CORE LABORATORIES
AUSTRALIA PTY LTD

ROUTINE CORE ANALYSIS REPORT

HARVEY-3

WEST AUSTRALIA

Prepared for
Department of Mines and Petroleum

November 2015

Contract DMP 680714
Core Laboratories file: PRP-15 068

Rock Properties
Core Laboratories
Perth
Australia

CORE LABORATORIES
AUSTRALIA PTY LTD

5th November 2015

Department of Mines and Petroleum
100 Plain Street
East Perth
WA 6004

Attention : Louise Stelfox

Subject : Routine Core Analysis
Well : Harvey-3
Contract : DMP 680714
File : PRP-15 068

Dear Louise,

Presented herein is the final report of a routine core analysis study conducted on cores from the above well that arrived at our laboratory in July 2015.

We appreciate the opportunity to present this service to Department of Mines and Petroleum. Please contact us should you require any further information or assistance.

Yours sincerely,
Core Laboratories Australia Pty Ltd

James Brown
Senior Core Analyst

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INTRODUCTION

Harvey-3 was cored continuously from 584.0 to 1550.0m (966.0 metres). The core analysis work conducted on the cores was based on DMP Document "SWH Project, Harvey 2, 3, 4 Core Analysis Program, Routine Core Analysis, Special Core Analysis, Planning Document, Version 9" which is included as an Appendix in this report.

All core material from the Wonnerup Member and selected sections of core from the Yalgorup Member were delivered from the GSWA Core Library to Core Laboratories in July 2015. Sections of core preserved at the well-site had been previously delivered to Core Laboratories from March to May 2015 (during and shortly after the coring phase of the well programme).

Services performed on selected plug samples and presented in the report include:

- Porosity, permeability and grain density at NOBP ("reservoir" samples)
- Specific permeability to brine at NOBP ("reservoir" samples)
- Fresh state permeability to brine at NOBP ("seal/aquitard" samples)
- Threshold injection pressure to CO_2 at NOBP ("seal/aquitard samples")

The rationale for these tests and the samples selected was as follows:

(A) In the Wonnerup Member and the sandy sections of the Yalgorup Member ("reservoir" samples) to evaluate the storage capacity, injectivity and transmissitivity of these formations with respect to CO_2 injection. Two further points to note are:

   a. Porosity and permeability to air data were determined at net overburden pressure (NOBP) on all samples. These data were also generated at 800psi on approximately 20% of the samples so that (i) porosity/permeability data can be generated at any other selected overburden pressure using Stan Jones' 2-point fit equations* (ii) data can be correlated to porosity/permeability data derived from other wells (including Harvey#1, Harvey#2, Harvey#4).
   b. Specific permeabilities to brine were measured so that the more optimistic permeability to air data can be correlated to provide more realistic aquifer-related permeabilities.

(B) In the Eneabba Basal Shale and claystone rich facies of the Yalgorup Member ("seal/aquitard" samples) to evaluate the seal capacity of these formations (that is, their ability to retain CO_2 injected into the "reservoir" formations).

Please note this quote provided by the DMP:
The GSWA is currently reviewing the stratigraphy of the southern Perth Basin, including the usage of units originally defined in the northern Perth Basin. The formation names and tops quoted in the DMP's Harvey studies are therefore preliminary and may be subject to change following this review.

*SPE 15380, 1986.

SUMMARY

Porosity and permeability measurements in the Yalgorup Member (sand-rich facies) were determined at 1250psi on 50 samples of which 13 were also measured at 800psi. Porosity and permeability measurements in the Wonnerup Member were determined at 1700psi on 133 samples of which 27 were also measured at 800psi. Grain Density was measured on all samples. 34 samples underwent permeability to brine and threshold pressure to CO2.

	Minimum	Maximum	Average
Yalgorup Member (sand-rich facies)			
Net Confining Pressure of 800psi.			
Porosity (%)	10.1	30.4	21.0
Permeability, Horizontal, Kinf (md)	0.004	6730	1246
Grain Density (g/cc)	2.592	2842	2.662
Net Confining Pressure of 1250psi.			
Porosity (%)	5.8	30.4	21.1
Permeability, Horizontal, Kinf (md)	0.002	26900	1272
Permeability to brine (md)	0.0001	4180	902
Basal Eneabba unit & Clay-rich Facies Yalgorup Member			
Permeability to brine (md)	<0.00001	0.00003	
Threshold Pressure to CO_2 (psi)	850	4500	
Wonnerup Member (sand-rich facies)			
Net Confining Pressure of 800psi.			
Porosity (%)	17.1	24.1	20.5
Permeability, Horizontal, Kinf (md)	2.39	6810	1015
Grain Density (g/cc)	2.624	2.897	2.643
Net Confining Pressure of 1750psi.			
Porosity (%)	12.9	24.9	19.5
Permeability, Horizontal, Kinf (md)	0.003	10800	6345
Permeability to brine (md)	0.929	5247	629

LABORATORY PROCEDURES

Core Preparation:

The core material from the Harvey-3 well was laid out and sampling points were marked on the Wonnerup Member at a spacing of one sample per metre. Sampling points in the Yalgorup Member were selected in some of the sandy sections. A proposed listing of samples was forwarded to the Department of Mines and Petroleum on the 23rd July 2015. The final selection of sampling points was determined on the 30th July 2015 while viewing the core.

Sample Preparation:

Horizontal routine core analysis plugs for porosity, permeability and grain density were cut and trimmed from the core to form 1.5" diameter cylinders (in SQ (120mm) core) and 1.0" diameter cylinders (in HQ 63.5mm) core) using 2% potassium chloride as the bit lubricant. Some samples, due to their friable nature, were mounted in Teflon, Nickel foil and screens to avoid grain loss. All samples were then cleaned of residual salts by warm methanol. Complete salt removal was indicated by the methanol, in which the samples were immersed, producing a negative reaction to silver nitrate. After cleaning, the samples were dried in a convection oven at 95°C. To ensure complete drying, each sample was weighed then put back into the oven for twenty-four hours, then reweighed. This process was repeated until consecutive weights were within +/- 0.01 g. After drying, the samples were cooled down in a desiccator to room temperature prior to analysis. The uncleaned, trimmed, plug off-cuts were placed into labelled snap-lock bags.

Grain Volume and Grain Density:

The weight, diameter and length of all samples were measured before they were processed through the Ultrapore™ porosimeter to determine grain volume. As a standard quality control measure, a calibration check plug was run with every ten samples. Grain density data were calculated from grain volume and sample weight data. For mounted samples, corrections were made for Teflon, Nickel and screen weights and volumes.

Porosity and Permeability:

The plug samples were run at the requested confining stresses while determining porosity and permeability. A standard check plug was run with every set of samples. Klinkenberg permeability (K_{inf}) values are obtained directly from the CMS^{TM}300, since it operates by unsteady-state principles. Porosity data was obtained by combining pore volumes from the CMS^{TM}300 data with grain volumes from the Ultrapore porosimeter-corrected for Teflon, Nickel and screen volumes for mounted samples. Permeability to brine was determined for every fifth sample for these "reservoir" samples.

Preserved Sample Preparation:

Some sections of preserved clay-rich facies core ("seal/aquitard") were selected for permeability to brine and threshold pressure to CO_2. The end of the PVC tubing was removed and the mineral oil drained out. The core was gently slid out of the tube and inspected for obvious fractures, minor faulting, micro-fractures and other heterogeneity features like sand lenses. The plugs were drilled and trimmed with mineral oil, wrapped in Saran wrap and aluminium foil and placed into snap lock plastic bags and stored in a refrigerator until commencement of analysis.

Permeability to Brine

- Selected "seal/aquitard" samples were unwrapped and loaded into individual core holders.
- The confining stress was gradually increased from ambient to the requisite net overburden pressure.
- The sample was initially flushed with the simulated formation brine (50,000 mg/L) under back-pressure to eliminate any trapped gas in the pore spaces.
- Brine flow (injection) rates were kept low to ensure laminar flow. For lower permeability samples, the net confining stress was adjusted to account for the increased upstream pressure.
- Brine injection was continued until stabilised flow pressure was attained.
- The effluent was inspected for production of fines. No fines were noticed in the effluent brine collected for any of the samples tested.
- Permeability to brine was calculated at the given injection rate using this equation :

$$Kw = (14700.Q.\mu.L) / \Delta P.A$$

where :

Kw = *permeability to brine, md*
Q = *rate,* cm^3/sec
A = *cross sectional area,* cm^2
L = *length, cm*
ΔP = *differential pressure (inlet-outlet), psi*
μ = *viscosity, cP*
14700 = conversion factor from psi to atmospheres and Darcy to millidarcies

- Since the "seal/aquitard" samples submitted for permeability to brine measurements were clay-rich facies, high flow pressures (>6,000 psi) were often utilised in an attempt to initiate flow. Where no flow was observed after a period of 24 hours, the tests were terminated and reported as "no flow". Wherever flow was possible, it took extended periods, between 2 to 10 days, to attain equilibrium for permeability measurements.

Threshold Pressure to Carbon Dioxide (CO_2) Gas

- Upon completion of the permeability to brine measurement, the sample underwent threshold pressure to CO_2 measurement.
- With the sample still loaded in the core-holder at the applied net overburden pressure, the brine flow line at the upstream-end was removed and any excess brine from the end-stem was syringed out before attaching the CO_2 gas injection line. A graduated pipette was attached at the downstream effluent end.
- Gas injection (displacement) pressure was incrementally increased until effluent brine was first produced in the pipette. This pressure was recorded as the "threshold pressure", sometimes referred to as the "entry pressure", or "displacement pressure".
- The overburden pressure was continuously adjusted to compensate for the increasing CO_2 displacement pressures to maintain the **net** overburden pressure.
- Displacement/injection pressure was increased beyond 5,000 psi in most cases. Where no effluent brine was noted, testing was terminated and reported as "no injection".

Company : Department of Mines and Petroleum

Well: Harvey-3

POROSITY, PERMEABILITY, and GRAIN DENSITY

SAMPLE NUMBER	SAMPLE DEPTH (m)	CONFINING STRESS (800psi) CMS Kinf (md)	CMS Kair (md)	POROSITY (%)	CONFINING STRESS (1250psi) CMS Kinf (md)	CMS Kair (md)	POROSITY (%)	Permeability Kbrine (md)	GRAIN DENSITY (g/cc)	COMMENTS
Yalgorup Member										
142	760.15	4700	4750	30.4	4370	4420	29.7	2847	2.644	Mounted in Ni sleeving
143	769.30				1380	1390	30.4		2.638	Mounted in Ni sleeving
144	795.00				2110	2140	29.3		2.642	Mounted in Ni sleeving
145	808.50				298	360	23.7		2.638	Mounted in Ni sleeving
146	847.00				546	605	26.3		2.640	Mounted in Ni sleeving
147	863.00	17.3	19.9	23.7	16.2	18.9	23.4	2.38	2.637	Mounted in Ni sleeving
148	864.00				6.04	7.50	22.6		2.678	Mounted in Ni sleeving
149	874.00				26900	27100	30.1		2.637	Mounted in Ni sleeving
150	895.50				-	3050	29.6		2.630	Poor sample
151	904.00				1680	1860	26.0		2.632	Mounted in Ni sleeving
152	919.00	6730	6790	28.6	6550	6610	28.3	4180	2.631	Mounted in Ni sleeving
153	929.00				3740	3950	28.2		2.631	Mounted in Ni sleeving
154	938.00				2420	2490	28.2		2.639	Mounted in Ni sleeving
155	957.00				850	806	24.7		2.636	Mounted in Ni sleeving
156	990.50				-	937	29.2		2.656	Poor sample
157	991.00	-	1920	30.1	-	1890	29.3		2.645	Poor sample
158	1004.30				386	432	29.0		2.675	Mounted in Ni sleeving
159	1036.00				1.06	1.33	14.1		2.680	Mounted in Ni sleeving
161	1055.50				57.3	63.4	17.8		2.632	Mounted in Ni sleeving
162	1066.60				-	760	24.9		2.592	Poor sample
163	1079.85	2.88	3.37	10.1	1.82	2.17	9.6	0.0001	2.657	
164	1087.00				316	340	22.5		2.623	
165	1090.00				13.2	16.2	21.9		2.634	Mounted in Ni sleeving
166	1106.00				1080	1120	25.0		2.615	
167	1145.20				-	-	-		-	Failed
168	1179.70	819	946	27.7	811	928	27.5	178	2.649	
169	1194.00				1670	2240	27.2		2.646	
170	1204.00				4.67	5.76	17.0		2.683	
171	1220.00				2.09	2.68	21.2		2.644	
172	1234.20				0.844	1.15	16.5		2.640	
173	1235.10	-	33.7	20.4	-	26.6	19.6		2.713	Poor sample
174	1250.50				169	183	21.6		2.697	Mounted in Ni sleeving
175	1258.05				0.014	0.024	5.8		2.654	
176	1269.50				389	415	24.1		2.630	Mounted in Ni sleeving
177	1279.30				18.8	25.5	24.0		2.625	
178	1285.70	131	139	19.1	122	130	18.8	1.68	2.629	
179	1303.90				10.2	13.6	22.1		2.622	
180	1313.50				131	143	18.9		2.632	
181	1337.00				8.45	10.7	22.9		2.612	
182	1350.05				244	280	23.4		2.622	
183	1355.50	35.2	39.5	20.5	32.1	36.4	20.2	0.217	2.624	
184	1363.83				204	215	20.3		2.636	
185	1372.00				384	399	21.3		2.631	

Company : Department of Mines and Petroleum

Well: Harvey-3

POROSITY, PERMEABILITY, and GRAIN DENSITY

SAMPLE NUMBER	SAMPLE DEPTH (m)	CONFINING STRESS (800psi)			CONFINING STRESS (1250psi)				GRAIN DENSITY (g/cc)	COMMENTS
		CMS Kinf (md)	CMS Kair (md)	POROSITY (%)	CMS Kinf (md)	CMS Kair (md)	POROSITY (%)	Permeability Kbrine (md)		
187	1394.30				16.2	17.8	18.1		2.634	
186	1395.70				321	333	20.5		2.635	
1	1411.31				-	-	-		2.680	Fractured rubble
V1	1411.34				0.0002	0.0013	11.6		2.737	
2	1412.11				0.057	0.125	13.8		2.812	
3	1413.00	0.206	0.358	16.6	0.185	0.317	16.5		2.655	
V2	1412.85				0.091	0.181	15.0		2.653	
4	1414.00	21.4	26.4	21.6	15.3	21.2	21.4	5.92	2.635	
V3	1413.80				8.23	9.64	14.3		2.635	
5	1415.00				0.014	0.041	12.8		2.746	
V4	1415.04				0.0077	0.025	15.8		2.795	
V5	1416.06				0.0002	0.0012	7.0		2.728	
6	1415.81			12.0	-	-	-		2.706	Porosity by Hg. Bulk volume
V6	1416.88				0.0002	0.0013	12.7		2.842	
7	1417.06				0.018	0.049	14.5		2.809	
8	1417.50	0.004	0.014	11.7	0.002	0.008	11.5		2.767	

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POROSITY, PERMEABILITY, and GRAIN DENSITY

SAMPLE NUMBER	SAMPLE DEPTH (m)	CONFINING STRESS (800psi) CMS Kinf (md)	CMS Kair (md)	POROSITY (%)	CONFINING STRESS (1700psi) CMS Kinf (md)	CMS Kair (md)	POROSITY (%)	Permeability Kbrine (md)	GRAIN DENSITY (g/cc)	COMMENTS
Wonnerup Member										
9	1418.00				13.4	16.1	14.0		2.624	
10	1419.10	1.68	2.39	19.6	1.52	2.17	19.2	0.929	2.639	
11	1420.00				29.7	35.1	23.2		2.636	
12	1421.00				15.5	17.8	19.1		2.641	
13	1422.00				7.35	9.05	19.2		2.642	
14	1423.10				48.6	58.1	23.4		2.637	
15	1424.00	1070	1260	23.8	1040	1250	23.6	1017	2.630	
16	1425.05				0.003	0.010	12.9		2.819	
17	1426.00				0.836	1.160	16.8		2.639	
18	1427.00				47.1	56.9	24.9		2.640	
19	1428.00				506	615	23.8		2.639	
20	1429.00	20.5	24.9	22.4	17.6	22.0	22.0	5.82	2.643	
21	1430.00				157	197	22.6		2.654	
22	1431.00				10200	10300	21.6		2.636	Mounted in Ni sleeving
23	1432.00				174	203	23.4		2.647	
24	1432.93				109	121	24.2		2.654	
25	1434.00	1230	1490	19.5	1150	1400	19.0	1132	2.629	
26	1435.00				536	582	24.4		2.637	
27	1436.00				1.98	2.75	21.4		2.684	
28	1437.00				376	448	22.2		2.629	
29	1438.00				1010	1250	20.3		2.630	
30	1439.00	348	463	21.3	308	409	20.9	156	2.648	
31	1440.00				290	337	19.7		2.641	
32	1441.00				1500	1600	16.5		2.631	
33	1442.00				1220	1570	17.1		2.637	
34	1443.00				241	368	17.0		2.629	
35	1444.00	490	620	18.4	446	582	18.0	441	2.632	
36	1445.00				271	330	15.9		2.636	
37	1446.00				535	678	17.0		2.632	
38	1447.00				142	178	20.0		2.645	
39	1448.00				133	167	19.9		2.637	
40	1449.00	119	142	17.1	105	127	16.7	28.2	2.628	
41	1450.00				207	277	16.6		2.632	
42	1451.00				394	518	17.0		2.639	
43	1451.95				780	1190	17.1		2.630	Mounted in Ni sleeving
44	1453.00				318	491	17.7		2.631	
45	1454.00	327	405	19.8	299	371	19.4	130	2.634	
46	1455.00				246	290	22.2		2.638	
47	1456.00				404	588	20.0		2.633	
48	1457.00				567	715	19.2		2.633	
49	1458.00				177	213	19.1		2.641	
50	1459.00	151	185	22.6	139	171	22.3	37.3	2.631	
51	1460.00				253	294	21.4		2.640	

Company : Department of Mines and Petroleum

Well: Harvey-3

POROSITY, PERMEABILITY, and GRAIN DENSITY

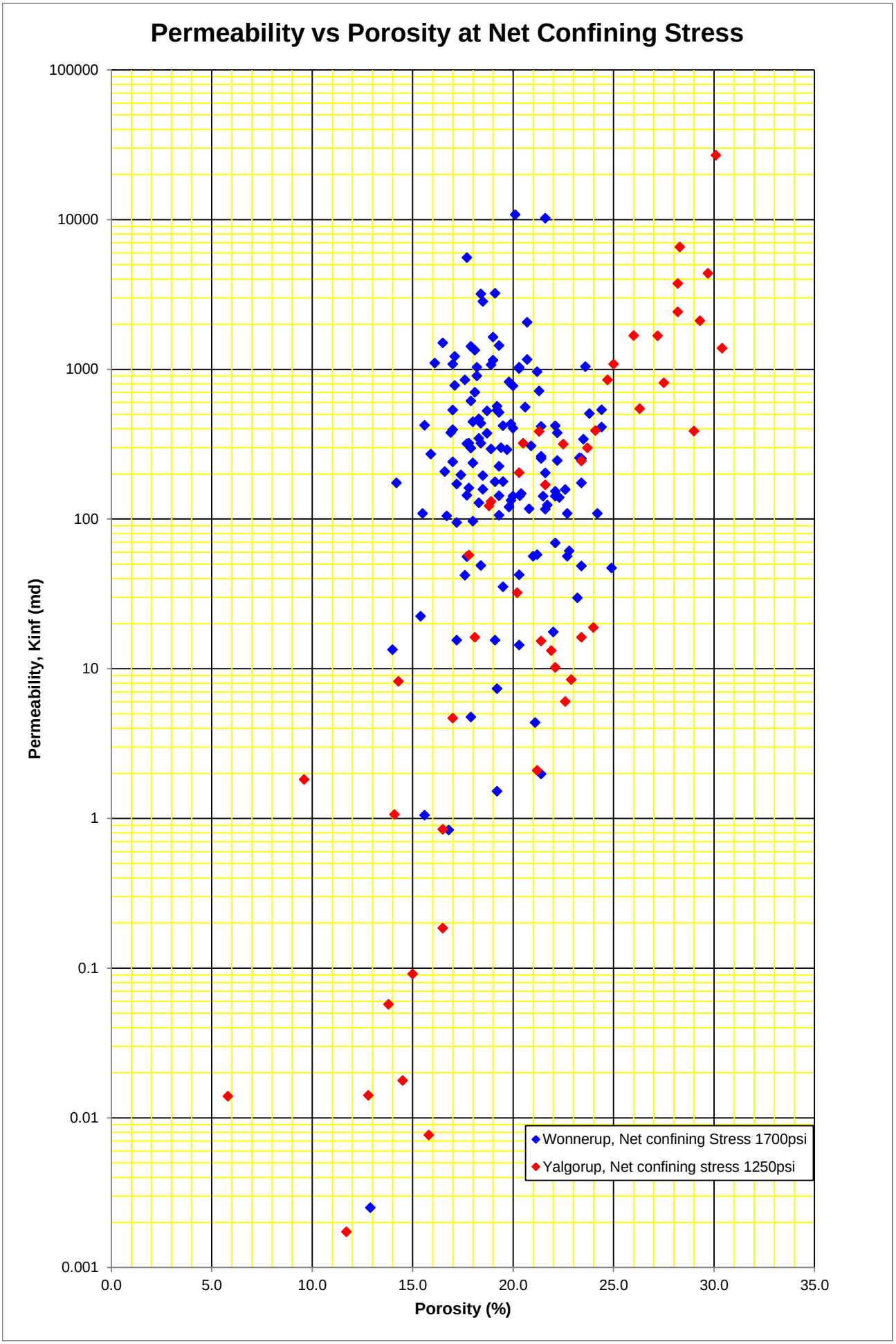
SAMPLE NUMBER	SAMPLE DEPTH (m)	CONFINING STRESS (800psi)			CONFINING STRESS (1700psi)				GRAIN DENSITY (g/cc)	COMMENTS
		CMS Kinf (md)	CMS Kair (md)	POROSITY (%)	CMS Kinf (md)	CMS Kair (md)	POROSITY (%)	Permeability Kbrine (md)		
52	1460.95				148	217	20.4		2.633	
53	1462.00				823	1030	19.8		2.632	Mounted in Ni sleeving
54	1463.00				161	244	17.8		2.637	
55	1464.00	882	1190	22.2	716	1030	21.3	649	2.635	Mounted in Ni sleeving
56	1465.04				775	1050	20.0		2.639	
57	1466.00				153	196	22.1		2.635	
58	1467.00				56	65	22.7		2.641	
59	1468.00				415	544	21.4		2.637	Mounted in Ni sleeving
60	1469.00	280	371	24.1	253	335	23.4	212	2.649	Mounted in Ni sleeving
61	1470.00				256	327	23.3		2.640	Mounted in Ni sleeving
62	1471.00				109	137	22.7		2.644	
63	1472.00				411	514	24.4		2.649	
64	1473.00				902	1120	18.2		2.641	Mounted in Ni sleeving
65	1474.00	6510	6810	18.4	5560	6080	17.7	5247	2.629	Mounted in Ni sleeving
66	1475.00				373	496	18.7		2.637	Mounted in Ni sleeving
67	1476.00				422	660	15.6		2.631	
68	1477.00				466	723	18.3		2.631	
69	1478.00				96.5	147	18.0		2.641	Mounted in Ni sleeving
70	1479.00	213	329	18.9	195	309	18.5	190	2.641	
71	1480.00				321	555	17.8		2.632	
72	1481.00				42.0	52.8	17.6		2.648	
73	1482.00				615	929	17.9		2.636	
74	1483.00				1340	1610	18.1		2.634	
75	1484.00	550	854	19.2	527	815	18.7	462	2.632	
76	1485.00				144	221	17.7		2.635	Mounted in Ni sleeving
77	1486.00				69	86	22.1		2.651	
78	1487.00				197	321	17.4		2.635	
79	1488.00				142	177	21.5		2.646	
80	1489.00	170	215	22.8	142	180	22.1	96.0	2.641	Mounted in Ni sleeving
81	1490.00				558	764	20.6		2.634	
82	1491.00				61.1	72.3	22.8		2.638	
83	1492.00				143	188	20.3		2.638	
84	1493.00				297	482	17.9		2.634	
85	1494.00	135	164	22.2	124	152	21.7	62.2	2.636	Mounted in Ni sleeving
86	1495.00				128	202	18.3		2.640	Mounted in Ni sleeving
87	1496.00				1640	2410	19.0		2.657	Mounted in Ni sleeving
88	1497.00				143	228	19.3		2.631	
89	1498.00				1.05	1.46	15.6		2.671	
90	1499.00	5.04	6.40	21.6	4.36	5.79	21.1	2.98	2.662	
91	1500.00				14.4	18.2	20.3		2.652	
92	1501.00				178	216	19.5		2.648	
93	1502.00				94.5	125	17.2		2.637	
94	1503.00				106	157	19.3		2.897	Mounted in Ni sleeving
95	1504.00	62.4	71.6	21.6	57.7	65.7	21.2	13.3	2.641	
96	1505.00				3220	3900	19.1		2.638	Mounted in Ni sleeving

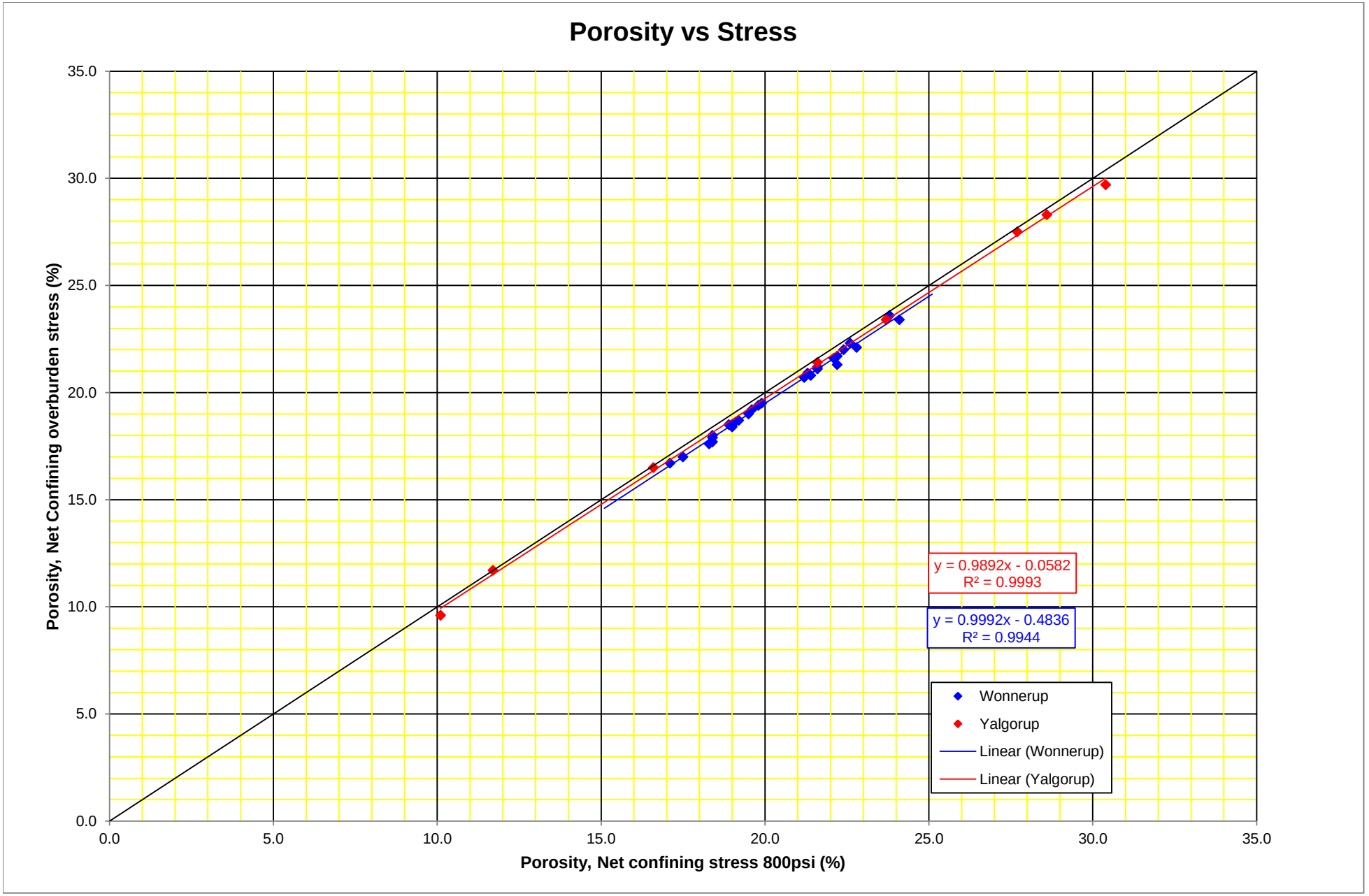
Company : Department of Mines and Petroleum

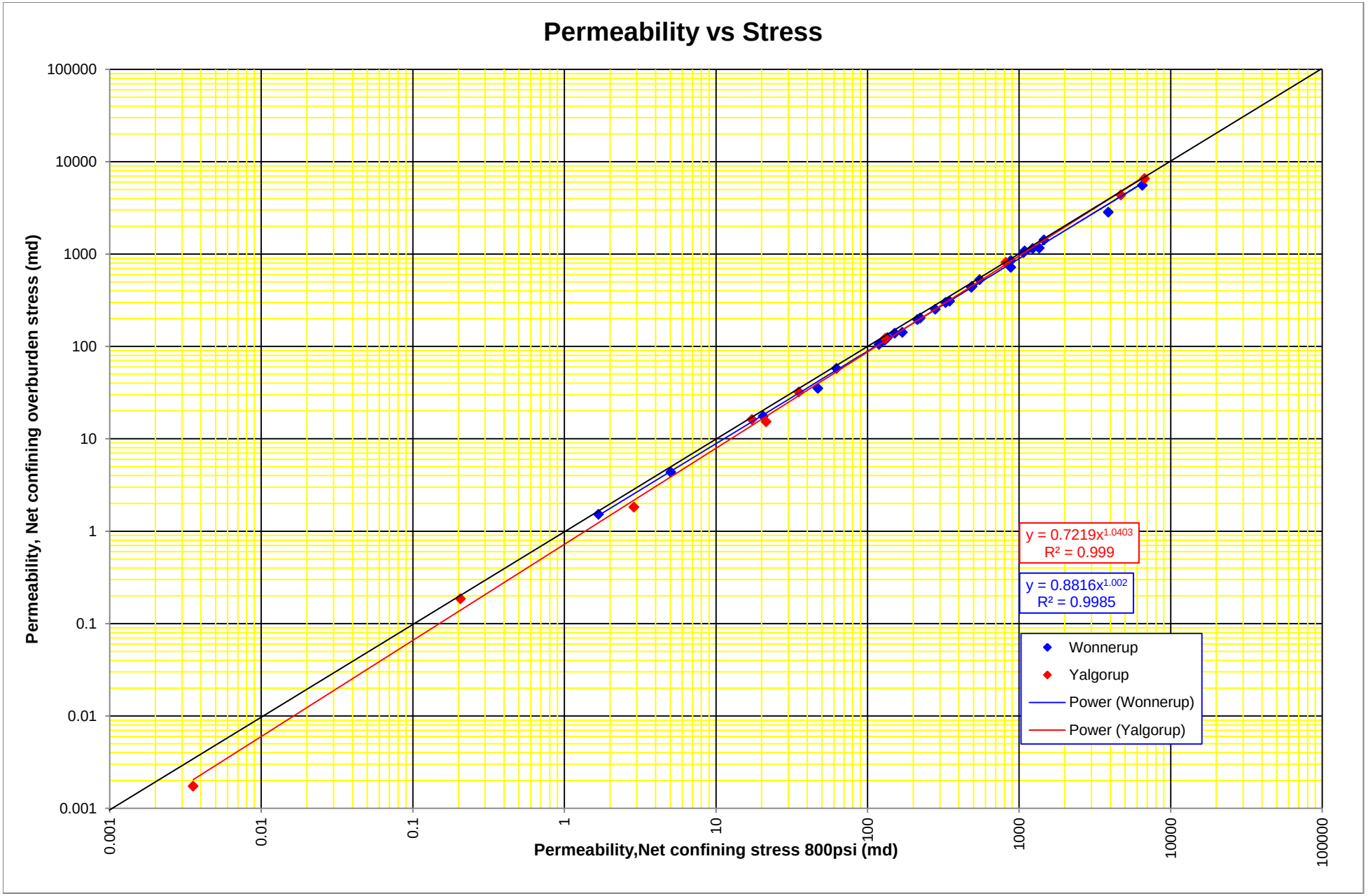
Well: Harvey-3

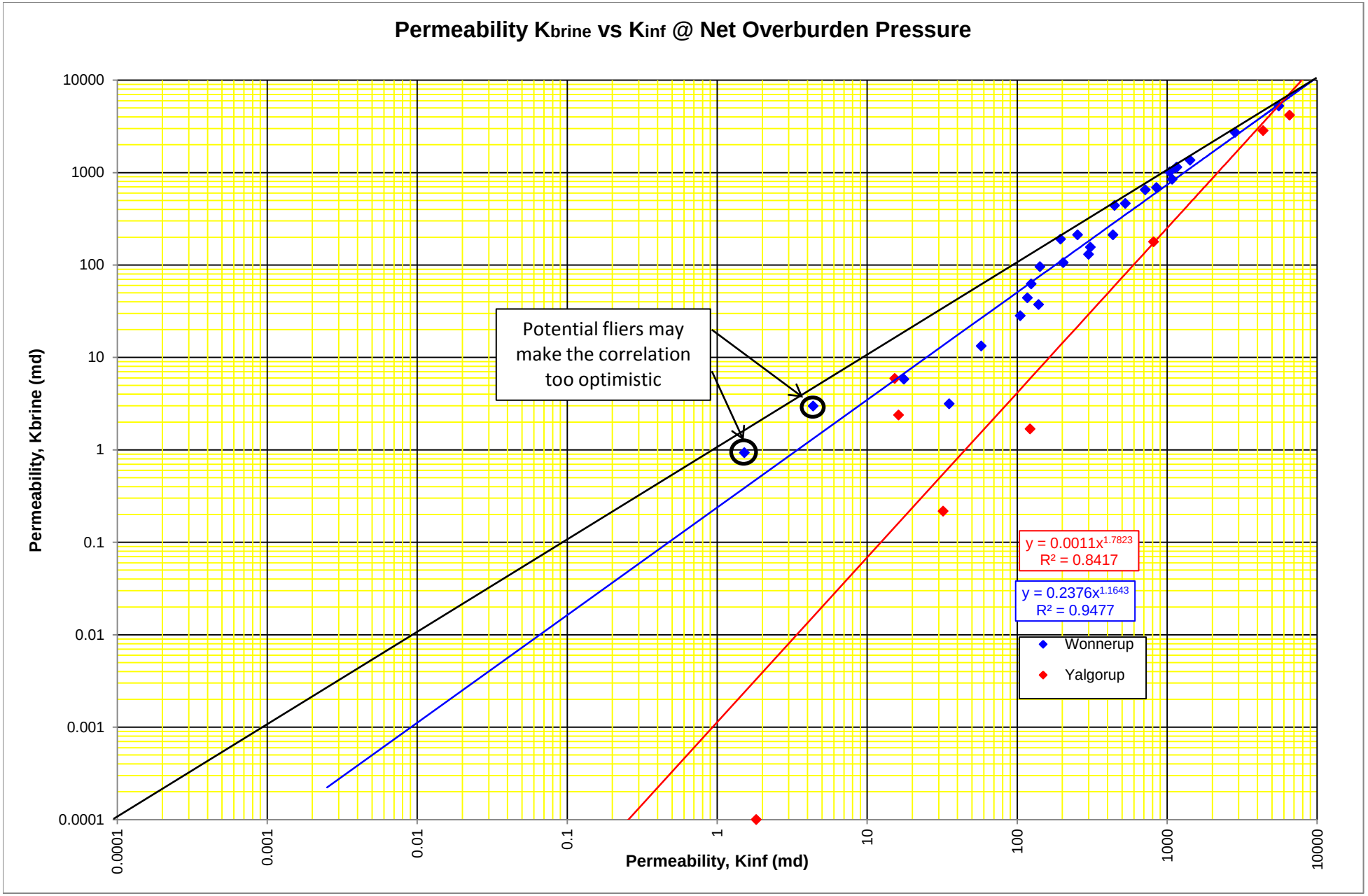
POROSITY, PERMEABILITY, and GRAIN DENSITY

SAMPLE NUMBER	SAMPLE DEPTH (m)	CONFINING STRESS (800psi)			CONFINING STRESS (1700psi)				GRAIN DENSITY (g/cc)	COMMENTS
		CMS Kinf (md)	CMS Kair (md)	POROSITY (%)	CMS Kinf (md)	CMS Kair (md)	POROSITY (%)	Permeability Kbrine (md)		
97	1506.00				10800	10900	20.1		2.633	Mounted in Ni sleeving
98	1507.00				116	172	21.6		2.652	
99	1508.00				262	348	21.4		2.639	
100	1509.00	223	277	22.1	203	252	21.6	106	2.640	
101	1510.00				341	409	23.5		2.639	
102	1511.00				2060	3040	20.7		2.635	
103	1512.00				419	514	22.1		2.645	
104	1513.00				22.4	36.8	15.4		2.648	
105	1514.00	130	160	21.4	117	145	20.8	44.1	2.644	
106	1515.00				431	666	19.9		2.631	
107	1516.00				56.3	64.4	21.0		2.641	
108	1517.00				293	379	18.9		2.636	
109	1518.00				346	483	18.3		2.633	
110	1519.00	1460	2140	18.4	1420	2070	17.9	1361	2.633	
111	1520.00				1100	1620	16.1		2.638	
112	1521.00				378	599	16.9		2.633	
113	1522.00				320	490	18.4		2.633	
114	1523.00				237	331	18.0		2.634	
115	1524.00	1090	1630	17.5	1080	1600	17.0	848	2.632	
116	1525.00				174	225	14.2		2.644	
117	1526.00				171	258	17.2		2.646	
118	1527.00				1030	1560	18.2		2.642	
119	1528.00				514	714	19.3		2.668	
120	1528.95	883	1330	18.3	849	1260	17.6	687	2.638	
121	1530.00				42.3	50.4	20.3		2.661	
122	1530.95				15.5	18.2	17.2		2.640	
123	1532.00				48.8	59.5	18.4		2.637	
124	1533.00				1440	2120	19.3		2.636	
125	1534.00	47.1	73.3	19.9	35.2	56.7	19.5	3.14	2.633	
126	1535.00				532	827	19.2		2.631	
127	1536.00				962	1230	21.2		2.667	
128	1537.00				109	157	15.5		2.630	
129	1538.00				420	606	19.5		2.632	
130	1539.00	1360	2050	21.2	1160	1860	20.7	1141	2.630	
131	1540.00				56.0	69.3	17.7		2.644	
132	1541.00				4.75	5.93	17.9		2.653	
133	1542.00				120	150	19.8		2.656	
134	1543.00				225	339	19.3		2.636	
135	1544.00	485	698	19.0	436	633	18.4	212	2.640	
136	1545.00				1030	1410	20.3		2.639	
137	1546.00				158	244	18.5		2.638	
138	1547.00				3180	3240	18.4		2.633	Mounted in Ni sleeving
139	1548.00				702	1070	18.1		2.645	
140	1549.00	3880	4450	19.0	2840	3700	18.5	2712	2.677	
141	1550.00				1070	1580	18.9		2.639	Mounted in Ni sleeving


Permeability vs Porosity at Net Confining Stress
Permeability, Kinf (md)
100000
10000
1000
100
10
1
0.1
0.01
0.001
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
Porosity (%)
Wonnerup, Net confining Stress 1700psi
Yalgorup, Net confining stress 1250psi


Porosity vs Stress
Porosity, Net Confining overburden stress (%)
Porosity, Net confining stress 800psi (%)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
y = 0.9892x - 0.0582
R² = 0.9993
y = 0.9992x - 0.4836
R² = 0.9944
Wonnerup
Yalgorup
Linear (Wonnerup)
Linear (Yalgorup)


Permeability vs Stress
Permeability, Net confining overburden stress (md)
100000
10000
1000
100
10
1
0.1
0.01
0.001
Permeability,Net confining stress 800psi (md)
0.001
0.01
0.1
1
10
100
1000
10000
100000
y = 0.7219x^1.0403
R² = 0.999
y = 0.8816x^1.002
R² = 0.9985
Wonnerup
Yalgorup
Power (Wonnerup)
Power (Yalgorup)


Permeability Kbrine vs Kinf @ Net Overburden Pressure
Permeability, Kbrine (md)
Permeability, Kinf (md)
10000
1000
100
10
1
0.1
0.01
0.001
0.0001
0.0001
0.001
0.01
0.1
1
10
100
1000
10000
Potential fliers may make the correlation too optimistic
y = 0.0011x^1.7823
R² = 0.8417
y = 0.2376x^1.1643
R² = 0.9477
Wonnerup
Yalgorup

Permeability to Brine and threshold Pressure to CO2 at Net Confining Stress

Eneabba -800psi Net confining stress
Yalgorup Member -1250psi. Net confining stress

Formation name	Sample no.	Depth (m)	Permeability To water (md)	CO2 threshold Pressure (psi)
Eneabba	PSH5	720.23	No flow	no injection
Eneabba	PSH6	720.28	No flow	no injection
Eneabba	PSV3	720.40	No flow	no injection
Eneabba	PSH7	725.44	No flow	no injection
Eneabba	PSH8	725.62	0.00002	2850
Yalgorup	PSH9	740.70	No flow	no injection
Yalgorup	PSH10	740.76	No flow	no injection
Yalgorup	PSH13	914.78	No flow	no injection
Yalgorup	PSH14	914.89	No flow	no injection
Yalgorup	PSV5	915.00	No flow	no injection
Yalgorup	PSH11	965.64	No flow	no injection
Yalgorup	PSH12	965.70	0.00003	850
Yalgorup	PSV4	965.78	No flow	no injection
Yalgorup	PSH15	1226.38	No flow	no injection
Yalgorup	PSH16	1226.42	No flow	no injection
Yalgorup	PSV6	1226.55	No flow	no injection
Yalgorup	PSH17	1291.53	No flow	no injection
Yalgorup	PSH18	1291.61	No flow	no injection
Yalgorup	PSV7	1291.83	No flow	no injection
Yalgorup	PSH19	1324.43	No flow	no injection
Yalgorup	PSH20	1324.48	0.00001	4500
Yalgorup	PSV8	1324.70	No flow	no injection
Yalgorup	PSH21	1326.88	No flow	no injection
Yalgorup	PSH22	1326.94	No flow	no injection
Yalgorup	PSH23	1353.68	No flow	no injection
Yalgorup	PSV9	1353.71	No flow	no injection
Yalgorup	PSH24	1353.81	No flow	no injection
Yalgorup	PSH25	1388.04	No flow	no injection
Yalgorup	PSH26	1388.10	No flow	no injection
Yalgorup	PSH27	1406.28	No flow	no injection
Yalgorup	PSH28	1406.33	No flow	no injection
Yalgorup	PSV10	1406.48	No flow	no injection
Yalgorup	PSH29	1416.60	No flow	no injection
Yalgorup	PSH30	1416.65	No flow	no injection

APPENDIX A

PLUGGING LIST

Date: 15/10/2015

Client: Department of Mines and Petroleum

Well: Harvey-3

Job No: **PRP - 15068**

Sample No.	PREPOSED Depth (m)	Depth Check	Revised Depth	Comments
142	760.15	√		Top Yalgorup (741m)
143	769.30	√		
144	795.00	√		
145	808.50	√		
146	847.00	√		
147	863.00	√		
148	864.00	√		
149	874.00	√		
150	895.50	√		
151	904.00	√		
152	919.00	√		
153	929.00	√		
154	938.00	√		
155	957.00	√		
156	990.50	√		
157	991.00	√		
158	1004.30	√		
159	1036.00	√		
160	1036.80			Removed 30-7-15 as sample 159 is in same sand unit
161	1055.50	√		
162	1066.60	√		
163	1079.85	√		
164	1087.00	√		
165	1090.00	√		
166	1106.00	√		
167	1145.20	Failed		
168	1179.70	√		
169	1194.00	√		
170	1204.00	√		
171	1220.00	√		
172	1234.20	√		
173	1235.20	√	1235.10	
174	1250.50	√		
175	1258.05	√		
176	1269.50	√		
177	1279.30	√		
178	1285.70	√		
179	1303.90	√		
180	1313.50	√		
181	1337.00	√		
182	1350.00	√	1350.05	

PLUGGING LIST

Date: 15/10/2015

Client: Department of Mines and Petroleum

Well: Harvey-3

Job No: **PRP - 15068**

Sample No.	PREPOSED Depth (m)	Depth Check	Revised Depth	Comments
183	1355.50	√		
184	1364.00	√	1363.83	
185	1372.00	√		
187	1394.30	√		Additional 30-7-15
186	1395.70	√		
1	1411.10	√	1411.31	
V1	1411.10	√	1411.34	
2	1412.10	√	1412.11	
3	1413.00	√		
V2	1413.00	√	1412.85	
4	1414.00	√		
V3	1414.00	√	1413.80	
5	1415.00	√		
V4	1415.00	√	1415.04	
V5	1416.00	√	1416.06	
6	1416.05	√	1415.81	
7	1417.00	√	1417.06	
V6	1417.00	√	1416.88	
8	1417.50	√		
9	1418.00	√		Top Wonnerup (1418m)
V7	1418.00			Postponed 30-7-15
10	1419.10	√		
11	1420.00	√		
12	1421.00	√		
V8	1421.00			Postponed 30-7-15
13	1422.00	√		
14	1423.10	√		
15	1424.00	√		
V9	1424.00			Postponed 30-7-15
16	1425.00	√	1425.05	
17	1426.00	√		
18	1427.00	√		
V10	1427.00			Postponed 30-7-15
19	1428.00	√		
20	1429.00	√		
21	1430.00	√		
V11	1430.00			Postponed 30-7-15
22	1431.00	√		
23	1432.00	√		
24	1433.00		1432.93	
V12	1433.00			Postponed 30-7-15
25	1434.00	√		

PLUGGING LIST

Date: 15/10/2015

Client: Department of Mines and Petroleum

Well: Harvey-3

Job No: **PRP - 15068**

Sample No.	PREPOSED Depth (m)	Depth Check	Revised Depth	Comments
26	1435.00	√		
27	1436.00	√		
V13	1436.00			Postponed 30-7-15
28	1437.00	√		
29	1438.00	√		
30	1439.00	√		
V14	1439.00			Postponed 30-7-15
31	1440.00	√		
32	1441.00	√		
33	1442.00	√		
V15	1442.00			Postponed 30-7-15
34	1443.00	√		
35	1444.00	√		
36	1445.00	√		
V16	1445.00			Postponed 30-7-15
37	1446.00	√		
38	1447.00	√		
39	1448.00	√		
V17	1448.00			Postponed 30-7-15
40	1449.00	√		
41	1450.00	√		
42	1451.00	√		
V18	1451.00			Postponed 30-7-15
43	1452.00	√	1451.95	
44	1453.00	√		
45	1454.00	√		
V19	1454.00			Postponed 30-7-15
46	1455.00	√		
47	1456.00	√		
48	1457.00	√		
V20	1457.00			Postponed 30-7-15
49	1458.00	√		
50	1459.00	√		
51	1460.00	√		
V21	1460.00			Postponed 30-7-15
52	1460.95	√		
53	1462.00	√		
54	1463.00	√		
V22	1463.00			Postponed 30-7-15
55	1464.00	√		
56	1465.00	√	1465.04	
57	1466.00	√		

PLUGGING LIST

Date: 15/10/2015

Client: Department of Mines and Petroleum

Well: Harvey-3

Job No: **PRP - 15068**

Sample No.	PREPOSED Depth (m)	Depth Check	Revised Depth	Comments
V23	1466.00			Postponed 30-7-15
58	1467.00	√		
59	1468.00	√		
60	1469.00	√		
V24	1469.00			Postponed 30-7-15
61	1470.00	√		
62	1471.00	√		
63	1472.00	√		
V25	1472.00			Postponed 30-7-15
64	1473.00	√		
65	1474.00	√		
66	1475.00	√		
V26	1475.00			Postponed 30-7-15
67	1476.00	√		
68	1477.00	√		
69	1478.00	√		
V27	1478.00			Postponed 30-7-15
70	1479.00	√		
71	1480.00	√		
72	1481.00	√		
V28	1481.00			Postponed 30-7-15
73	1482.00	√		
74	1483.00	√		
75	1484.00	√		
V29	1484.00			Postponed 30-7-15
76	1485.00	√		
77	1486.00	√		
78	1487.00	√		
V30	1487.00			Postponed 30-7-15
79	1488.00	√		
80	1489.00	√		
81	1490.00	√		
V31	1490.00			Postponed 30-7-15
82	1491.00	√		
83	1492.00	√		
84	1493.00	√		
V32	1493.00			Postponed 30-7-15
85	1494.00	√		
86	1495.00	√		
87	1496.00	√		
V33	1496.00			Postponed 30-7-15
88	1497.00	√		

PLUGGING LIST

Date: 15/10/2015

Client: Department of Mines and Petroleum

Well: Harvey-3

Job No: **PRP - 15068**

Sample No.	PREPOSED Depth (m)	Depth Check	Revised Depth	Comments
89	1498.00	√		
90	1499.00	√		
V34	1499.00			Postponed 30-7-15
91	1500.00	√		
92	1501.00	√		
93	1502.00	√		
V35	1502.00			Postponed 30-7-15
94	1503.00	√		
95	1504.00	√		
96	1505.00	√		
V36	1505.00			Postponed 30-7-15
97	1506.00	√		
98	1507.00	√		
99	1508.00	√		
V37	1508.00			Postponed 30-7-15
100	1509.00	√		
101	1510.00	√		
102	1511.00	√		
V38	1511.00			Postponed 30-7-15
103	1512.00	√		
104	1513.00	√		
105	1514.00	√		
V39	1514.00			Postponed 30-7-15
106	1515.00	√		
107	1516.00	√		
108	1517.00	√		
V40	1517.00			Postponed 30-7-15
109	1518.00	√		
110	1519.00	√		
111	1520.00	√		
V41	1520.00			Postponed 30-7-15
112	1521.00	√		
113	1522.00	√		
114	1523.00	√		
V42	1523.00			Postponed 30-7-15
115	1524.00	√		
116	1525.00	√		
117	1526.00	√		
V43	1526.00			Postponed 30-7-15
118	1527.00	√		
119	1528.00	√		
120	1529.00	√	1528.95	

PLUGGING LIST

Date: 15/10/2015

Client: Department of Mines and Petroleum

Well: Harvey-3

Job No: **PRP - 15068**

Sample No.	PREPOSED Depth (m)	Depth Check	Revised Depth	Comments
V44	1529.00			Postponed 30-7-15
121	1530.00	√		
122	1531.00	√	1530.95	
123	1532.00	√		
V45	1532.00			Postponed 30-7-15
124	1533.00	√		
125	1534.00	√		
126	1535.00	√		
V46	1535.00			Postponed 30-7-15
127	1536.00	√		
128	1537.00	√		
129	1538.00	√		
V47	1538.00			Postponed 30-7-15
130	1539.00	√		
131	1540.00	√		
132	1541.00	√		
V48	1541.00			Postponed 30-7-15
133	1542.00	√		
134	1543.00	√		
135	1544.00	√		
V49	1544.00			Postponed 30-7-15
136	1545.00	√		
137	1546.00	√		
138	1547.00	√		
V50	1547.00			Postponed 30-7-15
139	1548.00	√		
140	1549.00	√		
141	1550.00	√		
5FS	1459.40	√	1459.40	Additional 31-7-15 Ali Saeedi Sample (CSIRO)
6FS	1459.40	√	1459.46	Additional 31-7-15 Ali Saeedi Sample (CSIRO)
CL-1	1411.46-.60	√		WC and Plug
CL-2	1454.11-.25	√		WC and Plug
				Preserved Samples
PSH1		Failed		664.55-664.90
PSH2		Failed		664.55-664.90
PSH3		Failed		696.70-697.00
PSH4		Failed		696.70-697.00
PSH5	720.23	√		
PSH6	720.28	√		

PLUGGING LIST

Date: 15/10/2015

Client: Department of Mines and Petroleum

Well: Harvey-3

Job No: **PRP - 15068**

Sample No.	PREPOSED Depth (m)	Depth Check	Revised Depth	Comments
PSH7	725.44	√		
PSH8	725.62	√		
PSH9	740.70	√		
PSH10	740.76	√		
PSH11	965.64	√		
PSH12	965.70	√		
PSH13	914.78	√		
PSH14	914.89	√		
PSH15	1226.38	√		
PSH16	1226.42	√		
PSH17	1291.53	√		
PSH18	1291.61	√		
PSH19	1324.43	√		
PSH20	1324.48	√		
PSH21	1326.88	√		
PSH22	1326.94	√		
PSH23	1353.68	√		
PSH24	1353.81	√		
PSH25	1388.04	√		
PSH26	1388.10	√		
PSH27	1406.28	√		
PSH28	1406.33	√		
PSH29	1416.60	√		
PSH30	1416.65	√		
PSV1		Failed		664.55-664.90
PSV2		Failed		696.70-697.00
PSV3	720.40	√		
PSV4	965.78	√		
PSV5	915.00	√		
PSV6	1226.55	√		
PSV7	1291.83	√		
PSV8	1324.70	√		
PSV9	1353.71	√		
PSV10	1406.48	√		

PSH_ : Indicates; Preserved sample horizontal orientation

PSV_ : Indicates; Preserved sample vertical orientation

_FS : Indicates; Flow study sample

CL_ : Indicates; Community Liaison samples

Preserved Core Inventory

Well Name: Harvey-3A

Client: Department of Mines and Petroleum

Job No.: PRP-15068

All the below samples are currently in the Warehouse fridge							
Core	Sample No	Top Depth	Btm Depth		Selected	Plugs	Comments
Short Term Preservation	1	604.25	604.65				5 inch PVC tube
	2	647.55	647.90				5 inch PVC tube
	3	657.00	657.20				5 inch PVC tube
	4	662.70	663.05				5 inch PVC tube
							Basal Eneabba unit
	5	664.55	664.90		RCA-1	PSH1, PSH2, PSV1	5 inch PVC tube
	6	673.25	673.55				5 inch PVC tube
	7	696.70	697.00		RCA-1	PSH3, PSH4, PSV2	5 inch PVC tube
	10	716.25	716.45				5 inch PVC tube
	8	717.50	717.80				5 inch PVC tube
	9	720.15	720.45		RCA-1	PSH5, PSH6, PSV3	5 inch PVC tube
	11	725.40	725.70		RCA-1	PSH7, PSH8	5 inch PVC tube
	12	728.60	728.90				5 inch PVC tube
	13	740.50	740.80		RCA-1	PSH9, PSH10	5 inch PVC tube
							Top Yalgorup Member
	14	743.75	743.95				5 inch PVC tube
	15	765.55	765.85		RCA-1	PSH11, PSH12, PSV4	5 inch PVC tube
	16	778.25	778.55				5 inch PVC tube
	17	888.05	888.35				5 inch PVC tube
	18	914.70	915.00		RCA-1	PSH13, PSH14, PSV5	5 inch PVC tube
	19	1171.70	1172.00				5 inch PVC tube
	20	1226.35	1226.65		RCA-1	PSH15, PSH16, PSV6	5 inch PVC tube
	21	1291.50	1291.90		RCA-1	PSH17, PSH18, PSV7	5 inch PVC tube
	22	1298.00	1298.30				5 inch PVC tube
	23	1317.20	1317.60				5 inch PVC tube
	24	1324.40	1324.85		RCA-1	PSH19, PSH20, PSV8	5 inch PVC tube
	25	1326.85	1327.30		RCA-1	PSH21, PSH22	5 inch PVC tube
	26	1332.80	1333.15				5 inch PVC tube
	27	1353.65	1353.95		RCA-1	PSH23, PSH24, PSV9	5 inch PVC tube
	28	1377.80	1378.10				5 inch PVC tube
	29	1388.00	1388.35		RCA-1	PSH25, PSH26	5 inch PVC tube
	30	1393.15	1393.50				5 inch PVC tube
	31	1406.25	1406.55		RCA-1	PSH27, PSH28, PSV10	5 inch PVC tube
	32	1416.50	1416.85		RCA-1	PSH29, PSH30	5 inch PVC tube
							Top Wonnerup Member

Preserved Core Inventory

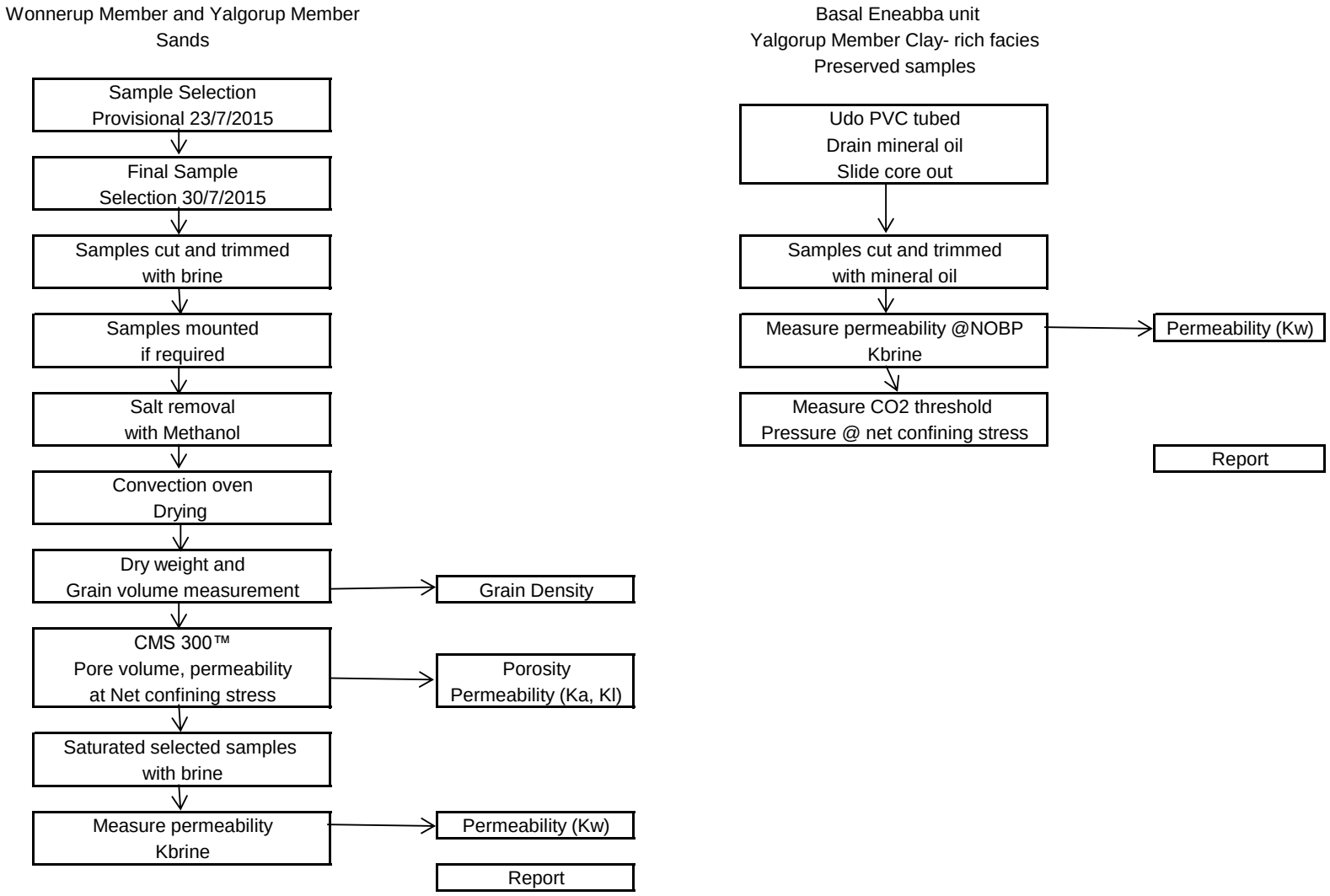
Well Name: Harvey-3A

Client: Department of Mines and Petroleum

Job No.: PRP-15068

All the below samples are currently in the Warehouse fridge							
Core	Sample No	Top Depth	Btm Depth		Selected	Plugs	Comments
Radio-isotope	RI1	688.55	688.85				5 inch PVC tube
	RI2	725.05	725.35				5 inch PVC tube
	RI3	735.30	735.60				5 inch PVC tube
	RI4	1317.60	1317.95				5 inch PVC tube
	RI5	1324.20	1324.50				5 inch PVC tube
	RI6	1379.50	1379.75				5 inch PVC tube
	RI7	1389.95	1390.25				5 inch PVC tube
	RI8	1407.00	1407.25				5 inch PVC tube
Yalgorup Sandstone	YS1	1290.95	1291.95				5 inch PVC tube
	YS2	1286.10	1287.05				5 inch PVC tube
	YS3	1348.70	1349.70				5 inch PVC tube
	YS4	1396.90	1397.85				5 inch PVC tube
Long Term Preservation	LS1	1300.95	1301.45				5 inch PVC tube
	LS2	1323.70	1324.20				5 inch PVC tube
	LS3	1358.65	1359.20				5 inch PVC tube

Analysis Flow Chart



APPENDIX B

SWH Project
Harvey 2, 3, 4 Core Analysis Program
Routine Core Analysis
Special Core Analysis

Planning Document

Version	Date	Done by	Reviewed by	Approved by
Update 9	June 24, 2015	TK	LS	
Update 8	June 16, 2015	LS		
Update 7	May 26, 2015	SS	LS	
Update 6	May 20, 2015	SS/LS		
Update 5	May 18, 2015	SS/LS	LS	
Update 4	May 11, 2015	SS/LS		
Update 3	April 20, 2015	SS/LS		
Update 2	28 Feb 2015	SS	LS	DVG
Update 1	24 Feb 2015	SS	LS	
RFT Scope	Oct 2014	SS/LS	DVG	

1 SUMMARY OF APPROACH TO CORE ANALYSIS

The DMP RFT scope was discussed and adapted based on the project objectives through discussions with Core Lab (Core Analysis Consultants), ODIN (Modelling and Interpretation consultants) and GSWA. The finalised scope is outlined below and the rationale defined in the subsequent sections.

In terms of classification the core analysis terminology for cap rock refers to the Eneabba basal 'shale' and the Yalgorup paleosols. The reservoir refers to the Wonnerup sands and the Yalgorup sandy facies.

While normally TRA analysis would not be done on cap-rock, in the case of the Lesueur as these are dominated by paleosols a few TRA tests are worth performing in addition to special MICP (SCAL) work.

A specific learning from the Harvey 1 exercise is to perform a CT scan of plugs for SCAL so that the plugs tested are representative.

A certain number of plugs will be required for the ANLEC research projects. Around 5 plugs per well will likely be needed for the paleo-salinity while the requirements for the others is yet to be defined.

Tabulation of Strata tops: predicted vs preliminary actual (updated 16/06/15).

16/06/2015

Depth to strata tops

Harvey 2 DDH1 Rig 16 (RT = 0.6m)

	Odin's 3-D seismic depth prognosis (m AHD)	Approx. actual depth interpretation (m depth)	Approx. strata elevation (m AHD) from Core	Diff between prognosed & prelim actual (m)
X : 392052.65 Y : 6347141.74				
G.L (m AHD)	15.40			
Rig table datum (m AHD)	16.00			
Driller's datum (m AHD)	16.00			
Base of Leederville unconformity (m sub sea)	-145	135	-119	-26
Eneabba basal shale (m sub sea)	-425	393	-377	-48
Top Yalgorup Member (m sub sea)	-491	419	-403	-88
Top Wonnerup Member (m sub sea)	-1,237	1,245	-1,229	-8
Final depth	~ 1,350 m	1,351	-1,335	-15
Completion depth (m)		414.6	-399	

Harvey 3 DDH1 Rig 16 (RT = 0.6m)

	Odin's 3-D seismic depth prognosis (m AHD)	Approx. actual depth interpretation (m depth)	Approx. strata elevation (m AHD) from Core	Diff between prognosed & prelim actual (m)
X : 387392.24 Y : 6343895.95				
Lat and Long				
Ground elevation, as surveyed (m AHD)	20.20			
Rig table datum (m AHD)	20.80			
Driller's datum (m AHD)	20.80			
Base of Leederville unconformity (m sub sea)	-226	cased	tentatively from GR log ?	
Eneabba basal shale (m sub sea)	-628	655	-634	6
Top Yalgorup Member (m sub sea)	-713	741	-720	7
Top Wonnerup Member (m sub sea)	-1,426	1,418	-1,398	-28
Final depth	~ 1,550 m			
Completion depth (m)		HQ coring to TD		

Installing casing to TD, approx.

1,462 m (16/6/14)

Harvey 4 DCA Rig (RT = 4.0m)

	Odin's 3-D seismic depth prognosis (m AHD)	Approx. actual depth interpretation (m depth)	Approx. strata elevation (m AHD) from Cuttings	Diff between prognosed & prelim actual (m)
X : 389946.08 Y : 6343842.51				
Ground elevation, as surveyed (m AHD)	15.89			
Rig table datum (m AHD)	19.89			
Driller's datum (m AHD)	15.89			
Base of Leederville unconformity (m sub sea)	-154	165	-149	-5
Eneabba basal shale (m sub sea)	-837	808	-792	-43
Top Yalgorup Member (m sub sea)	-1,016	1,020	-1,004	-12
Top Wonnerup Member (m sub sea)	-1,665	1,617	-1,601	-64
Final depth	~ 1,800 m	1,802	-1,786	-14
Completion depth (m)		1,802	-1,786	

Drilling finished 21/04/15

Notes

Well sites surveyed by DMP's surveyor in Nov 14 and again on 25 April 2015.

Actual strata tops are preliminary pending palynology results and wireline logging data

There is difficulty in defining transition between the Eneabba Formation and

Yalgorup Member.

Intervals Cored

Harvey 2 was fully-cored. Core samples preserved in mineral oil (claystone and/or siltstone- rich facies):

Sample Number	Depth (m)		Date
	Start	End	
1	402.1	402.45	12/01/2015
2	411.75	412.1	14/01/2015
3	417.6	417.95	14/01/2015
4	424.7	425.05	14/01/2015
5	433	433.35	14/01/2015
6	452.1	452.45	14/01/2015
7	464.7	464.95	15/01/2015
8	487.4	487.75	15/01/2015
9	492	492.3	16/01/2015
10	501.95	502.3	16/01/2015
11	510.95	511.3	17/01/2015
12	725.2	725.55	27/01/2015
13	742.75	743	27/01/2015
14	748.1	748.45	27/01/2015
15	754.9	755.2	27/01/2015
16	767.05	767.3	28/01/2015
17	775.9	776.25	28/01/2015
18	790.65	790.95	28/01/2015
19	815.9	816.25	29/01/2015
20	835.35	835.65	30/01/2015
21	961.25	961.6	04/02/2015
22	968.25	968.55	04/02/2015
23	979.1	979.4	05/02/2015
24	988	988.25	05/02/2015
25	1036.4	1036.7	07/02/2015
26	1107.85	1108.15	08/02/2015
27	1119.15	1119.4	08/02/2015
28	1132.05	1132.4	09/02/2015
29	1145.25	1145.55	09/02/2015
30	1166.05	1166.35	10/02/2015
31	1190.75	1191.05	10/02/2015
32	1228.55	1228.8	12/02/2015

Radio-isotope samples

Sample Number	Depth (m)		Date
	Start	End	
R1	464.3	464.55	15/01/2015
R2	512.4	512.75	17/01/2015
R3	975.9	976.22	05/02/2015
R4	1085.25	1085.55	08/02/2015

Harvey 3 was fully-cored.

Core samples preserved in mineral oil (claystone and/or siltstone- rich facies):

Sample Number	Depth (m)		Date
	Start	End	
1	604.25	604.65	27/03/2015
2	647.55	647.9	28/03/2015
3	657	657.2	28/03/2015
4	662.7	663.05	28/03/2015
5	664.55	664.9	29/03/2015
6	673.25	673.55	29/03/2015
7	696.70	697.00	31/03/2015
8	717.50	717.80	01/04/2015
9	716.25	716.45	01/04/2015
10	720.15	720.45	01/04/2015
11	725.05	725.35	01/04/2015
12	728.60	728.90	02/04/2015
13	740.50	740.80	02/04/2015
14	743.75	743.95	02/04/2015
Harvey 3A			
15	765.55	765.85	09/04/2015
16	778.35	778.65	09/04/2015
17	888.05	888.35	17/04/2015
18	914.7	915	19/04/2015
19	1171.1	1172	03/05/2015
20	1226.3	1226.65	08/05/2015

Radio-isotope samples

Sample Number	Depth (m)		Date
	Start	End	
R1	688.55	688.85	30/03/2015
R2	725.05	725.35	01/04/2015
R3	735.3	735.6	02/04/2015

Yalgorup Member Sandstone (Glad wrapped)

Sample Number	Depth (m)		Date
	Start	End	
YS1	1250.95	125195	11/05/2015

Harvey 4 was interval-cored (four times), with a special large barrel use to retrieve a broken TCI roller bit in the Yalgorup Member.

Run 1		
893.00-894.00 m	placed in oil in PVC tubes	exposed to air for ~ 3 hours, transported to CoreLab on 19/02
894.00-895.00 m	placed in oil in PVC tubes	exposed to air for ~ 3 hours, transported to CoreLab on 19/02
895.00-895.96 m	placed in oil in PVC tubes	exposed to air for ~ 3 hours, transported to CoreLab on 19/02
895.96-896.00 m	dropped	-
896.00-896.30 m	wrapped in plastic, refrigerated	???
896.3	zipped plastic bag	transported to Core Library on 23/04/2015
896.30-897.30 m	placed in oil in PVC tubes	exposed to air for ~ 6.5 hours, transported to CoreLab on 19/02
897.30-898.30 m	placed in oil in PVC tubes	exposed to air for ~ 6.5 hours, transported to CoreLab on 19/02
898.30-899.25 m	placed in oil in PVC tubes	exposed to air for ~ 6.5 hours, transported to CoreLab on 19/02
899.25-899.30 m	zipped plastic bag	transported to Core Library on 23/04/2015
899.30 m	zipped plastic bag	transported to Core Library on 23/04/2015
Run 2		
898.40-898.60 m	zipped plastic bag	transported to Core Library on 23/04/2015
898.60-899.60 m	placed in oil in PVC tubes	exposed to air for ~ 2 hours, transported to CoreLab on 20/02
899.60-900.60 m	placed in oil in PVC tubes	exposed to air for ~ 2 hours, transported to CoreLab on 20/02
900.60-901.60 m	placed in oil in PVC tubes	exposed to air for ~ 2 hours, transported to CoreLab on 20/02
901.60-901.75 m	wrapped in glad wrap, alfoil, refrigerated	transported to CoreLab on 20/02
901.75-902.75 m	placed in oil in PVC tubes	exposed to air for ~ 2.75 hours, transported to CoreLab on 20/02
902.75-903.75 m	placed in oil in PVC tubes	exposed to air for ~ 2.75 hours, transported to CoreLab on 20/02
903.75-904.80 m	placed in oil in PVC tubes	exposed to air for ~ 2.75 hours, transported to CoreLab on 20/02
904.80-905.05 m	wrapped in glad wrap, alfoil, refrigerated	transported to CoreLab on 20/02
905.05-905.15 m	zipped plastic bag	transported to Core Library on 23/04/2015
905.15-906.15 m	placed in oil in PVC tubes	exposed to air for ~ 3.75 hours, transported to CoreLab on 20/02
906.15-907.15 m	placed in oil in PVC tubes	exposed to air for ~ 3.75 hours, transported to CoreLab on 20/02
907.15-908.05 m	placed in oil in PVC tubes	exposed to air for ~ 3.75 hours, transported to CoreLab on 20/02
908.05-908.35 m	2 x zipped plastic bags	transported to Core Library on 23/04/2015
Run 3		
1665.05-1666.65 m	wrapped in glad wrap and kept in tray	transported to Core Library on 29/4/2015
Run4		
1792.70-1802.55	kept in tray (except samples below)	transported to Core Library on 29/4/2015
1795.10-1795.60	Long term preservation sample - glad wrapped and placed in tubes	transported to Core Labs on 23/04/2015
1797.60-1798.10	Long term preservation sample - glad wrapped and placed in tubes	transported to Core Labs on 23/04/2015
1800.65-1801.15	Long term preservation sample - glad wrapped and placed in tubes	transported to Core Labs on 23/04/2015

The two samples from Run 1 in zip lock bags were crumbled core from the lifter and barrel join. These are estimated to be 0.05 – 0.10 m long.

Well Name	Sample type	Depth from (m)	Depth To (m)	Sampling and Preservation method	Comments
Harvey 4	6" Core from Yalgorup	1325.50	1326.60	Washed, placed in tray	Core was recovered during core operations to retrieve metals pieces from the bottom of the hole. Sent to Core Library 13/05/15.
Harvey 4	6" Core from Yalgorup	1324.00	1325.25	In PVC tube in mineral oil	Core was recovered during core operations to retrieve metals pieces from the bottom of the hole. Sent to Core Labs 13/05

1,324	1,327	Sandstone	Pale grey with thin purple mottled bands. Very fine to very coarse grained - occasional granular grains, moderately to poorly sorted, angular to sub-rounded, predominantly quartz (clear to frosted with grey and purple grains in purple bands), feldspar (white, pink); minor black heavy minerals, trace garnet and glauconite (increasing in purple band). Well cemented with trace argillic (pale green, dark purple) cementation. (Note: core samples are very different from drill cuttings either side, where siltstone/mudstone predominates - possible wash out from hole above, Steve Bolton, 2015).

Notes

- Plug selections to be referenced from Harvey 3 as the well has whole cores over the entire area of interest
- Horizontal Plugs to be taken every 1 m and Vertical Plugs every 3 m (close to 3rd horizontal plug) in wells Harvey 3 and Harvey 4.
- Harvey 4 has fewer plugs as the wells have been interval cored.
- Plug frequency reduced in Harvey 2 as it is not in the fairway of interest.
- The number of plugs has been increased from the original plan of 280 plugs (165 H, 105V).
- SCAL plugs to be CT scanned to check for consistency.
- No provision as yet for additional plugs for R&D. Researchers to advise.
- The well H-2 intercepts the F0 fault. This provides an opportunity to collect some plugs and do some tests in the fault zone. Whilst not visibly obvious, approximate depth of the intercept is between 340 and 440 m. This is largely based on Hylogger data where some distinct markers are seen – amorphous silica (348-385 m), gypsum (from 420 m), wet core signature (430-440 m). Cap rock type tests are planned here with 6 H and 2 V plugs.

2 FINAL SCOPE: ROUTINE CORE ANALYSIS (RCA)

No	Sample	Program	Requirement with estimated volumes	Comments
1.	Caprock (Eneabba and Yalgorup)	Preparation	Harvey 2: F10 investigation 6 horizontal plugs and 2 vertical plugs (normal to bedding) Harvey 2: 10 horizontal plugs and 5 vertical plugs (normal to bedding) Harvey 3: 30 horizontal and 10 vertical plugs (normal to bedding) Harvey 4: 10 horizontal plugs and 5 vertical plugs (normal to bedding)	V plugs should be cut adjacent to relevant H plugs. From original plan number of V plugs reduced. V plugs taken every 2nd or 3rd H plug.
2.	Reservoir Yalgorup and Wonnerup)	Preparation	Harvey 2: 20 H and 10 V in Wonnerup Harvey 3: 140 Hand 50 V in Wonnerup Harvey 3: 20 H and 5 V in Yalgorup	. V plugs should be cut adjacent to relevant H plugs.

No	Sample	Program	Requirement with estimated volumes	Comments
			Harvey 4: 10 H and 5 V in Wonnerup	
3.	Caprock (Eneabba and Yalgorup	Routine rock properties: Caprock analysis	Harvey 2: F10 investigation 5 horizontal plugs and 1 vertical plugs (normal to bedding) Harvey 2: 8 horizontal plugs and 4 vertical plugs (normal to bedding) Harvey 3: 27 horizontal and 9 vertical plugs (normal to bedding) Harvey 4: 8 horizontal plugs and 4 vertical plugs (normal to bedding) Use selected plugs from Item 1	Kw and threshold pressure for CO2 injection to understand the paleosol properties for containment. Some vertical plugs to include the tree root systems in the Yalgorup
4.	Reservoir Yalgorup and Wonnerup)	Routine rock properties: Porosity and permeability (P&P) to gas and water (Kg and Kw) at NOBP	Harvey 2: 20 horizontal and 10 vertical plugs Harvey 3: 140 H + 50 V plugs—Wonnerup Harvey 3: 20H + 5 V--Yalgorup Harvey 4: 10 horizontal and 5 vertical plugs Use plugs from Item 2	For evaluating porosity, Ka, Kw and grain density. Kw on 20% of plugs or more to be able to draw a correlation No Kw measurements in Harvey 2. Plugs to be taken in Wonnerup and Yalgorup sands.
5.	Reservoir Yalgorp and Wonnerup)	As in Item 4 but at a different pressure	Use selected plugs from Item 4	To evaluate the properties in 4 at a different pressure for estimation of KPhi at any NOBP using 2-point fit
6.	Core: Caprock and reservoir	Petrographic analysis: thin section (TS), X-Ray diffraction (XRD) and Scanning electron microscopy (SEM)	Use end-trims from the Caprock and P&P plugs. Caprock – F10 test – 6 samples Caprock: 14 representative samples Reservoir: 20 representative samples (4 Yalgorup and 16 Wonnerup)	For reservoir, plugs to be taken in Wonnerup and Yalgorup sands. For caprock samples, consider in Yalgorup and Eneabba paleosols. Select from those that undergo MICP/Pc tests in the SCAL programme. For the F10 confirm mineralogy particularly Gypsum
7.	Fluid	Fluid compositional analyses	Consider a total of 6 Modular Formation Dynamics Tester (MDT) samples	3 samples from H4 and possibly 3 from H3. Use 50% of the samples or less for baseline dissolved CO2 in the formation water in addition to the planned tests (10 ions etc.).

3 FINAL SCOPE: SPECIAL CORE ANALYSIS (SCAL)

No	Sample	Program Name	Details	CoreLabs Discussions
1.	Caprock	Kw and threshold capillary pressure	Capillary Pressure for supercritical CO2 brine: 1) capillary pressure H2 fault—1H + 1V H2 shale—2H+1V H3 shale—3H +1V H4 shale—2H+1V	On *samples from Eneabba Formation/Yalgorup Member.* 10 plugs selected from RCA item 1. 7H and 3V. 2 plugs from the F10 fault set in H2 (1H and 1V) 12 plugs in total
2.	Caprock and Reservoir	Capillary pressure: mercury injection capillary pressure (MICP)	Will provide pore size distribution curves, capillary entry pressure and to establish seal capacity (not suitable in heterogeneous seal)	On *samples from Eneabba Formation/Yalgorup Member.* Trim ends of 10 plugs from SCAL item 1. This is a destructive test. 2 plugs from the F10 fault set in H2 (trim-ends from SCAL item 1). Trims of 6 Krel samples (SCAL item 4). 18 samples in total
3.	Caprock and Reservoir	Geomechanical testing: Triaxial compression test with ultrasonic velocities (TXC)	The parameters measured are static/dynamic Young's Modulus, Bulk Modulus, Shear Modulus and Poisson's Ratio for rock stability	Use V plugs from P&P for the Wonnerup reservoir. This is a destructive test but the materials will still be available for other uses.
4.	Reservoir	Relative permeability	Drainage and imbibition and end point measurements for CO_2/water (brine) under high pressure and temperature	End point measurement for 4 horizontal plugs. Drainage and imbibition for 2 horizontal plugs. Plugs from porosity and permeability (P&P) testing will be used if suitable (RCA item 4)

Note: Versions 7 & 8 of this document include input from ODIN Consulting.

Document developed by Sandeep Sharma, in consultation with Tony Kenniard, Core Lab, 26 May 2015.

Reviewed by Louise Stelfox, 16 June 2015

Update to sample numbers (in yellow) advised by Tony Kenniard, Core Lab, 24 June 2015.