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APSG Spring Meeting
25 April 07

Proposed Spatial Data Management Specifications for Purchase of Well Data for use by Petroleum Industry Operators

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- **Overview and Need**
- **Standards: Objectives and Methodology**
- **Examples: Case Studies**
- **Specifications: Contents and Highlights**
- **Additional Requirements: Directional Surveys, Professional Competencies, Training, Customer Participation**
- **Conclusions and Recommendations**

Process Activities Currently under Development

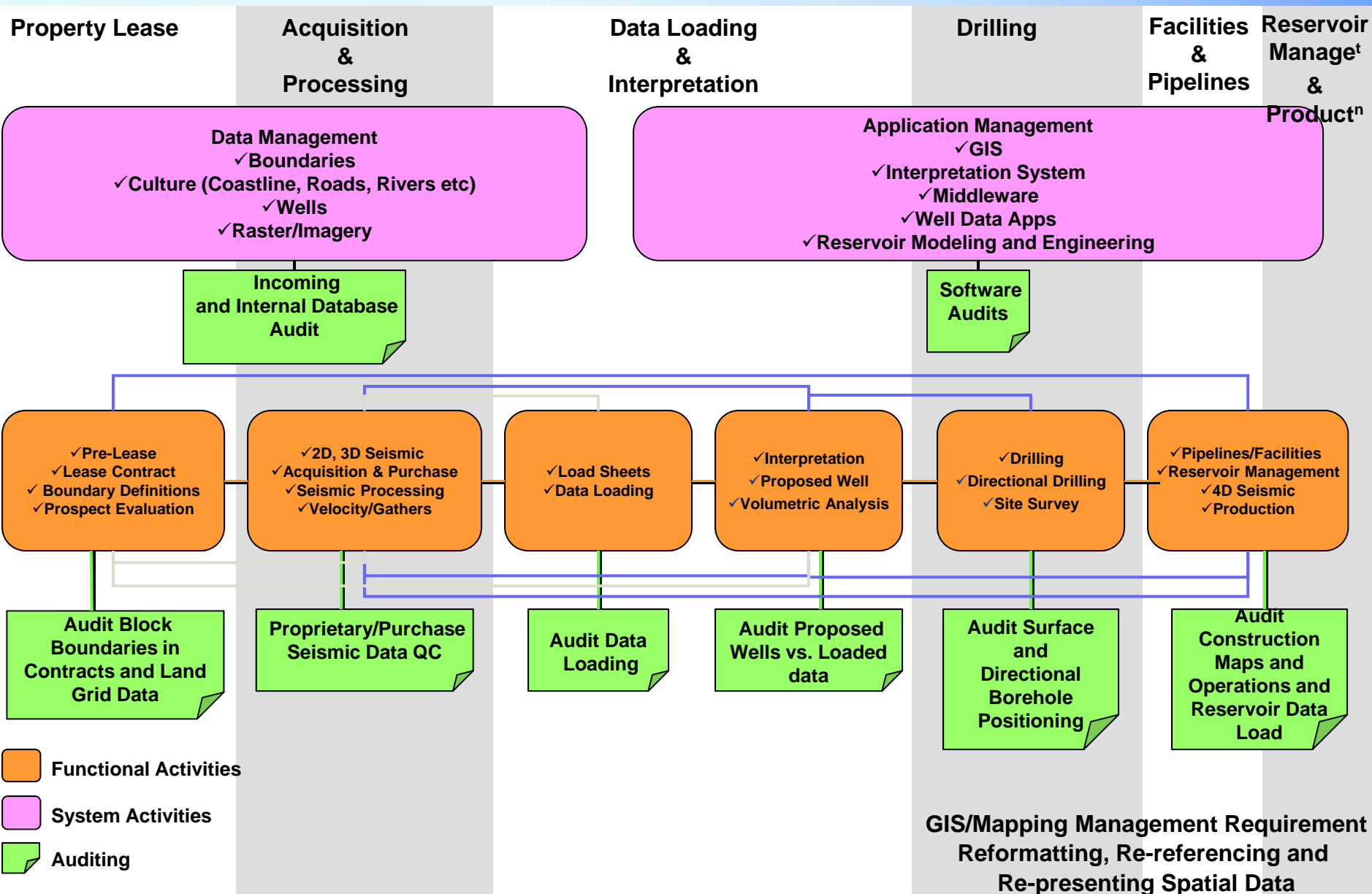


- **Land Boundary Spatial Management**
- **Seismic Acquisition and Processing**
- **Data Loading in applications**
- **Proposed Well Locations**
- **Site Surveys**
- **Rig Positioning**
- **Directional Surveys**
- **Construction, Engineering and Facilities Planning**
- **Reservoir Services Spatial Data Management**
- **Purchased Data**
- **SW licensing**

Process Components for each Activity

- **Agreement that it is needed**
- **User template for support request**
- **Flow Chart**
- **Written Description**
- **Check off list(s)**
- **Incorporated into Project business documentation**
- **Properly Communicated (Sharepoint?)**
- **Specifications including list of Deliverables**
- **Any required Formats**
- **Document management process**
- **Video/DVD**
- **Powerpoint**

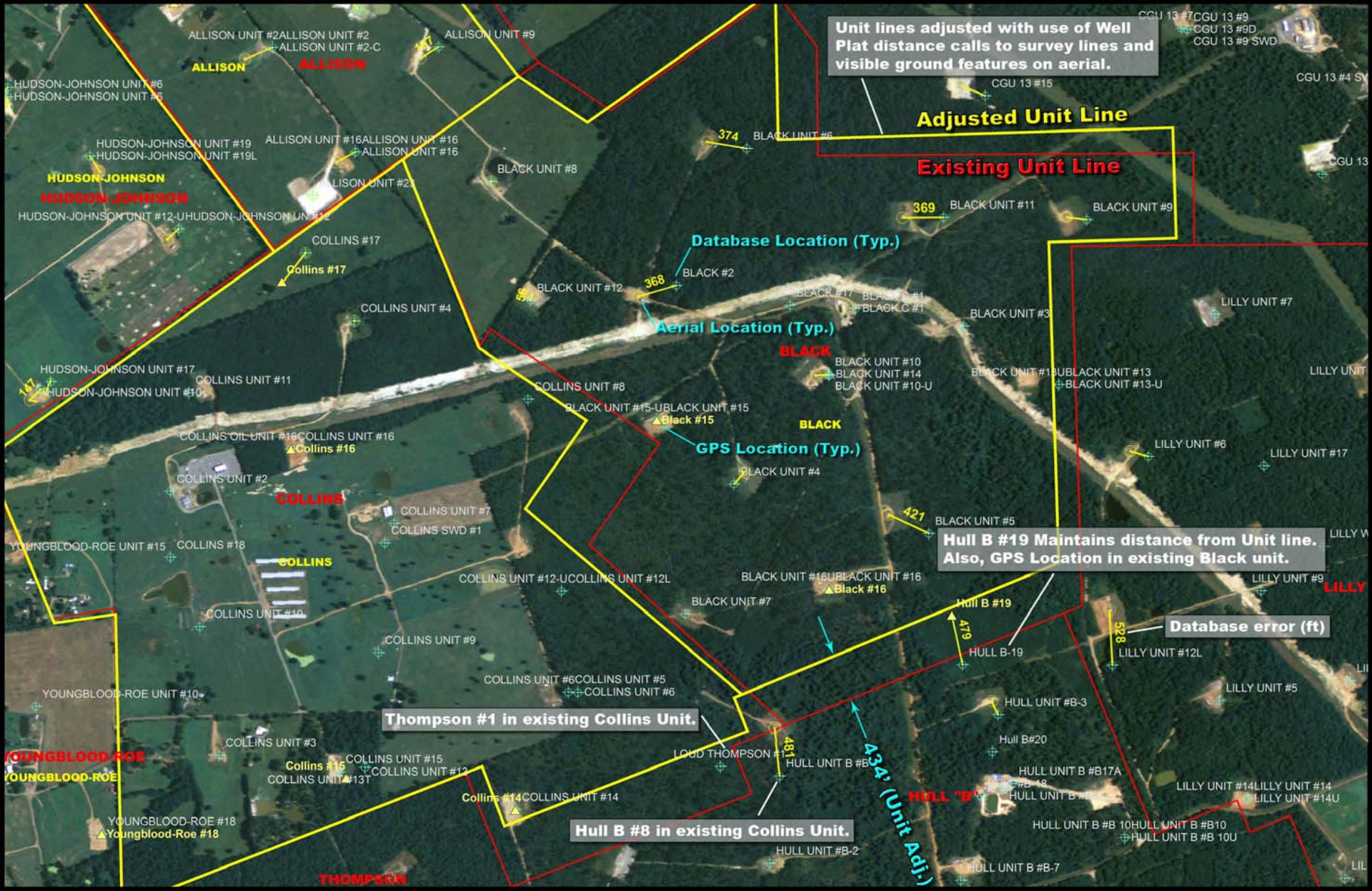
Summary '30,000 Ft' Spatial Workflow



- **To ensure data integrity of well locations in company well file, with clearly defined accuracy and reliability, in terms of spatial and location attributes and mathematics**
- **To provide efficient quality control and assurance procedures during transactional processes**
- **Define the quality of data source for well locations by quantitative and qualitative methods. Ensure the following three standards:**
 - **application of sound geodetic principles in the manipulation and presentation of this data in the vendor database prior to delivery to users**
 - **provision of appropriate metadata and updating capability**
 - **provision of datasets that are useable in multiple geoscience and engineering applications, as appropriate**

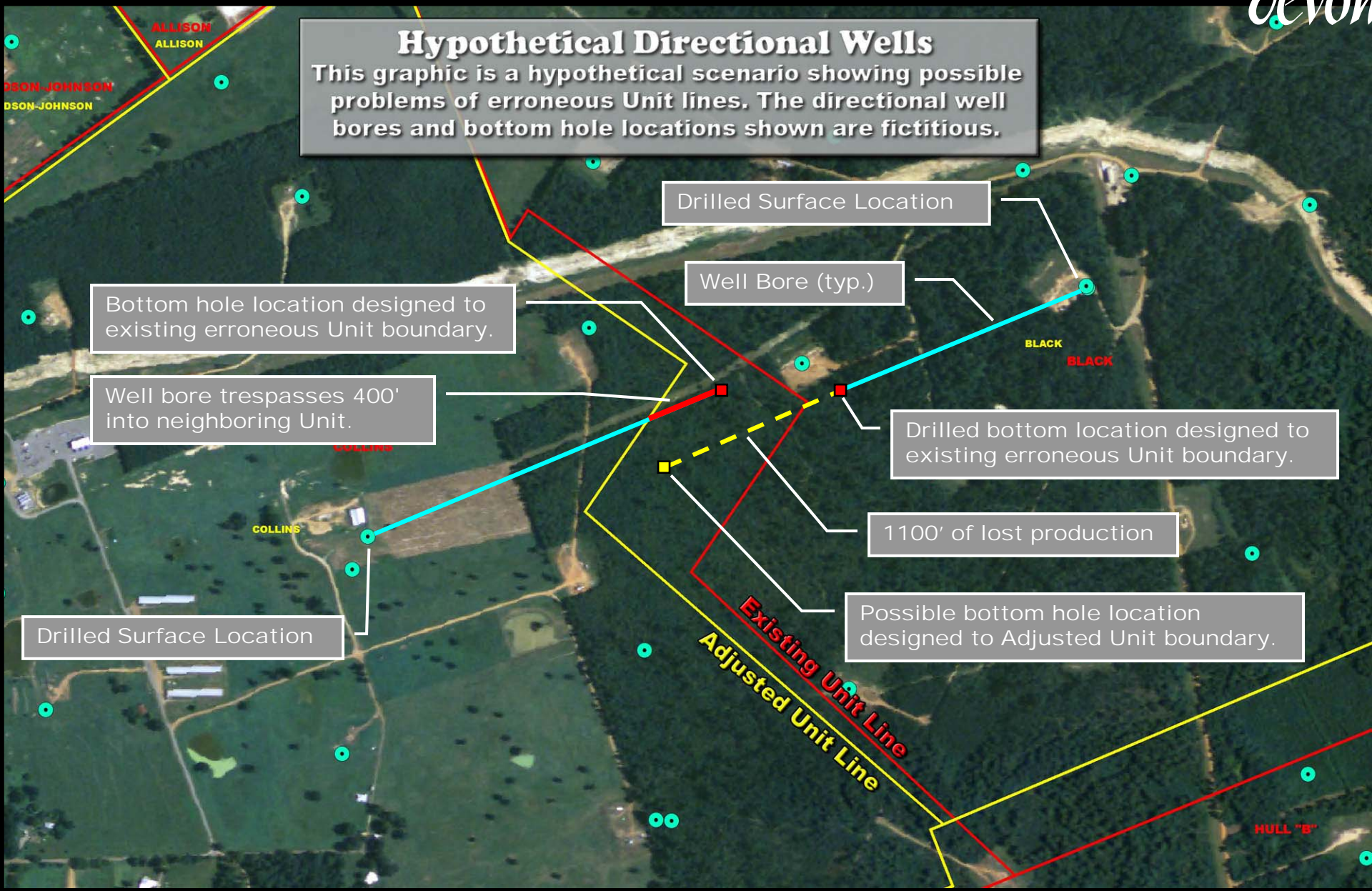
Unit boundary & Well database errors

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Hypothetical Directional Wells

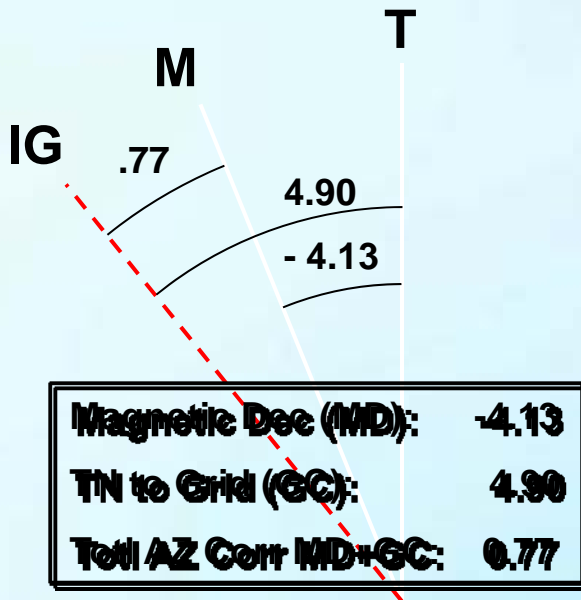
Fictional directional wells trespass and loss of production



Directional Survey Disconnect

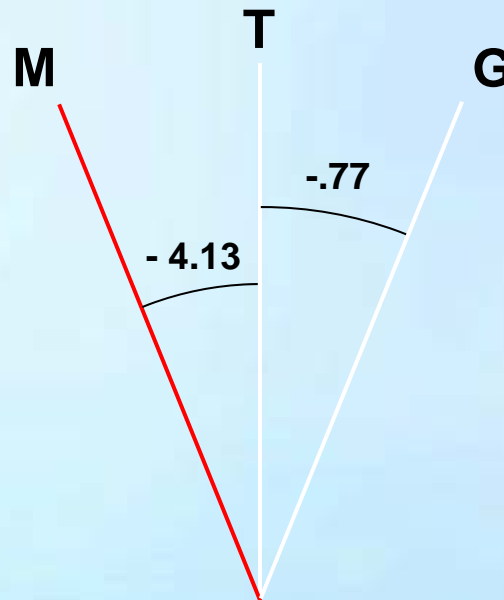
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Incorrect Processing



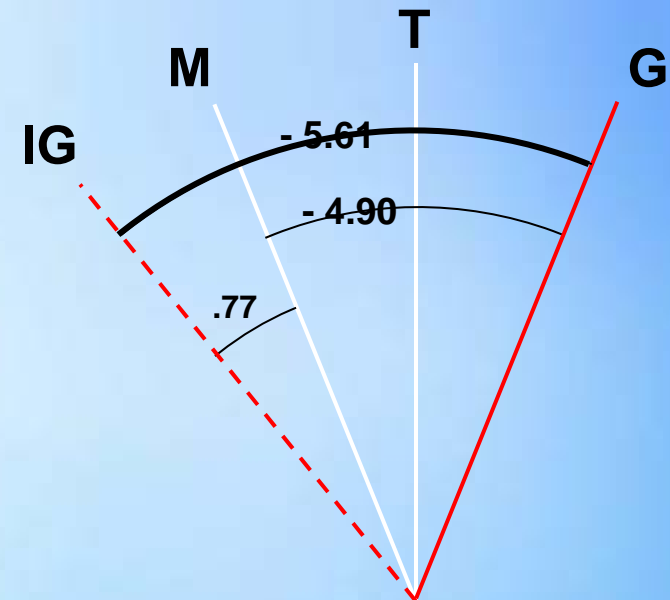
Magnetic Dec (MD):	-4.13
TN to Grid (GC):	<u>4.90</u>
Total AZ Corr MD+GC:	0.77

Correct Solution



MN to TN:	-4.13
TN to Grid:	<u>-0.77</u>
True Corr:	-4.90

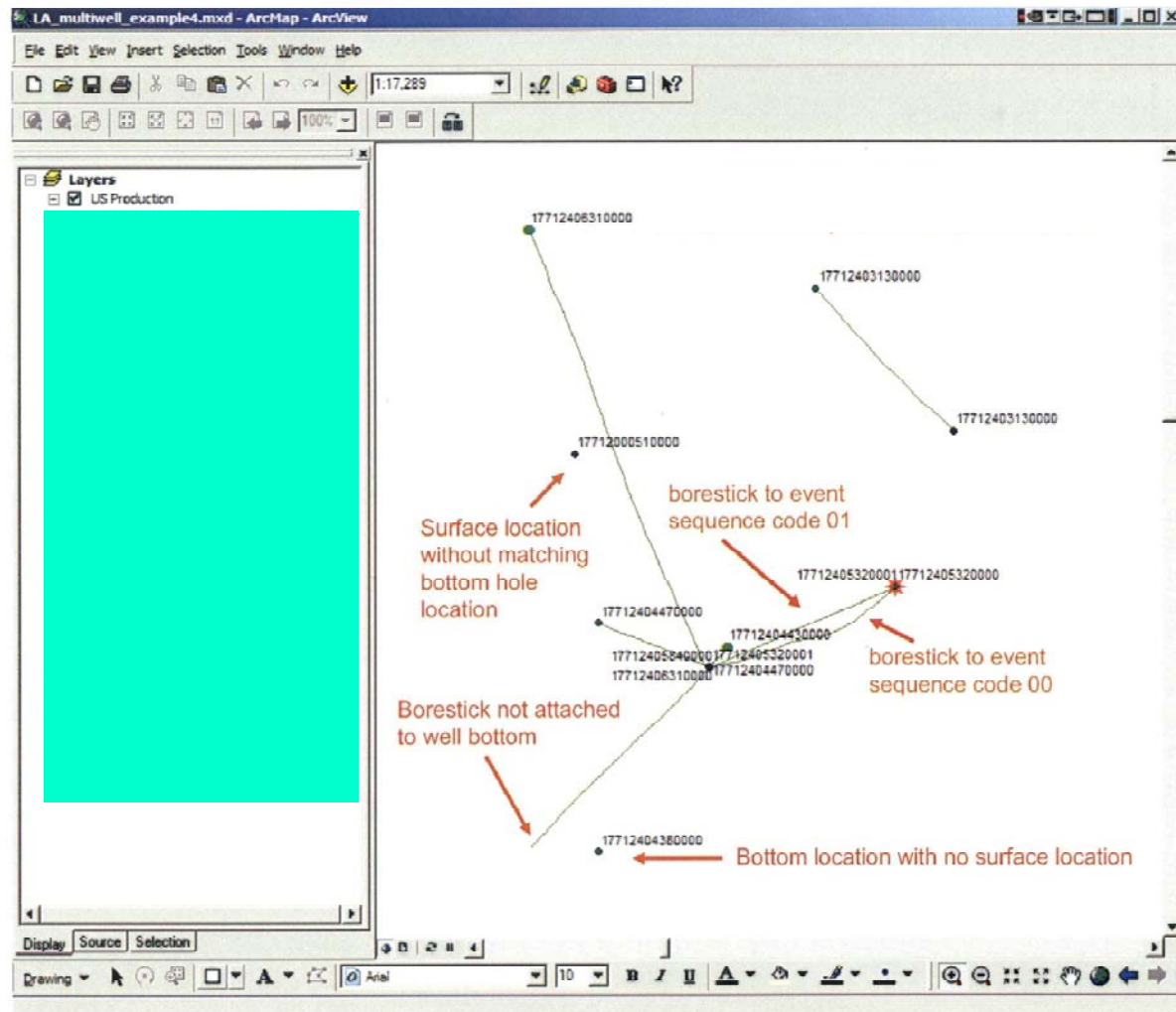
Correction



Valid Corr:	-4.90
Wrong corr:	<u>0.77</u>
Correction Applied:	-5.67

Error in 5 wells: 5,300 foot offset, target locations misplaced by 520 ft

Commercial Well Location Data



Source of Data: A simple and recent Case Study

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Report Number 1631
16 March 2007

- 1 Deepwater well for Woodside in Great Australian Bight comes back on radar on Chikyu's schedule once drillship completes Calliance-2 in WA-28-R, spudded 24 February (see also item 12)

Maritime Safety Information current at 231130 UTC MAR 07.

Issued by the Australian Maritime Safety Authority.
Maritime Rescue Coordination Centre (RCC Australia).

Part 4. Summary of Mobile Drilling Rigs:

Name	Position
ATWOOD EAGLE	21 28.5S 113 49.5E
CHIKYU	14 34.4S 121 34.7E
ENSCO 106	20 30.0S 115 25.8E
NAN HAI VI	13 57.0S 122 02.8E
OCEAN BOUNTY	19 30.6S 116 36.3E
OCEAN EPOCH	13 48.1S 123 20.1E
SEDCO 703	20 08.2S 115 02.4E
SONGA VENUS	12 55.8S 124 28.1E
STENA CLYDE	12 17.7S 124 19.9E
STYBARROW PROJECT	21 26.0S 113 50.0E

- ✓ Notification received
- ✓ Drill rig identified
- ✓ Rig position stated

Useful confirmations....

Calliance-2 Appraisal Well Environmental Plan Summary

Calliance-2 Appraisal Well Drilling Environmental Plan Summary

This summary of the Calliance-2 Appraisal Well Environment Plan has been submitted to comply with Regulation 11(7)(8) of the Petroleum (Submerged Lands) (Management of Environment) Regulations 1999.

1. Project Description

Woodside Energy Ltd. (Woodside) proposes to drill the Calliance-2 gas appraisal well using the drill ship the Chikyu operated by Seadrill. The well is located within Permit Area WA-28-R in approximately 500 m water, approximately 247 km north-west from the Western Australian coastline and 49 km south-south-west of Scott Reef.

The well will be drilled using water based muds and will be profiled using vertical seismic profiling. No well testing activities will be undertaken.

2. Coordinates of Activity

Well	GDA 1994 MGA Zone 50	
	Easting E	Northing N
Calliance-2	346 912	838 8317

3. Description of the Receiving Environment

The most sensitive environment in the area is Scott Reef. Scott Reef is not a World Heritage Property, Marine Park or listed as a Ramsar Wetlands. The reef flat of South Scott reef is managed by the Western Australian Department of Environment and Conservation. Scott

- ✓ More research...
- ✓ Confirm coordinates

ProjCRS to GeogCRS calculation, then map results...

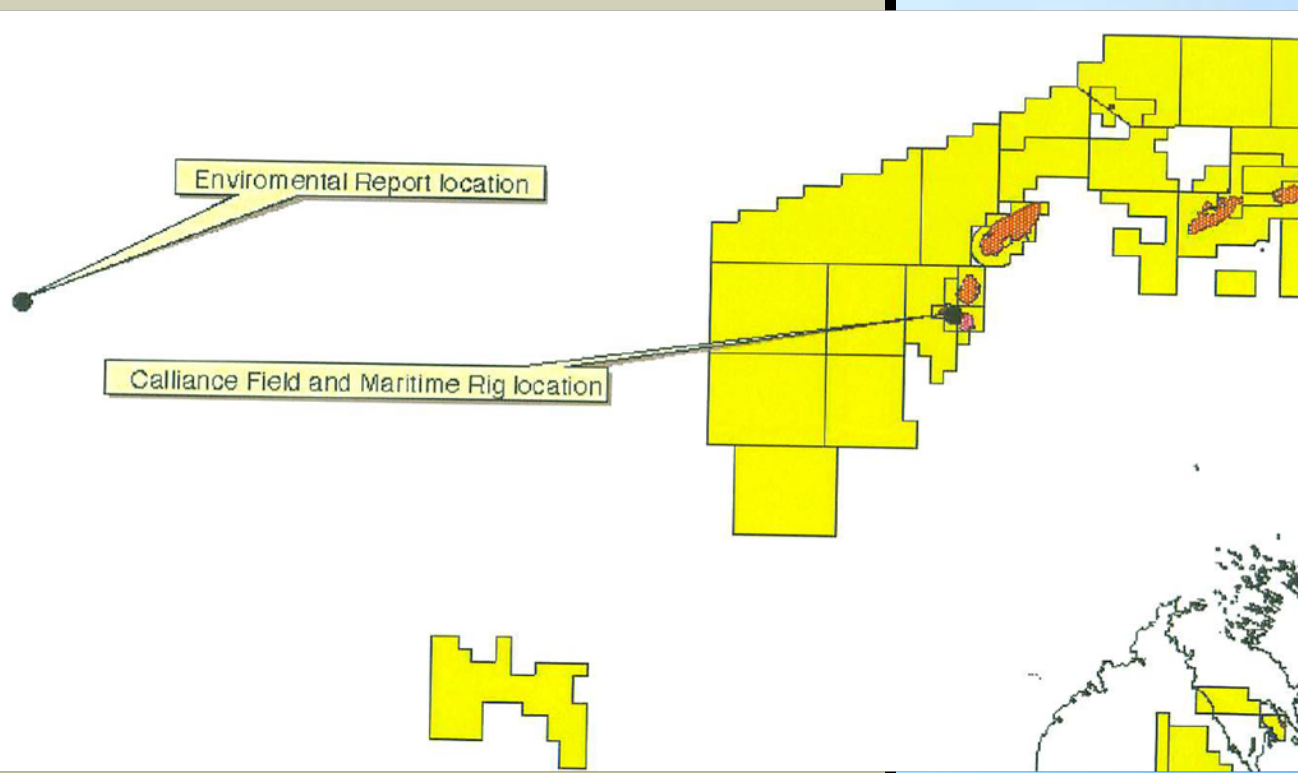
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GDA 1994 – MGA 50
E 346912
N 8388317

"GALILEO"



S14, 34, 26.265
E115,34,44,139



❖ Mis-tie !!!

Investigate source data sets...

GDA 1994 – **MGA 51**
E 346912
N 8388317



S14, 34, 26.265
E121, 34, 44, 139

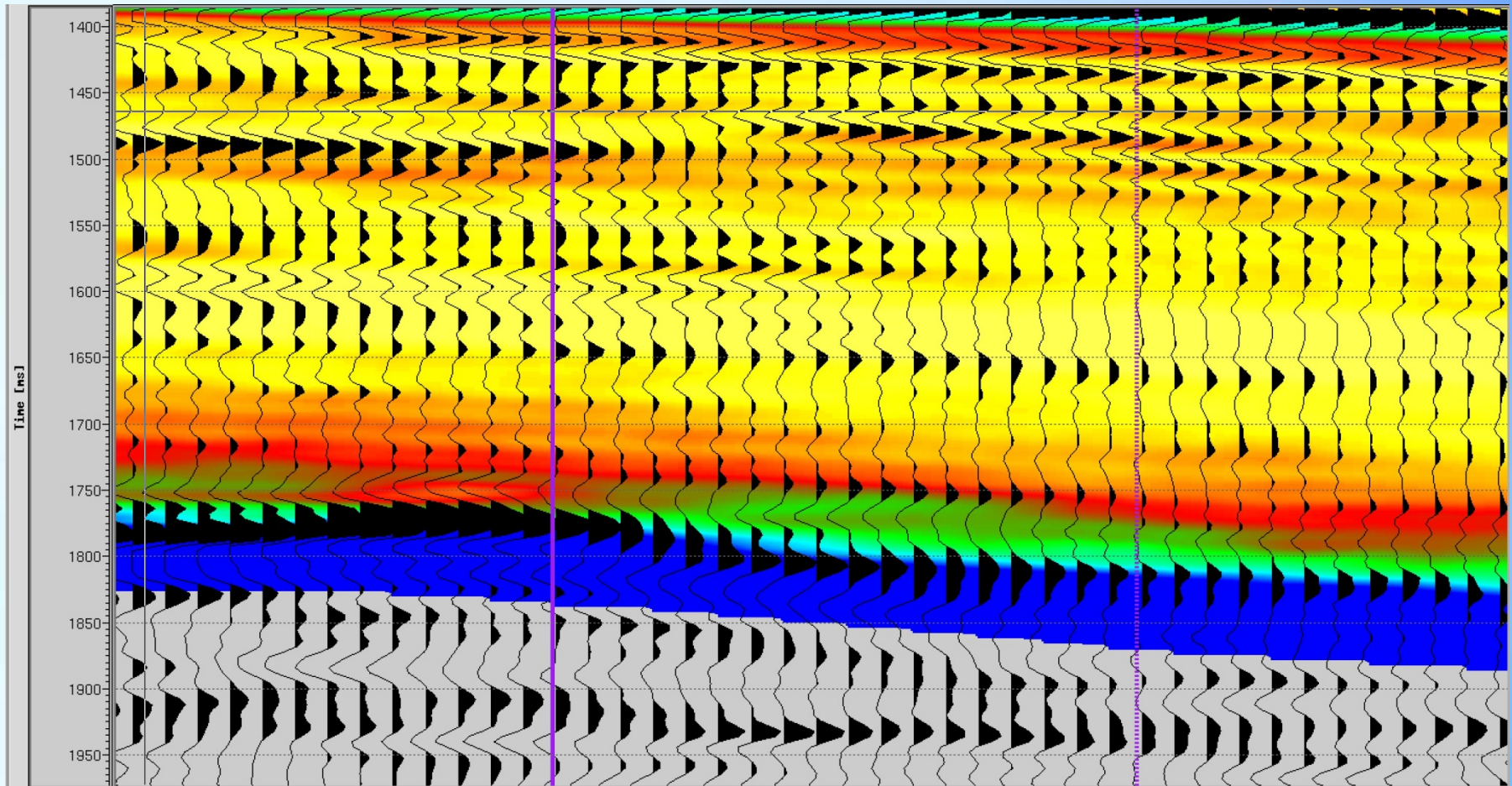
- New position plots correctly and is verified by Australian Maritime Notification
- Simply incorrect zone

2. Coordinates of Activity

Well	GDA 1994 MGA Zone 50	
	Easting E	Northing N
Calliance-2	346 912	838 8317

Incorrect Well Location = Inversion Insanity!

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Specifications: Contents and Highlights

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Let us exam some details:

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In the absence of statistics ... grammar:

Quality Indicator	Definition	Example
1	Company owned well with fully documented history	Wells drilled and quality controlled by Devon Energy
2	Other source with substantive documentation, or, two reliable sources agree	A partner well, where location is quality controlled in accordance with the same or better standards as employed by Devon
3	Single reliable source of external knowledge with documentation	Coordinate information received pursuant to a request of a reliable geodetic specialist in another operator company, but without documentation
4	Majority vote is probable for reliable adjacent well data (based on country and/or company)	Wells without datum are transformed by using the 'most likely' input datum based on the other wells with known datum in the same general category (e.g. operator or country)
5	Not reliable, little confidence is given to this source information	No confidence – accuracy may well be worse than 500 meters. If datum cannot be reasonably deduced this quality indicator should be set.

Table 1. Position Quality Indicators for Well Locations

Source: Devon Geodetic Operations

5.3 Units of Measurement

Several different units of measurement have been used in location of wells. Examples are: Clarke's links used in Trinidad, international meter, the German Legal Meter, and a variety of British and Imperial yards, links, chains and feet – many of which remain in active use in Projected Coordinate Reference Systems today. For example, a “foot” might be any of the following: International foot, US Survey foot, Clarke's foot, British foot (Sears 1922), British foot (Benoit 1895 A and B), British foot (1865), British foot (1936), Indian Foot, Indian foot (1937), Indian foot (1962), Indian foot (1975) and Gold Coast foot.

Unambiguous identity of, and correct knowledge and application of the appropriate units of measurement are required. Conversion is provided within the EPSG dataset.

Survey Principle No. 3 is “Consistency”

5.5 Angular Representation Consistency for Latitude and Longitude

The following table specifies the minimum acceptable number of right decimal places that must be specified to preserve consistent precision for various angular units at the precisions given in the table:

Unit	Right Decimal Places (0.6-6mm)	Right Decimal Places (6 to 60 cm)
Decimal Degrees	8	6
Decimal Minutes following Integer Degrees	6	4
Decimal Seconds following Integer Degrees and Minutes	4	2
Radians	10	8
Grads	8	6

Table 2. Consistency in Angular Representation

Metadata *(the red headed step child !)*

Metadata element: A unit of information within metadata, used to describe a particular characteristic of the data.

Metadata Profile: A modification of an existing metadata standard to adapt to data issues, cultural issues, or both. A profile is typically a subset of a base standard that tailors the metadata elements in the base standard to better describe the data to the community that uses it. Metadata profiles allow communities to follow a metadata standard, while at the same time enhancing the standard so that it is more appropriate for a particular use or locale.

Metadata: Information that describes the content, quality, condition, origin, and other characteristics of data or other pieces of information. Metadata for spatial data may describe and document its subject matter; how, when, where, and by whom the data was collected; availability and distribution information; its projection, scale, resolution, and accuracy; and its reliability with regard to some standard. Metadata consists of properties and documentation. Properties are derived from the data source (for example, the coordinate system and projection of the data), while documentation is entered by a person (for example, keywords used to describe the data).

- **Preserve Original Data**

- throughout the life of the data

- **Database fields**

- Hundreds of fields being created with little or no explanations or standardizations

- **Datum Transformations**

- EPSG codes !!!

- Vertical component of a well location is vital to the integrity of the data set
- Correctly referenced and accurate height data (ellipsoid, elevation, or z elements) are required. Drillers reference to a range of different physical points to determine the along hole depth, known as measured depth. Where available these depths shall be data based:
 - zero measured depth usually from rotary table or kelly bushing
 - well reference point from mud line or ground level
 - vertical reference datum from mean sea level, lowest astronomical tide or land survey datum
- Vertical component may prove challenging for legacy data
- All future data collections should attempt to document height or elevation, or both, as well as the associated vertical reference datum (e.g., MSL, LAT) as a useful attribute

Knowledge is key to real progress:

13 Reference Material

Use of EPSG Geodetic Dataset, Surveying and Positioning / EPSG Guidance Note 7-1, OGP (downloadable without charge from www.epsg.org)

Conversion and Transformation Formulas, Surveying and Positioning / EPSG Guidance Note 7-2, OGP (downloadable without charge from www.epsg.org)

Use of bin grids and coordinate reference systems in workstations. Surveying & Positioning / EPSG Guidance Note 7-3, OGP, www.epsg.org

Use of ITRF as a reference geodetic system for surveying and positioning. Surveying & Positioning / EPSG Guidance Note 7-4, OGP, www.epsg.org

Data Exchange Format (DXF), Format for Devcon Data Release, UK NIP

Directional and Information Survey Data Submission Requirements, NTL No. 2004-N03, US MMS

Guidelines for the Quality Control of Proposed Well Coordinates. Surveying & Positioning / EPSG Guidance Note 16, OGP, www.epsg.org

Guidance Note for Geodetic and Cartographic Applications (Precision and Presentation). APSG, www.apsg.org

*Units of Measurement, Wikipedia Free Internet Encyclopedia,
http://en.wikipedia.org/wiki/Units_of_measurement*

*Geodesy or Geodetics, Wikipedia Free Internet Encyclopedia,
<http://en.wikipedia.org/wiki/Geodesy> or <http://en.wikipedia.org/wiki/Geodetics>*

Wikipedia caveat: Undoubtedly useful for general knowledge of subject matter, industry geodetic experts have recently challenged some of the technical information cited

- **Essential for sales terms and conditions**
- **Items must be clearly stated with timelines**
- **Formats must be agreed**
- **Procedure for updates (full replacement or partial), modifications, additions and deletions must be detailed here**
- ***.... User inputs is being soughta work in progress....***

- **Directional Survey Standards**
 - Spatial Reference and Orientation
 - Survey Data Completeness
- **Professional Competencies**
 - Employment of, or access to, fully competent geodetic specialists
 - Training of Scouts
- **Customer Participation**
 - As a data source
 - As a data user
 - As a process reviewer

1. Continue to **work closely with vendors** during development of document
2. Proposed technical specifications undergo **peer review** through APSG TAC for acceptance
3. Distribution for comments to oil operators through **OGP S&P** and **APSG** membership
4. **Adopt** these technical specifications for petroleum industry use as:
 - Guidance to database compilers
 - Contracting of products and services
 - Improving practices and procedures of users

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Thank you.