Routledge Unit #1
Waterflood Enhanced Oil Recovery (EOR) Application

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- Attached .pdf files
    - Unit Agreement, Land notifications, Geological maps, Working Interest approvals

Summary / Conclusions

- The proposed Waterflood EOR Project for Routledge Unit #1 is within the Routledge Lodgepole Pool.
- Original Oil in Place (OOIP) in the Routledge Unit #1 has been calculated to be 33.4 MMbbl. This estimate is based on reservoir volumetrics.
- Cumulative production to the end of January 2012 from the Routledge Unit #1 is 16 MMbbl Oil and 171 MMbbl Water.
- Figure #1 displays production from the proposed area, which peaked in October 1964, at 2,197 bbl of oil per day (OPD). As of January 2012, production was 372 OPD, 11,375 bbl of water per day (WOD) and a 96.8% water cut.
- Based on a waterflood 'Pilot Project' initiated in 1974 and operated until 1994, Routledge Unit #1 is expected to be suitable reservoir for Waterflood EOR Operations.
- Estimated Ultimate Reserves using current primary recovery is 16,929 Mbbl. Estimated Ultimate Reserves using primary + waterflood EOR is estimated at 18,115 Mbbl. Incremental recovery due to waterflood project is estimated to be 3.55%
- Following approval, four (4) selected existing wells will be converted in 2012 to water injectors in order to implement a waterflood pressure support scheme.
- The Waterflood Enhanced Oil Recovery Project is expected to commence in Q4 2012.
- Initial injection pipeline construction and conversions are scheduled for Q3/Q4 2012 with further future pipeline construction and injector conversions in 2013/2014.
- Currently, Enerplus is targeting November 1st, 2012 as the start-up date for the waterflood injection.

RESOURCE POTENTIAL IN ROUTLEDGE UNIT #1

Geological Discussion

The Routledge pool was discovered in May 1954 at a depth of approximately 630 m.

Technical Studies

The Geological information included in this submission was completed through internal Enerplus and independent reviews of the available open-hole logs, core data, and completion information. Hydrogeology data for the Routledge pool, which is included, was part of a larger hydrogeology study of the Lodgepole reservoir in the Virden-Daly area completed by Canadian Discovery Ltd. in May 2010. All of this information was compiled to develop a suite of geological maps and to determine reservoir parameters to support the calculation of the Routledge Unit #1 OOIP. It was also used in estimating secondary recovery to be obtained from waterflood within the unit.

Stratigraphy & Sedimentology

- The stratigraphy of the reservoir in the Routledge Unit #1 is illustrated on the structural cross sections attached (Appendix B); the primary producing horizons within the unit are the Lower Virden (Sandhills and the 1st, 2nd, 3rd, 4th Oolites) and the Scallion Member; there less production from the Upper Virden Member; reservoir is impacted by a natural water drive from a dynamic aquifer within the Lodgepole formation.

- Mississippian Lodgepole Strata subcrop across a northwesterly trending paleoerosional high, underlain by basement controlled structural elements.

- Oil is trapped in Lodgepole oolitic and skeletal carbonate reservoirs beneath the overlying dense, tight dolomite/anhydrite cap rock and against an up dip escarpment to the northeast.

- The Lodgepole Formation contains the cherty lime mudstone of the Scallion Member upwards through oolitic and skeletal sands of the Virden Member.

- The Lower Watrous red siltstones and shales lie unconformably upon the subcropping Lodgepole Formation; the red beds thicken up dip of the pool to the NE.

- There are four well defined stratigraphic units (sedimentology is also described) from top downwards in the Lodgepole Formation:

1) **Flossie Lake Member** – the Flossie Lake Member is comprised of dense recrystallized dolomite & limestones with abundant anhydrite; there is no production in unit, sub tidal depositional environment, unconformably underlies the Amaranth (seal)

2) **Whitewater Lake Member** - upper unit contains mixed oolite & skeletal wackestones to packstones interbedded with lime mudstone; the lower unit of the Whitewater Lake consists of red shale and argillaceous lime mudstone; the Whitewater Lake has minor oil production in unit, sub tidal depositional environment

3) **Virden Member** – **Upper Virden Member** ("Crinoidal") is a thick skeletal & crinoidal packstone to grainstone with good intergranular and intercrystalline porosity deposited in a sub tidal environment; **Lower Virden Member** is a fine grained oolitic and skeletal packstone to grainstone interbedded with red argillaceous lime mudstone and shale; facies is a shallow marine shelf supported by the depositional patterns and or cyclicity; the Virden Member forms a consistent oil reservoir in the Routledge Unit except where diagenesis resulting in dolomitization & anhydrite infilling has eliminated the reservoir quality; Diagenesis has resulted in the creation of a 15 to 30 m thick impermeable cap rock; The Virden Member is the secondary oil producing reservoir within the Unit

4) **Scallion Member** ("Cherty") – this is the main producing horizon within the Lodgepole Formation. It is comprised of lime mudstone with lesser skeletal or crinoidal wackestone to packstone; chert nodules, chalky limestone, dense lime mudstone and silicified skeletal wackestone and packstone are common; the Upper Scallion has good to excellent intercrystalline/ intergranular porosity plus solution-enhanced vuggy porosity, conformably overlies the Bakken; Depositional environment occurred on a shallow carbonate shelf

Structure

- Structure contour maps are provided for the top of the Scallion Member and the Lower Virden Member (Appendix A / Appendix B)

- The general trend of the pool is from NW to SE with dip to the southwest

- The Whitewater Lake and Upper Virden reservoirs are oil productive to the SW, followed in an up dip direction by the Lower Virden member and then further up dip by the Scallion Member; each reservoir unit rises in structure to the NE to the point where dolomitization and anhydrite infilling have obliterated the reservoir quality and thereby formed a tight, impermeable cap rock

- Post-Watrous subsidence to the SW tilted all units by 3 m/km thereby increasing the structural relief of all the subcropping beds

- The Scallion Member structure ranges from a high of -185 m to a low of -235 m subsea

- Structural closure is seen along the northeastern edge of the unit; a paleoerosional low to the northeast of the Routledge unit exists.

- Underlying structural elements control the northwest-southeast Virden Trend.

- Structure is related to the dissolution of the Mid Devonian Prairie Evaporite salt which overlies the Winnipegosis Formation; there is evidence of multi-stage salt solution during the Mid Devonian, Mississippian and post Mississippian.

- Structural collapse up-dip and parallel to the paleo-escarpment resulted in preservation of a thick Lodgepole section beneath the unconformity.

- The low at section 15-009-25W1 confirms late fault movement and provides further evidence of basement faulting.

Reservoir Continuity

- The cross section and geological maps (Appendix B) illustrate the lateral continuity of the Scallion, Lower Virden and Upper Virden Members within the Lodgepole Formation; the lateral continuity of the reservoir units is essential in a successful waterflood scheme.

- Laterally, oil was trapped against either northeast trending structural lows or tight dolomite reservoirs (from sub aerial exposure at the Mississippian erosion surface resulting in extensive dolomitization & anhydrite-infilling).

- No significant depositional thinning occurs in the reservoir units within the Routledge Unit #1.

- There appears to be vertical continuity in the Lodgepole Formation (Scallion, Lower Virden & Upper Virden).

Reservoir Quality

- Porosity (Phi•h) and permeability (k•h) maps for the Scallion, Lower Virden and Upper Virden are provided (Appendix A / Appendix B).

- Maps were generated using core data (core analysis and core descriptions); Cutoff used was 1.0 mD on the permeability.

- Porosity estimation is difficult due to the vintage of the vertical well logs in Routledge Unit #1, the majority of vertical wells were drilled in the late 1950's and early 1960's; a significant portion of wells only have electric induction logs, gamma ray logs, few porosity logs ran.

- As noted from the Phi•h and k•h maps, the primary reservoir unit is contained within the Scallion Member with secondary reservoirs within the Lower Virden and Upper Virden, respectively.

Fluid Contacts

- The estimated original oil/water contact for the Lodgepole reservoir is at -214 m subsea.

- The Lodgepole Formation and the members in the Routledge Unit #1 form a single hydrostratigraphic unit.

- A single well developed oil line and water line was identified on the pressure vs. elevation plot.

- The Routledge pool is a classic representation of an oil pool with down dip water at -214 m subsea with the possibility of an 8 to 10 m transition zone.

- Height of the oil column is estimated to be 20 to 25 meters.

OOIP Estimates

Total volumetric OOIP for the Lodgepole formation, within the Routledge Unit #1 area, has been calculated to be 33.4 MMbbl.

A listing of the of the Lodgepole formation rock and fluid properties used to characterize the reservoir are provided below.

Table 1: Routledge Unit

LODGEPOLE FORMATION ROCK & FLUID PARAMETERS		
Formation Pressure	6,700 kPa	Initial Avg. Reservoir Pressure
Formation Temperature	30^0 C	
Saturation Pressure	1,400 kPaa	Bubble Point (from analog)
GOR	22 m^3/m^3	Gas Oil Ratio (from analog)
API Oil Gravity	33.6	Degrees API
Average S_{wi} (fraction)	0.32	Initial Water Saturation
Produced Water Specific Gravity	1.04	
Produced Water pH	8.1	
Produced Water TDS	55,000 ppm	
Reservoir Wettability	Mod. to Strong Oil Wet	From analog
Oil viscosity @ 25^0 C	5.7 cp	
R_w @ 25^0 C	0.127 Ohm • m	

Waterflood EOR Project Development

Technical Evaluations

Historical Production and Forecast for Existing Depletion Mechanism

A historical group production plot for the unit is shown in Figure #1. Oil Production commenced in June 1954 and peaked in March 1959, on primary production, at 1,888 bbl/d OPD. As of January 2012, production was 401 bbl OPD, 11,378 bbl WPD and a 96% water cut.

Oil production is declining at an annual rate of approximately 14% under the current (primary and natural water drive) production method.

Cumulative production to end of January 2012 from the Routledge Unit #1 wells is 15.9 MMbbl of oil, and 171 MMbbl of water, representing a 47.6% RF of the Unit OOIP.

The forecasted primary and natural water drive oil production profile is plotted in Figure 2. Using the decline analysis method, an ultimate recoverable oil of 16.9 MMbbl has been forecasted. Based on the geological description, primary production decline rate, and waterflood response in adjacent Lodgepole pools, the Routledge Unit #1 is expected to be a suitable reservoir for the Waterflood EOR Project.

Waterflood Pilot, 1973 - 1994

Previously, a waterflood pilot project was undertaken by the former Unit operator (Chevron), beginning in 1973 and discontinued in 1994. This pilot included the conversion of the 100/13-22-009-25W1 well into an injector. A total of 2,585 Mbbl of water was injected back into the Lodgepole over this period and despite the limited size of the pilot area (single inverted 9-spot pattern); a flattening of the combined decline rate of the eight pattern producers offsetting the 100/13-22 well was observed.

From the years 1959 - 1974 prior to water injection, an average of 8% decline annually was observed at these wells. Between the years 1975 - 1994, with injection of water at 100/13-22, the average annual decline of the same offsetting producers fell to 3%. Since 1995, following the termination of water injection, the average annual decline rate of these producers reverted back to 8%.

Aquifer Support / Historical Pressure Survey Results

It is believed that there is strong aquifer support for the Lodgepole reservoir in Routledge, particularly from the South-West direction. The main evidence of this is in the historical bottom hole pressure survey results since the reservoir was discovered in 1954 (Figure #4). The original reservoir pressure is 6,700 kPa. It can be seen that this pressure level is maintained until 1990 (and likely beyond, although there is not any bottom hole pressure data to confirm this). It can also be noted that there is evidence for reservoir pressure depletion commencing in 2003, particularly in some parts of the reservoir. This pressure depletion would be most evident in the North (around Sections 32 and 33-009-25W1) and North-East (around Sections 28 and 22-009-25W1).

The 2010 bottom hole pressure survey results have a wide range of scatter on the chart in Figure #4. When the same data is plotted as a bubble map in Figure #5 to analyze areal distribution, it can be seen that the results with high pressure values are mainly in the South-West (Sections 16, 20 and 21-009-25W1). The low pressure survey results are located mostly in two separate areas: around Sections 22, 32 & 33-009-25W1. Moderately low pressure survey results are located in Section 28-009-25W1. A similar areal trend is observed from 2012 pressure survey results (Figure #6) also.

In light of the above discussion, the proposed waterflood EOR should be considered to be more of a “pressure support” scheme that will assist the existing natural influx of water rather than a normal pattern waterflood, such as the waterflood projects in other Virden area Lodgepole Oil Units.

Routledge Unit #1 Pressure Predictions

Currently Enerplus does not have a reservoir simulation model set up for Routledge Unit 1 and so it is difficult to accurately predict pressure behavior into the future, particularly in view of the aquifer support received by this reservoir.

Enerplus has recently attempted a rigorous material balance method. No meaningful results have been obtained other than the conclusion that an active aquifer must be included to properly model the historical production and average reservoir pressure data. Failure of material balance methods is likely due to inadequate and/or poor quality of production, water injection (disposal) measurements in the field. As well, the pressure may not be representative of actual reservoir pressure due to completions that are in multiple flow units in many wells. Lastly, active aquifer strength estimation is onerous and the material balance model appears to be highly sensitive to small changes in aquifer properties or aquifer strength received by some parts of the reservoir. These reasons would lead us to believe that the available production/pressure information is not a true representation of actual field history and so it is difficult to deploy material balance methods in this case.

Proposed Water Injection Well Conversions and Timing

Enerplus tentatively proposes to convert a total of 13 inactive or low rate oil producers to water injection wells with 6 of them being horizontal and the remaining being vertical (Figure #3). This is expected to create a peripheral/line drive waterflood scheme.

As discussed earlier, primary production from the wells in the North-East part of the Unit (i.e. the general area consisting of Sections 32, 33, 27, 28 and 22-009-25W1) has depleted the reservoir pressure significantly from the initial reservoir pressure indicating a need for secondary waterflood pressure support, going forward.

The pressure depleted region of the Unit is divided into 3 distinct areas based on reservoir pressure levels: “North Area” – consisting of Sections 05-010-25, 32 and 33-009-25W1 (with a total of 5 proposed injectors); “Central Area” – located mainly in Sections 27, 28 and partially 29-009-25W1 (with a total of 4 proposed injectors); and “South Area” – in parts of Sections 15, 21 and Sec. 22-009-25W1(with a total of 4 proposed injectors). The remaining area inside the Routledge Unit 1 is mainly in the “South-West” of the Unit; no new injectors are currently proposed in this 4th area (called “South-West Area” – consisting of Sections 09,10, 15, 16, 20 and partially Sec 21-009-25W1) since the aquifer influx is providing adequate support to maintain relatively higher reservoir pressures.

The table below lists all 13 proposed wells in the 3 pressure depleted areas and their corresponding Phase (1, 2 or 3) and Year conversion (2012, 2013 or 2014) to water injection. The first phase involves conversion of a total of 4 wells in Q3/Q4 2012 to injectors in the North (2) and Central (2) Areas – 3 vertical and one horizontal injector. The corresponding maximum injection rates and supply pressures are also listed in the table.

Currently plans are underway to re-complete and tie-in the 4 wells to be converted to injectors in 2012. Phase 2 (a total of 6 wells: 5 horizontal and 1 vertical) and Phase 3 (a total of 3 wells: 2 horizontal and 1 vertical) injector tie-ins are tentative scheduled. Timing and number of injectors to be converted, will be decided in future based on how the reservoir pressure level in each Area responds to the prior injection wells’ start-up and the injection rates realized in the field. Ongoing Voidage Replacement Ratio (VRR) values for each Area will be also be considered.

Ultimately, conversion of existing wells will be dependent upon wellbore integrity and condition to be identified during re-completions operations. In the event, that a wellbore is not deemed suitable, an alternate candidate may be selected or a new well drilled.

Table 2: Routledge Unit #1
Injection Well Conversion: Timing & Maximum Injection Rates

Waterflood/Pressure Support Area	Proposed Injection Well (Bottomhole)	Phase	Timing	**Maximum Injection Rates m^3/d**
North	00/07-32-009-25W1	1	2012	**112**
North	00/03-05-010-25W1	1	2012	**254**
Central	00/02-28-009-25W1	1	2012	**213**
Central	02/13-21-009-25W1	1	2012	**487**
Central	02/01-28-009-28W1	2	2013?	**347**
Central	02/09-29-009-25W1	2	2013?	**170**
North	02/03-05-010-25W1	2	2013?	**508**
North	02/06-32-009-25W1	2	2013?	**196**
South	02/04-22-009-25W1	2	2013?	**653**
South	00/14-15-009-25W1	2	2013?	**280**
North	02/14-28-009-25W1	3	2014?	**140**
South	00/03-22-009-25W1	3	2014?	**186**
South	02/11-21-009-25W1	3	2014?	**309**

As discussed earlier, the aquifer from the South-West direction supports the pressure level in the South-West Area of the Unit and consequently no new injectors are being proposed in this area.

In summary, Enerplus is currently proposing the following schedule that is based on a tentative development program / project plan:

- Convert 4 wells (Waterflood Phase 1) to water injection Q3 2012
- Injection pipelines construction Q3/Q4 2012
- Start-up of water injection, following approval of this project: November 1st, 2012
- Additional injection pipelines construction 2013
- Convert 6 of 13 wells (Phase 2) to water injection 2013 (tentative)
- Convert remaining 3 of 13 wells (Phase 3) to water injection 2014 (tentative)

Proposed Injection Pipeline System

The injection pipeline system is designed to provide a minimum of 6,000 kPa of pressure to each well at maximum projected flow rates listed in Table 2 previously. Actual wellhead injection pressures will be controlled by wellhead chokes. These chokes will also be used to divert water to areas requiring more injection volumes than others.

Secondary Waterflood EOR Production Forecast

The oil production profile under Secondary Waterflood depletion mechanism has been developed based on volumetrics OOIP and response observed to date in neighboring Lodgepole Oil Units under waterflood in the area (Virden Roselea, North Virden Scallion pools, etc.).

The proposed Routledge Unit #1 Secondary Waterflood oil production forecast over time is plotted in Figure #2.

An incremental volume of 1,186 Mbbl of oil reserves are forecasted to be recovered under the proposed Waterflood EOR production scheme, over and above the existing primary/natural water drive production recovery method. Incremental secondary recovery factor (RF) is forecasted to be 3.55%.of the estimated OOIP.

Estimated Fracture Pressure

Completion data from the existing producing wells within the Virden area indicate an actual fracture pressure gradient range of 18-20 kPa/m TVD. Enerplus fracture pressure estimation is based on a fracture gradient of 19 kPa/m and therefore, with a typical reservoir depth of 625 m TVD, the fracture pressure in Routledge Unit 1 is expected to be ~11,875 kPa (bottom hole). This will limit the maximum wellhead injection pressure to ~5,600 kPa.

Waterflood Operating Strategy

Injection Water, Rates and Reservoir Pressure

The injection water for the Unit is the produced water from the Lodgepole formation that is separated from produced oil and cleaned up at the Routledge Unit #1 16-17-009-25W1 Battery. It is then injected back into the same (Lodgepole) formation. Most of the injection water will be diverted from the current water disposal wells located at 15-17 and 16-17, depending upon the injectivity of the new injectors in the North, Central and South areas. Any excess water will be re-injected at the existing disposal wells (15-17 and/or 16-17).

As mentioned previously, there will be a total 4 waterflood “Areas” inside the Routledge Unit #1 and the VRR calculations will be based on the corresponding injection and production rates in each area. The water injection strategy (future injector conversions) in each area will be dependent on the corresponding reservoir pressure.

Reservoir Pressure Management during Waterflood

At this time, it is speculative to anticipate a specific time-frame to re-pressurize the Lodgepole reservoir by compensating for the voidage created due to cumulative primary/natural drive production and the current rate of pressure depletion in each of the 4 areas. Initial monthly VRR’s are expected to be approximately 0.4 to 1.2 (40% to 120%) during the fill up period in North, Central, South Areas. The target average reservoir operating pressure level for waterflood operations in each of the 4 areas will be 80 – 120% (5,360 – 8,040 kPa) of original reservoir pressure in Routledge Unit 1 (6,700 kPa).

Waterflood Surveillance and Optimization

Routledge Unit #1 EOR response and waterflood surveillance consists of the following:

- Regular production well rate and water cut testing
- Monthly water injection rate and well-head (WH) pressure vs. target maximum wellhead pressure
- Bottom hole reservoir pressure surveys, as needed, to establish pressure trends in each Area
- Ongoing VRR’s and Cum. VRR for each of the 4 Areas
- Use of some or all of: Water Oil Ratio (WOR) trends, log WOR vs. cumulative oil, etc. methods

This data collection and subsequent analysis is expected to provide an increasing understanding of the reservoir performance. Diligent monitoring and control of the waterflood operations will significantly reduce or eliminate the potential for out-of-zone injection, undesired channeling or water breakthrough if any. The monitoring and surveillance will also provide early indication of any such issues so that waterflood operations may be modified to maximize ultimate secondary reserves recovered from the Unit.

Reservoir Pressure Surveys

For each converted injection well, a measured bottom hole reservoir pressure will be obtained prior to water injection. Enerplus expects to periodically obtain useful bottom hole reservoir pressure data on a number of existing producing wells within the project area after the waterflood start-up. These pressures will be reported within the Annual Progress Reports for the Unit as per Section 73 of the Drilling and Production Regulation.

Sweep Efficiency Optimization by Injector Conversions, Vertical Producing Well Re-Completions and Additional Infill Horizontal Well Drilling:

Future injection well conversions of inactive or low rate production wells in each of the four (4) areas will increase the sweep efficiency. Also, recompleting the vertical wells that have not been previously completed in a given flow unit (Scallion, Upper Virden or Lower Virden) will also improve the vertical sweep efficiency. Another way to improve horizontal sweep efficiency is by drilling additional infill horizontal wells that will be considered as the waterflood progresses.

Planned Corrosion Control Program

Injection Wells

- Casing cathodic protection where required
- Corrosion inhibited water in the annulus above packer
- Internally coated tubing surface to packer
- Surface freeze protection of annular fluid
- Corrosion resistant master valve
- Corrosion resistant pipeline valves

Producing Wells

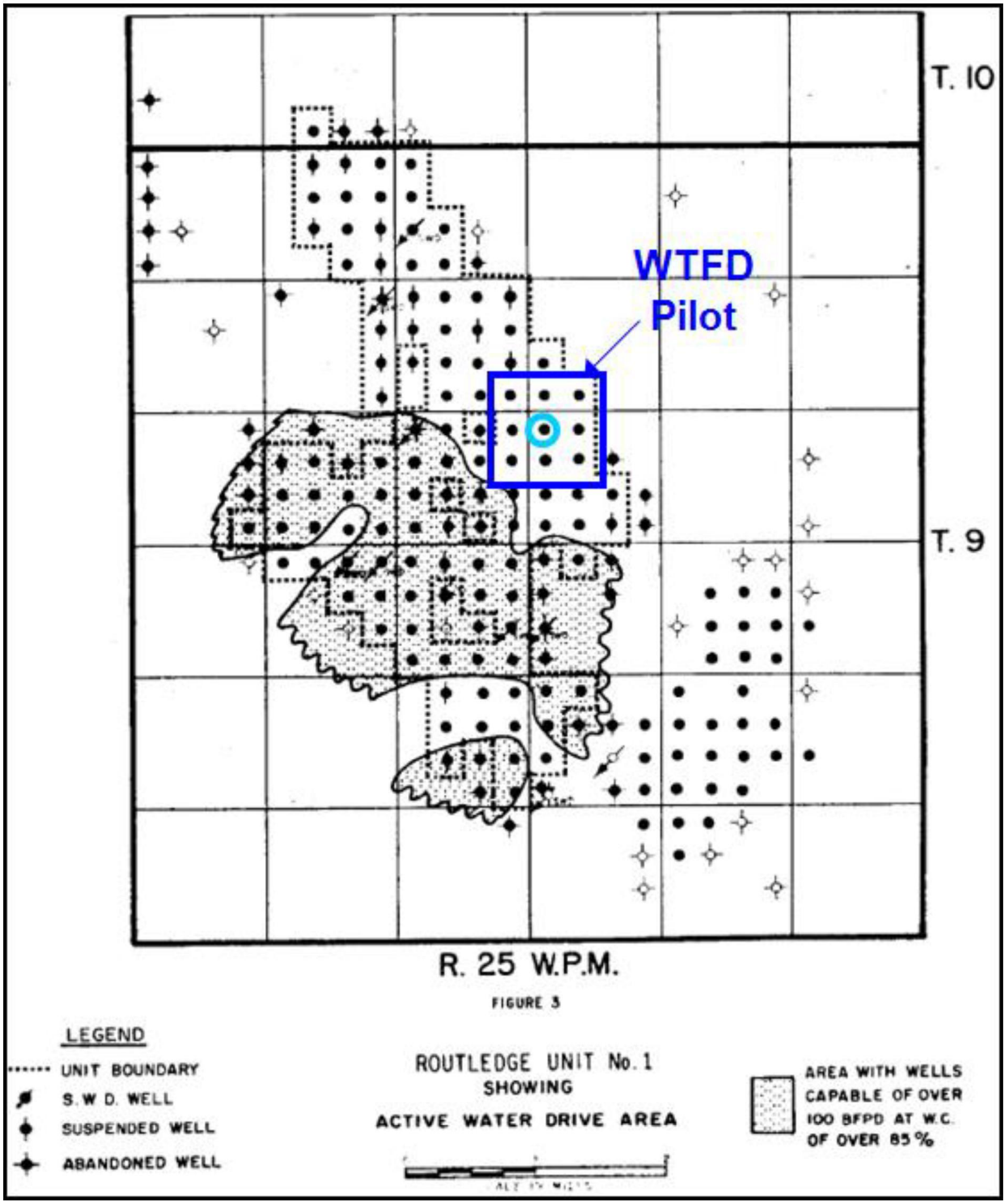
- Casing cathodic protection where required
- Down hole batch corrosion inhibition as required
- Down hole scale inhibitor injection as required

Pipelines

- New high pressure pipeline to proposed well injection locations will be a composite pipe
- Corrosion is not an issue

Chevron Waterflood Injector Pilot Project Area Map

Excerpt from Chevron's application for waterflood pilot in 1973
Pilot initiated in 1974 with 13-22 injector – Discontinued 1994



Appendix A:
Routledge Unit #1 Waterflood Application
Figures 1 – 22

Figure: 1
Cumulative Production

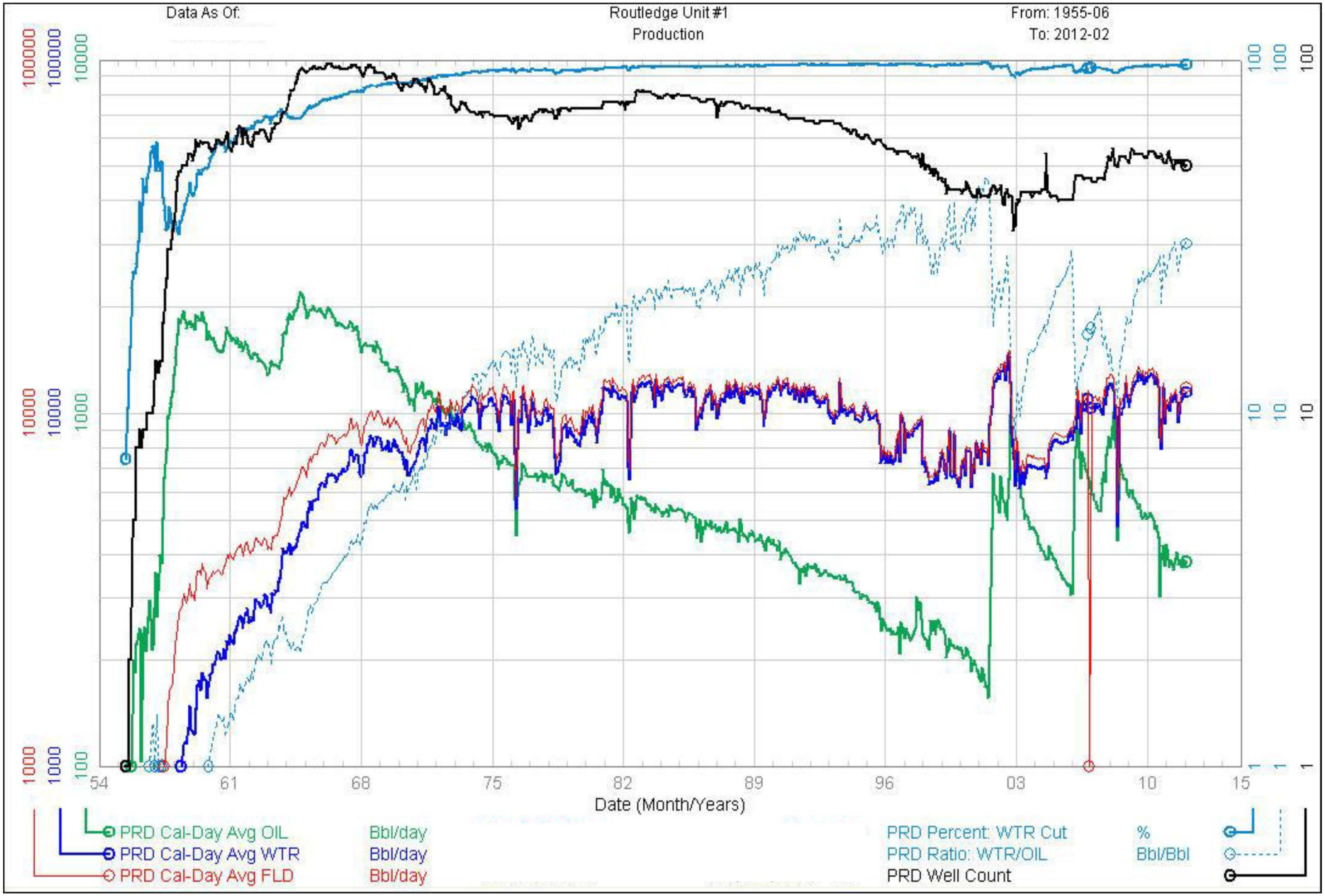


Figure: 2

Oil Ultimate Forecast (Primary & Primary + Waterflood)

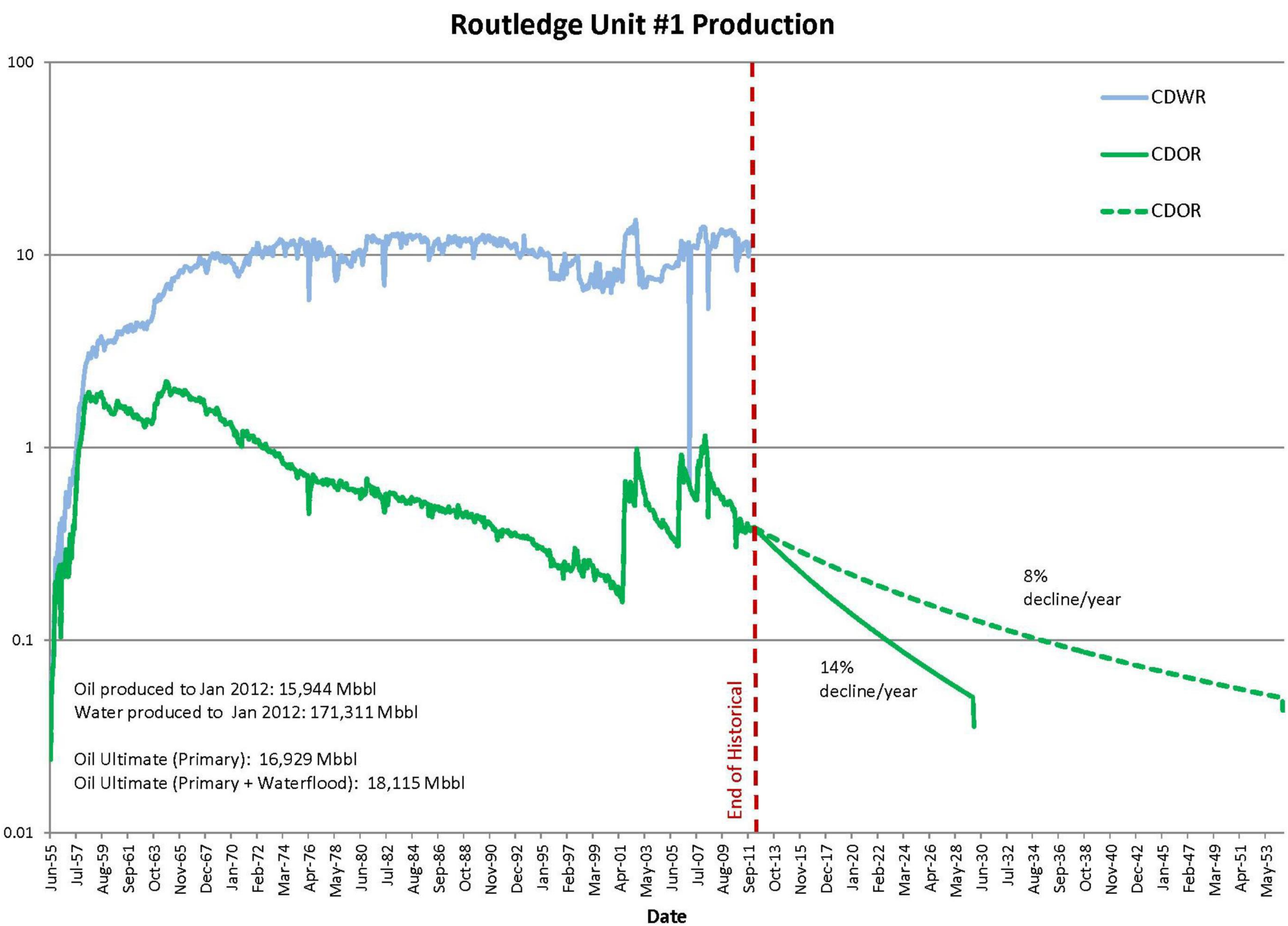


Figure: 3
Routledge Unit #1 Conversion Well Locations

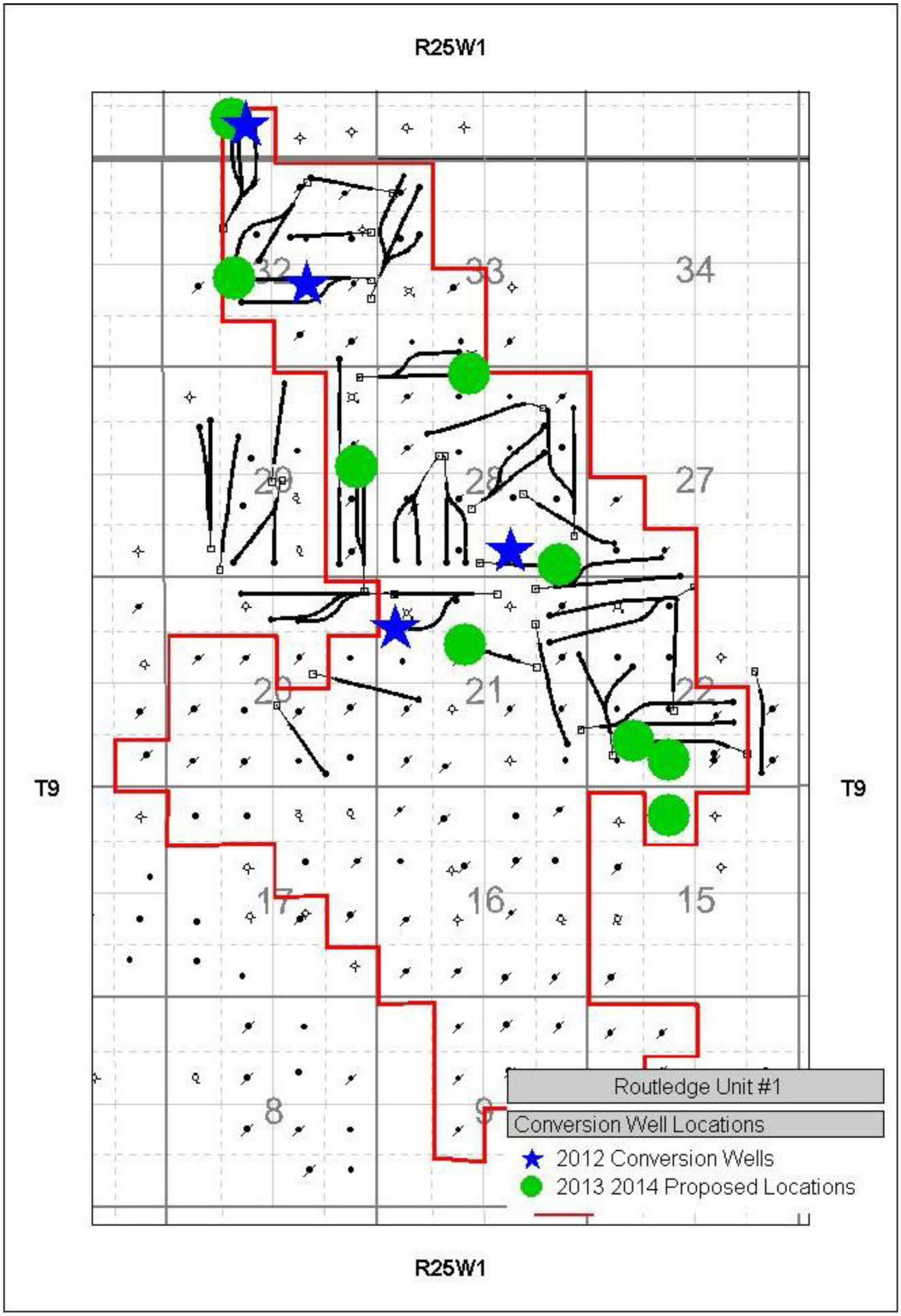


Figure: 4

Routledge Unit #1 Historical Bottom hole Pressure Data (1954 – 2010)

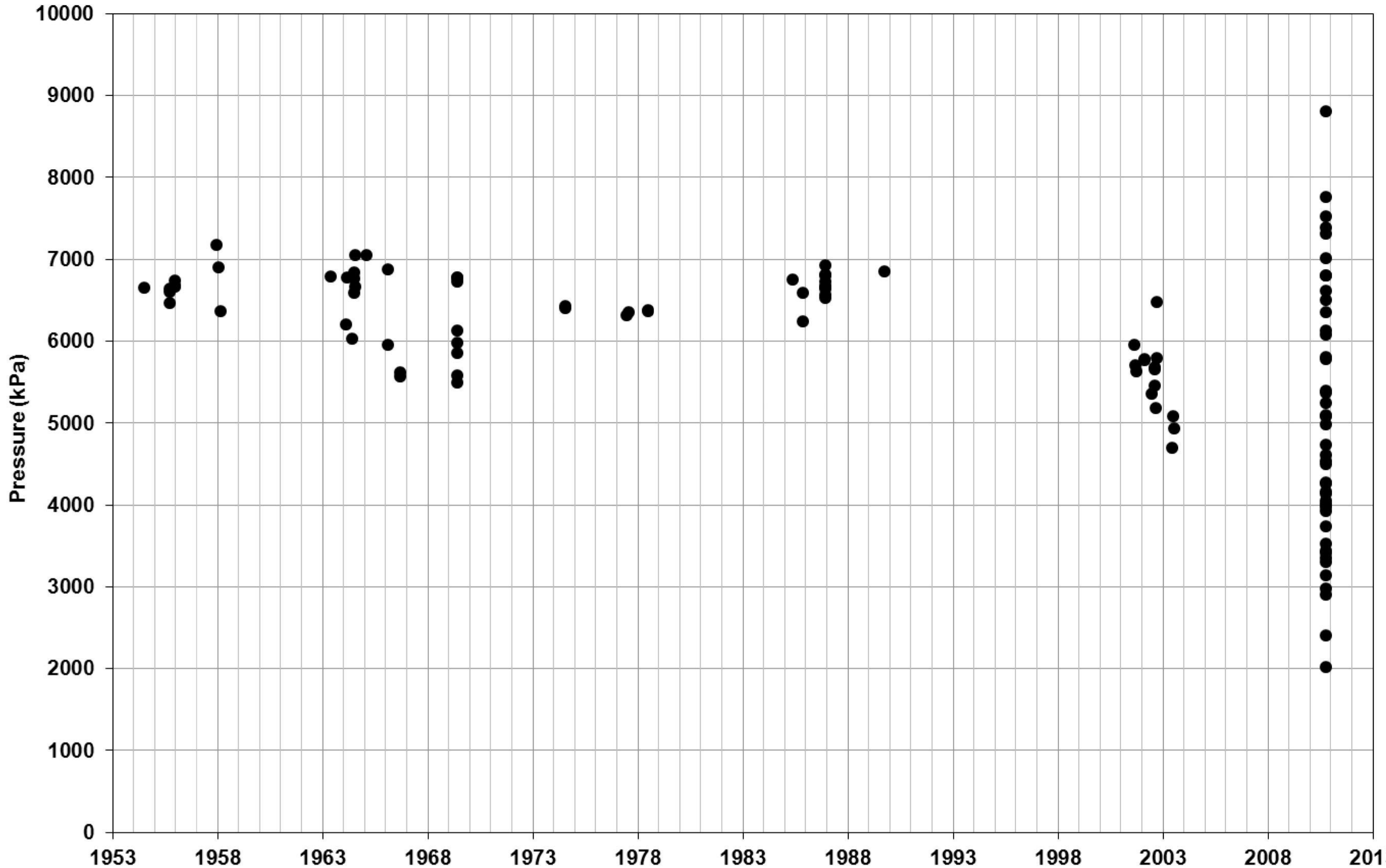


Figure: 5
Routledge Unit #1 2010 Bottom Hole Pressure Data

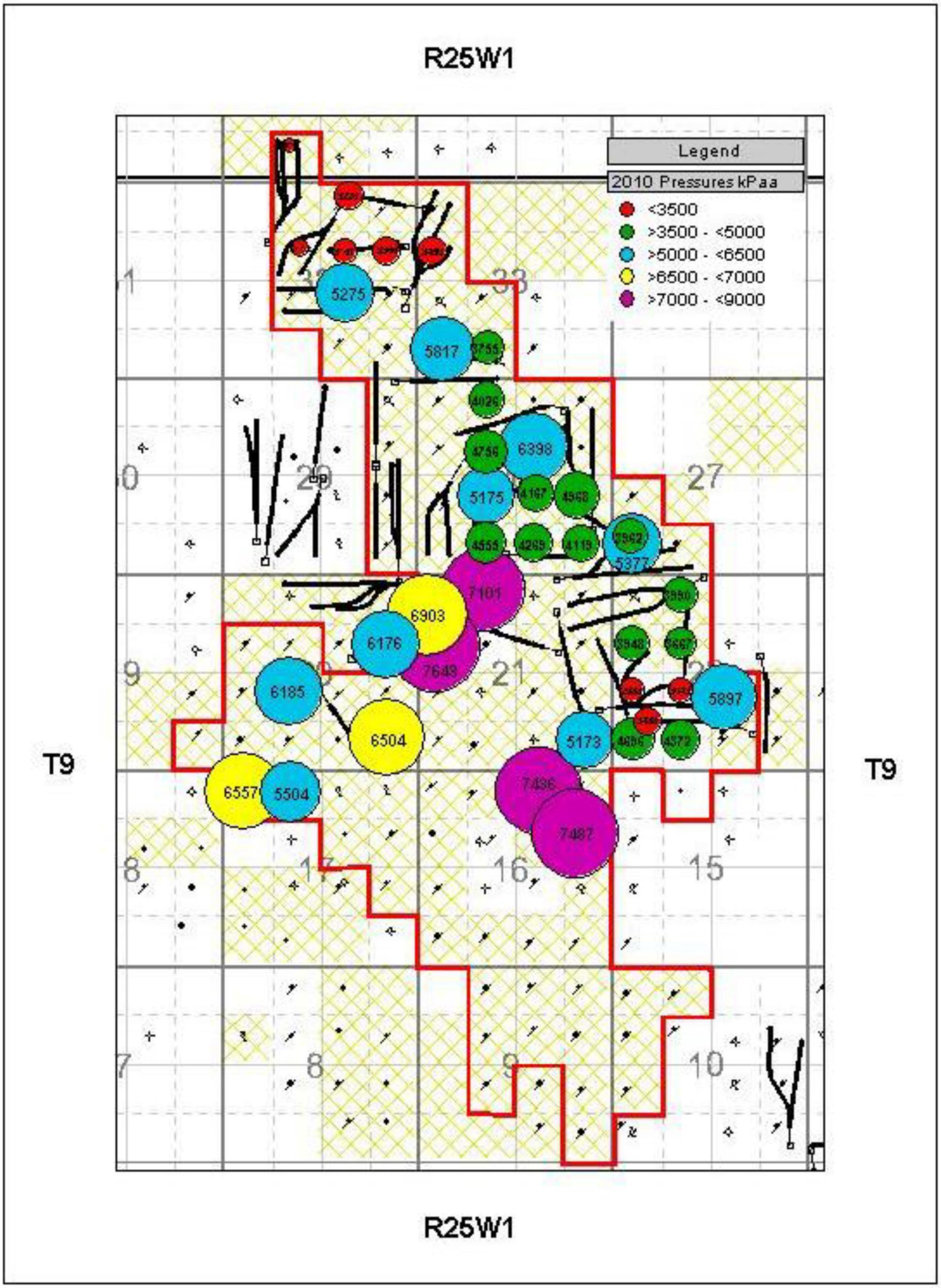


Figure: 6
Routledge Unit #1 2012 Bottom Hole Pressure Data

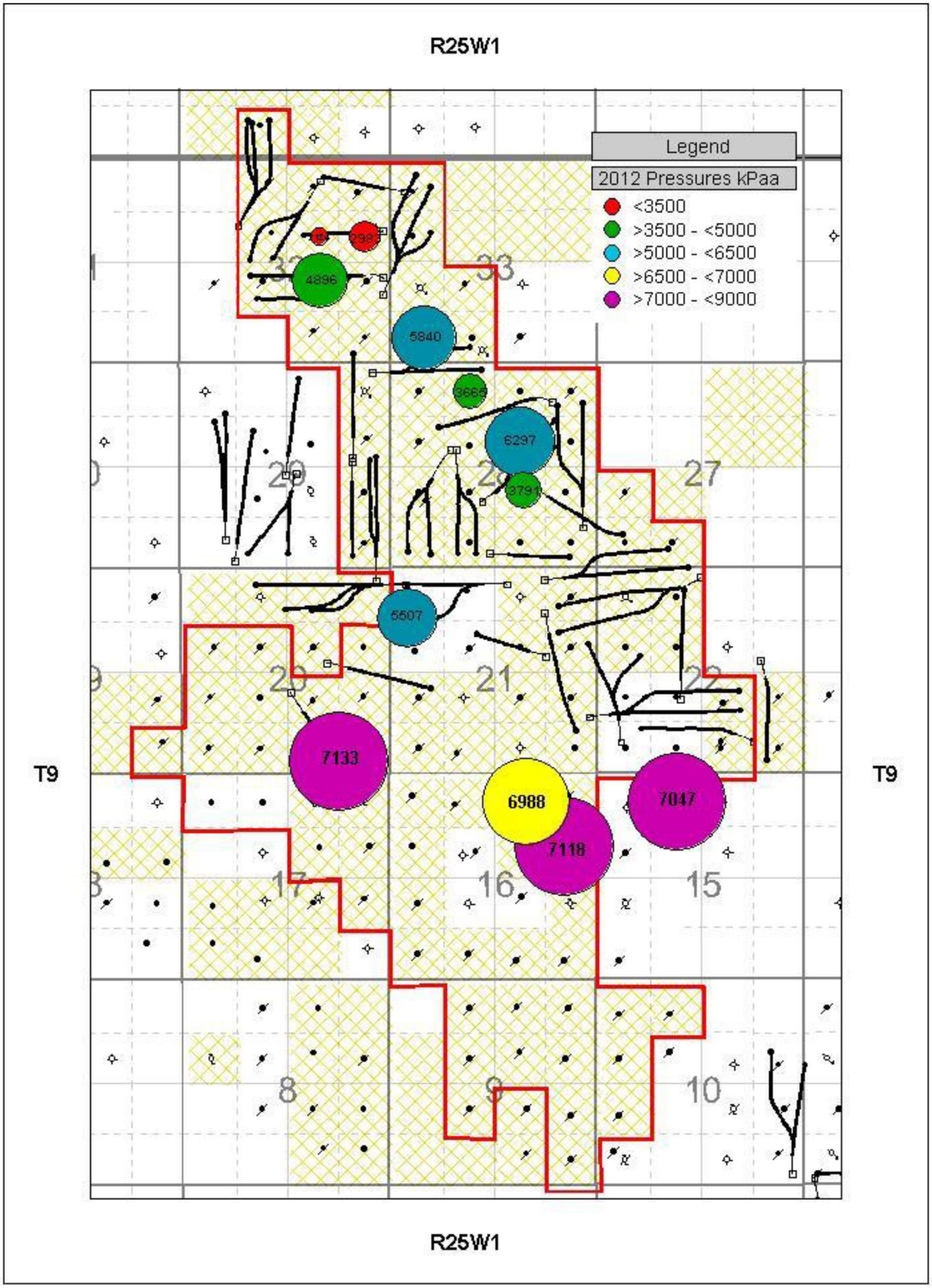


Figure: 7
Typical Vertical Water Injector Down Hole Diagram

enerPLUS

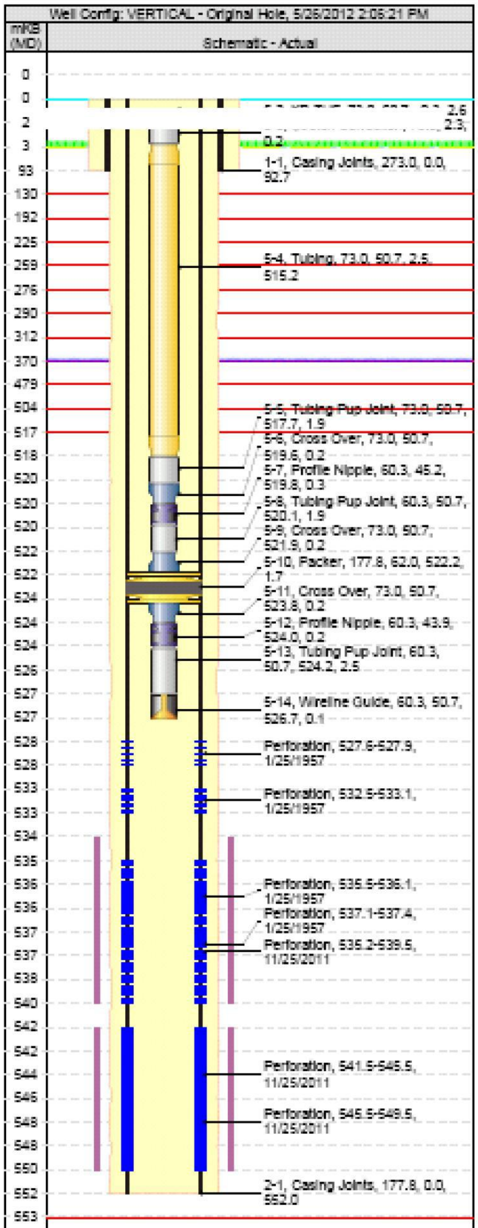
DownHole Diagram

Well Name: VIRDEN ROSELEA UNIT NO. 1 PROV. WIW 6-29-10-25(WPM

Referenced UWI / API	Licensed Surface Location	License / API #	Licensed Field Name	Province/State
100/06-29-010-25W1/00	062901025W1	001384	VIRDEN	MANITOBA
Well Configuration Type	**Original KB Elevation (m)**	**KB-Ground Distance (m)**	**KB-Casing Flange Distance (m)**	**KB-Tubing Head Distance (m)**
VERTICAL	374.00	3.10		2.60

Wellheads

Well Config: VERTICAL - Original Hole, 5/26/2012 2:06:21 PM



Well Header

Directions To Well

From Virden go on 259 east to stop sign, continue east on #259 for 5.4km, turn right, go 2.2km to Enerplus 1-29 battery, go right 1.2km to 5-29, go right 0.3km east into location.

Boreholes

Borehole Name

Original Hole

Casing Strings

Casing Description	String OD (mm)	String Wt (kg/m)	String Grade	String Top Thrd	Set Depth (mKB)
SURFACE	273.0				92.70
PRODUCTION	177.8				552.00

Perforation Statuses

Date	Top (mKB)	Btm (mKB)	Pool/Deposit	Current Status
11/25/2011	545.50	549.50	Original Hole, 100/06-29-010-25W1/00, LODGEPOLE, 100/06-29-010-25W1/00, No	Open - Flowing
11/25/2011	541.50	545.50	Original Hole, 100/06-29-010-25W1/00, LODGEPOLE, 100/06-29-010-25W1/00, No	Open - Flowing
11/25/2011	535.20	539.50	Original Hole, 100/06-29-010-25W1/00, LODGEPOLE, 100/06-29-010-25W1/00, No	Open - Flowing
1/25/1957	527.60	527.90	Original Hole, 100/06-29-010-25W1/00, LODGEPOLE, 100/06-29-010-25W1/00, No	OPEN
1/25/1957	537.10	537.40	Original Hole, 100/06-29-010-25W1/00, LODGEPOLE, 100/06-29-010-25W1/00, No	OPEN
1/25/1957	532.50	533.10	Original Hole, 100/06-29-010-25W1/00, LODGEPOLE, 100/06-29-010-25W1/00, No	OPEN
1/25/1957	535.50	536.10	Original Hole, 100/06-29-010-25W1/00, LODGEPOLE, 100/06-29-010-25W1/00, No	OPEN

Stimulations & Treatments

Type	Max Btm Depth (mKB)	Min Top Depth (mKB)	Pool
Acid Squeeze	549.50	533.50	Original Hole, 100/06-29-010-25W1/00, LODGEPOLE, 100/06-29-010-25W1/00, No

Tubing Item # Displayed on Right Side

Tubing - Production set at 526.83mKB on 11/27/2011 13:00

Tubing Description			Run Date	
Tubing - Production			11/27/2011	
String OD (mm)	**String Wt (kg/m)**	**String Grade**	**String Length (m)**	**Set Depth (mKB)**
73.0	9.673	J-55	526.83	526.83

Set Tension (daN)

Item No.	Jts	Item Description	Comment	Len (m)	Top (mKB)
5-1	1	Tubing stick up from THF.		-0.30	0.00
5-2	1	KB-THF		2.60	-0.30
5-3	1	Stretch Correction		0.18	2.30

Figure: 8
Typical Horizontal Water Injector Down Hole Diagram

DownHole Diagram

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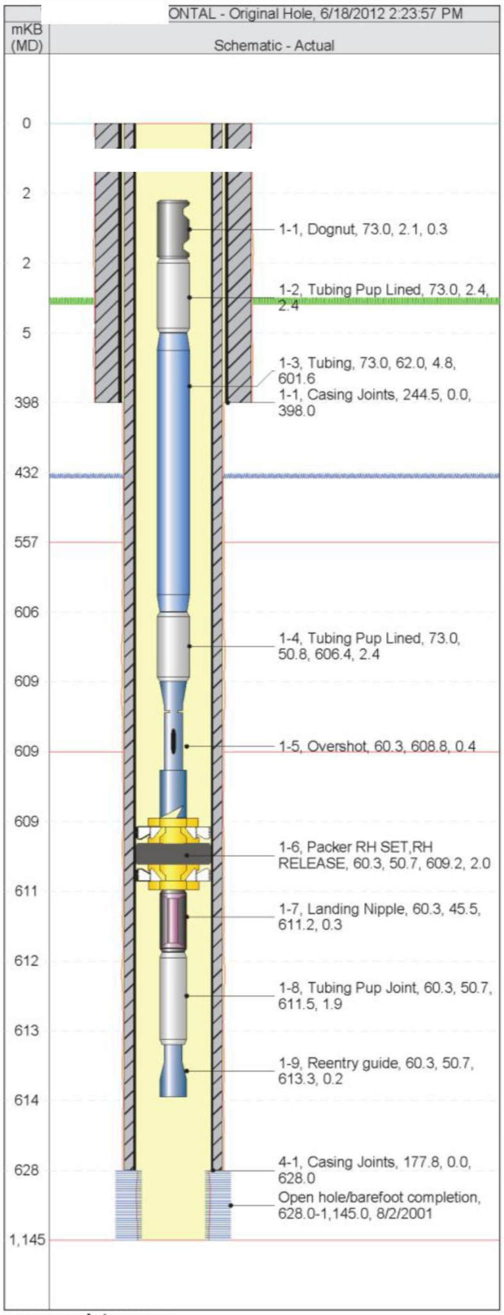
Well Name: VIRDEN ROSELEA UNIT NO. 1 HZNTL WIW A1-25-10-26(WP

Referenced UWI / API	Licensed Surface Location	License / API #	Licensed Field Name	Province/State
103/01-25-010-26W1/00	162401026W1	004991	VIRDEN	MANITOBA
Well Configuration Type	**Original KB Elevation (m)**	**KB-Ground Distance (m)**	**KB-Casing Flange Distance (m)**	**KB-Tubing Head Distance (m)**
HORIZONTAL	441.30	3.80		

Wellheads

Type



Well Header

Directions To Well

Boreholes

Borehole Name
Original Hole

Casing Strings

Casing Description	String OD (mm)	String Wt (kg/m)	String Grade	String Top Thrd	Set Depth (mKB)
SURFACE	244.5	48.068	H-40		398.00
INTERMEDIATE	177.8	29.763	J-55		628.00

Perforation Statuses

Date	Top (mKB)	Btm (mKB)	Pool/Deposit	Current Status
8/2/2001	628.00	1,145.00	Original Hole, 103/01-25-010-26W1/00, MISSISSIPPIAN, 103/01-25-010-26W1/00, No	OPEN
8/5/2001	628.00	1,210.00	Borehole, 102/04-30-010-25W1/02, MISSISSIPPIAN, 102/04-30-010-25W1/02, No	OPEN

Stimulations & Treatments

Type	Max Btm Depth (mKB)	Min Top Depth (mKB)	Pool

Tubing Item # Displayed on Right Side

Tubing - Production set at 613.49mKB on 11/26/2010 11:00

Tubing Description			Run Date		
Tubing - Production			11/26/2010		
String OD (mm)	**String Wt (kg/m)**	**String Grade**	**String Length (m)**	**Set Depth (mKB)**	**Set Tension (daN)**
73.0	9.673	J-55	611.36	613.49	

Item No.	Jts	Item Description	Comment	Len (m)	Top (mKB)
1-1	1	Dognut		0.25	2.13
1-2	1	Tubing Pup Lined		2.41	2.38
1-3	63	Tubing		601.58	4.79
1-4	1	Tubing Pup Lined		2.41	606.37
1-5	1	Overshot		0.41	608.78
1-6	1	Packer RH SET,RH RELEASE		1.97	609.19
1-7	1	Landing Nipple		0.30	611.16
1-8	1	Tubing Pup Joint		1.88	611.46
1-9	1	Reentry guide		0.15	613.34

Rods Item # Displayed on Left Side

Rod Description			Run Date	
String Length (m)	**Set Depth (mKB)**	**String Grade**	**String OD (mm)**	**String Wt (kg/m)**

Item No.	Jts	Item Description	OD (mm)	Len (m)	Top (mKB)	Grade

Other In Hole

Run Date	Pull Date	Description	OD (mm)	Comment	Top (mKB)
4/20/2007	11/24/2010	Packer	114.0		412.90
11/26/2010		Packer	114.0	Packer is RH set, RH release.On /off Left hand	609.19

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Figure: 9
Pipeline Schematic
(Maximum Supply Pressures at Wellhead, kPa given)

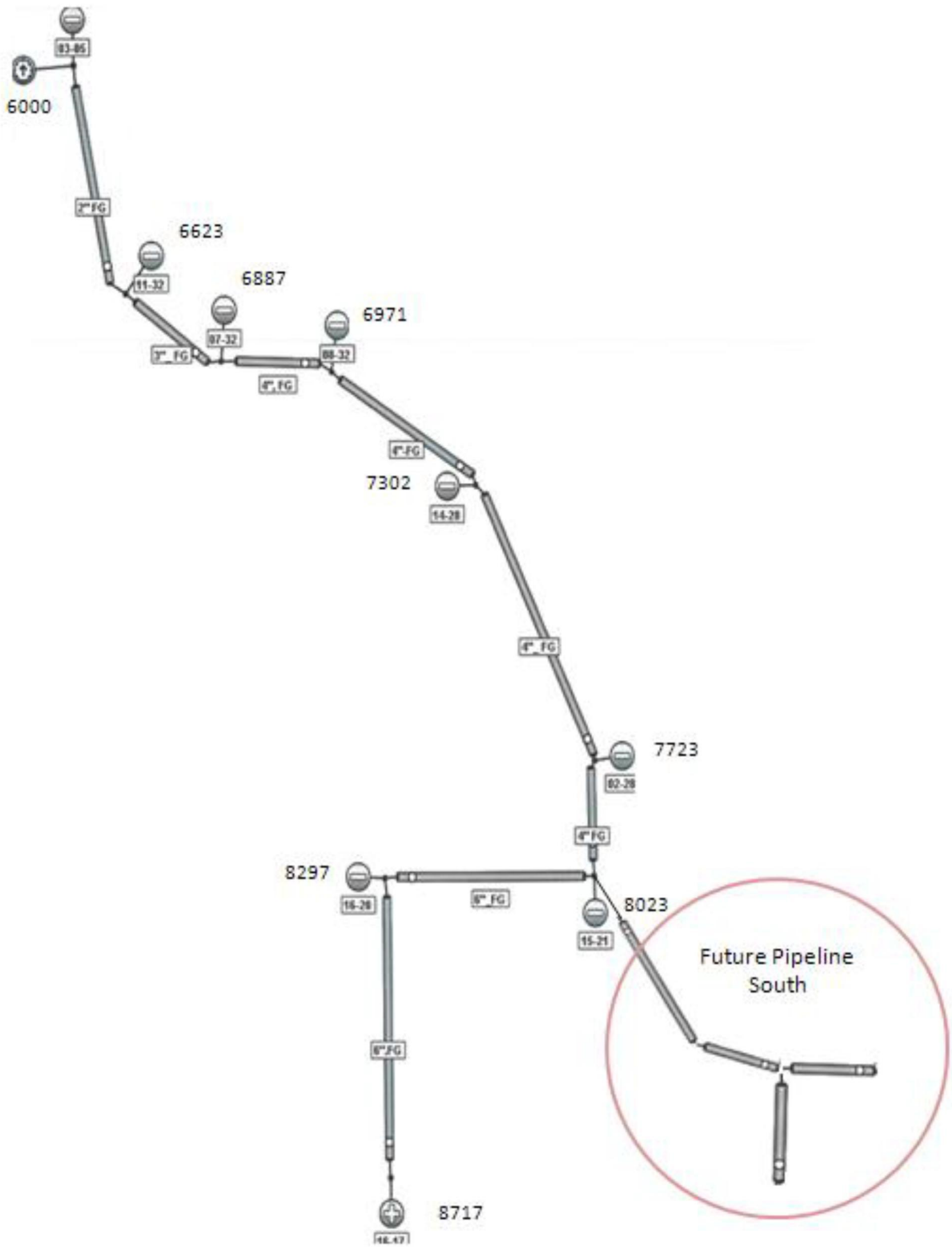


Figure: 10
Water Injection System

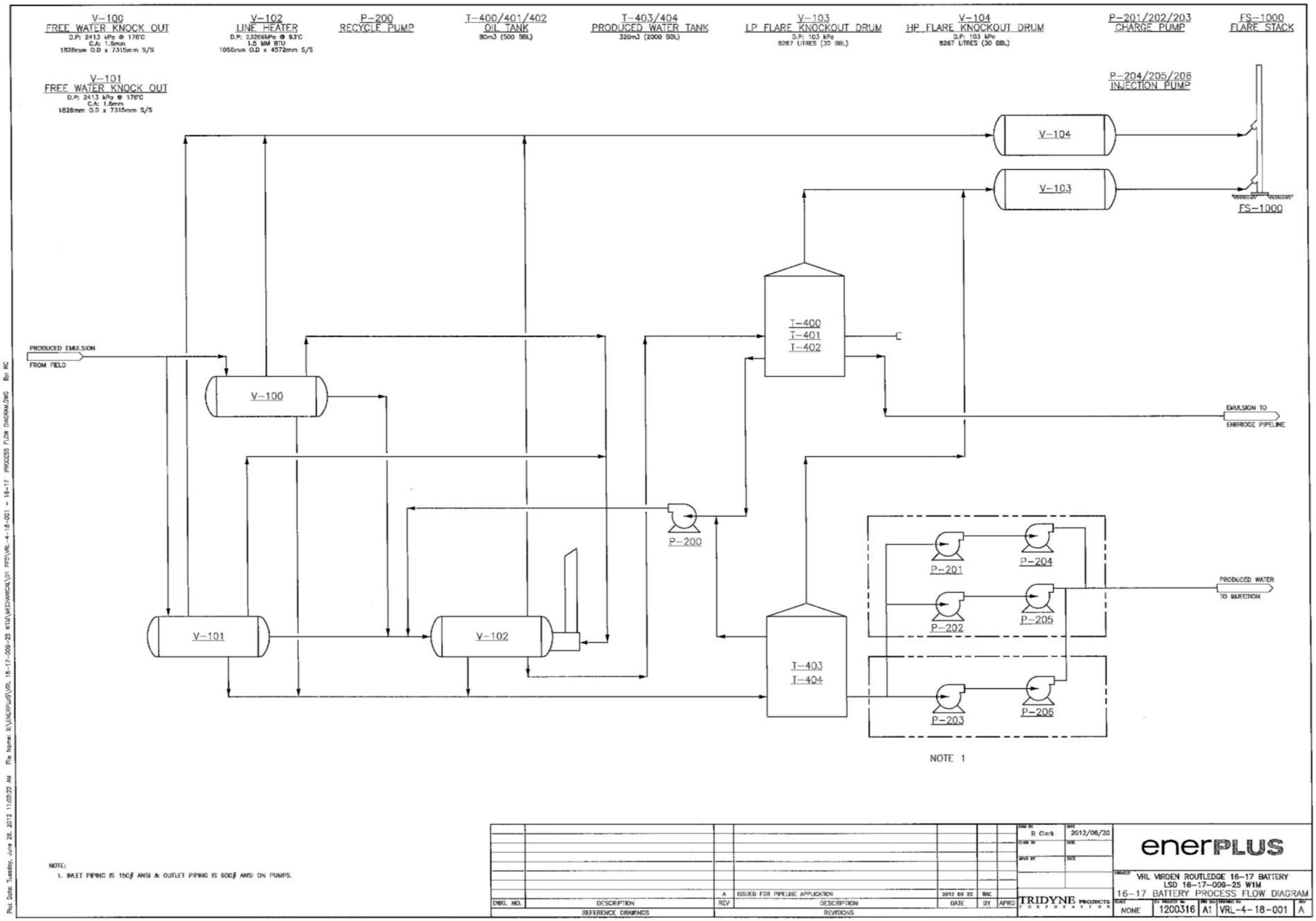
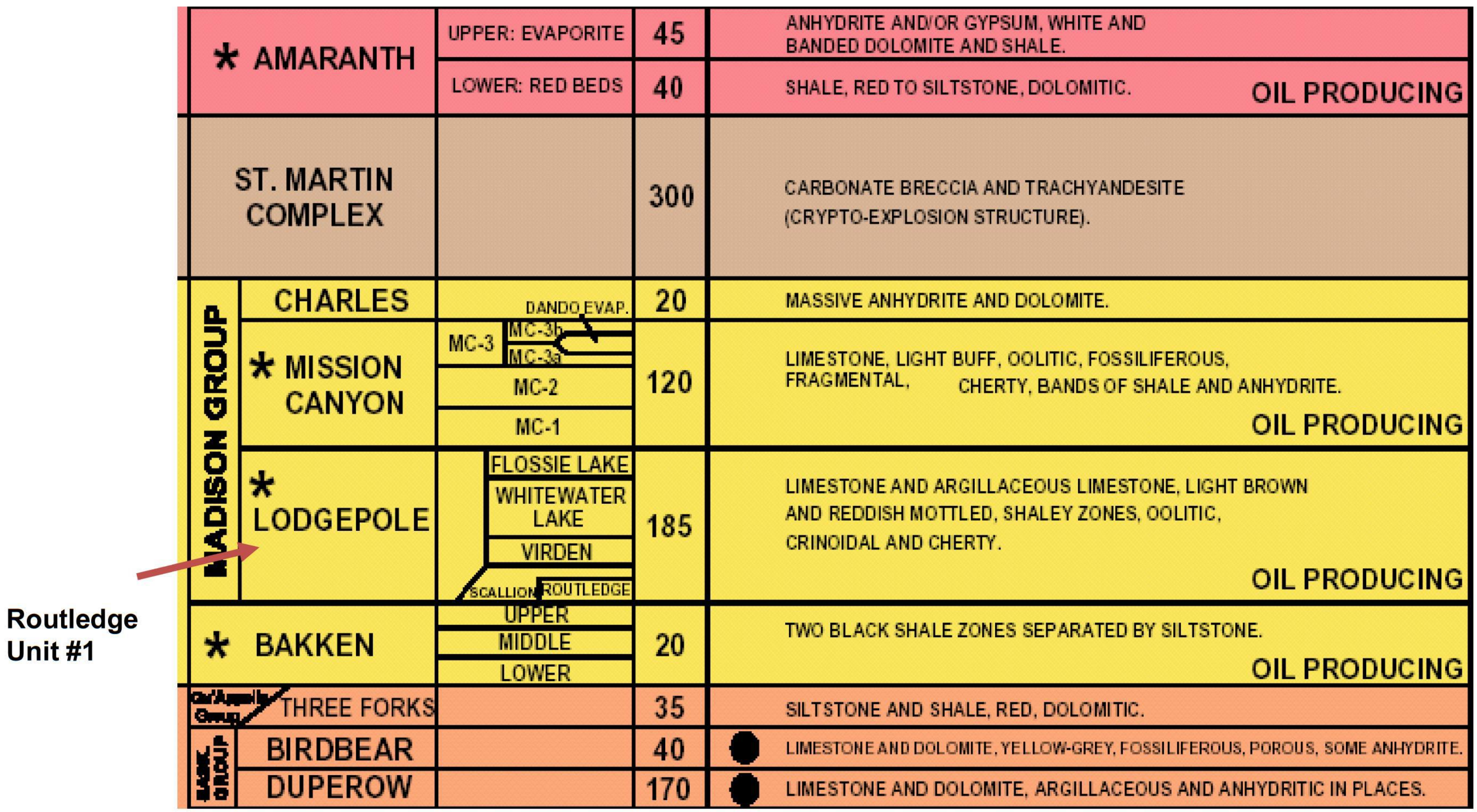


Figure: 12
Stratigraphy – Mississippian Lodgepole Formation



- Mission Canyon has been eroded
- Lodgepole is predominantly limestone with lesser amount of dolomite

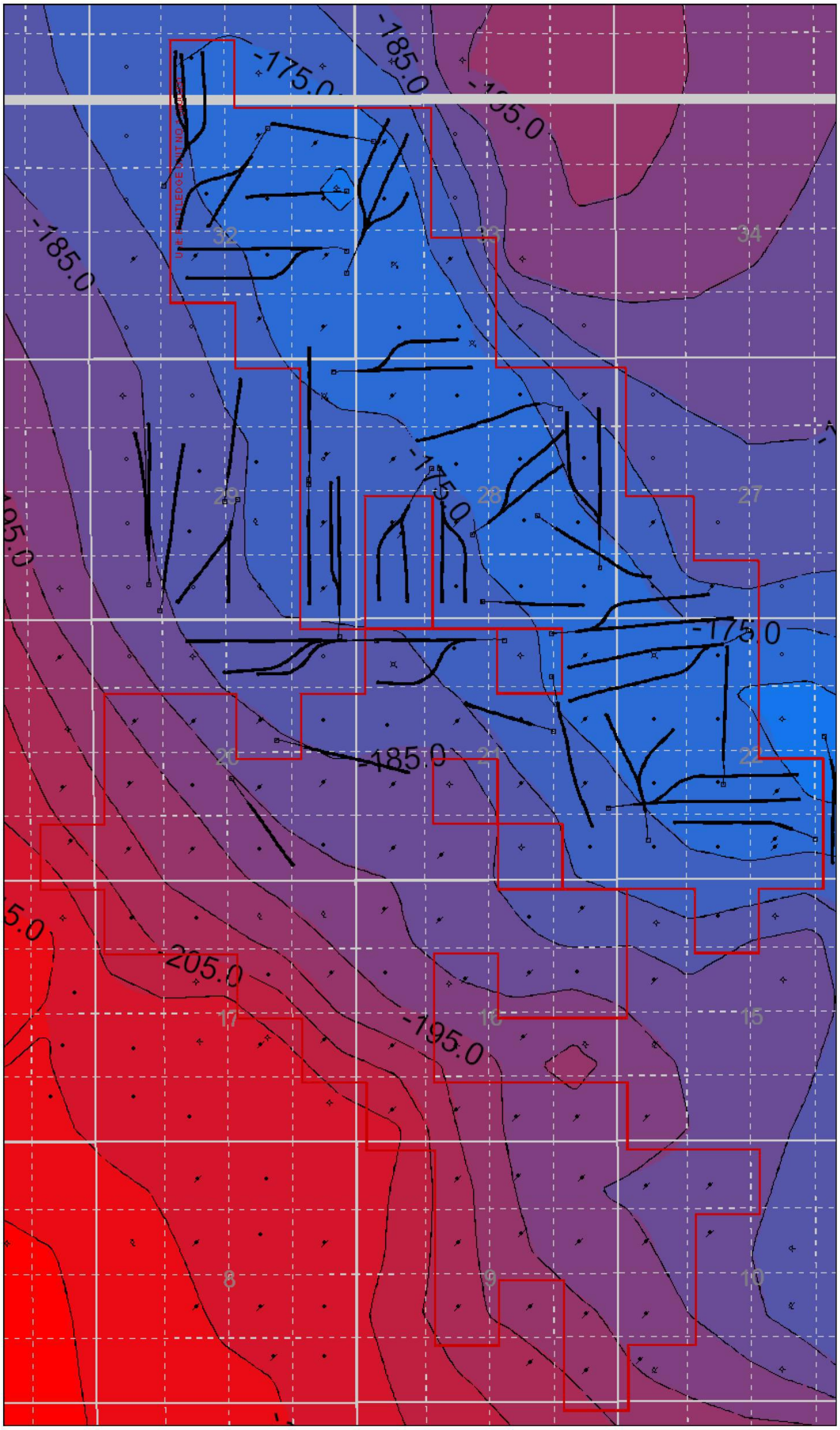
Figure: 13
Rock and Fluid Properties

Routledge Unit #1	Thickness (m)	Porosity (%)	Permeability (mD)
Flossi Lake (FL)	0.7	9.6	10.7
Upper White Water (UWW)	1.4	8.4	12.3
Upper Virden (UV)	2.2	11.0	33.1
Sandhill (SD)	1.3	12.0	10.4
1st Oolite (1^{st})	0.6	13.8	18.1
2nd Oolite (2^{nd})	0.9	11.7	15.2
3rd Oolite (3^{rd})	0.9	11.4	18.0
4th Oolite (4^{th})	1.0	9.0	6.9
Scallion (SC)*	1.0 -11.7	11.0 – 15.6	1.5 – 69.3

* Range is given as SC Mbr was not fully drilled/cored.

Note: Values given are weighted averages derived from core analysis

Figure: 14
Upper Virden Structure Map



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Routledge Unit #1
Upper Virden Structure Map
C.I. = 5 m

Figure: 15
Lower Virden Structure Map

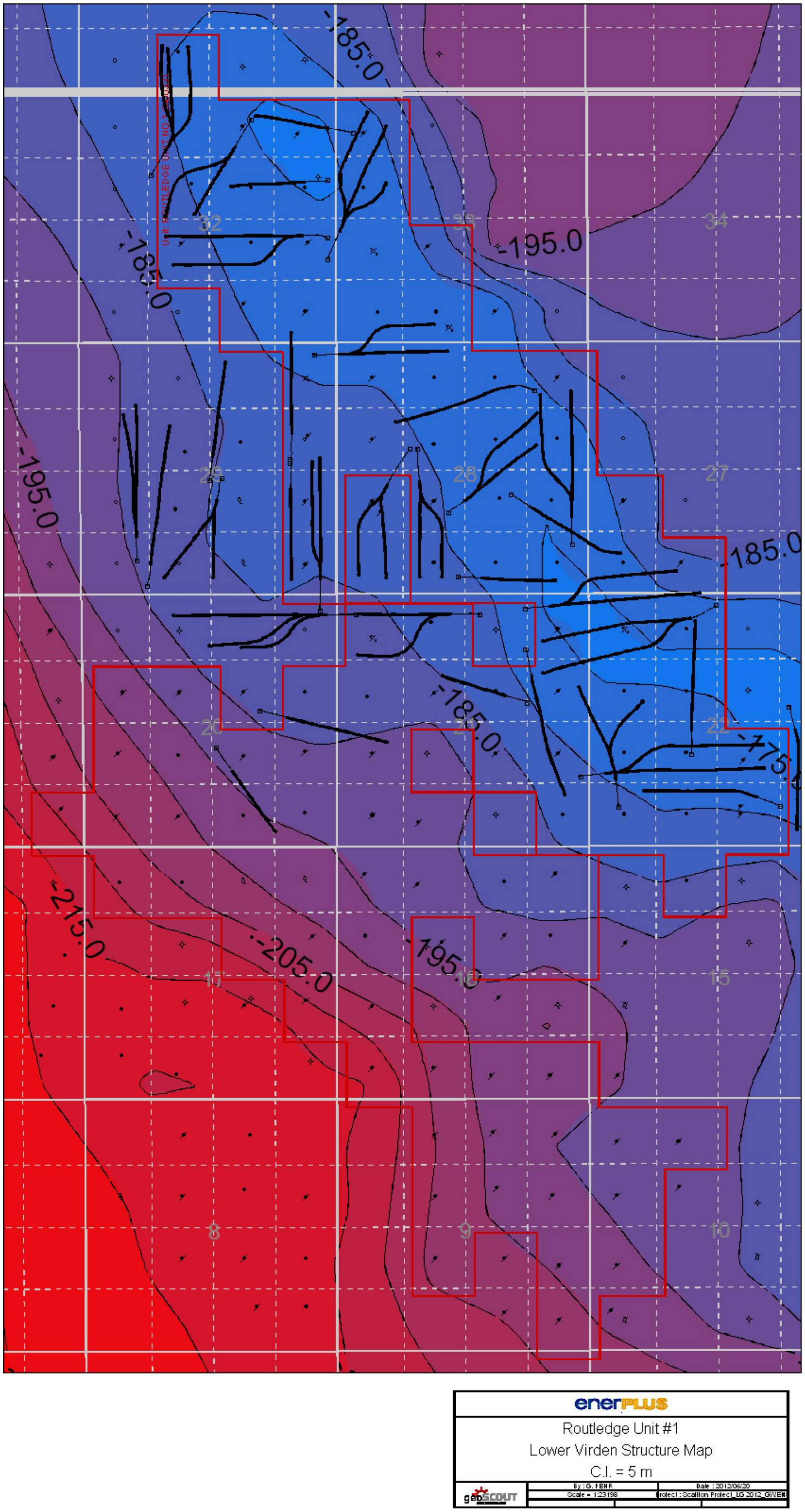
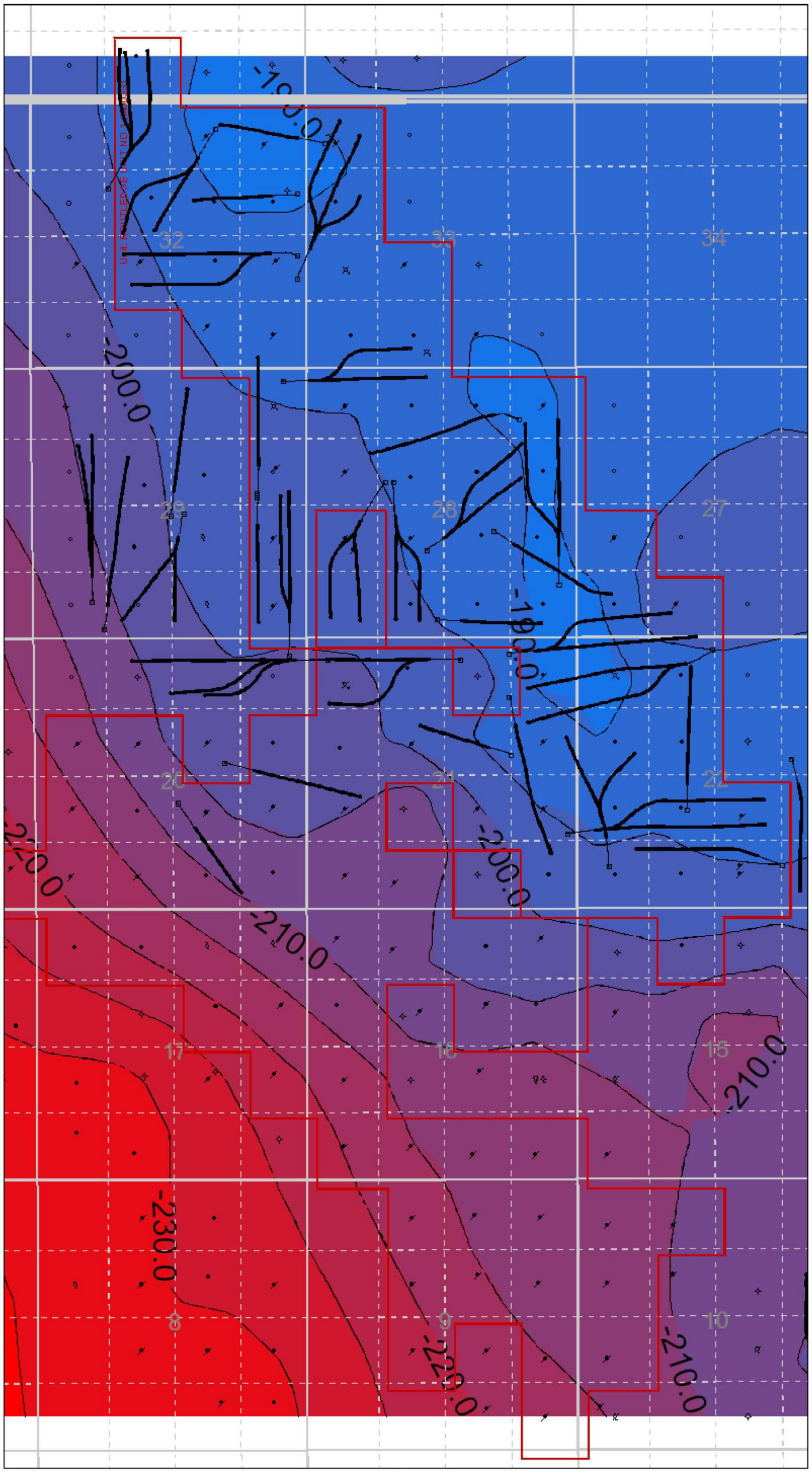


Figure: 16
Scallion Structure Map



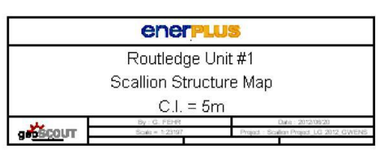
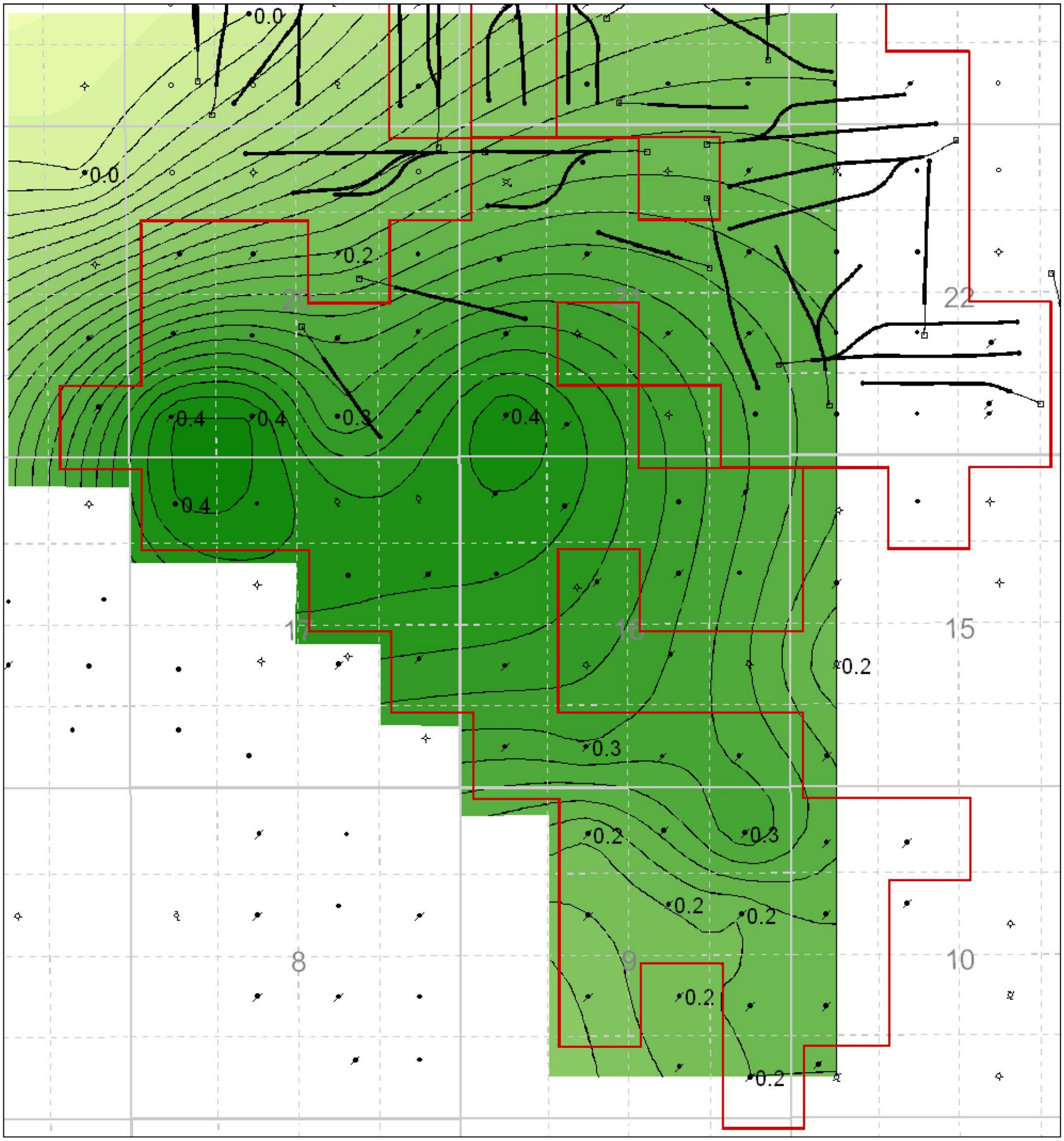


Figure: 17
Upper Virden Phi • H



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Routledge Unit #1
Upper Virden Phi * H
C.I. 0.02 m

Figure: 18
Upper Virden Perm. * H

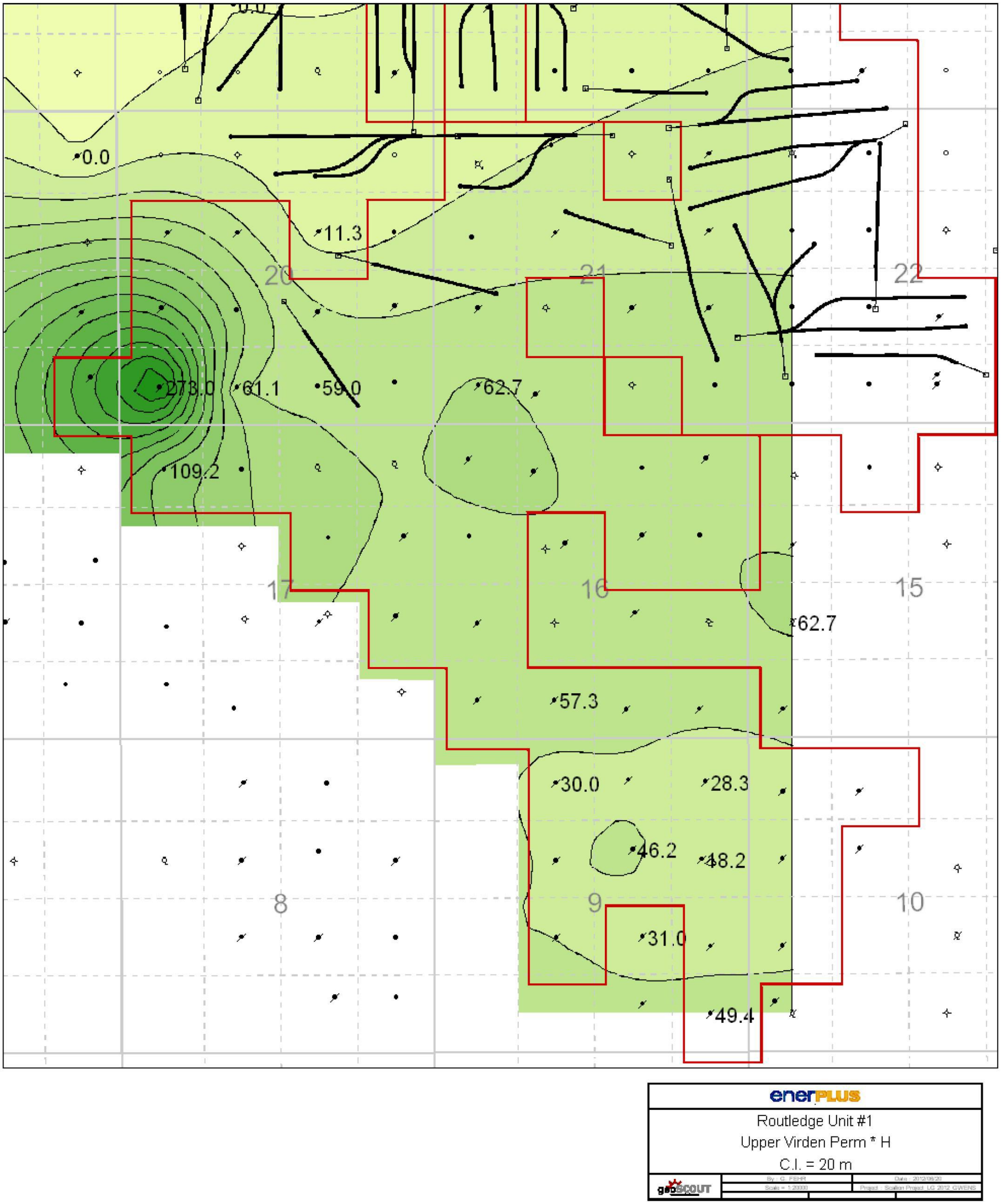

Figure: 19
Lower Virden Phi • H

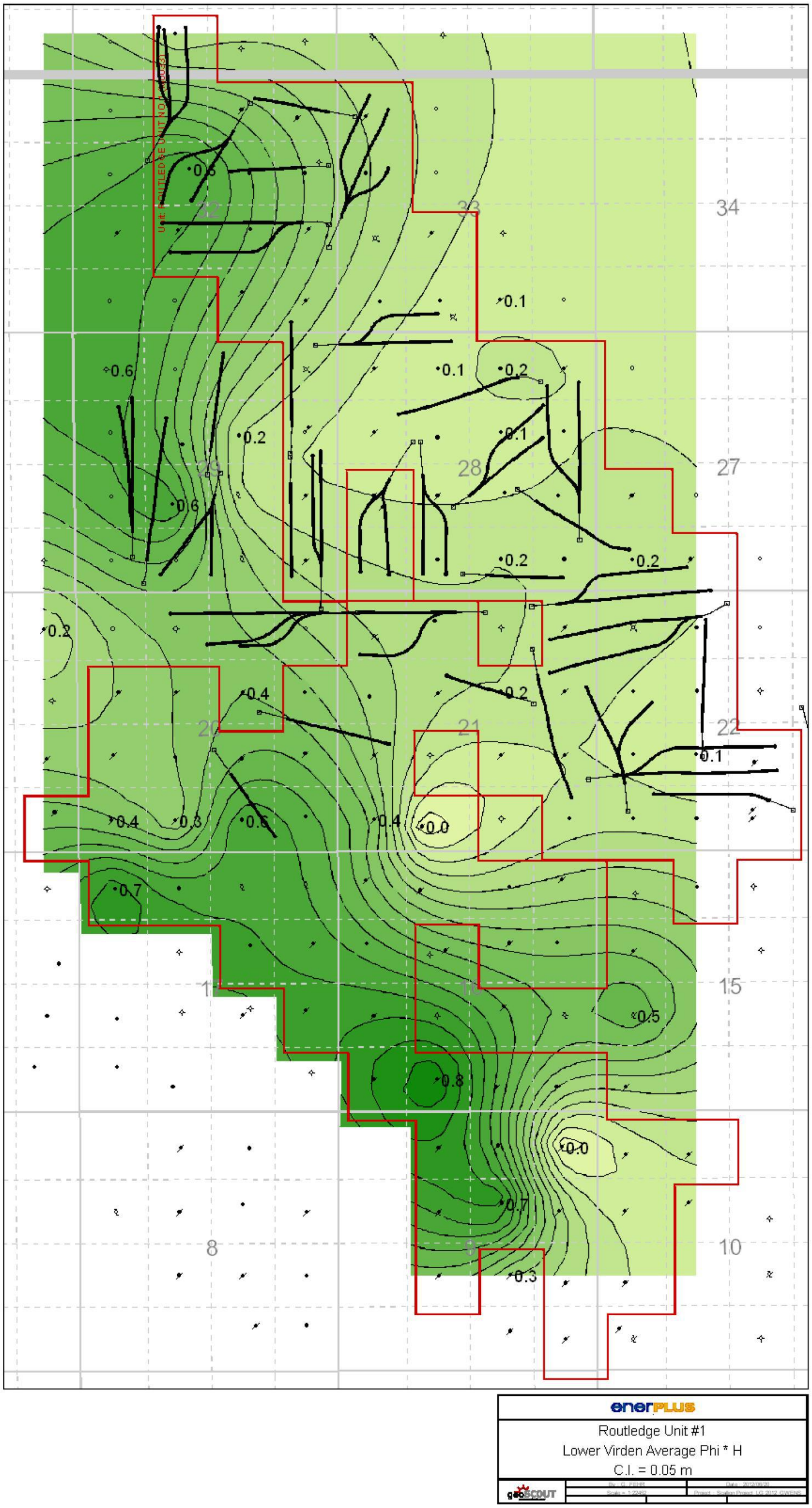

Figure: 20
Lower Virden Perm. • H

Figure: 21
Scallion Phi • H

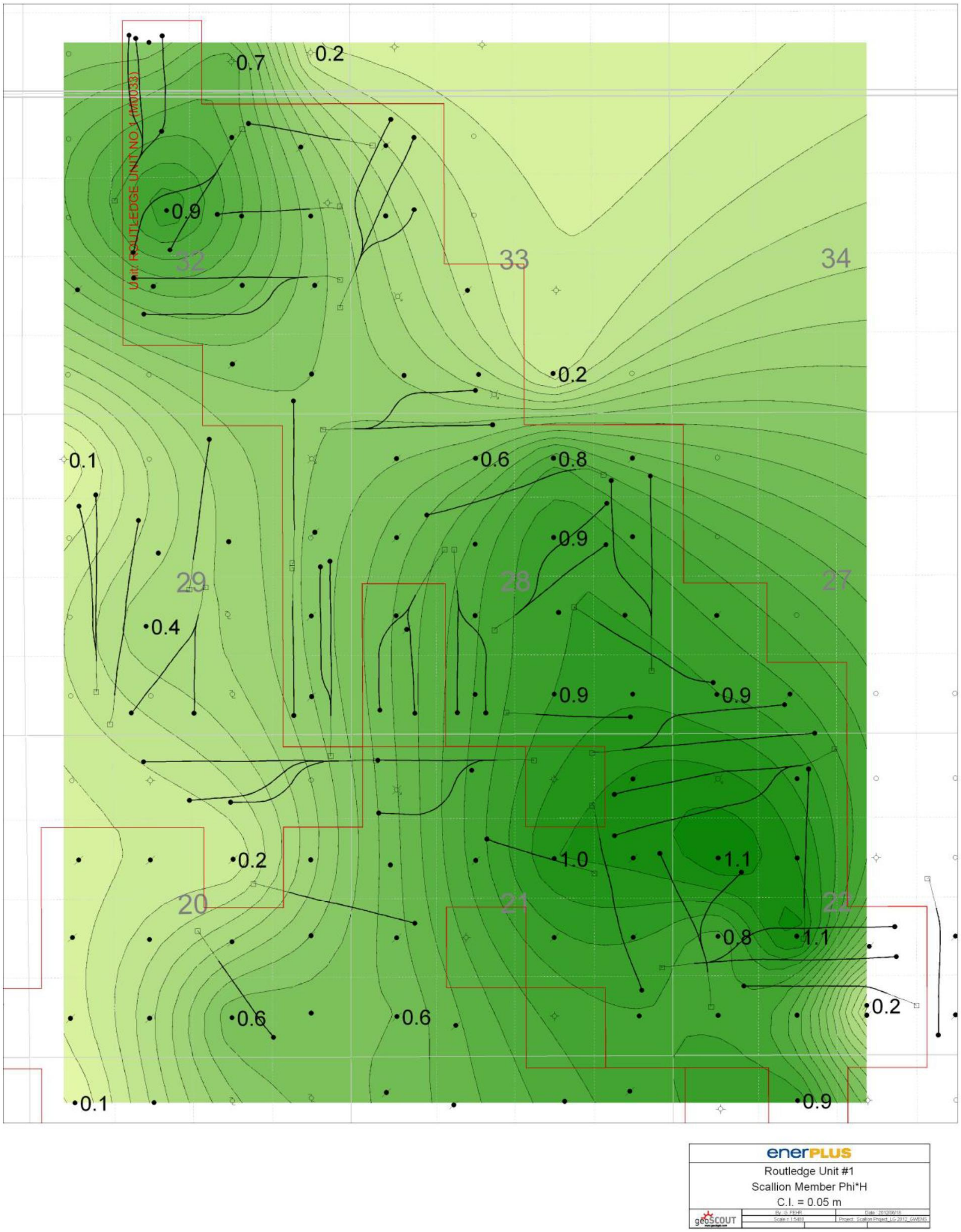

Figure: 22
Scallion Perm. • H