

Guidelines for estimation and classification of resources other than reserves (ROTR)

Synopsis of the new Canadian Oil and Gas Handbook (COGEH)
Guidelines

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Presentation Objectives

- Background to ROTR
- What do the Guidelines Cover
- Highlight Some Subject Areas of Interest
- Comment on differences to PRMS
- Summary and Conclusions

- Hopefully not too dry a subject....



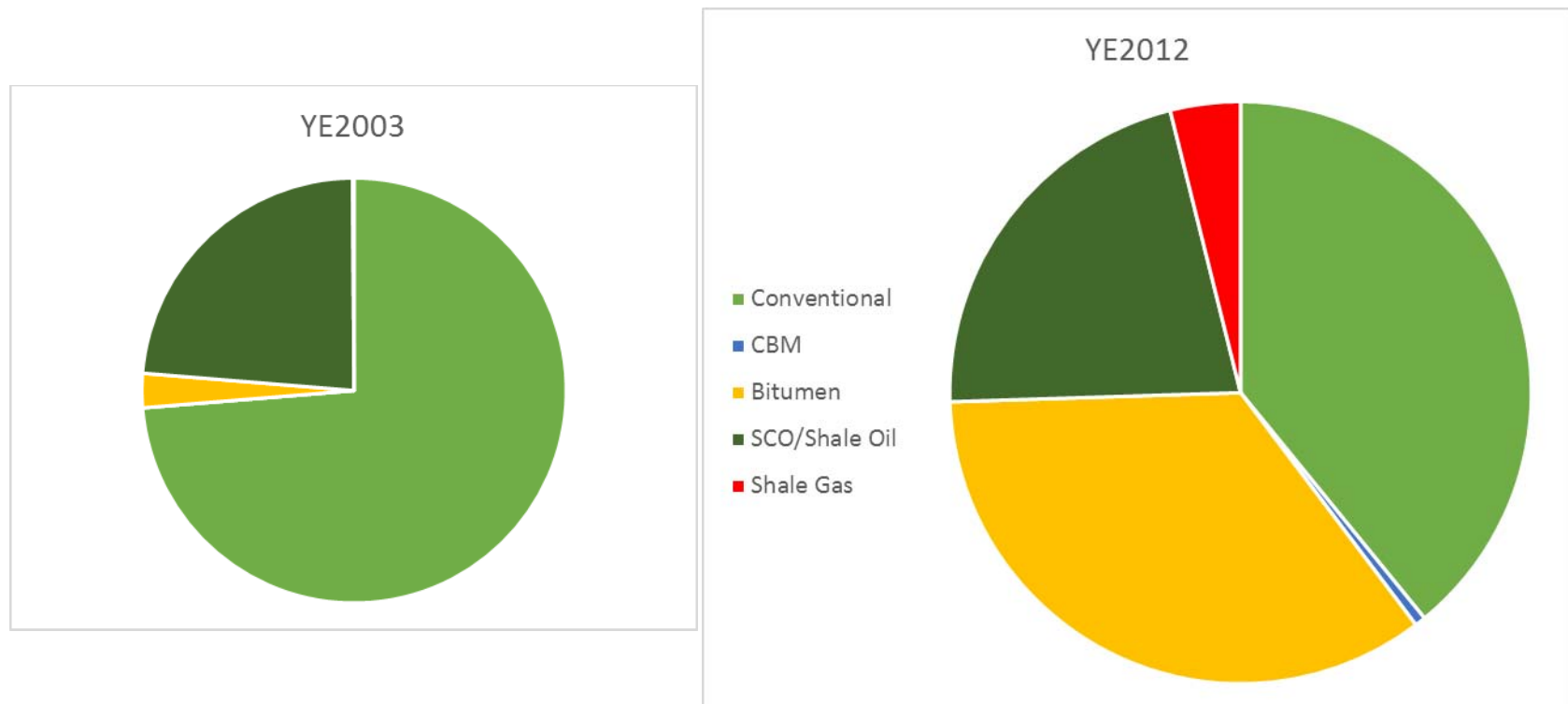
COGEH

- The Canadian Oil & Gas Evaluation Handbook (COGEH) is prepared by the SPEE Calgary Chapter. First issued in 2003 and pre-dates SPE-PRMS.
- Canadian listed companies must prepare resource estimates in accordance with COGEH
- COGEH Volume 2 provides detailed Guidelines for Estimation & classification of Oil & Gas Resources and Reserves
- **Volume 2 Section 2 (104 Pages), first issued June 2014, covers “Resources Other than Reserves”**

Reasons for the ROTR Guidelines

- Emergence of Unconventional Resources has led to a major increase in the reporting of contingent resources
- Significant concern about inconsistency in evaluation and disclosure of contingent resources
- In 2010 the Alberta Securities Commission (ASC) sent a letter to the SPEE Calgary Chapter requesting improved guidelines
- A 2012/2013 Oil & Gas Review by the ASC again flagged the issues

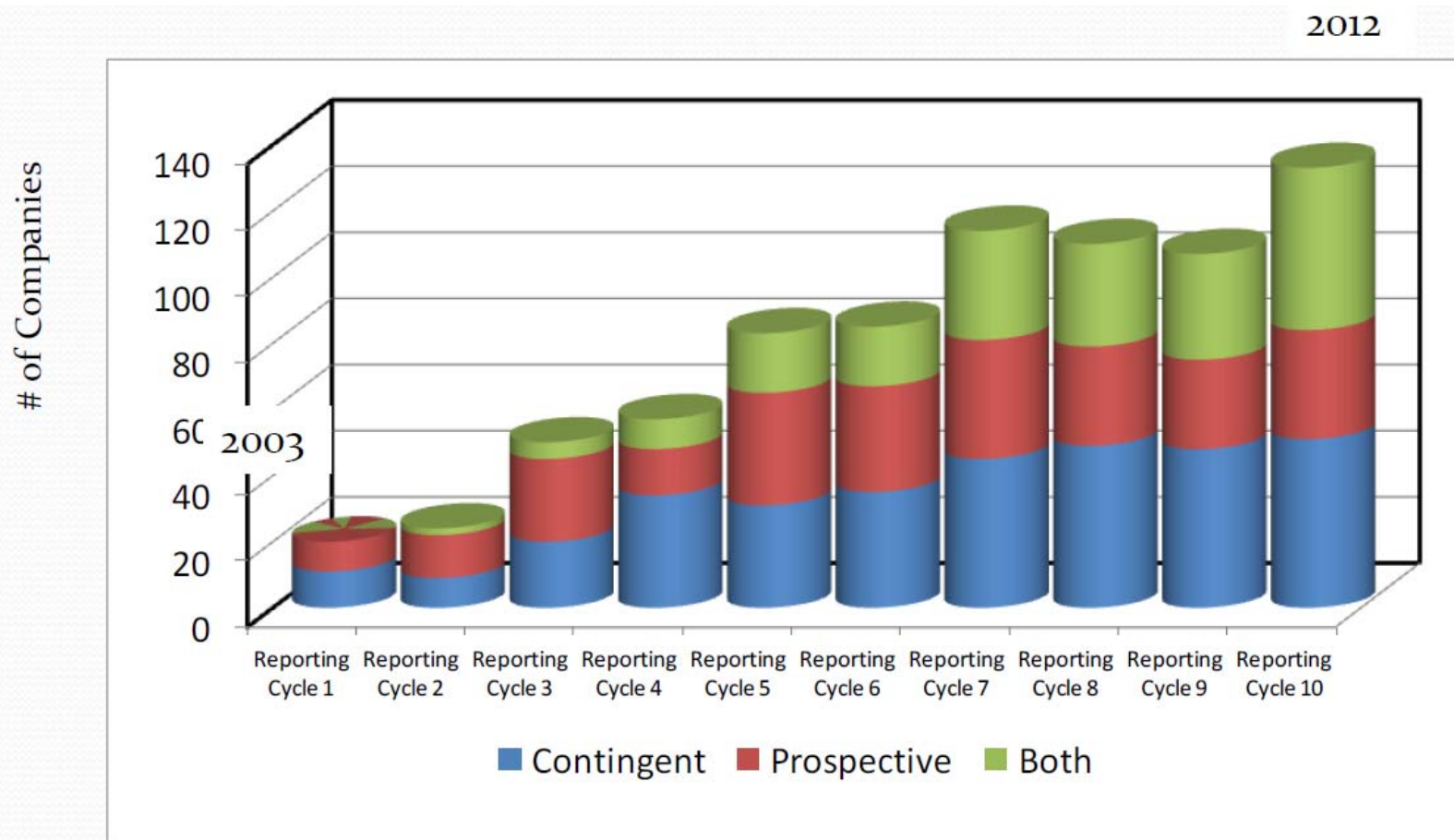
Increased Unconventional 2P Reserves



- 60% of the 2P reserves being disclosed in Canada are now Unconventional whereas 10 years ago it was approx. 25%

Source David Elliott

Increased Resource Disclosure

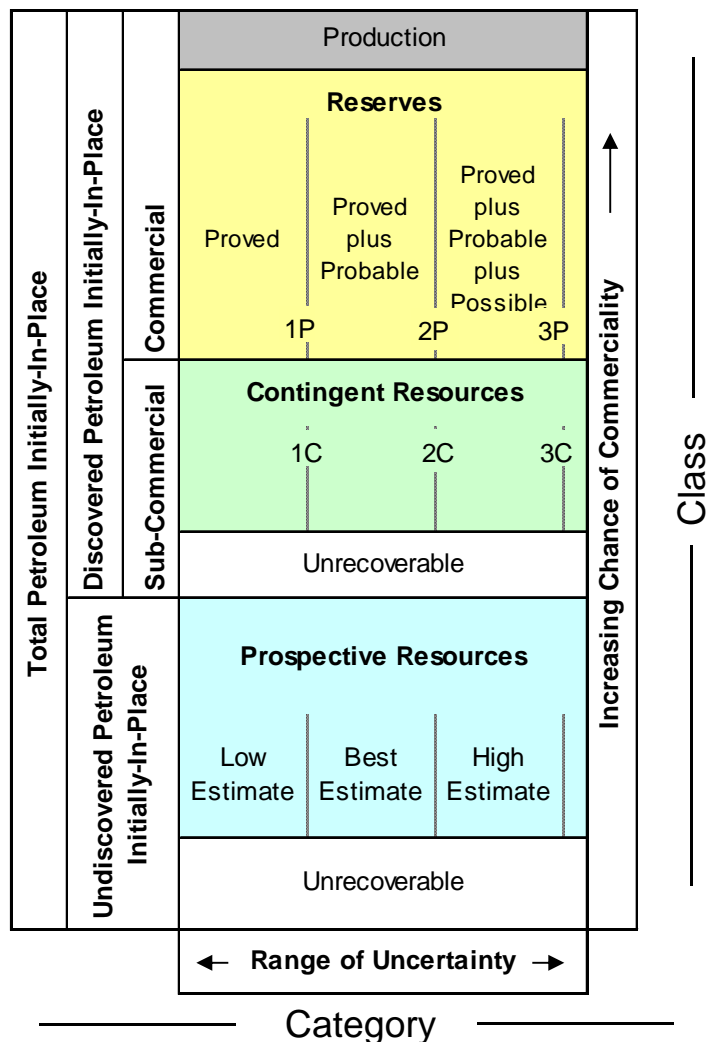


Source David Elliott

New Guideline Contents

- Introduction
- General Requirements for Classification of ROTR
- Petroleum Initially-In-Place (PIIP)
- Projects
- Contingent Resources
- Discovered Unrecoverable PIIP
- Prospective Resources
- Aggregation

2.2 General Requirements



■ Reserves

- Discovered (known accumulation)
- Recoverable
- Commercial
- Remaining

■ Contingent Resources

- Discovered (known accumulation)
- Recoverable
- Remaining
- Expected to be commercial upon resolution of contingencies
- Estimated volumes risked by chance of development

■ Prospective Resources

- Undiscovered
- Estimated volumes risked by chance of discovery & development

General Requirements

- Definitions are provided for Reservoir, Net Pay, Cut-off, Accumulation, Discovery and Known Accumulation.
 - Similar to PRMS but written more with unconventional resources in mind.
- Discusses use of Analogues
- Extrapolation from a Control Point

Discovery

- The confirmation of the existence of a significant quantity of potentially recoverable petroleum.

- PRMS
 - A discovery is one petroleum accumulation, or several petroleum accumulations collectively, for which one or several exploratory wells have established through testing, sampling, and/or logging the existence of a significant quantity of potentially **moveable** hydrocarbons.

Known Accumulation

- An accumulation that has been penetrated by a well that has demonstrated the existence of a significant quantity of **potentially** recoverable petroleum, preferably by flow testing that demonstrates the petroleum is moveable. If there is no flow test, log and/or core data may suffice provided a good commercial analogue is available to justify the assumption that the petroleum is moveable.
- Similar to PRMS with the addition of potentially.

Known Accumulation (continued)

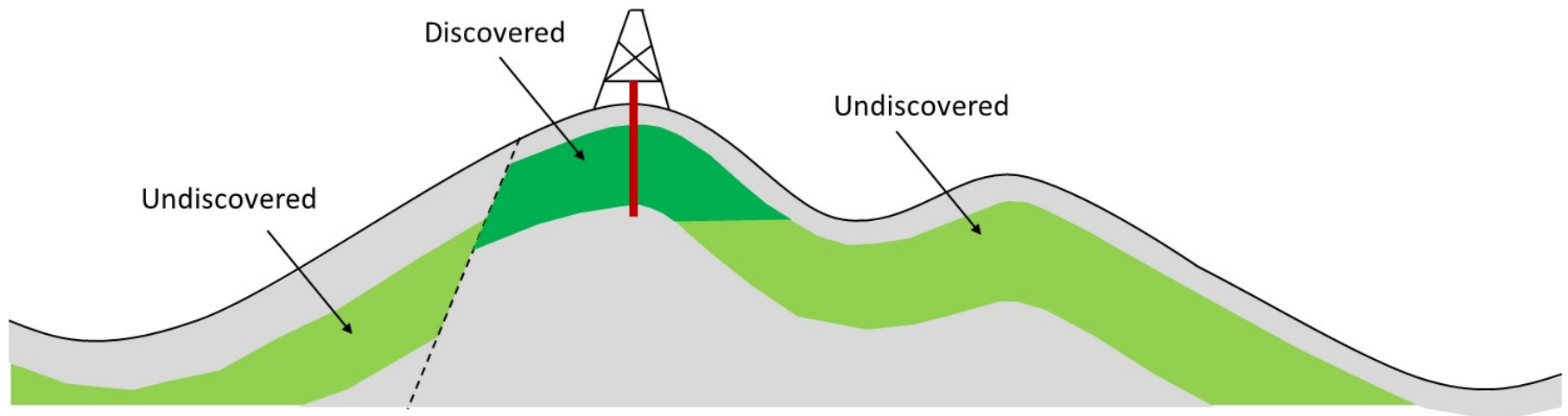
- Three pages of discussion, for example:
- Further guidance is provided on what does not constitute “significant quantities”
 - Recoveries from core, shows, cuttings, mud demonstrate the presence of petroleum but may not be adequate to demonstrate either the presence of significant quantities or their producibility.
 - Minor recoveries from tests (films, flecked mud, gas too small to measure) confirm the presence of petroleum but may not be adequate to demonstrate the presence of significant quantities and are not adequate to demonstrate producibility.
 - Such recoveries should be considered as shows that may indicate prospectivity rather than discovery.

Analogues

- Analogues in certain circumstances can
 - Avoid the requirement to test (e.g. bitumen) to define a discovery
 - Allow reserves to be booked without pilot testing
- Reservoir Analogue
 - A reservoir with similar rock properties (lithological, depositional, diagenetic, and structural), fluid properties (hydrocarbon type, composition, density, and viscosity), reservoir conditions (depth, temperature, and pressure), and drive mechanisms that can be used as a model for the reservoir being evaluated.
- Recovery Process Analogue
 - A recovery process that is an established technology or technology under development in the analogue reservoir that can be applied to the subject reservoir being evaluated.

2.3 Petroleum Initially in Place (PIIP)

- Total PIIP (TPIIP) comprises:
- Discovered PIIP (DPIIP)
 - Demonstrate continuity and productivity away from control point
- Undiscovered PIIP
 - $UPIIP = TPIIP - DPIIP$



Defining DPIIP

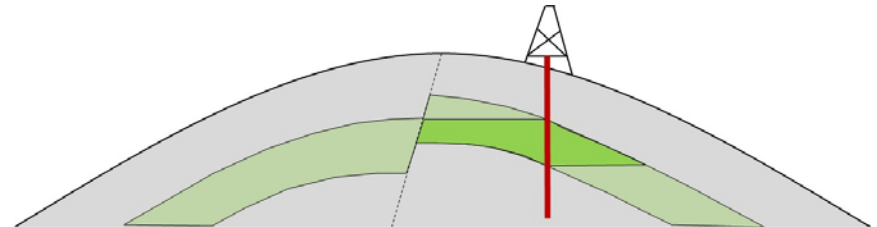
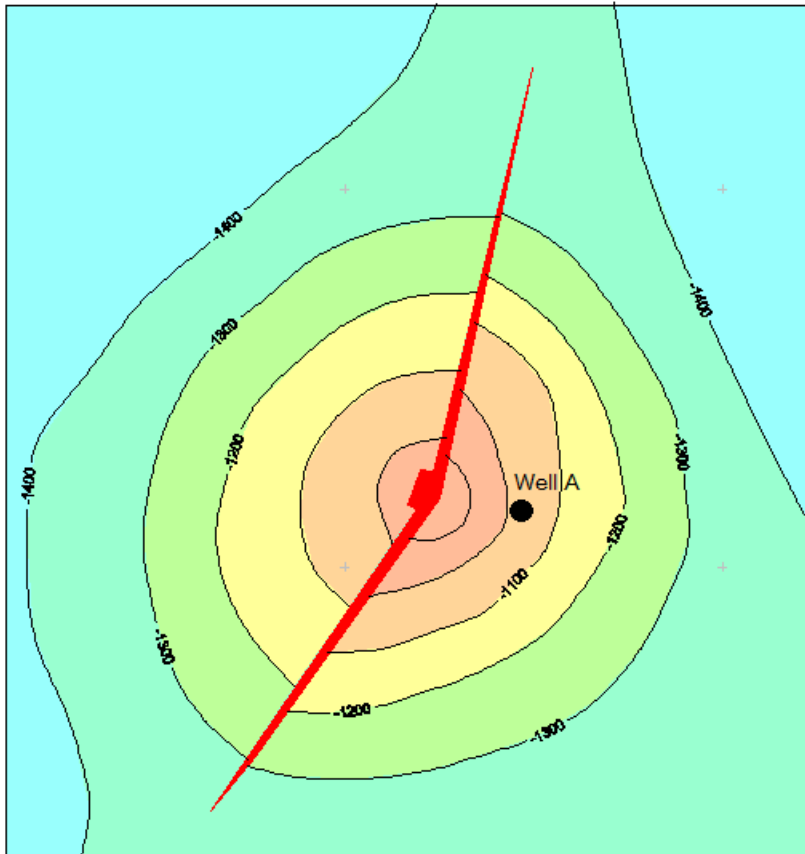
- Extrapolating away from a Control Point is critical in defining DPIIP
 - A well provides information at a point. The quality of information that may be extrapolated away from this point decreases with distance until further extrapolation is unreliable
- Need to integrate well & seismic data plus analogue information
- Must be able to demonstrate:
 - The continued presence of the geological unit of interest
 - It contains significant quantities of petroleum and that petroleum is recoverable
- Considerations
 - Depositional environment and depositional trends
 - Diagenesis, porosity & permeability trends
 - Faults
 - Well log correlatability (consistency)
 - Potential change in pressure regimes and fluid properties (gas, oil, water)

Defining DPIIP (continued)

- The guidelines make some other interesting remarks
 - In making judgments on the basis of these factors, the evaluator must be guided by the principle that ROTR are to be evaluated using the same technical due diligence as reserves, in order to facilitate orderly conversion of resources to reserves as risks and contingencies are removed. As a practical test, a known accumulation and its associated DPIIP should not carry significant risk, whereby the results of a development well might result in a material revision to the interpreted size of the known accumulation and its estimated DPIIP.
- Our take on this is to avoid the temptation to assign contingent resources over large structures where there is appraisal risk

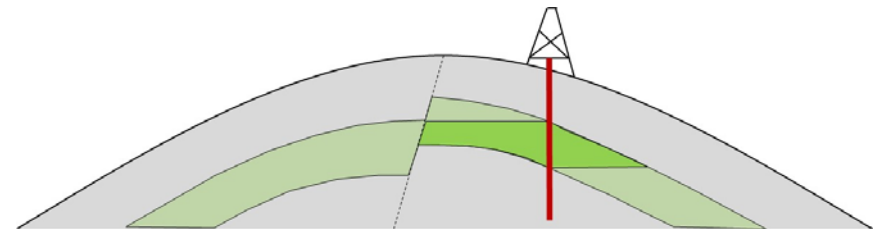
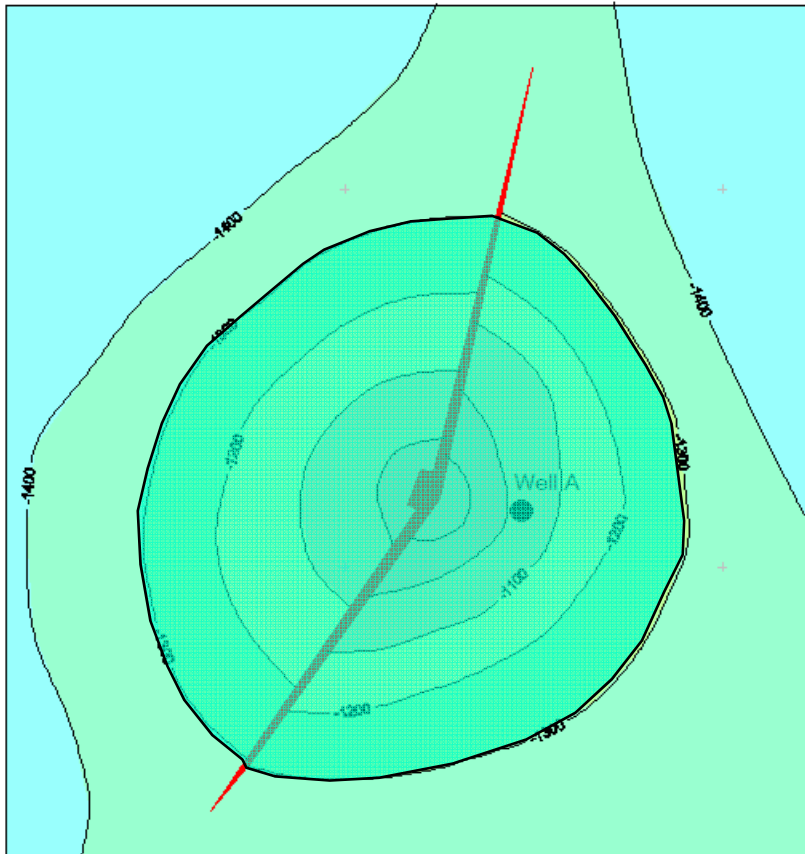
Extent of DPIIP – Example 1

Well A is a discovery. Structural trap. There are different options for defining DPIIP



Extent of DPIIP – Example 1

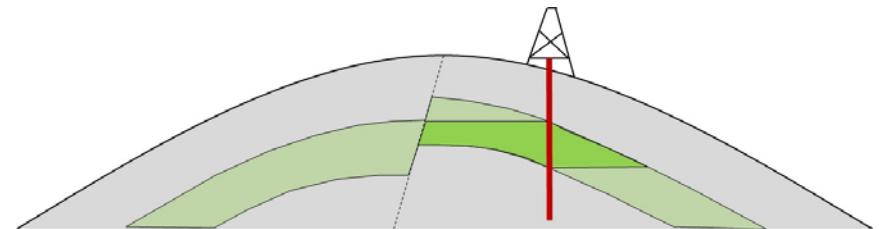
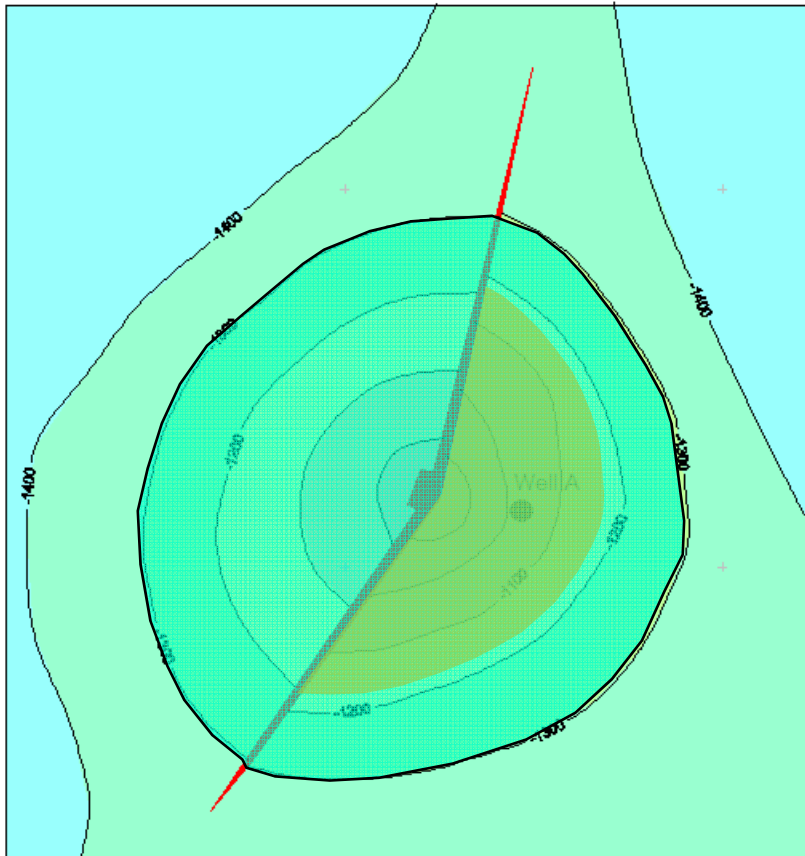
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- Structural Closure

Extent of DPIIP – Example 1

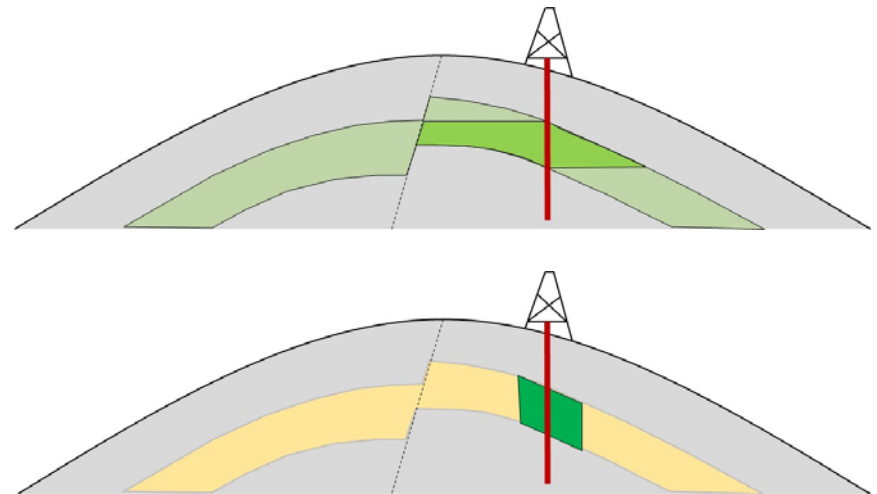
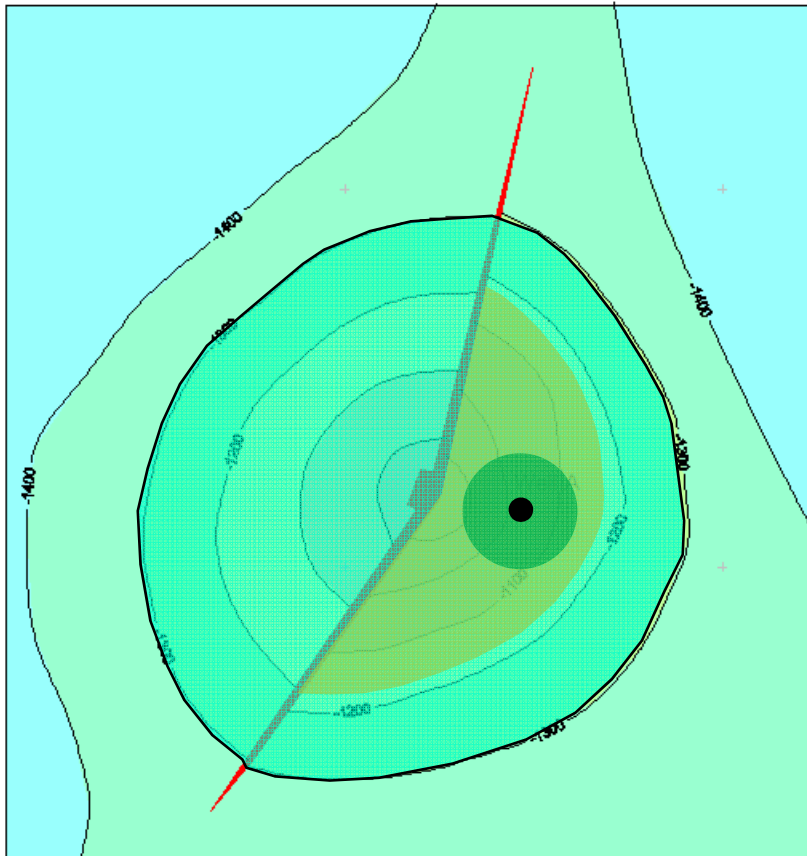
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- Structural Closure
- Top & Base of Petroleum in Well

Extent of DPIIP – Example 1

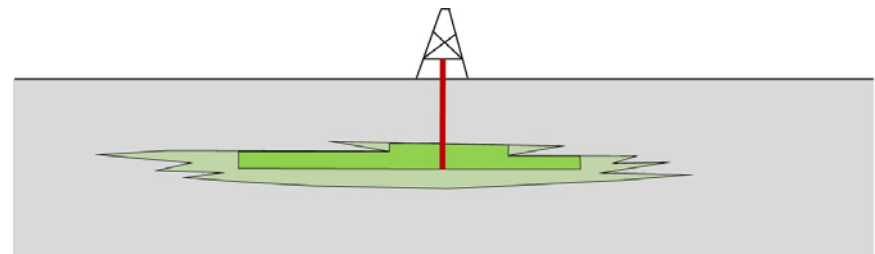
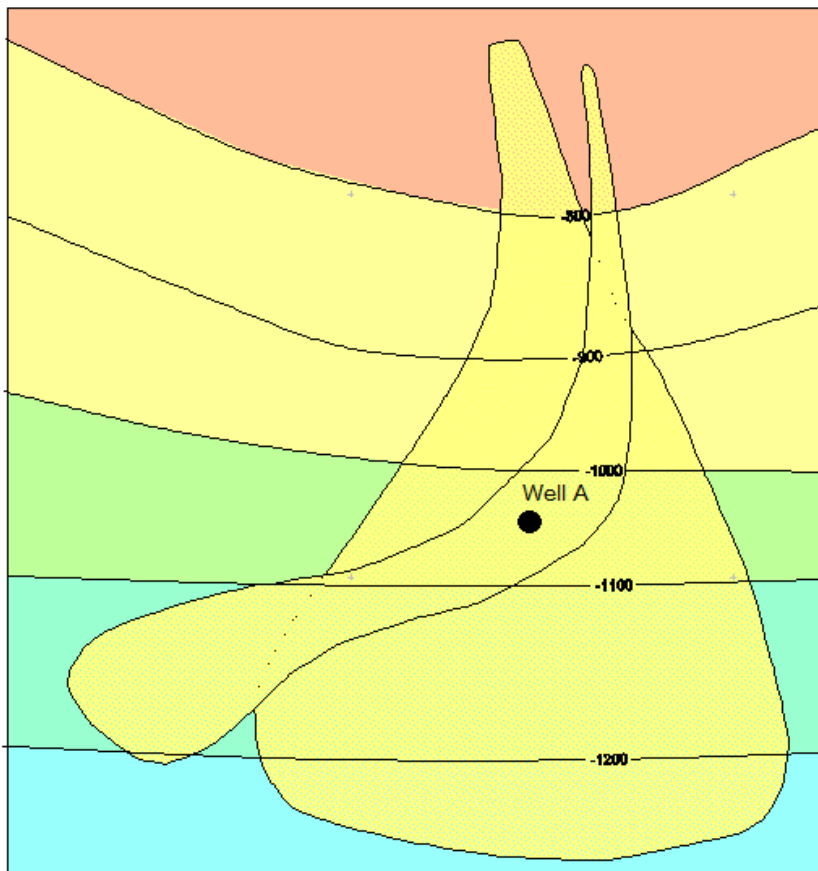
Well A is a discovery. Structural trap. There are different options for defining DPIIP



- Structural Closure
- Top & Base of Petroleum in Well
- Drainage Area

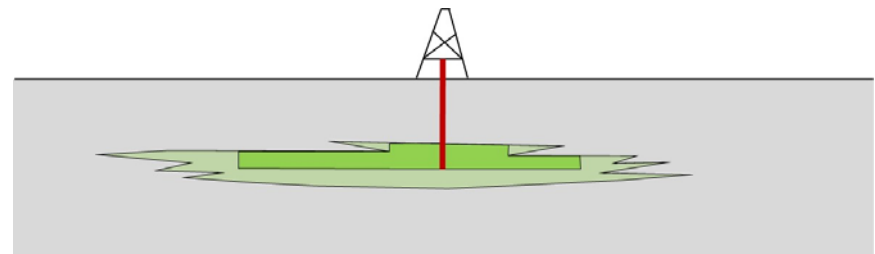
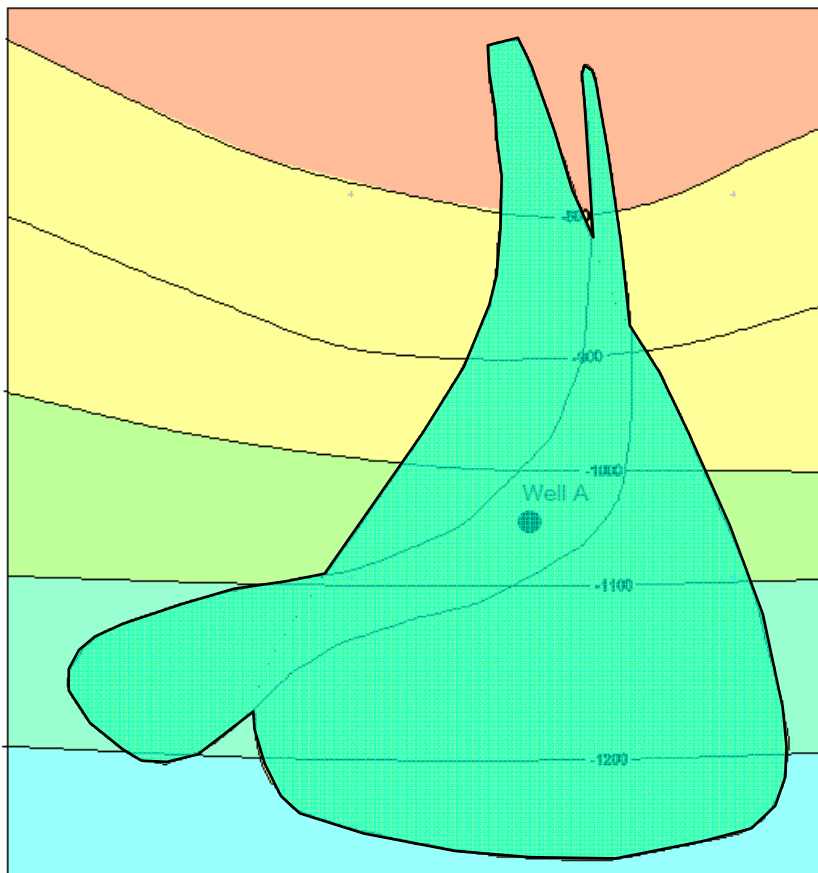
Extent of DPIIP – Example 2

Well A is a discovery. Stratigraphic trap.



Extent of DPIIP – Example 2

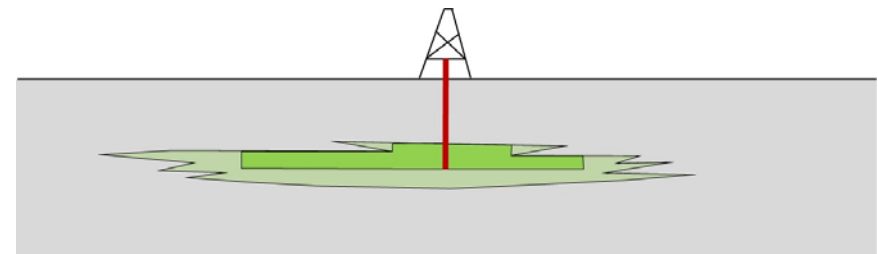
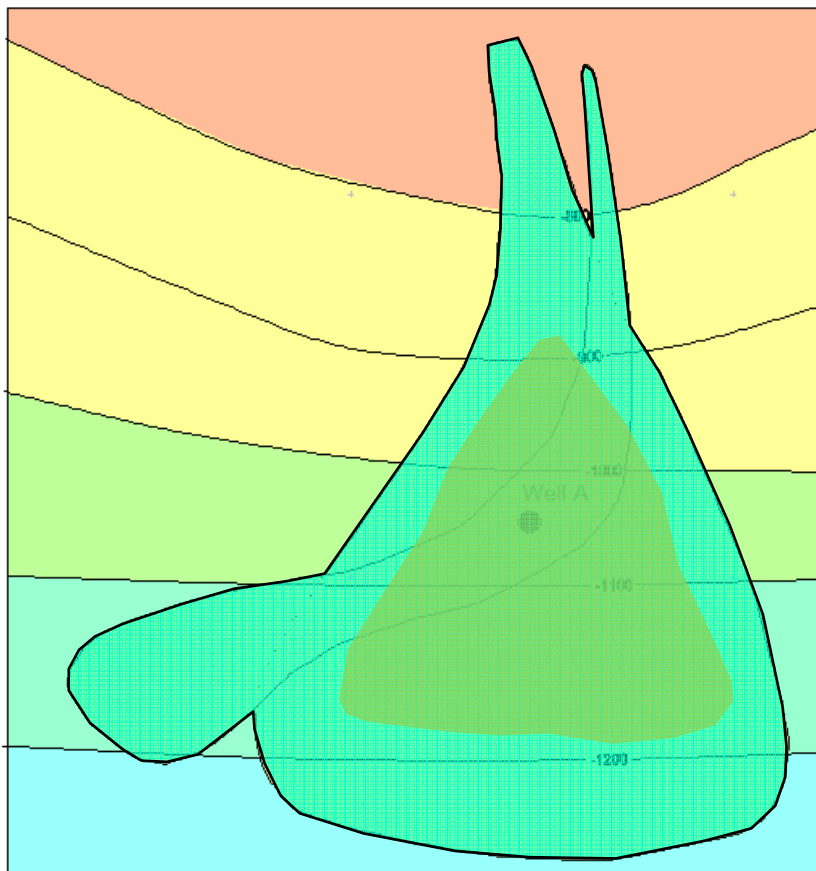
Well A is a discovery. Stratigraphic trap.



- Stratigraphic Closure (mapped)

Extent of DPIIP – Example 2

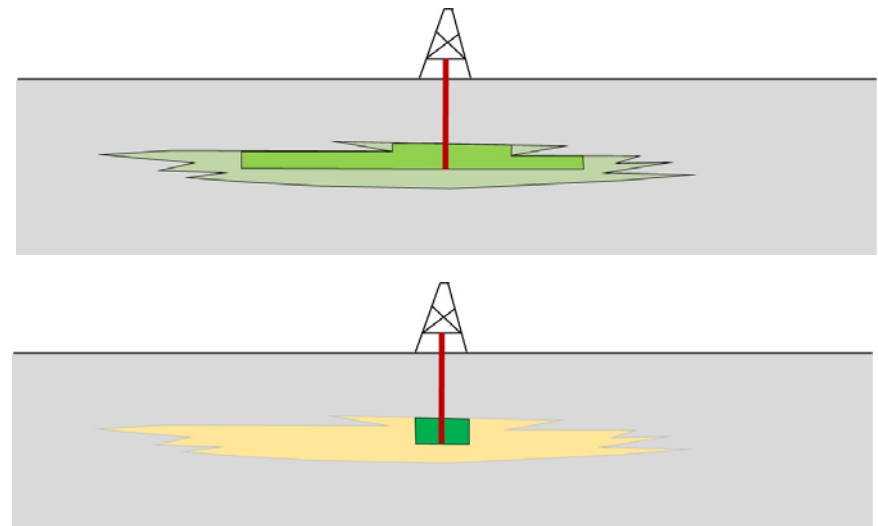
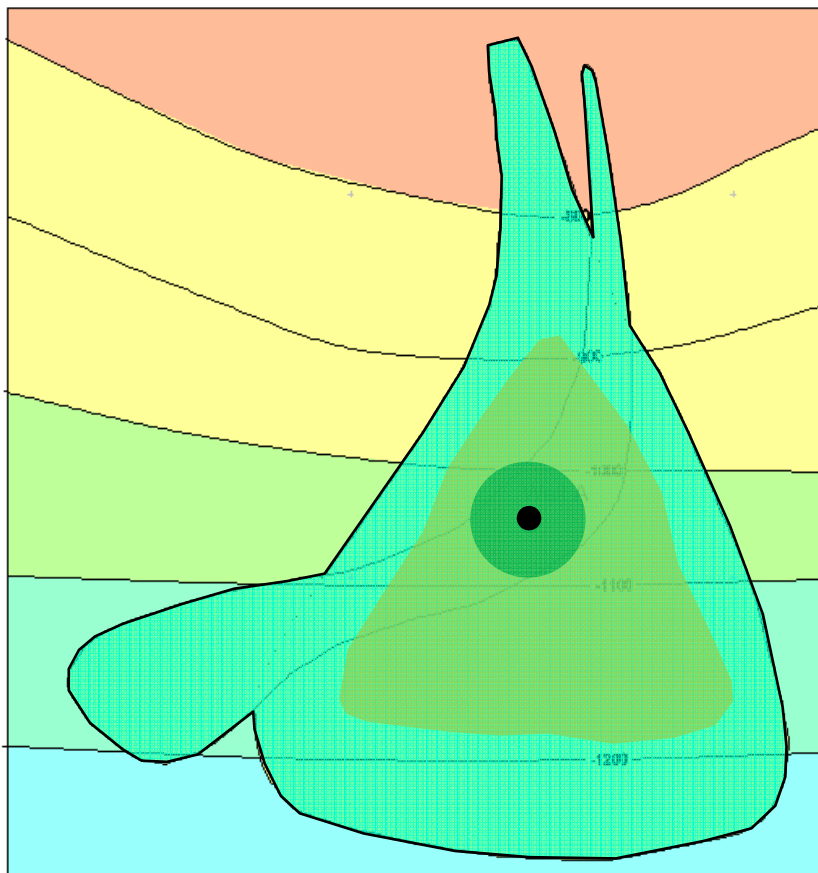
Well A is a discovery. Stratigraphic trap.



- Stratigraphic Closure (mapped)
- Top & Base of Petroleum in Well

Extent of DPIIP – Example 2

Well A is a discovery. Stratigraphic trap.



- Stratigraphic Closure (mapped)
- Top & Base of Petroleum in Well
- Drainage Area

2.4 Projects

- A defined activity, or set of activities, that provides the basis for the assessment and classification of resources
- As with PRMS the concept of a project is central to COGEH and is required for the evaluation of any resource class.
- Section discusses requirements for defining a Technically Feasible Recovery Project
 - Technology Development Process and the link to status of the technology
 - Studies work to support a Project Scenario
- Technology Status Definitions.....

Established Technology

- A recovery method that has been proven to be successful in commercial applications in the subject reservoir [or in good reservoir analogues].
- It is a prerequisite for assigning reserves and, by definition, is not a contingency if it is an established technology for the subject reservoir

Technology under Development (TUD)

- Technology Under Development is a recovery process that has been determined to be technically viable via field test and is being field tested further to determine its economic viability in the subject reservoir. Examples would be:
 - Established technology in reservoirs that are not good analogues to the subject reservoir
 - Established technology in other reservoirs that has been modified but not yet shown to be economically viable in the subject reservoir or in a good analogue
 - Technology that has been shown to be technically, but not economically, viable in the subject reservoir (e.g. by an experimental test) or in a good analogue
- Any recovery process until established in the subject reservoir or shown to be applicable via an analogue would be TUD

Technology Development

- Technology Development status needs to be accounted for when classifying resources
- What about a water injection pilot?

Technology	Reserves	Contingent Resources	Prospective Resources
Established	YES	YES	YES (analogue)
Under Development	NO	YES. If sufficient information to suggest potential commercial viability is available	Only as an extension of contingent resources that have been assigned on the basis of that technology under development
Experimental	NO	NO	NO

Project Evaluation Status

- Project evaluation status needs to be accounted for when classifying resources
- Should help distinguish between unproven reserves and contingent resources

Resource Classification	Project Evaluation Status
Reserves	Development Study
Contingent Resources <i>Economic, Sub-economic Undetermined</i>	Pre-development Study
Contingent Resources <i>Sub-Economic, Undetermined</i>	Conceptual Study
Prospective Resources	Conceptual Study

2.5 Contingent Resources

- Contingent resources are those quantities of petroleum estimates, at a given date, to be potentially recoverable from known accumulations using **established technology or technology under development**, but which are not currently considered to be commercially recoverable due to one or more contingencies
- There is a slight difference with PRMS: Those quantities of petroleum estimated, as of a given date, to be potentially recoverable from known accumulations by **application of development projects** but which are not currently considered to be commercially recoverable due to one or more contingencies.

Type of Contingencies

- Non-technical
 - Economic
 - Legal
 - Regulatory
 - Market access
 - Political
 - Environmental
 - Reasonable timeframe
- Technical
 - Technology under development

Contingent Resource Classification

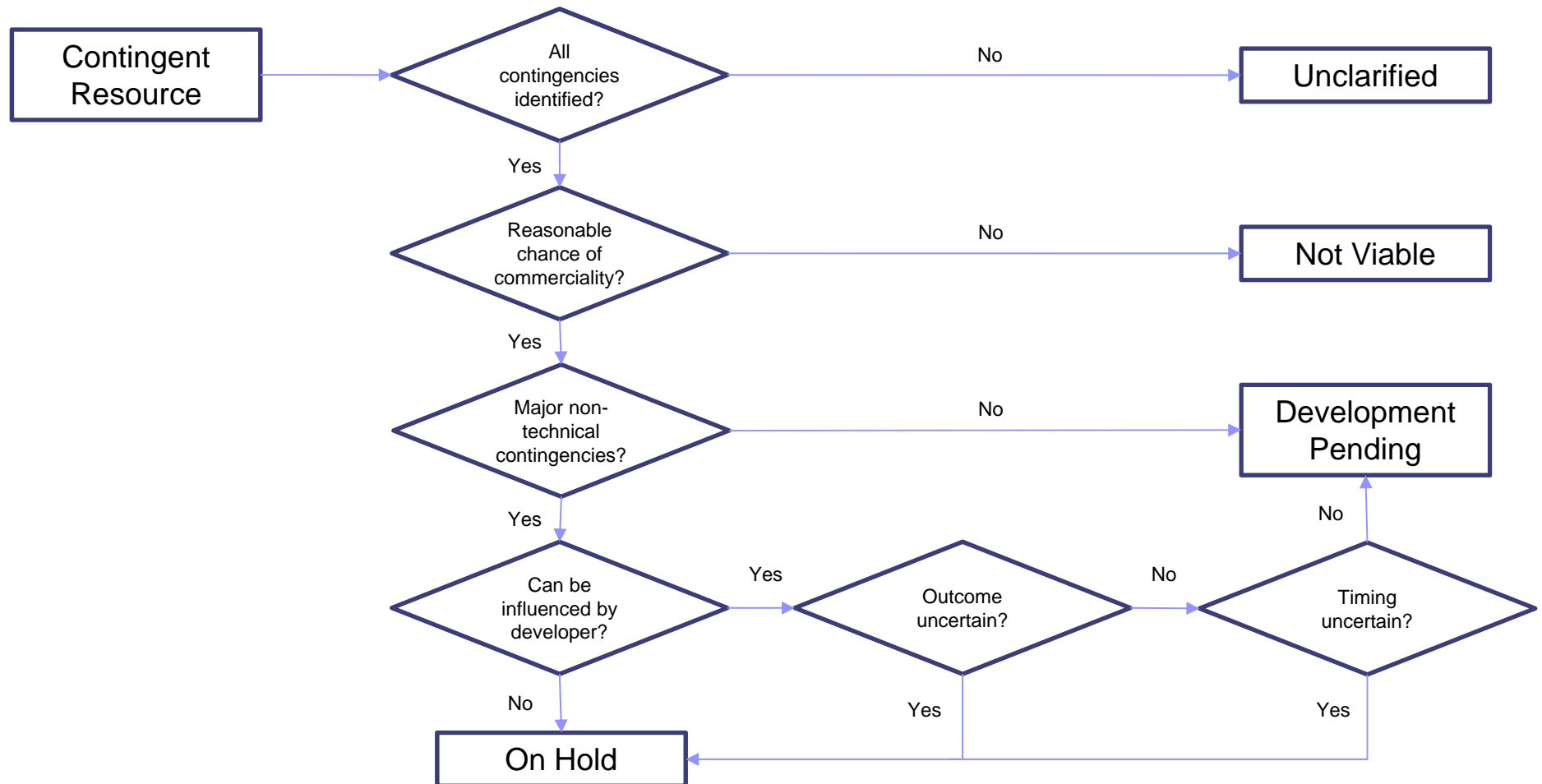
- Contingent resource estimates should have sufficient economic analysis to sub-classify as either economic or sub-economic under economic conditions that are the same as those used for reporting reserves
- Economic
 - Those contingent resources which are currently economically recoverable
- Sub-economic
 - Those contingent resources which are currently not economically recoverable
- Undetermined
 - Those contingent resources during the earliest stages of evaluation where economic analysis are incomplete such that it is premature to identify the economic viability of a project

Contingent Resources Sub-classes

Total Petroleum Initially-In-Place	Discovered Petroleum Initially-In-Place	Commercial	Production	Project Maturity Sub-classes		Increasing Chance of Commerciality ↑	
			Reserves				On Production
							Approved for Development
		Contingent Resources		Justified for Development			
				Development Pending			
			Development On Hold				
	Undiscovered Petroleum Initially-In-Place	Sub-Commercial		Development Unclassified			
				Development Not Viable			
		Place	Unrecoverable				
			Prospective Resources		Prospect		
	Lead						
	Play						
	Unrecoverable						
		←Range of Uncertainty →					

- Only difference with PRMS is split in On-Hold & Unclassified sub-classes
- Development pending
 - Resolution of final conditions for development is being actively pursued (high chance of commerciality)
- Development on hold
 - Major non-technical contingencies to be resolved usually beyond operator control (reasonable chance of commerciality)
- Development unclassified
 - Incomplete evaluation, Ongoing activity and data acquisition to resolve risks and uncertainties. Would apply to a project scenario based on the experience of the evaluator without meaningful input from the resource owner.
- Development not viable
 - No further data acquisition or evaluation is currently planned (low chance of commerciality)

Contingent Resources Sub-classes



- Includes Flowcharts for assessing Project Maturity
 - Example for Development On Hold

Moving Contingent Resources to Reserves

- Must have 100 percent chance of commerciality
- Within a defined project, reclassification is based on a best estimate evaluation
 - Total volume of contingent resources reclassified as reserves
 - If 1C does not meet the requirements for 1P (usually economics) they will be set to zero. These volumes have not disappeared since they are included in the best estimate (2P)
 - If a major development consists of several phases with differing contingencies then part of the contingent resources can be reclassified as reserves
 - Only projects with development commitments should be considered for reclassification

Reporting Contingent Resources

- The contingencies affecting contingent resources...should be specifically identified.
- Contingent resources should be classified according to economic status and sub-classified according to project maturity
- It's not totally clear whether "Chance of Development" must be quantified. Section 2.7.4 (on risking prospective resources) states that the evaluator must estimate the chance of development so it's hard to imagine this wouldn't apply to contingent resources. Section 2.5.1 states the estimated chance of development should be described or quantified.

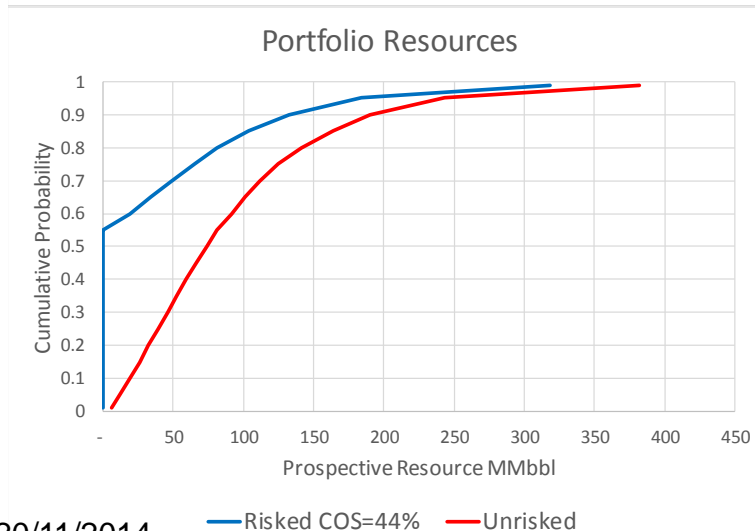
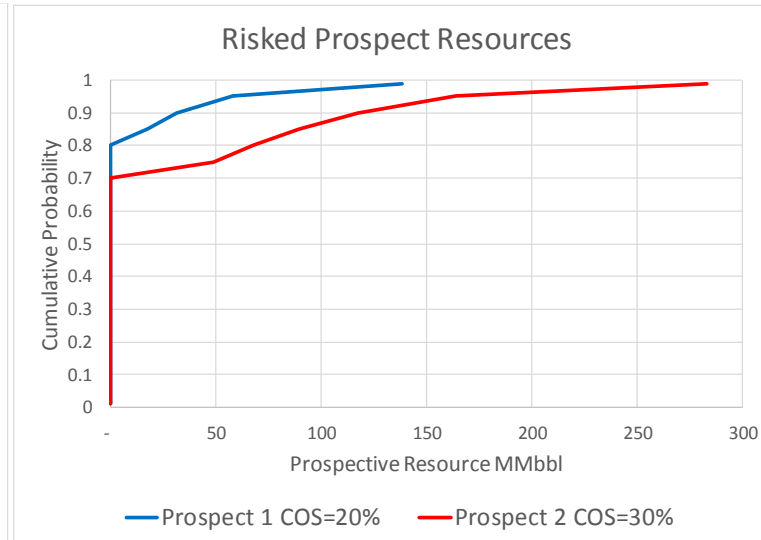
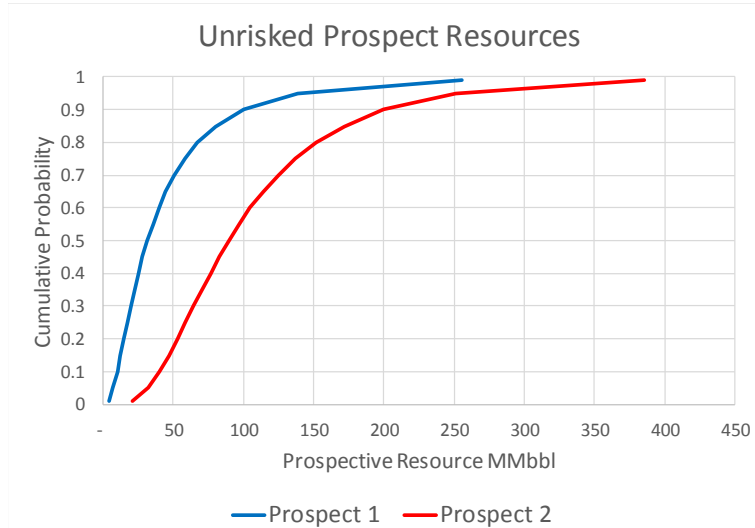
2.7 Prospective Resources

- Prospective resources are those quantities of petroleum estimates, at a given date, to be potentially recoverable from undiscovered accumulations by application of future development projects. Prospective resources have both an associated chance of discovery and a chance of development.
- Virtually the same definition as PRMS
- However apart from the distinction between DPIIP and UPIIP there is very little detail on assessing prospective resources especially with respect to unconventional resources

2.8 Aggregation of Resource Estimates

- Discusses three scenarios
 - Aggregation of individual prospects into an exploration portfolio
 - Aggregation of individual well estimates to the property level
 - Aggregation across resource classes

Reporting Unrisked Portfolio Estimates



- For reporting Prospective Resources should report risked and unrisked estimates on a Portfolio Basis
- BUT adding the Unrisked Prospect P50's or Means does not give the Unrisked Portfolio P50 or Mean

Summary & Conclusions

- New Guidelines provide useful reference with respect to Unconventional Resources but are also relevant to Conventional Resources
- Provide useful discussion around classification of Contingent Resources
- Should improve Contingent Resources reporting and hopefully improve the status of this useful category
- Perhaps more could have been done in area of assessing and risking unconventional prospective resources
- Should be read by anyone reporting reserves or resources even if only reporting according to PRMS

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