

# GWPC Directional Survey Spatial Database

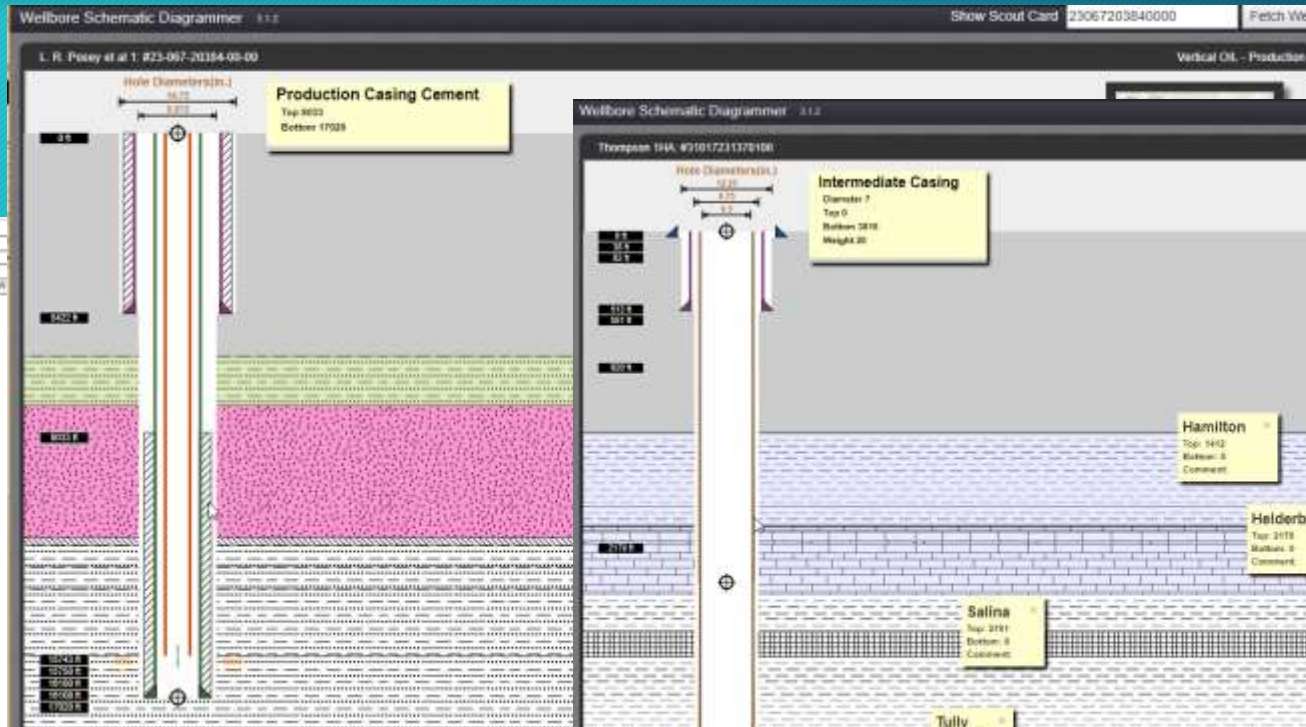
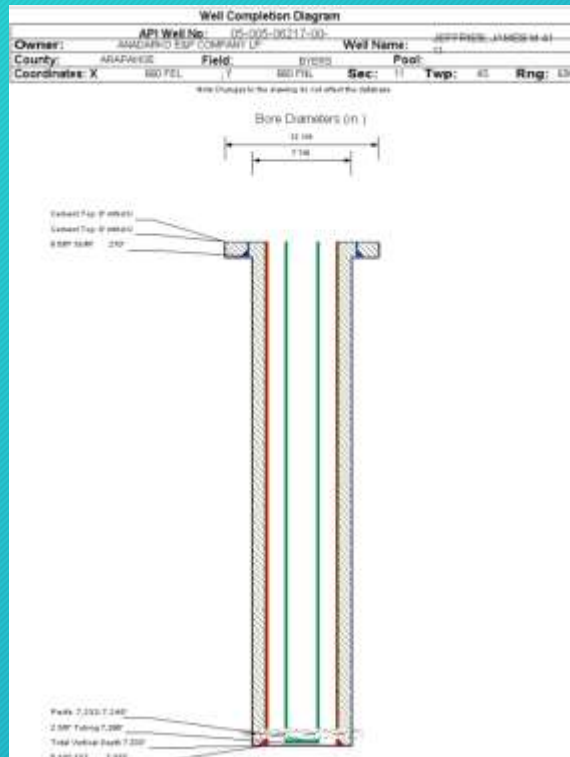
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Authors: Don Drazan and Jim Milne

# Background

- RBDMS has been a national system for state regulatory programs for over 25 years
- Over 23 states are using the core RBDMS application or one of its tools
- The system was designed to understand risks associated w/ underground injection of fluids
- The system migrated to address all oil and gas regulatory functions
- Industry shifts to directional wells required updating of function and data storage

# Previous Tools





# Overview- New Process

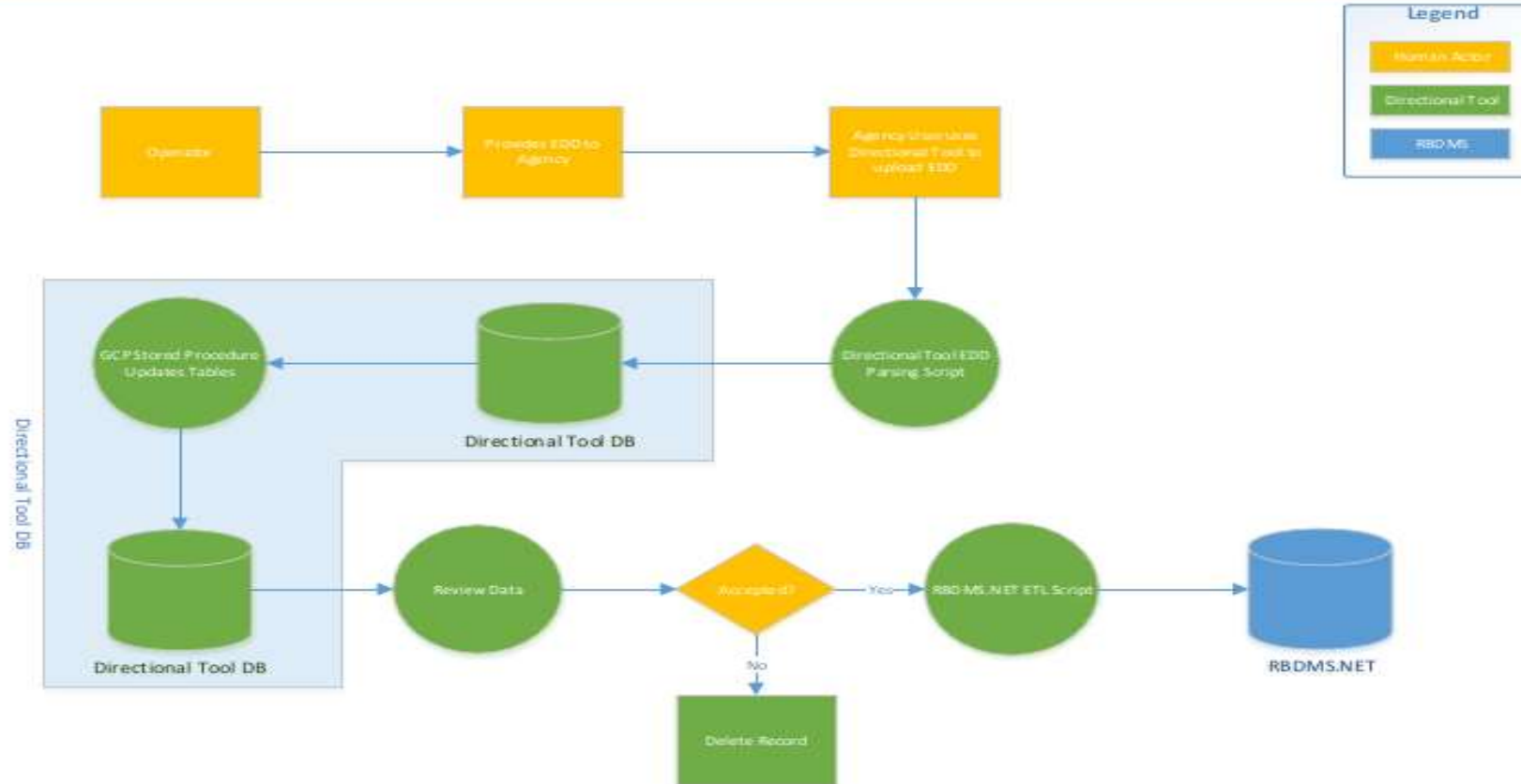
- Directional Survey data are stored as points and lines in SQL Server tables.
- Line features are stored as 3D features referenced to “subsea” elevations.
- Line features also contain measured depth as a GIS measures property.
- Point features are stored as 3D points with point attributes such as: surface location, kick off point, and bottom-hole location.
- Spatial data can easily be extracted for display on 2D maps and 3D models using various GIS software products.

# Process

1. Operator submits standardized Excel Electronic Data Deliverable (EDD) with Directional Header and Survey Point Data.
2. Data are imported to SQL Server Directional Survey Import tables for processing.
3. SQL Server stored-procedure calculates the latitude/longitude and elevation of each survey point and writes 3D point and line feature data to the import tables as spatial data types.
4. Data from the import tables are moved to permanent RBDMS tables to be stored as official directional data repository records.
5. Point and line features can then be extracted for processing through various GIS tools for maps, 3D models, and as downloads for the public.

# Projected Flow for Processing Survey Data

## RBDMS.NET DIRECTIONAL DATA FLOW



# EDD

A	B	C	D	E	F	G	H	I	J
Header Information	MeasuredDepth	Inclination	Azimuth	DoglegRate	VerticalSection	NorthOffset	EastOffset	TrueVerticalDepth	DirectionalPointNote
APINumber	0	0	0			0	0	0	SurfaceLocation
051233336100	478	1	245			-2	-3	478	
LateralName	604	1	240			-3	-6	604	
Lateral1	728	0	258			-4	-7	728	
WellNameNumber	854	1	251			-4	-8	854	
State Antelope 41-15HZ	979	1	273			-4	-10	979	
WellSurfaceLocationPLSS	1105	2	274			-4	-13	1105	
15-T5N-R62W	1228	1	255			-4	-16	1228	
OperatorNumber	1353	1	243			-5	-18	1353	
8960	1446	1	296			-5	-20	1446	
OperatorName	1540	2	351			-3	-21	1540	
Bonanza Creek Operating	1633	4	14			1	-20	1633	
CitingType	1727	5	17			8	-18	1726	
Actual	1820	7	21			17	-15	1819	
DirectionalSurveyCompany	1913	8	22			28	-11	1911	
Baker Hughs	2007	10	25			41	-5	2004	
DirectionalSurveyType	2100	11	26			56	2	2096	
MWD	2192	12	25			72	10	2186	
SurveyReferenceElevation	2286	13	24			91	18	2278	
4663	2380	14	21			112	27	2369	
ElevationDatum	2473	14	19			133	34	2459	
NAVD88	2567	14	18			154	42	2550	



# Database Tables

## DirectionalSurveyHeaderImport

Column Name	Data Type	Allow Nulls
<b>DirectionalSurveyHeaderKey</b>	int	<input type="checkbox"/>
APINumber	varchar(12)	<input checked="" type="checkbox"/>
LateralName	varchar(20)	<input checked="" type="checkbox"/>
WellNameNumber	varchar(50)	<input checked="" type="checkbox"/>
WellSurfaceLocationPLSS	varchar(50)	<input checked="" type="checkbox"/>
OperatorNumber	varchar(10)	<input checked="" type="checkbox"/>
OperatorName	varchar(50)	<input checked="" type="checkbox"/>
CitingType	varchar(10)	<input checked="" type="checkbox"/>
DirectionalSurveyCompany	varchar(50)	<input checked="" type="checkbox"/>
DirectionalSurveyType	varchar(20)	<input checked="" type="checkbox"/>
SurveyReferenceElevation	float	<input checked="" type="checkbox"/>
ElevationDatum	varchar(15)	<input checked="" type="checkbox"/>
NorthReference	varchar(4)	<input checked="" type="checkbox"/>
iFGridConvergence	float	<input checked="" type="checkbox"/>
iFGridScaleFactor	float	<input checked="" type="checkbox"/>
SurfaceLatitude	float	<input checked="" type="checkbox"/>
SurfaceLongitude	float	<input checked="" type="checkbox"/>
SurfaceLatLongDatum	varchar(15)	<input checked="" type="checkbox"/>
Comment	varchar(1000)	<input checked="" type="checkbox"/>
<b>DirectionalLineFeature</b>	geography	<input checked="" type="checkbox"/>

## DirectionalSurveyDataImport

Column Name	Data Type	Allow Nulls
DirectionalSurveyDataKey	int	<input type="checkbox"/>
<b>DirectionalSurveyHeaderKey</b>	int	<input type="checkbox"/>
MeasuredDepth	float	<input checked="" type="checkbox"/>
Inclination	float	<input checked="" type="checkbox"/>
Azimuth	float	<input checked="" type="checkbox"/>
DoglegRate	float	<input checked="" type="checkbox"/>
VerticalSection	float	<input checked="" type="checkbox"/>
NorthOffset	float	<input checked="" type="checkbox"/>
EastOffset	float	<input checked="" type="checkbox"/>
TrueVerticalDepth	float	<input checked="" type="checkbox"/>
<b>TrueVerticalElevationCalc</b>	float	<input checked="" type="checkbox"/>
<b>LatitudeCalc</b>	float	<input checked="" type="checkbox"/>
<b>LongitudeCalc</b>	float	<input checked="" type="checkbox"/>
DirectionalPointNote	varchar(40)	<input checked="" type="checkbox"/>
<b>DirectionalPointFeature</b>	geography	<input checked="" type="checkbox"/>

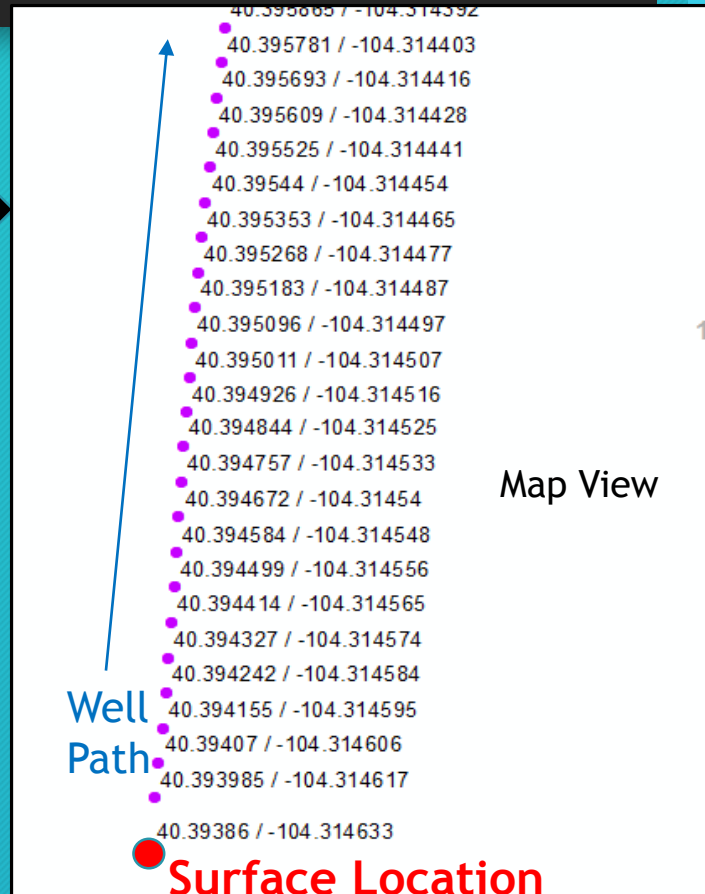
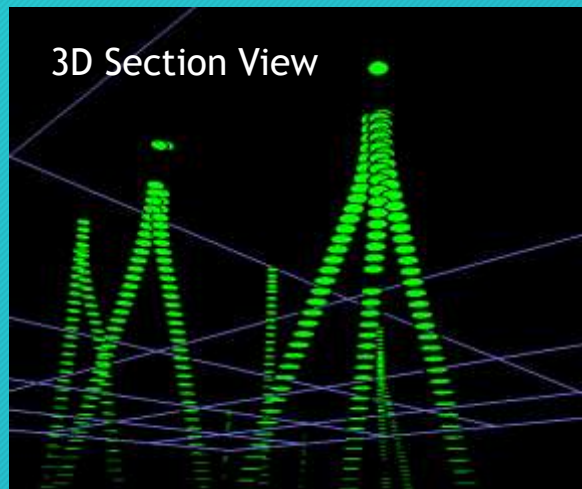
Tables store EDD imported data along with calculated fields (green) and spatial fields (red).

# Stored Procedure Point Calculations \*

Latitude and Longitude values are calculated for each survey point based on the surface location latitude/longitude and x-y offsets from the surface location (Must specify NAD83, NAD27, or WGS84).

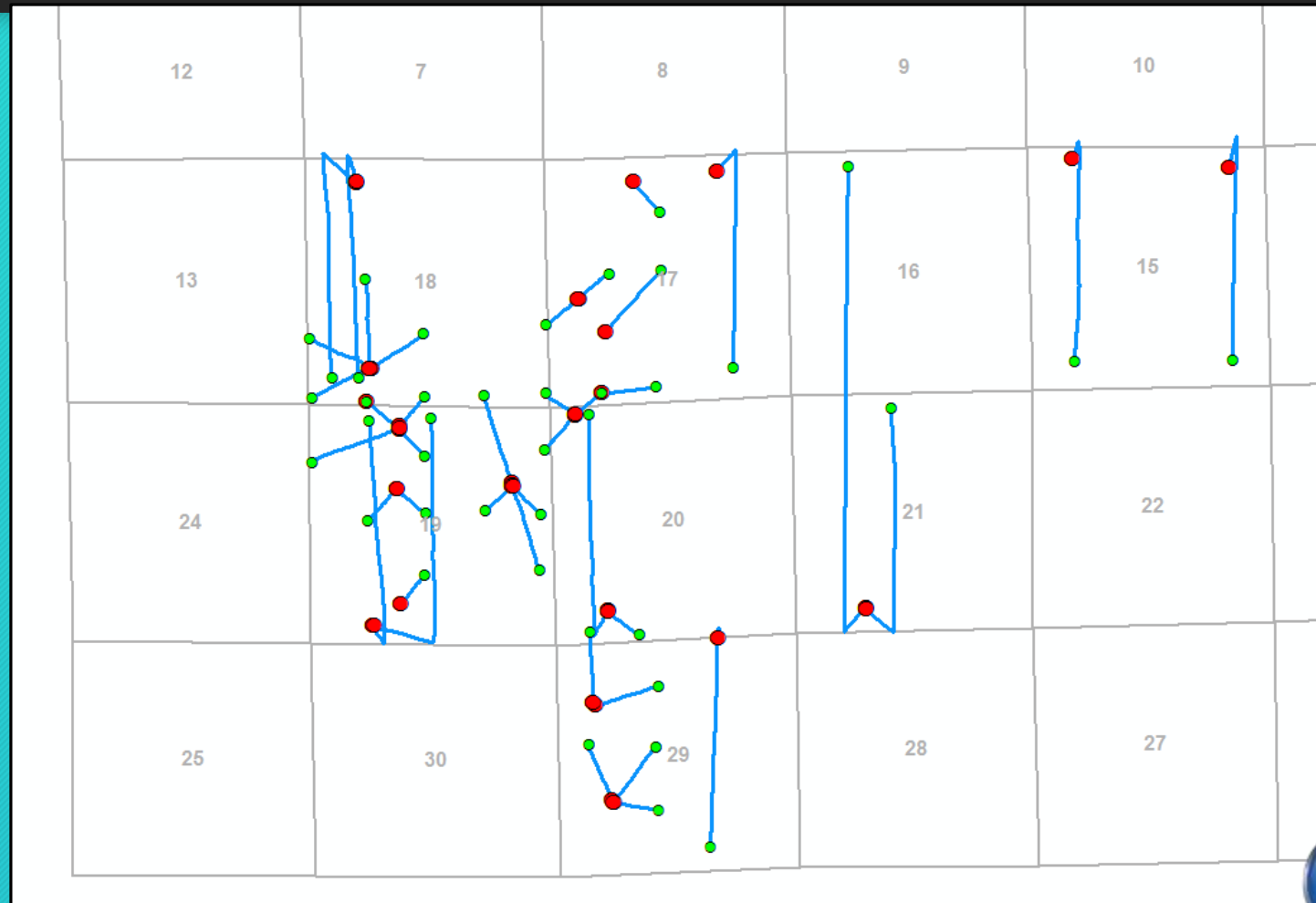


Subsurface elevations are calculated based on surface elevations (KB) and true vertical depth values for each survey point.





# Map View of Spatial Data\*



Red Dot = Surface Location  
Green Dot = Bottomhole  
Blue Line = Wellbore Path

\*Well data  
provided by  
COGCC  
Map software-  
ESRI ArcGIS

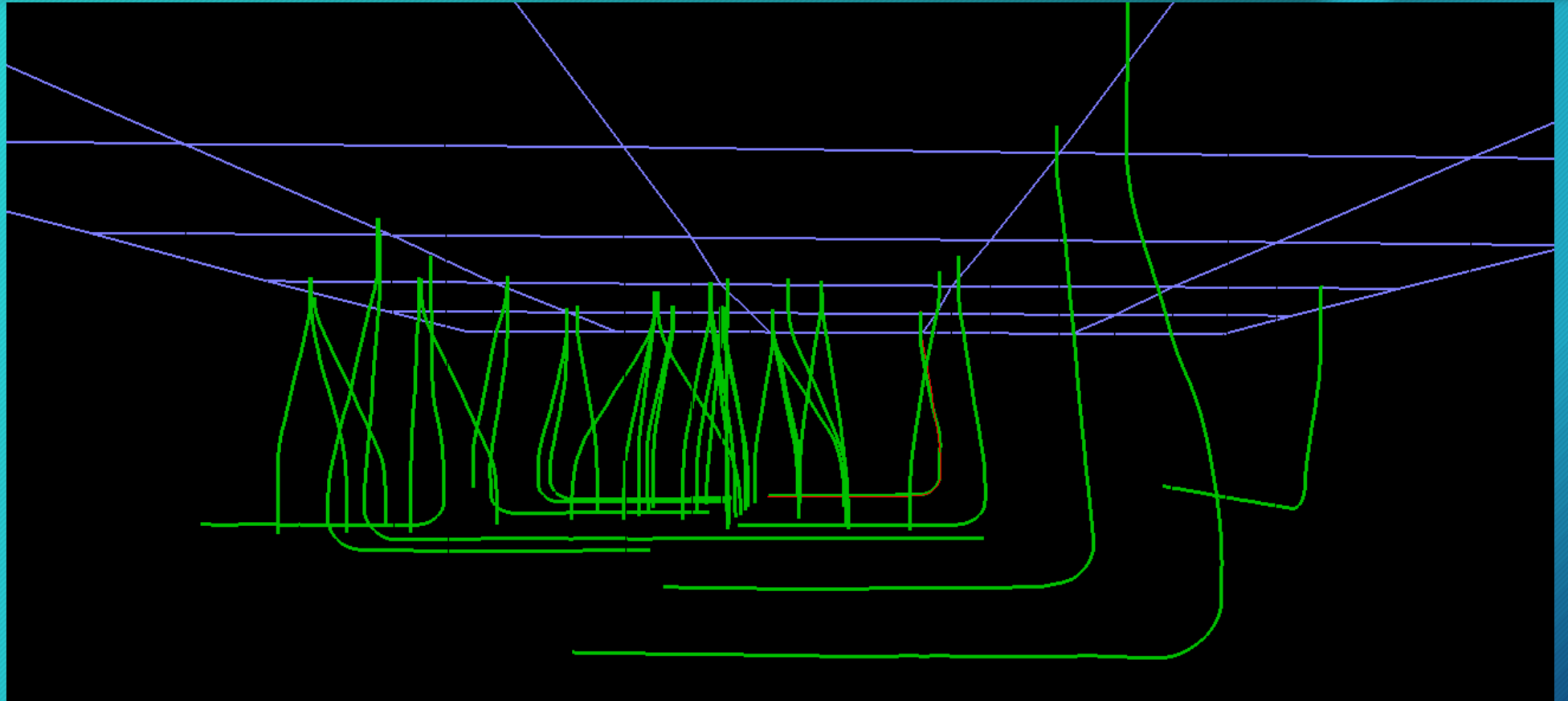


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# 3D View of Wellbores\*

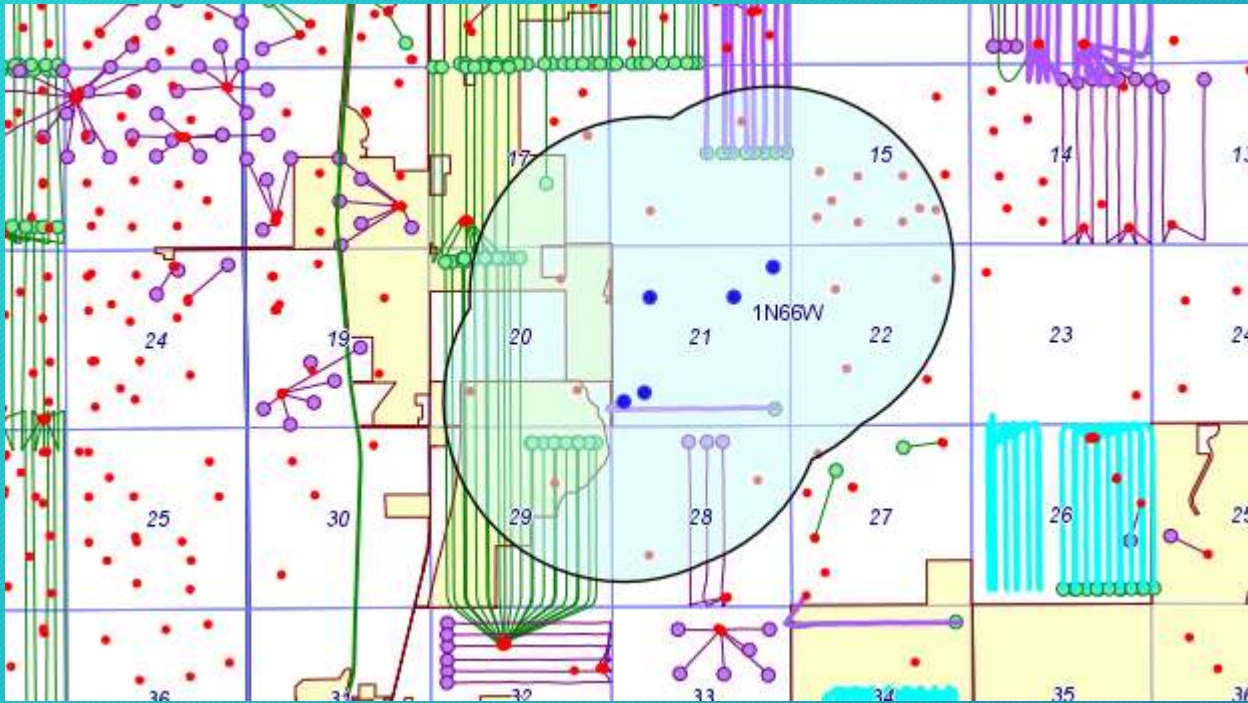
Green Lines =  
Horizontal and  
Directional Wellbores

Blue Lines =  
Section Lines



\*Well data provided  
by COGCC  
Map software-  
Blue Marble Global  
Mapper

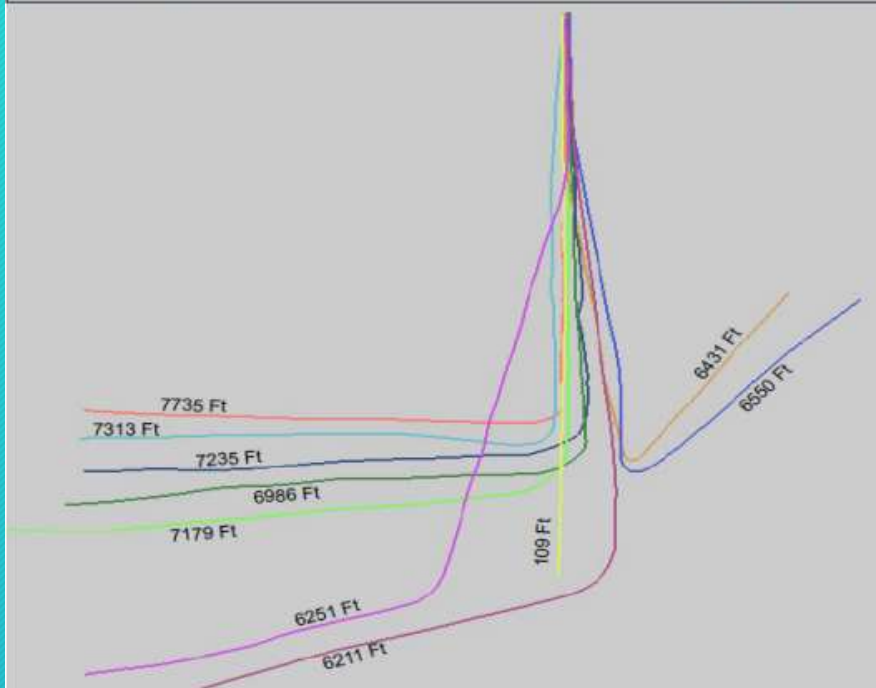
# Why Is This Data Important



- Increase in directional drilling
- Heightened chance of collisions
- Ability to accurately identify wells in an Area of Review

# Current Outstanding Tasks

3-D Diagram of 9 wells drilled from a single pad



- System is currently configured to consume Latitude / Longitude if expansion is required (UTM, State Plane) more specialized software is needed
- Import tables currently designed
- Long term DB tables under development
- EDD form still under review
- Formal process for vetting and loading data still required

# Questions/ More Information

Don Drazan

GWPC Project Coordinator

[don@drazanenergy.com](mailto:don@drazanenergy.com)

Jim Milne

Geologist/GIS Specialist

[milnej@comcast.net](mailto:milnej@comcast.net)

