

**Constructing National Well Catalog
with ArcGIS 10 and IHS Enerdeq
2013**

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Purpose of NWC



- } National Well Catalog (NWC)
 - } Asset teams are interested in oil and gas well information around the country
 - } Wells with Fidelity E&P Co. interest
 - } Wells owned by other companies
 - } Historical data about wells
- } A fast and simple way to get data
 - } Avoid bewildering array of applications
 - } Let's use a map
 - } Blend with Fidelity E&P's proprietary well data

Fidelity E&P Co. enterprise



} Corporate parent

 <p>MDU Resources Group, Inc. Building a Strong America®</p>	<ul style="list-style-type: none">§ Bismarck, ND§ Energy§ Construction§ Utilities§ Fortune 500
 <p>FIDELITY Exploration & Production Company <i>An MDU Resources Group company</i></p>	<ul style="list-style-type: none">§ Denver, CO§ 11.1 MBOE production (2011)§ \$456.3 M revenue (2011)

What is a well catalog?



- } A list of wells
 - } *Not* an oil & gas data model
- } Enterprise data asset
 - } *Not* “cloud computing”
- } Indexed and searchable
- } Geo-referenced data
- } A data backplane to access other data and applications that rely on a unique well ID for reference

Challenges



- } Choice of a unique well ID
 - } "What is a well?"
- } Comprehensive coverage
- } Cost
- } Currency of data
- } Automation
- } Priority of source

Unique well ID



- } Establish one surface location
 - } 10-digit API number
- } Establish one or more bottom hole locations
 - } 14-digit API number
- } Assume each surface location gets at least one bottom hole location
- } Differentiate by proximity of surface and bottom hole
 - } Nearby bottom holes treated as vertical wellbores
 - } Outliers treated as directional wellbores
 - } *Caution: this is not a subsurface modeling database*

Coverage



- } Domestic historical header and production data
- } 8600 Fidelity E&P wells
 - } Corporate "database of record"
- } 3.9 M non-Fidelity top hole locations
- } 4.4 M non-Fidelity bottom hole locations
 - } Several commercial data sources available
 - } Fidelity E&P Co. uses data from IHS, Inc.

Cost



- } "Big data" cliché
- } Cost is a function of completeness and quality of data
- } Value-add for collecting and organizing data for oil & gas industry

Currency of data

- } There is no point-in-time baseline
- } Data must be updated daily



Automation



- } Coverage and currency demand automation
- } No humans in the loop
- } Server power
 - } Intel® Xeon® CPU X5660 4x2.0 GHz
 - } 16 GB RAM
- } Elapsed processing time 7 hours/night
- } Event notification via Email

Priority of sources



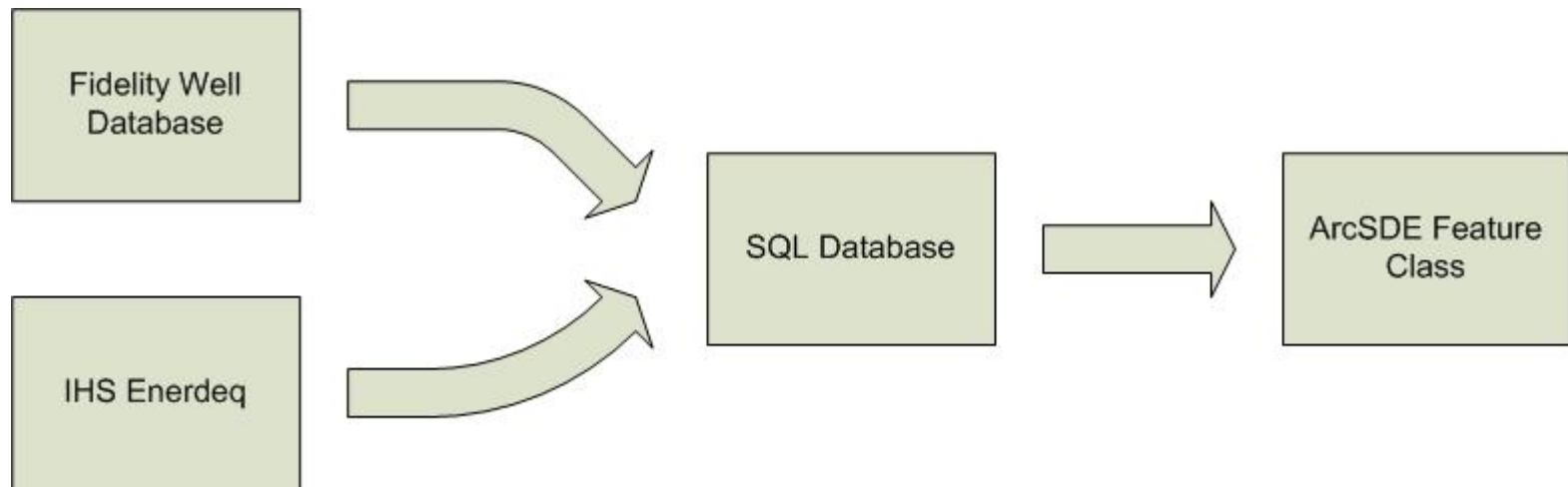
- } Proprietary data first
- } Commercial data second
- } Any null fields in proprietary rows are backfilled with commercial data
- } Sources of attributes are tracked



Design considerations

- } Inception of project: populate an initial well header table
 - } Validate software requirements and preliminary design
 - } Seek review by data supplier IHS, and Enterprise GIS supplier petroWEB, Inc.
 - } Bulk well load from IHS
 - } Tune database performance
- } Technologies
 - } SQL Server
 - } Python
 - } C# for update task
 - } C# ArcObjects for wellbore polylines
 - } ArcGIS Geoprocessing Tools
 - } Microsoft Task Scheduler

Data sources



Data sources



- } SQL database populated with initial load from IHS
- } Over 70 well header fields are included
- } SQL views used to replace well data with corresponding proprietary data
- } Fidelity E&P data given priority
- } Null fields from Fidelity E&P are backfilled with IHS data
- } Resulting feature classes are a blend of IHS and Fidelity E&P data



Tables, views, feature classes

- } SQL tables used wherever possible
 - } High performance
 - } Warehouse IHS data
 - } Fidelity E&P data in proprietary SQL database
- } SQL views help shape data
 - } "Rules engine"
- } Final table is produced
- } Serves as *Input Table Parameter* value in geoprocessing
- } Geoprocessing yields feature classes
 - } Top hole 10
 - } Bottom hole 14
 - } Wellbore path representations

Order of processing



- } Three distinct processing episodes
 - } Top and bottom hole locations processed nightly
 - } Requires exclusive database locks
 - } Update task processed continuously
 - } No interference with other processes
 - } Wellbore path processed over period of days
 - } No interference with other processes

Update task characteristics



- } Unattended process
- } All well and production data continuously updated
- } Adds/updates/deletes accomplished
- } Fields backfilled
- } Work queued by county
- } Deployed on multiple computers for max throughput
- } Functional and performance monitoring via Email



Update task benefits

- } No interference with GIS users or other systems
- } No interference with nightly catalog update
- } High performance and throughput
- } 1000 transactions per hour or more
- } Fault tolerant
 - } Network outages
 - } Server downtime
 - } Vacations
- } Low disk space utilization



Update task technology

- } Windows Task Scheduler
 - } Windows 7 and Windows Server 2008
- } IHS Enerdeq Web Service API
- } Windows console application C# .NET
- } Multiple worker "bots"
 - } One unit of work at a time (county)
 - } Any failed bot is quickly replaced
 - } Extended data gaps due to service down are quickly filled
- } Run continuously for 28 months to date
 - } Practically no faults due to IHS data discrepancy or other
 - } Enerdeq Web Service API is sensible, stable, and fast

Geoprocessing


















- } Windows MS-DOS batch scripts
- } Python scripts
- } Transact-SQL scripts
- } Windows Task Scheduler invokes batch scripts
- } ArcGIS Geoprocessing Tools
 - } Table manipulation tools
 - } Make XY Event Layer



Map symbols

- } Large number of well statuses summarized
 - } Rules engine
 - } Cross reference tables support classification
- } 15 distinct symbols result

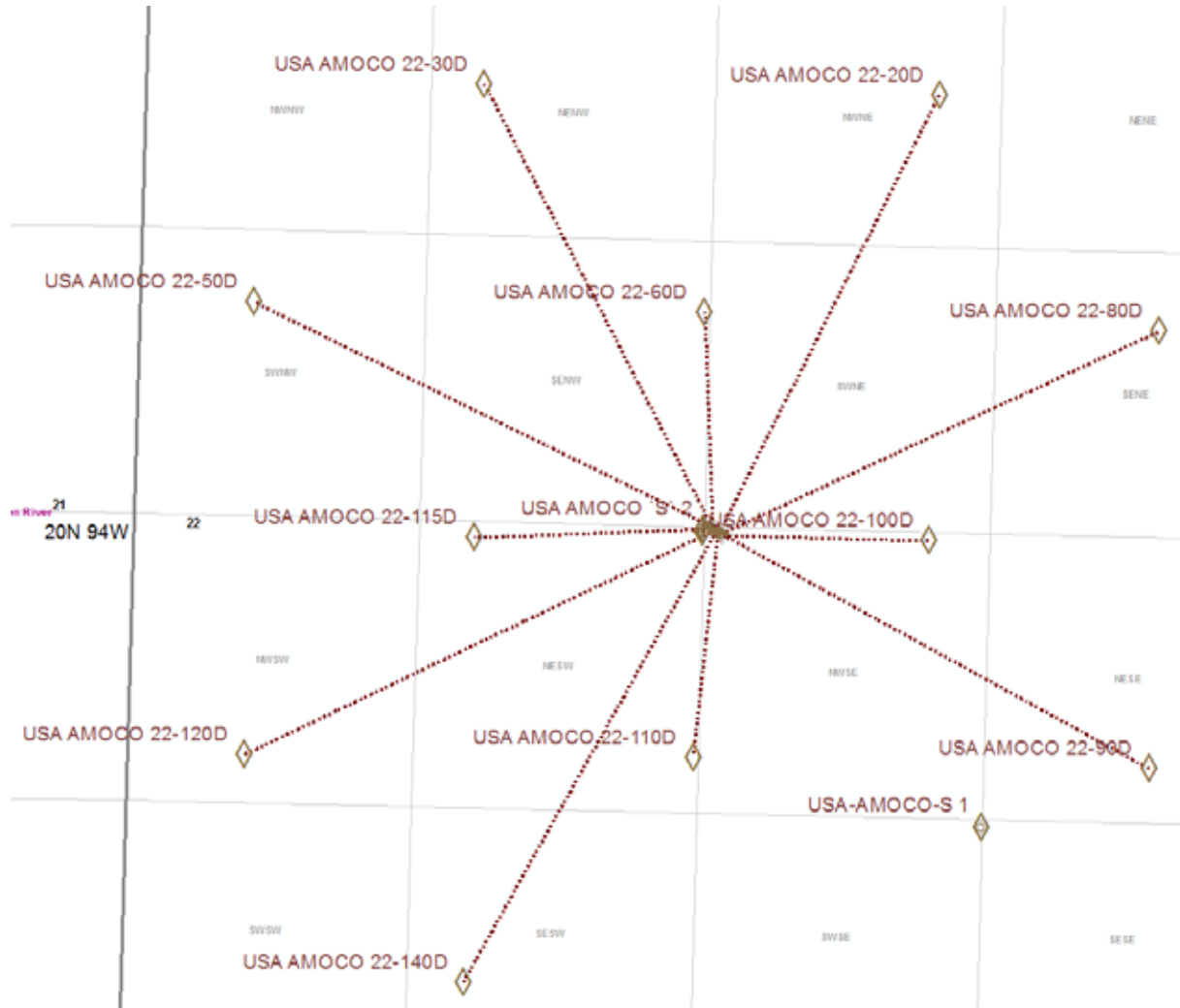
<ul style="list-style-type: none"> Application for Permit to Drill Drilling Dry Hole Oil Producer Gas Producer Oil and Gas Producer Surveyed Well Location	<ul style="list-style-type: none"> Shut In Abandoned Temporarily Abandoned Injection Active Water Well Completed Well Waiting On Completion Other
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Wellbore paths



- } Representations of relationships
- } Not wellbore survey data
- } Relate top-to-bottom hole locations

Wellbore paths



Enterprise GIS



- } Fidelity E&P Co. functional disciplines use Enterprise GIS
- } NWC attributes provide good flexibility for GIS maps
- } Access to dozens of reports
 - } Well header
 - } Production
 - } Facility
- } Exports for PETRA
- } High performance and data availability through petroWEB

Conclusion



- } A few key components can be used to customize and enhance the national well data set maintained by IHS
- } Seamless combination with Fidelity E&P data is achieved
- } NWC meets our goals of Currency, Completeness, and Performance

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