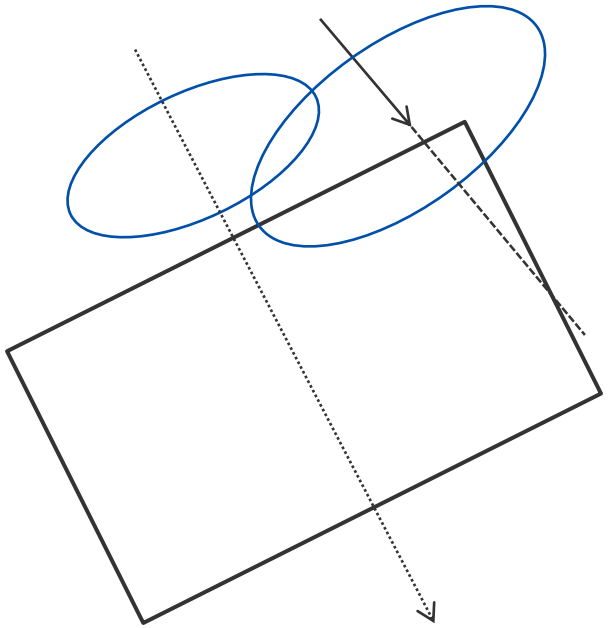
# Positional Uncertainty

- Sources
  - Wellhead position measurement ☑
  - Wellbore position ☑
  - Geologic target position uncertainty ☒

Plan

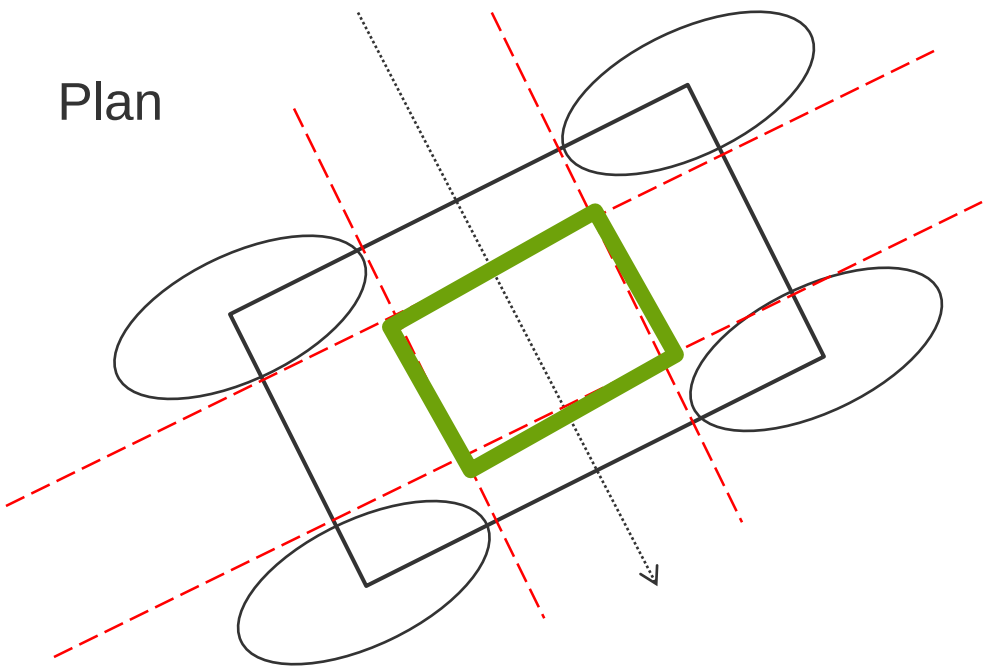


Actual



# Simple Driller's Target

- Subtract Lateral uncertainty from sides
- Subtract Radial Uncertainty from  front & back



# Consequences of Missed Target

- Inefficient development of reserves
  - Positional Uncertainty confidence level
    - Commensurate with acceptance of risk

| Target | 1 sigma | 2 sigma | 3 sigma |
|---|---|---|---|
| Layer (1D) | 68.2% | 95.4% | 99.7% |
| Top (2D) | 39% | 86% | 99% |
| Shape (3D) | 20% | 74% | 97% |

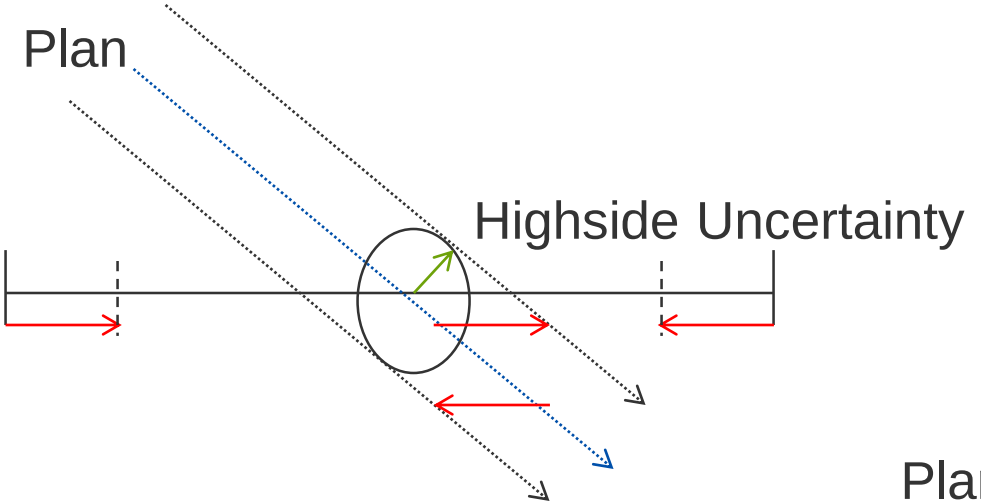
- Target sizing confidence level is independent of collision avoidance confidence level

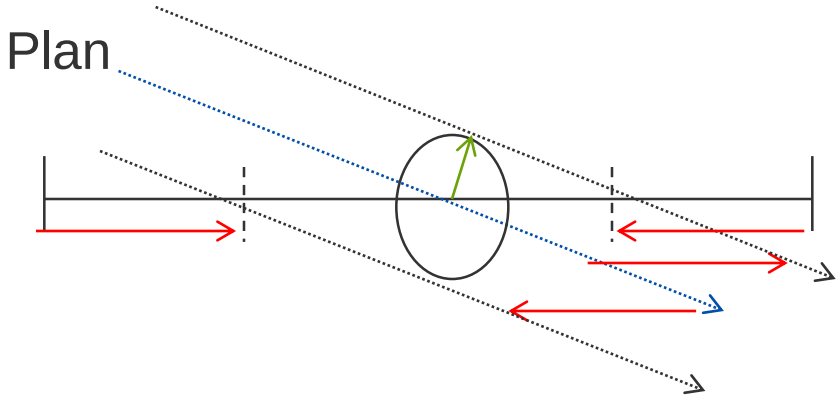
# Target Erosion

- The act of reducing the geologic target to the driller's target taking account of wellbore positional uncertainty at the target location
  - 1D / layer ; subtract vertical positional uncertainty from target top and bottom depths, narrowing the target TVD window.
  - 2D with depth confirmation (geologic correlation) ; subtract lateral uncertainty from the target's lateral bounds and radial uncertainty from the target's displacement boundaries.
  - 2D without depth confirmation ; subtract lateral uncertainty from the target's lateral bounds and *(high side uncertainty/cosine [wellbore inclination at target])* from the target's displacement boundaries.
  - 3D ; subtract lateral uncertainty from the target's lateral bounds, radial uncertainty from the target's displacement boundaries, and vertical uncertainty from the target's top and bottom boundaries
- The algorithm for target erosion is complex and relies on computer software. The above is only guidance

# Role of Vertical Uncertainty

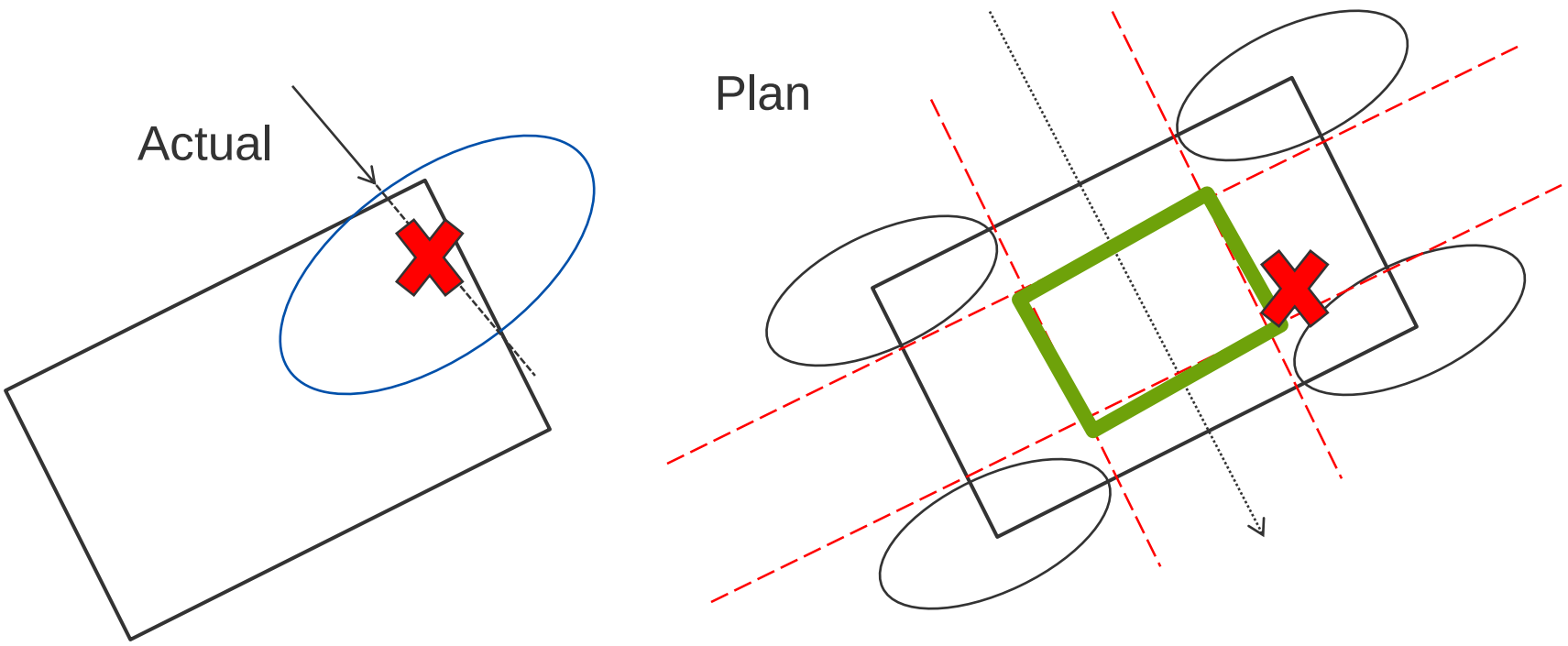
- Without depth confirmation vertical uncertainty has significant erosion



# Target Intersection Management

- Investigate a target extension before incurring additional expense
- Investigate methods to improve PU or confirm geologic position before POOH



# Geosteering

- Aid to rather than replacement for target sizing
  - Need assurance of intersecting targeted reservoir
- Poor integration between target sizing and geosteering
  - Integration with incremental positional uncertainty similar to magnetic ranging for relief wells
  - Issues
    - Attitude is dominant requirements
    - Focus on TVD however lateral positioning is often a requirement
    - Wellbore position v wellbore position characterization
    - Continuous data from distant sensors

# Summary

- Requirements
  - Simplified  geologic target description
- Objective
  - Assurance of having met the well's value based well objectives
- Method
  - Root Sum of Squares of wellbore and wellhead positional uncertainty
  - Select confidence level appropriate for risk consequences
  - Identify soft boundaries & hard lines
  - Select method based on target dimensionality
  - Include vertical uncertainty if no depth confirmation