Where is my Well?

Robert Wylie

16th April, 2026

x^nDrilling, Inc

Where is my Survey Program?

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ISCWSA online Course

"Introduction to Wellbore Positioning"

Module 6.3:

"Understanding and Using the ISCWSA Error Model"

TERMINOLOGY

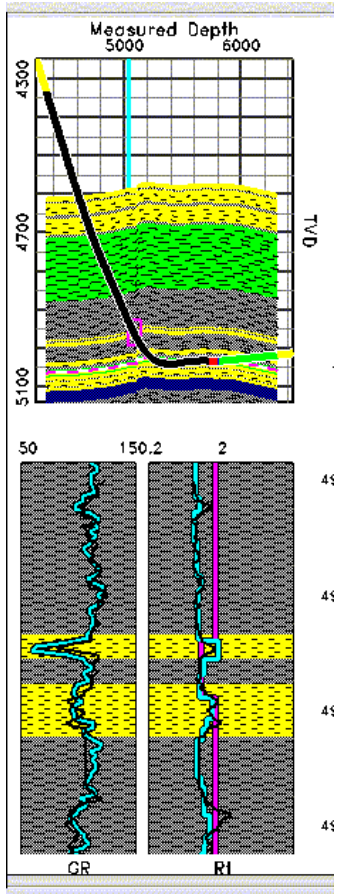
ISCWSA Error Model
Mathematical Framework
Weighting Function
Propagation Mode
Tool Code
Position Uncertainty Model (PUM)
IPM
Survey Program

ISCWSA online Course

"Introduction to Wellbore Positioning"

From Module 6.3:

"Developing and using the Survey Program"



Source

- ## What is a Survey Program

The ADSP (Actual Design Survey Program) is
- the survey or sequence of surveys :
  used to generate the “definitive” well path for the “as-drilled” Actual Well
  using a single survey or multiple surveys.

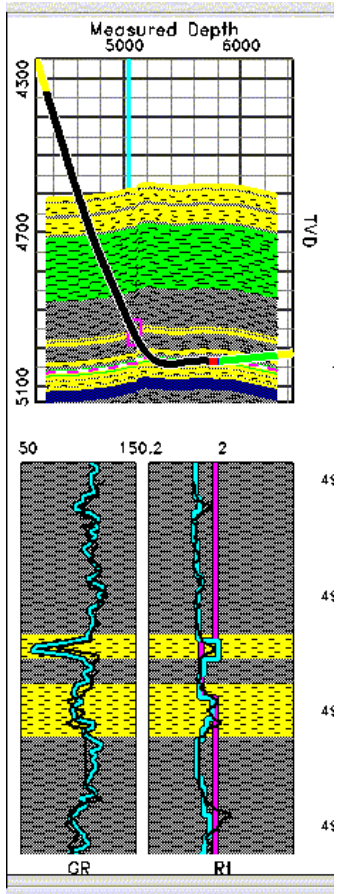
- ## Why

Safety.
Economics
- Meet Well Positional Uncertainty goals
- Drilling, completions, reservoir, recompletions

- ## When

- Planning phase
- Drilling phase
- Entire Life of well

- Development
- Implementation
- Recording and understanding



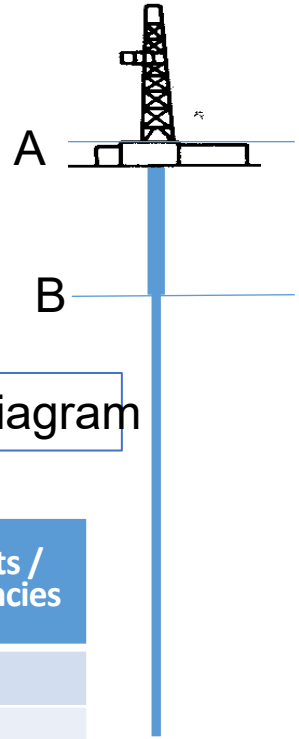
1. The survey program shall be considered part of the well design and **included in the drilling program**.

2. The survey program shall define the **required wellbore positioning requirements**, as they are required during various stages of operations and well construction activities acting as a set of instructions to the operations.
3. The survey program shall be **detailed enough** to ensure the requirements are clearly understood so that when executed the positional uncertainty assumptions for the well design remain valid.
4. A **fit-for-purpose** survey program shall:
    1. prescribe sufficient data to determine the well position with the accuracy estimation prescribed to **meet the defined well's positioning objectives**, and

    2. provide **sufficient survey interval** to accurately characterize the wellbore as it is mathematically interpolated between stations within **the bounds of the prescribed survey tool PUM**.

API RP-78 basic Survey Program Contents reflecting the sequence of survey operations including

1. survey tool type
2. survey interval
3. start/end depth
4. positional uncertainty model assignment
5. north reference



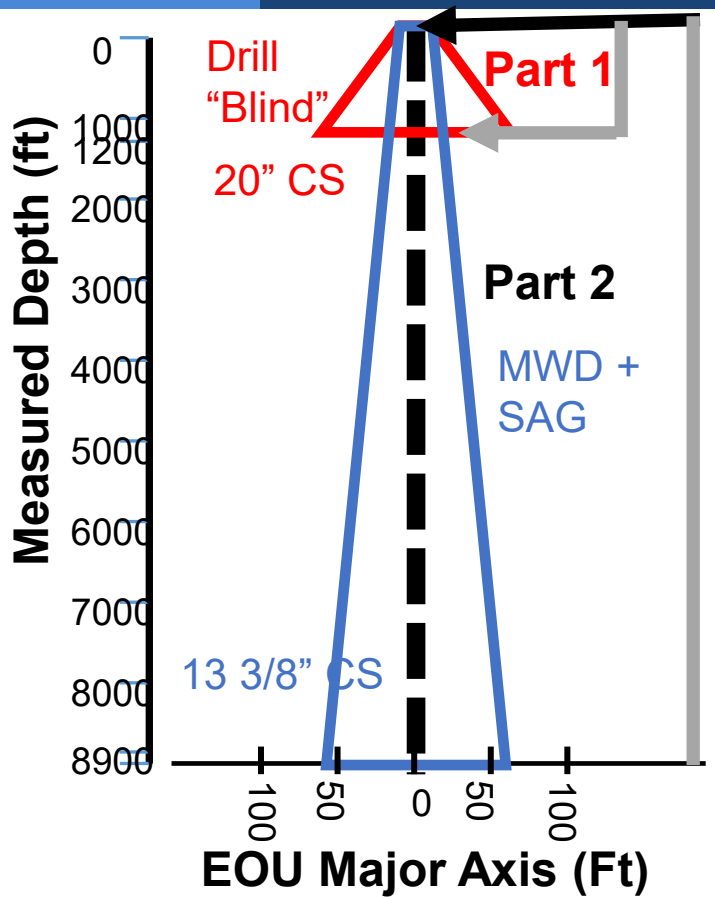
Simple Well Diagram

Part	Seq.	Survey Tool (survey tool code)	Service Provider	Hole Size (in.)	Casing Size (in.)	Well Depth Interval (ft)		Survey Frequency	Comments / contingencies
						From	To		
1	1	None	N/A	26	20	0	1200	Not Applicable	
2	1	MWD (MWD+SAG)	N/A	17 1/2	13 3/8	0	8900	1 per stand	

Tree Diagram

A graphic representation of the Parts of the Well, and the Positional Uncertainties that are applicable at different points of the life of the well.

Part	Seq.	Survey Tool (survey tool code)	Service Provider	Hole Size (in.)	Casing Size (in.)	Well Depth Interval (ft)	
						From	To
1	1	None	N/A	26	20	0	1200
2	1	MWD (MWD+SAG)	N/A	17 1/2	13 3/8	0	8900



Tree Diagram

Part	Seq.	Survey Tool (survey tool code)	Service Provider	Hole Size (in.)	Casing Size (in.)	Well Depth Interval (m)		Survey Frequency	Comments / contingencies
						From	To		
1	1	None	N/A	32	26	0	113	N/A	
2	1	MWD (MWD-INC_ONLY)	N/A	32	26	0	113	1/stand	
	2	MWD (MWD+SAG)	N/A	24	18 5/8	113	1660	1/stand	
3	1	Gyro Casing Multishot (Gyro_CNSG+CASING)	N/A	24	18 5/8	0	1660	10m or less	
	2	MWD (MWD+IFR)	N/A	17	13 3/8	1660	2040	1/stand	
	3	MWD (MWD + IFR)	N/A	12 ¼	9 7/8	2040	3067	1/stand	
	4	MWD (MWD + IFR)	N/A	8 ½	7	3067	3515	1/stand	

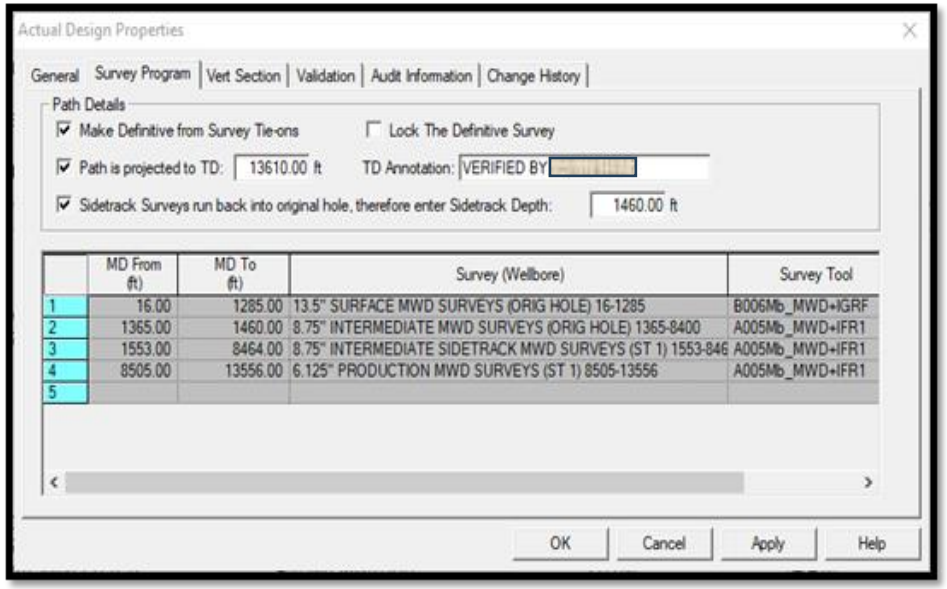
More Complex Survey program

Directional Survey Program

Part	Hole	Casing	Depth From	Depth To	Survey Tool	Vendor	Survey Frequency	QC Requirements	Tool Code
1	26"	-	Seabed @342 ft	865 ft	Keeper GyroMWD	Scientific Drilling	Maximum 30 ft	SDI JORPS	SDI_C510Gb_KPR_gyroMWD
	17 1/2"		865 ft	2975 ft	MWD+IFR1+SAG	slb	Stand (~96 ft)	SLB JORPS; MWD to be SAG corrected	A009Mc_MWD+IFR1+SAG_R5
2	-	13 3/8"	Seabed @342 ft	2950 ft	Keeper Continuous Gyro Multishot	Scientific Drilling	25 ft	SDI JORPS; S/Specialist Acceptance Req'd	SDI_C505Gb_KPR_WL_NS-CT
	12 1/4"	-	2975 ft	7455 ft	MWD+IFR1+SAG	slb	Stand (~96 ft); 6 overlapping repeats	SLB JORPS; MWD to be SAG corrected	A009Mc_MWD+IFR1+SAG_R5
C	12 1/4"	-	2975 ft	7455 ft	EMS	Scientific Drilling	Stand (~96 ft)	SDI JORPS; EMS to be SAG corrected	B010Mc_EMS+IFR1+SAG+MS_R5
3	-	9 5/8"	Seabed @342 ft	7400 ft	Keeper Continuous Gyro Multishot	Scientific Drilling	25 ft	SDI JORPS; S/Specialist Acceptance Req'd	SDI_C505Gb_KPR_WL_NS-CT
	8 1/2"	-	7455 ft	11200 ft	MWD+IFR1+SAG	slb	Stand (~96 ft); 6 overlapping repeats	SLB JORPS; MWD to be SAG corrected	A009Mc_MWD+IFR1+SAG_R5
C	8 1/2"	-	7455 ft	11200 ft	EMS	Scientific Drilling	Stand (~96 ft)	SDI JORPS; EMS to be SAG corrected	B010Mc_EMS+IFR1+SAG+MS_R5

Survey Tool Details

OWSG Prefix	Short Name	Long Name	Application	Technology Type
A009Mc	A009Mc_MWD+IFR1+SAG_R5	ISCWSA MWD + IFR1 + Sag Correction	MWD with IFR1 (IFR or Crustal Anomaly Correction) and Sag Correction. NOT TO BE USED WHILE PLANNING A WELL UNLESS THE IFR MODEL WILL BE AVAILABLE AND USED DURING THE DRILLING OPERATION.	Generic Magnetic Tool
B009Mc	B009Mc_MWD+LRGM+SAG_R5	ISCWSA MWD + LRGM or WMM + Sag Correction	MWD Using IGRF or WMM with Sag Correction	Generic Magnetic Tool
B010Mc	B010Mc_EMS+IFR1+SAG+MS_R5	ISCWSA EMS + IFR1 + Axial Corr + Sag Correction	EMS with IFR1 (IFR or Crustal Anomaly Correction) and Axial Correction and Sag Correction	Generic Magnetic Tool
SDI_C505Gb	SDI_C505Gb_KPR_WL_NS-CT	SDI Keeper Wireline Gyrocompass-Initialized Continuous	Standard Keeper Wireline (drillpipe or casing depth correlated)	Contractor Specific Gyro Tool
SDI_C510Gb	SDI_C510Gb_KPR_gyroMWD	SDI Keeper gyroMWD	Keeper gyroMWD North-Seeking Gyrocompass	Contractor Specific Gyro Tool



- Well Planning Software and Reports
- Sections of the Drilling Program
- Survey Management Company

Survey Program Sources

Well Information

Well Name:	**Example Well 1**	*Rig:*	**Example Rig**
Revision:	**2**	*Field:*	**Denver-Julesburg**
Operator:	**Example Operator**	*Pad:*	**Example Pad**
Survey Contractor:	**Example MWD**	*State, Country:*	**Colorado, USA**
AFE #:	**MV1234567**	*County:*	**Weld**

Coordinate System:	**US State Plane**	
Geo Datum:	**NAD83**	
Map Zone:	**Colorado North (ftUS)**	
Vertical Datum:	**Mean Sea Level**	
North Reference:	**GRID**	
TVD Reference:	**4930**	**Feet**
Latitude:	**40.549018**	**N**
Longitude:	**104.553952**	**W**
Northings:	**1,444,250.70**	**US Feet**
Eastings:	**3,262,900.10**	**US Feet**
Survey Calculation Method:	**Minimum Curvature**	
FAC Sigma Level:	**2.00**	

Survey Program

Hole Section	Start Depth (ft)	End Depth (ft)	Survey Method	Magnetic Reference	Corrections	Error Model for Survey QC
Surface	0	2,000	Wireline Gyro	None	None	OWSG Rev. 5 - Gyro NS+CT
Intermediate	2,000	5,000	MWD+IFR1	IFR1	None	OWSG Rev. 5 - MWD+IFR1
Production	5,000	20,000	MWD+IFR1+SAG+MS	IFR1	MSA + Sag	OWSG Rev 5 - MWD+IFR1+SAG+MS

Geomagnetics

Date	Total Field (nT)	Declination (deg)	Dip Angle (deg)	Grid Conv. (deg)	Total Correction	Hole section
2/23/2023	51743.8	7.48	66.72	0.61	6.87	Intermediate / Production

QUESTIONS?

Can YOU give me the complete Survey Program
for the well you are working on?