

# Appendix J

## Groundwater

## Appendix J Groundwater

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# Appendix J.1 Groundwater Chemistry

## J.1 Groundwater Chemistry

Table 1-1 Summary of Ground Water Chemistry at Refinery Site Bores

Analyte	Units	Monitoring Bore				Environmental Investigation Trigger Levels: ANZECC, 2000	
		Y1	Y2	Y3	Y4	Stock Water	Irrigation
						<b>Trigger Level Exceedance Legend</b>	
						<b>1000</b>	<b>1000</b>
TDS	mg/L	<b>9,792</b>	<b>10,202</b>	<b>8,832</b>	678	2,000- 4,000 <sup>#</sup>	NR
Calcium	mg/L	266	344	506	8	1,000	NR
Magnesium	mg/L	438	382	348	13	NR	NR
Sodium	mg/L	2,310	2,450	1,800	128	NR	115-460*
Potassium	mg/L	60	20	18	<1	NR	NR
Sulphate	mg/L	473	534	272	18	1,000	NR
Chloride	mg/L	5,230	5,230	4,470	197	NR	175-700*
Total Alkalinity	mg/L	234	225	115	41	NR	NR
Arsenic	mg/L	<0.001	<0.001	<0.001	<0.001	NR	2.0 <sup>^</sup>
Barium	mg/L	0.032	0.290	0.244	0.036	NR	NR
Cadmium	mg/L	0.0003	0.0002	0.0002	<0.0001	NR	0.05 <sup>^</sup>
Chromium	mg/L	<0.001	0.052	0.068	<0.001	NR	1.0 <sup>^</sup>
Cobalt	mg/L	0.012	0.087	0.050	0.003	NR	0.1 <sup>^</sup>
Copper	mg/L	0.003	0.007	0.002	0.001	NR	5 <sup>^</sup>
Lead	mg/L	0.108	0.004	0.149	0.021	NR	5 <sup>^</sup>
Manganese	mg/L	1.92	1.21	1.45	0.110	NR	10 <sup>^</sup>
Nickel	mg/L	0.006	0.024	0.021	<0.001	NR	2 <sup>^</sup>
Zinc	mg/L	0.08	0.056	0.125	0.060	NR	5 <sup>^</sup>
Mercury	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	NR	0.002 <sup>^</sup>
C6-C9 Fraction	µg/L	<20	<20	NT	NT	NR	NR
C10-C14 Fraction	µg/L	<50	<50	NT	NT	NR	NR
C15-C28 Fraction	µg/L	200	<100	NT	NT	NR	NR
C29-C36 Fraction	µg/L	<50	<50	NT	NT	NR	NR
Benzene	µg/L	<1	<1	NT	NT	NR	NR
Toluene	µg/L	<2	<2	NT	NT	NR	NR
Ethylene	µg/L	<2	<2	NT	NT	NR	NR
Xylene	µg/L	<4	<4	NT	NT	NR	NR

# Appendix J.2 Bore Information

## J.2 Bore Information

DATE 30/01/2006

**BORE CARD REPORT - PUBLISHABLE**

REG NUMBER 91090

REGISTRATION DETAILS

<b>OFFICE</b> Rockhampton	<b>BASIN</b> 1320	<b>LATITUDE</b> 23-55-20	<b>MAP-SCALE</b> 104
<b>DATE LOG RECD</b>	<b>SUB-AREA</b>	<b>LONGITUDE</b> 151-02-28	<b>MAP-SERIES</b> M
<b>D/O FILE NO.</b> 520/001(10)	<b>SHIRE</b> 2100-CALLIOPE	<b>EASTING</b> 300606	<b>MAP-NO</b> 9150
<b>R/O FILE NO.</b> 81-00014	<b>LOT</b> 10	<b>NORTHING</b> 7353002	<b>MAP NAME</b> GLADSTONE
<b>H/O FILE NO.</b>	<b>PLAN</b> CL40348	<b>ZONE</b> 56	<b>PROG SECTION</b>
	<b>ORIGINAL DESCRIPTION</b> L10 CL40348	<b>ACCURACY</b> SKET	<b>PRES EQUIPMENT</b>
		<b>GPS ACC</b>	
<b>GIS LAT</b> -23.922228591	<b>PARISH NAME</b> 3374-MT LARCOM		<b>ORIGINAL BORE NO</b> STREETER OLO
<b>GIS LNG</b> 151.041035824	<b>COUNTY</b> CLINTON		<b>BORE LINE</b> -
<b>CHECKED</b> Y	<b>PROPERTY NAME</b>		<b>POLYGON</b>
	<b>FIELD LOCATION</b>		<b>RN OF BORE REPLACE</b>
<b>FACILITY TYPE</b> SF	<b>DATE DRILLED</b> 07/APR/93		<b>DATA OWNER</b>
<b>STATUS</b> EX	<b>DRILLERS NAME</b> WEST K		<b>CONFIDENTIAL</b>
<b>ROLES</b> WS	<b>DRILL COMPANY</b> DEPCO		
	<b>METHOD OF CONST.</b> ROTARY		

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	07/04/1993	1	Polyvinyl Chloride	5.900	WT	141	0.00	16.00
A	07/04/1993	2	Perforated or Slotted Casing	3.000	AP	141	10.00	16.00
A	07/04/1993	3	Gravel Pack		GR		10.00	16.00
A	07/04/1993	4	Open Hole				16.00	16.10

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	0.80	TOPSOIL
2	0.80	3.00	CLAY
3	3.00	5.00	CLAY & BOULDERS
4	5.00	13.00	CLAYBOUND BOULDERS WATER
5	13.00	16.10	FRACTURED FRESH ANDESITE WATER

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RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
901			ONE TEST HOLE
902			SWL 7/4/93 3M
903			AIRTEST 7/4/93 4.5L/S
910			DRILLERS COND 7/4/93 1640 MICROS/CM

STRATIGRAPHY DETAILS

SOURCE	RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
DNR	1	0.00		CRANIA BEDS

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	10.00	16.00	TCHY	07/04/1993	-3.00	N	COND 1640	4.50	Y	FR	CRANA BEDS

PUMP TEST DETAILS PART 1

\*\*\*\* NO RECORDS FOUND \*\*\*\*

PUMP TEST DETAILS PART 2

\*\*\*\* NO RECORDS FOUND \*\*\*\*

BORE CONDITION

\*\*\*\* NO RECORDS FOUND \*\*\*\*

ELEVATION DETAILS

\*\*\*\* NO RECORDS FOUND \*\*\*\*

WATER ANALYSIS PART1

\*\*\*\* NO RECORDS FOUND \*\*\*\*

WATER ANALYSIS PART 2

\*\*\*\* NO RECORDS FOUND \*\*\*\*

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 91090

WATER LEVEL DETAILS  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

WIRE LINE LOG DETAILS  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

FIELD MEASUREMENTS  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

SPECIAL WATER ANALYSIS  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

VALIDATION LOG - PART 1

REGDET	CASING	STRLOG	AQUIFR	PUMTES	ELVDET	WLVDDET	FIELDQ
Y 04/09/1998	Y 20/10/1993	Y 04/09/1998	Y 04/09/1998	Y 20/10/1993	Y 20/10/1993	Y 20/10/1993	Y 20/10/1993

VALIDATION LOG - PART 2

WATANL	SAMPLE	STRTIG	WIRLOG	MULCND	BRCND	FPREAD	GNOTES
Y 20/10/1993		Y 20/10/1993		Y 20/10/1993			

GENERAL NOTES  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

DATE 30/01/2006

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 111019

REGISTRATION DETAILS

OFFICE Rockhampton	BASIN 1320	LATITUDE 23-54-00	MAP-SCALE 104
DATE LOG RECD	SUB-AREA	LONGITUDE 151-02-41	MAP-SERIES M
D/O FILE NO. 520/001(66)	SHIRE 2100-CALLIOPE	EASTING 300940	MAP-NO 9150
R/O FILE NO.	LOT 24	NORTHING 7355463	MAP NAME GLADSTONE
H/O FILE NO.	PLAN CTN105	ZONE 56	PROG SECTION
	ORIGINAL DESCRIPTION	ACCURACY SKET	PRES EQUIPMENT
		GPS ACC	
GIS LAT -23.900053545	PARISH NAME 3374-MT LARCOM		ORIGINAL BORE NO STREETER
GIS LNG 151.044655392	COUNTY CLINTON		BORE LINE -
CHECKED Y	PROPERTY NAME WOODRIDGE		
	FIELD LOCATION BRUCE HIGHWAY VIA CALLIOPE		POLYGON
			RN OF BORE REPLACE
FACILITY TYPE SF	DATE DRILLED 22/SEP/95		DATA OWNER
STATUS EX	DRILLERS NAME ROBERTS N		CONFIDENTIAL N
ROLES WS	DRILL COMPANY DEPCO		
	METHOD OF CONST. ROTARY		

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	22/09/1995	1	Polyvinyl Chloride	5.900	WT	140	0.00	24.40

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	5.80	TOP SOIL, CLAY & CREEK GRAVEL
2	5.80	24.40	DIORITE

STRATIGRAPHY DETAILS

\*\*\*\* NO RECORDS FOUND \*\*\*\*

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
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DATE 30/01/2006

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 111019

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	22.30		INTR	22/09/1995	-1.50	N	COND 2500	0.63	Y	FR	MOUNT HOLLY BEDS

PUMP TEST DETAILS PART 1

\*\*\*\* NO RECORDS FOUND \*\*\*\*

PUMP TEST DETAILS PART 2

\*\*\*\* NO RECORDS FOUND \*\*\*\*

BORE CONDITION

\*\*\*\* NO RECORDS FOUND \*\*\*\*

ELEVATION DETAILS

\*\*\*\* NO RECORDS FOUND \*\*\*\*

WATER ANALYSIS PART1

\*\*\*\* NO RECORDS FOUND \*\*\*\*

WATER ANALYSIS PART 2

\*\*\*\* NO RECORDS FOUND \*\*\*\*

WATER LEVEL DETAILS

PIPE	DATE	MEASURE (m)	N/R	RMK	PIPE	DATE	MEASURE (m)	N/R	RMK	PIPE	DATE	MEASURE (m)	N/R	RMK
A	22/09/1995	-1.50		R										

WIRE LINE LOG DETAILS

\*\*\*\* NO RECORDS FOUND \*\*\*\*

FIELD MEASUREMENTS

PIPE	DATE	DEPTH (m)	COND (uS/cm)	pH	TEMP (C)	NO3 (mg/L)	DO (mg/L)	Eh (mV)	METH	SOURCE
A	22/09/1995	24.40	2500						AI	GB

**GROUNDWATER DATABASE**  
**BORE CARD REPORT - PUBLISHABLE**

REG NUMBER 111019

SPECIAL WATER ANALYSIS

\*\*\*\* NO RECORDS FOUND \*\*\*\*

VALIDATION LOG - PART 1

REGDET	CASING	STRLOG	AQUIFR	PUMTES	ELVDET	WLVDDET	FIELDQ
Y 04/01/1999	Y 04/01/1999	Y 04/01/1999	Y 04/01/1999			Y 04/01/1999	Y 04/01/1999

VALIDATION LOG - PART 2

WATANL	SAMPLE	STRTIG	WIRLOG	MULCND	BRCOND	FPREAD	GNOTES
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GENERAL NOTES

\*\*\*\* NO RECORDS FOUND \*\*\*\*

DATE 30/01/2006

**BORE CARD REPORT - PUBLISHABLE**

REG NUMBER 111795

REGISTRATION DETAILS

OFFICE Rockhampton	BASIN 1320	LATITUDE 23-53-30	MAP-SCALE 253
DATE LOG RECD	SUB-AREA	LONGITUDE 151-06-17	MAP-SERIES M
D/O FILE NO. 520/001(7)	SHIRE 2100-CALLIOPE	EASTING 307048	MAP-NO 9150-33
R/O FILE NO.	LOT 89	NORTHING 7356474	MAP NAME
H/O FILE NO.	PLAN CTN248	ZONE 56	PROG SECTION
	ORIGINAL DESCRIPTION	ACCURACY	PRES EQUIPMENT
		GPS ACC	
GIS LAT -23.891664071	PARISH NAME 897-CALLIOPE		ORIGINAL BORE NO
GIS LNG 151.104761513	COUNTY CLINTON		BORE LINE -
CHECKED Y	PROPERTY NAME JOHN HENDRY 'ROSS' BOYLE		
	FIELD LOCATION BOYLES ROAD, CALLIOPE		POLYGON
			RN OF BORE REPLACE
FACILITY TYPE SF	DATE DRILLED 20/SEP/02		DATA OWNER
STATUS EX	DRILLERS NAME M CROWSON		CONFIDENTIAL
ROLES WS	DRILL COMPANY GLADSTONE DRILLING		
	METHOD OF CONST. ROTARY		

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	20/09/2002	1	Polyvinyl Chloride	5.900	WT	140	0.00	20.00
A	20/09/2002	2	Perforated or Slotted Casing	1.500	AP	140	16.00	20.00
X	20/09/2002	3	Grout			205	0.00	2.00

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	3.00	DARK BROWN CLAY
2	3.00	5.00	BROKEN ROCK
3	5.00	16.00	LIGHT BROWN CLAY
4	16.00	20.00	BROKEN BROWN ROCK

STRATIGRAPHY DETAILS

\*\*\*\* NO RECORDS FOUND \*\*\*\*

DATE 30/01/2006

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 111795

<u>AQUIFER DETAILS</u>													
REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME		
1	16.00	20.00	MDST	20/09/2002	-10.00	N	COND 3500	2.52	Y	FR	CRANA BEDS		

PUMP TEST DETAILS PART 1  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

PUMP TEST DETAILS PART 2  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

BORE CONDITION  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

ELEVATION DETAILS  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

WATER ANALYSIS PART1  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

WATER ANALYSIS PART 2  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

WATER LEVEL DETAILS  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

WIRE LINE LOG DETAILS  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

<u>FIELD MEASUREMENTS</u>											
PIPE	DATE	DEPTH (m)	COND (uS/cm)	pH	TEMP (C)	NO3 (mg/L)	DO (mg/L)	Eh (mV)	METH	SOURCE	
A	20/09/2002	16.00	3500						Al	GB	

SPECIAL WATER ANALYSIS

GROUNDWATER DATABASE  
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REG NUMBER 111795

\*\*\*\* NO RECORDS FOUND \*\*\*\*

VALIDATION LOG - PART 1

REGDET	CASING	STRLOG	AQUIFR	PUMTES	ELVDET	WLVDDET	FIELDQ
Y 29/07/2003	Y 29/07/2003	Y 29/07/2003	Y 29/07/2003				

VALIDATION LOG - PART 2

WATANL	SAMPLE	STRTIG	WIRLOG	MULCND	BRCOND	FPREAD	GNOTES
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GENERAL NOTES

\*\*\*\* NO RECORDS FOUND \*\*\*\*

DATE 30/01/2006

BORE CARD REPORT - PUBLISHABLE

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**\*\* End of Report \*\***

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# GROUNDWATER DATABASE

DATE 30/01/2006

## BORE CARD REPORT - PUBLISHABLE

REG NUMBER 88338

### REGISTRATION DETAILS

OFFICE Rockhampton	BASIN 1320	LATITUDE 23-49-51	MAP-SCALE 104
DATE LOG RECD	SUB-AREA	LONGITUDE 151-09-31	MAP-SERIES M
D/O FILE NO. 515/030/0282	SHIRE 2100-CALLIOPE	EASTING 312438	MAP-NO 9150
R/O FILE NO. 30-0282	LOT 1	NORTHING 7363279	MAP NAME GLADSTONE
H/O FILE NO.	PLAN RP612126	ZONE 56	PROG SECTION
	ORIGINAL DESCRIPTION P108	ACCURACY SKET	PRES EQUIPMENT
		GPS ACC	
GIS LAT -23.830876784	PARISH NAME 897-CALLIOPE		ORIGINAL BORE NO OFFICE LICENCE ONLY
GIS LNG 151.158551632	COUNTY CLINTON		BORE LINE -
CHECKED Y	PROPERTY NAME		POLYGON
	FIELD LOCATION		RN OF BORE REPLACE
FACILITY TYPE SF	DATE DRILLED		DATA OWNER
STATUS EX	DRILLERS NAME		CONFIDENTIAL
ROLES WS	DRILL COMPANY		
	METHOD OF CONST. CABLE TOOL		

### CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	01/10/1969	1	Steel Casing (unspecified)	4.760	WT	152	0.00	23.80
A	01/10/1969	2	Perforated or Slotted Casing		AP	152	21.90	23.80

### STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	12.80	SOIL & GRITTY CLAY
2	12.80	23.77	MED TO HARD GRANITE(????) SOFT BANDS
902			SWL 23/10/69 - 11.2 M
903			BAILER TEST - 1.0 L/S
910			WRC COND 10/69 - 1880 MICROS/CM

### STRATIGRAPHY DETAILS

DNR	1	0.00	DOONSIDE FORMATION
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DATE 30/01/2006

BORE CARD REPORT - PUBLISHABLE

REG NUMBER 88338

SOURCE	RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
DNR	2	0.00		DOONSIDE FORMATION

AQUIFER DETAILS

REC	TOP BED(M)	BOTTOM BED(M)	BED LITHOLOGY	DATE	SWL (m)	FLOW	QUALITY	YIELD (l/s)	CTR	CONDIT	FORMATION NAME
1	17.40		GNTE	23/10/1969	-11.20	N			Y	WZ	DOONSIDE FORMATION
2	22.00	23.80	GNTE			N	COND 1880	1.00	Y	WZ	DOONSIDE FORMATION

PUMP TEST DETAILS PART 1

\*\*\*\* NO RECORDS FOUND \*\*\*\*

PUMP TEST DETAILS PART 2

\*\*\*\* NO RECORDS FOUND \*\*\*\*

BORE CONDITION

\*\*\*\* NO RECORDS FOUND \*\*\*\*

ELEVATION DETAILS

\*\*\*\* NO RECORDS FOUND \*\*\*\*

WATER ANALYSIS PART1

PIPE	DATE	RD	ANALYST	QAN	DEPT	RMK	SRC	COND (uS/cm)	pH	Si (mg/L)	TOTAL IONS (mg/L)	TOTAL SOLIDS (mg/L)	HARD	ALK	FIG. OF MERIT	SAR	RAH
A	23/10/1969	1	GCL	44034	22.00	PU	GB	1880	7.6		1256.55	1042.56	486	350	1.0	4.5	
A	09/09/1970	1	GCL	46660	22.00	PU	GB	1710	7.1		1221.20	982.30	439	385	0.9	4.6	

WATER ANALYSIS PART 2

PIPE	DATE	RD	Na	K	Ca	Mg	Mn	HCO3	Fe	CO3	Cl	F	NO3	SO4	Zn	Al	B	Cu
A	23/10/1969	1	227.0		84.0	67.0		421.0		3.0	430.0	0.55		24.0				
A	09/09/1970	1	222.0		82.0	57.0		470.0			355.0	0.20		35.0				

**GROUNDWATER DATABASE**  
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REG NUMBER 88338

WATER LEVEL DETAILS  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

WIRE LINE LOG DETAILS  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

FIELD MEASUREMENTS  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

SPECIAL WATER ANALYSIS  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

VALIDATION LOG - PART 1

REGDET	CASING	STRLOG	AQUIFR	PUMTES	ELVDET	WLVDDET	FIELDQ
Y 24/01/1992	Y 24/01/1992	Y 24/01/1992	Y 04/08/1999	Y 24/01/1992	Y 24/01/1992	Y 24/01/1992	Y 24/01/1992

VALIDATION LOG - PART 2

WATANL	SAMPLE	STRTIG	WIRLOG	MULCND	BRCND	FPREAD	GNOTES
Y 24/01/1992		Y 24/01/1992		Y 24/01/1992			

GENERAL NOTES  
 \*\*\*\* NO RECORDS FOUND \*\*\*\*

DATE 30/01/2006

**BORE CARD REPORT - PUBLISHABLE**

REG NUMBER 111583

REGISTRATION DETAILS

OFFICE Rockhampton	<b>BASIN</b> 1320	<b>LATITUDE</b> 23-52-14	<b>MAP-SCALE</b> 503
<b>DATE LOG RECD</b>	<b>SUB-AREA</b>	<b>LONGITUDE</b> 151-08-17	<b>MAP-SERIES</b> M
<b>D/O FILE NO.</b> 520/001/7	<b>SHIRE</b> 2100-CALLIOPE	<b>EASTING</b> 310410	<b>MAP-NO</b> 9150-3
<b>R/O FILE NO.</b>	<b>LOT</b> 40	<b>NORTHING</b> 7358844	<b>MAP NAME</b>
<b>H/O FILE NO.</b>	<b>PLAN</b> CTN157	<b>ZONE</b> 56	<b>PROG SECTION</b>
	<b>ORIGINAL DESCRIPTION</b>	<b>ACCURACY</b> SKET	<b>PRES EQUIPMENT</b>
		<b>GPS ACC</b>	
<b>GIS LAT</b> -23.87068022	<b>PARISH NAME</b> 897-CALLIOPE		<b>ORIGINAL BORE NO</b> PURKIS
<b>GIS LNG</b> 151.138072885	<b>COUNTY</b> CLINTON		<b>BORE LINE</b> -
<b>CHECKED</b> Y	<b>PROPERTY NAME</b>		<b>POLYGON</b>
	<b>FIELD LOCATION</b> CALLIOPE RIVER - TARGINIE RD VIA YARWUN		<b>RN OF BORE REPLACE</b>
<b>FACILITY TYPE</b> SF	<b>DATE DRILLED</b> 04/OCT/01		<b>DATA OWNER</b> DNR
<b>STATUS</b> EX	<b>DRILLERS NAME</b> BALL W		<b>CONFIDENTIAL</b> N
<b>ROLES</b> WS	<b>DRILL COMPANY</b> G WARD DRILLING		
	<b>METHOD OF CONST.</b> ROTARY		

CASING DETAILS

PIPE	DATE	RECORD NUMBER	MATERIAL DESCRIPTION	MAT SIZE (mm)	SIZE DESC	OUTSIDE DIAM (mm)	TOP (m)	BOTTOM (m)
A	04/10/2001	1	Polyvinyl Chloride	5.900	WT	140	0.00	22.50
A	04/10/2001	2	Perforated or Slotted Casing				10.50	22.50
A	04/10/2001	3	Gravel Pack	5.000	GR	165	0.00	22.50

STRATA LOG DETAILS

RECORD NUMBER	STRATA TOP (m)	STRATA BOT (m)	STRATA DESCRIPTION
1	0.00	1.00	TOP SOIL
2	1.00	17.00	CLAY & DECOMPOSED ROCK
3	17.00	22.50	BLUE GRANITE ? *

STRATIGRAPHY DETAILS

\*\*\*\* NO RECORDS FOUND \*\*\*\*



**GROUNDWATER DATABASE**  
**BORE CARD REPORT - PUBLISHABLE**

REG NUMBER 111583

SPECIAL WATER ANALYSIS

\*\*\*\* NO RECORDS FOUND \*\*\*\*

VALIDATION LOG - PART 1

REGDET	CASING	STRLOG	AQUIFR	PUMTES	ELVDET	WLVDDET	FIELDQ
Y 15/01/2002	Y 15/01/2002	Y 15/01/2002	Y 15/01/2002			Y 15/01/2002	Y 15/01/2002

VALIDATION LOG - PART 2

WATANL	SAMPLE	STRTIG	WIRLOG	MULCND	BRCOND	FPREAD	GNOTES
--------	--------	--------	--------	--------	--------	--------	--------

GENERAL NOTES

\*\*\*\* NO RECORDS FOUND \*\*\*\*

DATE 30/01/2006

BORE CARD REPORT - PUBLISHABLE

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**\*\* End of Report \*\***

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# Appendix J.3 Certificates of Analysis

## J.3 Certificates of Analysis



## CERTIFICATE OF ANALYSIS

<i>Client</i>	: URS AUSTRALIA PTY LTD (QLD)	<i>Laboratory</i>	: ALS Environmental Brisbane	<i>Page</i>	: 1 of 7
<i>Contact</i>	: MR TIM EZZY	<i>Contact</i>	: Michael Heery	<i>Work Order</i>	: <b>EB0604401</b>
<i>Address</i>	: GPO BOX 302 BRISBANE QLD AUSTRALIA 4001	<i>Address</i>	: 32 Shand Street Stafford QLD Australia 4053		
<i>E-mail</i>	: tim_ezzy@urscorp.com	<i>E-mail</i>	: Michael.Heery@alsenviro.com		
<i>Telephone</i>	: 07 3243 2111	<i>Telephone</i>	: 61-7-32437222	<i>Date received</i>	: 8 May 2006
<i>Facsimile</i>	: 07 3243 2199	<i>Facsimile</i>	: 61-7-32437259	<i>Date issued</i>	: 18 May 2006
<i>Project</i>	: 42625833	<i>Quote number</i>	: EN/001/05	<i>No. of samples</i>	- Received : 9
<i>Order number</i>	: 16031			<i>Analysed</i>	: 9
<i>C-O-C number</i>	: - Not provided -				
<i>Site</i>	: GPN Plant/RSF sites				

### ALSE - Excellence in Analytical Testing



NATA Accredited Laboratory  
825

This document is issued in  
accordance with NATA's  
accreditation requirements.

Accredited for compliance with  
ISO/IEC 17025.

This document has been digitally signed by those names that appear on this report and are the authorised signatories. Digital signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

<i>Signatory</i>	<i>Position</i>	<i>Department</i>
Carsten Emrich	Senior Organic Chemist	Organics - NATA 825 (818 - Brisbane)
Stephen Hislop	Laboratory Diagnostician	Inorganics - NATA 825 (818 - Brisbane)

## Comments

This report for the ALSE reference EB0604401 supersedes any previous reports with this reference. Results apply to the samples as submitted. All pages of this report have been checked and approved for release.

This report contains the following information:

### 1 Analytical results for samples submitted

When moisture determination has been performed, results are reported on a dry weight basis. When a reported 'less than' result is higher than the LOR, this may be due to primary sample extracts/digestion dilution and/or insufficient sample amount for analysis. Surrogate Recovery Limits are static and based on USEPA SW846 or ALS-QWI/EN38 (in the absence of specified USEPA limits). Where LOR of reported result differ from standard LOR, this may be due to high moisture, reduced sample amount or matrix interference. When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for process purposes. Abbreviations: CAS number = Chemical Abstract Services number, LOR = Limit of Reporting. \* Indicates failed Surrogate Recoveries.

### 1 Surrogate control limits

The analytical procedures used by ALS Environmental are based on established internationally-recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house procedure are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported herein. Reference methods from which ALSE methods are based are provided in parenthesis.

Page Number : 3 of 7  
 Client : URS AUSTRALIA PTY LTD (QLD)  
 Work Order : EB0604401



**Analytical Results**

				Client Sample ID :	RSF9	RSF1	Y1	Y2	Y3
				Sample Matrix Type / Description :	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
				Sample Date / Time :	5 May 2006 15:00	6 May 2006 15:00	6 May 2006 15:00	6 May 2006 15:00	6 May 2006 15:00
				Laboratory Sample ID :	EB0604401-001	EB0604401-002	EB0604401-003	EB0604401-004	EB0604401-005
Analyte	CAS number	LOR	Units						
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	<1	<1
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	543	787	234	225	115	115
Total Alkalinity as CaCO3		1	mg/L	543	787	234	225	115	115
<b>ED040F: Dissolved Major Anions</b>									
Sulphate as SO4 2-	14808-79-8	1	mg/L	27	150	473	534	272	272
<b>ED045P: Chloride by PC Titrator</b>									
Chloride	16887-00-6	1	mg/L	171	226	5230	5230	4470	4470
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L	79	32	266	344	506	506
Magnesium	7439-95-4	1	mg/L	47	51	438	382	348	348
Sodium	7440-23-5	1	mg/L	165	394	2310	2450	1800	1800
Potassium	7440-09-7	1	mg/L	4	10	60	20	18	18
<b>EG020F: Dissolved Metals by ICP-MS</b>									
Arsenic	7440-38-2	0.001	mg/L	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	7440-39-3	0.001	mg/L	0.257	0.155	0.032	0.290	0.244	0.244
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0001	0.0003	0.0002	0.0002	0.0002
Chromium	7440-47-3	0.001	mg/L	<0.001	0.021	<0.001	0.052	0.068	0.068
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.012	0.087	0.050	0.050
Copper	7440-50-8	0.001	mg/L	0.002	0.002	0.003	0.007	0.002	0.002
Lead	7439-92-1	0.001	mg/L	0.298	0.079	0.108	0.004	0.149	0.149
Manganese	7439-96-5	0.001	mg/L	0.055	0.022	1.92	1.21	1.45	1.45
Nickel	7440-02-0	0.001	mg/L	<0.001	0.004	0.006	0.024	0.021	0.021
Vanadium	7440-62-2	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc	7440-66-6	0.005	mg/L	0.234	0.047	0.080	0.056	0.125	0.125
<b>EG035F: Dissolved Mercury by FIMS</b>									
Mercury	7439-97-6	0.0001	mg/L	0.0002	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
<b>EN055: Ionic Balance</b>									
Total Anions		0.01	meq/L	16.2	25.2	162	163	134	134
Total Cations		0.01	meq/L	15.1	23.2	151	156	133	133
Ionic Balance		0.01	%	3.77	4.30	3.43	2.31	0.40	0.40
<b>EP080/071: Total Petroleum Hydrocarbons</b>									
C6 - C9 Fraction		20	µg/L	----	----	<20	<20	----	----
C10 - C14 Fraction		50	µg/L	----	----	<50	<50	----	----
C15 - C28 Fraction		100	µg/L	----	----	200	<100	----	----
C29 - C36 Fraction		50	µg/L	----	----	<50	<50	----	----

Page Number : 4 of 7  
 Client : URS AUSTRALIA PTY LTD (QLD)  
 Work Order : EB0604401



**Analytical Results**

				Client Sample ID :	RSF9	RSF1	Y1	Y2	Y3
				Sample Matrix Type / Description :	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID
				Sample Date / Time :	5 May 2006 15:00	6 May 2006 15:00	6 May 2006 15:00	6 May 2006 15:00	6 May 2006 15:00
				Laboratory Sample ID :					
Analyte	CAS number	LOR	Units	EB0604401-001	EB0604401-002	EB0604401-003	EB0604401-004	EB0604401-005	
<b>EP080: BTEX</b>									
Benzene	71-43-2	1	µg/L	----	----	<1	<1	----	
Toluene	108-88-3	2	µg/L	----	----	<2	<2	----	
Ethylbenzene	100-41-4	2	µg/L	----	----	<2	<2	----	
meta- & para-Xylene	108-38-3	2	µg/L	----	----	<2	<2	----	
	106-42-3								
ortho-Xylene	95-47-6	2	µg/L	----	----	<2	<2	----	
<b>EP080S: TPH(V)/BTEX Surrogates</b>									
1,2-Dichloroethane-D4	17060-07-0	0.1	%	----	----	100	95.6	----	
Toluene-D8	2037-26-5	0.1	%	----	----	94.0	93.8	----	
4-Bromofluorobenzene	460-00-4	0.1	%	----	----	91.6	93.5	----	

Page Number : 5 of 7  
 Client : URS AUSTRALIA PTY LTD (QLD)  
 Work Order : EB0604401



## Analytical Results

				Client Sample ID :	Y4	Y5	Rinsate	Trip Blank	
				Sample Matrix Type / Description :	LIQUID	LIQUID	LIQUID	LIQUID	
				Sample Date / Time :	6 May 2006 15:00	6 May 2006 15:00	6 May 2006 15:00	6 May 2006 15:00	
				Laboratory Sample ID :					
Analyte	CAS number	LOR	Units	EB0604401-006	EB0604401-007	EB0604401-008	EB0604401-009		
<b>ED037P: Alkalinity by PC Titrator</b>									
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----		
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	----		
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	41	241	5	----		
Total Alkalinity as CaCO3		1	mg/L	41	241	5	----		
<b>ED040F: Dissolved Major Anions</b>									
Sulphate as SO4 2-	14808-79-8	1	mg/L	18	532	<1	----		
<b>ED045P: Chloride by PC Titrator</b>									
Chloride	16887-00-6	1	mg/L	197	5130	5	----		
<b>ED093F: Dissolved Major Cations</b>									
Calcium	7440-70-2	1	mg/L	8	362	<1	----		
Magnesium	7439-95-4	1	mg/L	13	375	<1	----		
Sodium	7440-23-5	1	mg/L	128	2540	2	----		
Potassium	7440-09-7	1	mg/L	<1	23	<1	----		
<b>EG020F: Dissolved Metals by ICP-MS</b>									
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	----		
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----		
Barium	7440-39-3	0.001	mg/L	0.036	0.338	<0.001	----		
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.0002	<0.0001	----		
Chromium	7440-47-3	0.001	mg/L	<0.001	0.056	<0.001	----		
Cobalt	7440-48-4	0.001	mg/L	0.003	0.085	<0.001	----		
Copper	7440-50-8	0.001	mg/L	0.001	0.007	<0.001	----		
Lead	7439-92-1	0.001	mg/L	0.021	0.003	<0.001	----		
Manganese	7439-96-5	0.001	mg/L	0.110	1.20	<0.001	----		
Nickel	7440-02-0	0.001	mg/L	<0.001	0.023	<0.001	----		
Vanadium	7440-62-2	0.05	mg/L	<0.05	<0.05	<0.05	----		
Zinc	7440-66-6	0.005	mg/L	0.060	0.027	<0.005	----		
<b>EG035F: Dissolved Mercury by FIMS</b>									
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----		
<b>EN055: Ionic Balance</b>									
Total Anions		0.01	meq/L	6.97	161	0.24	----		
Total Cations		0.01	meq/L	7.07	160	0.08	----		
Ionic Balance		0.01	%	0.56	0.23	----	----		
<b>EP080/071: Total Petroleum Hydrocarbons</b>									
C6 - C9 Fraction		20	µg/L	----	<20	<20	<20		
C10 - C14 Fraction		50	µg/L	----	<50	<50	----		
C15 - C28 Fraction		100	µg/L	----	<100	<100	----		
C29 - C36 Fraction		50	µg/L	----	<50	<50	----		

Page Number : 6 of 7  
 Client : URS AUSTRALIA PTY LTD (QLD)  
 Work Order : EB0604401



**Analytical Results**

				Client Sample ID :	Y4	Y5	Rinsate	Trip Blank	
				Sample Matrix Type / Description :	LIQUID	LIQUID	LIQUID	LIQUID	
				Sample Date / Time :	6 May 2006 15:00	6 May 2006 15:00	6 May 2006 15:00	6 May 2006 15:00	
				Laboratory Sample ID :					
Analyte	CAS number	LOR	Units	EB0604401-006	EB0604401-007	EB0604401-008	EB0604401-009		
<b>EP080: BTEX</b>									
Benzene	71-43-2	1	µg/L	----	<1	<1	<1	<1	
Toluene	108-88-3	2	µg/L	----	<2	<2	<2	<2	
Ethylbenzene	100-41-4	2	µg/L	----	<2	<2	<2	<2	
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	----	<2	<2	<2	<2	
ortho-Xylene	95-47-6	2	µg/L	----	<2	<2	<2	<2	
<b>EP080S: TPH(V)/BTEX Surrogates</b>									
1,2-Dichloroethane-D4	17060-07-0	0.1	%	----	93.7	89.0	102		
Toluene-D8	2037-26-5	0.1	%	----	91.8	90.3	95.2		
4-Bromofluorobenzene	460-00-4	0.1	%	----	91.2	89.2	96.7		

Page Number : 7 of 7  
Client : URS AUSTRALIA PTY LTD (QLD)  
Work Order : EB0604401



## Surrogate Control Limits

Matrix Type: WATER - Surrogate Control Limits

Surrogate Control Limits

Method name	Analyte name	Lower Limit	Upper Limit
<b>EP080: TPH Volatiles/BTEX</b>			
EP080S: TPH(V)/BTEX Surrogates	1,2-Dichloroethane-D4	80	120
	Toluene-D8	88	110
	4-Bromofluorobenzene	86	115

Appendix J.4  
Refinery Groundwater Bore Logs

**J.4 Refinery Groundwater Bore Logs**

# URS Australia Pty Ltd

# Monitoring Well Y1

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001  
Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

Drilling Contractor: **Geoprobe**

Drilling Method: **Down Hole Hammer (DHH)**  
 Logged By: **Tim Ezzy**  
 Checked By: **Tim Ezzy**  
 Date Started: **02-05-06**  
 Date Finished: **02-05-06**

Relative Level: **mRL**  
 Coordinates: **7361234.000 mN**  
**314416.000 mE**  
 Permit No:

Client:  
**Gladstone Pacific Nickel**

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)		Depth (m)	Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
				0		silty CLAY, light grey	LO	G	F	SA	P		D	CL
				1		GRAVEL, moderately cemented hardpan	VS	G	C	A	P		D	GC
				2		CLAY, grey to light brown	HA					H	D	CH
				3										
				4										
				5										
				6										
				7										
				8										
				9										
				10										
				11										
				12		CLAYEY SANDY GRAVEL, water bearing unit	LO	G	C	A	P		S	GC
				13										
				14										
				15										
				16										
				17										
				18										
				19										

MONITORING WELL GPN\_PLA\_LOGS.GPJ WCC\_AUS.GDT 12/05/06 This drawing is subject to COPYRIGHT. It remains the property of URS Australia Pty Ltd.

**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
 SWL: Static Water Level IWL: Initial Water Level

# URS Australia Pty Ltd

# Monitoring Well Y2

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001  
Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

Drilling Contractor: **Geoprobe**

Drilling Method: **Down Hole Hammer (DHH)**  
 Logged By: **Tim Ezzy**  
 Checked By: **Tim Ezzy**  
 Date Started: **02-05-06**  
 Date Finished: **02-05-06**

Relative Level: **mRL**  
 Coordinates: **7361603.000 mN**  
**314172.000 mE**  
 Permit No:

Client:  
**Gladstone Pacific Nickel**

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)		Depth (m)	Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
				0		SANDY GRAVEL, yellow-brown	LO	G	C	A	P		D	GC
				1										
				2										
				3										
				4										
				4		Cement grout								
				4		Class 18 uPVC 50mm casing								
				5										
				6										
				6		SWL (6.25 mbTOC 6 May 05)								
				7										
				8		Bentonite seal								
				9										
				9										
				9		SANDY GRAVEL, water bearing unit	LO	G	C	A	P		S	GC
				10										
				11		Class 18 uPVC 50mm slotted screen in sand annulus								
				12		Endcap								
				13										
				14										
				15										
				16										
				17										
				18										
				19										

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**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
 SWL: Static Water Level IWL: Initial Water Level

# URS Australia Pty Ltd

# Monitoring Well Y3

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001  
Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

Drilling Contractor: **Geoprobe**

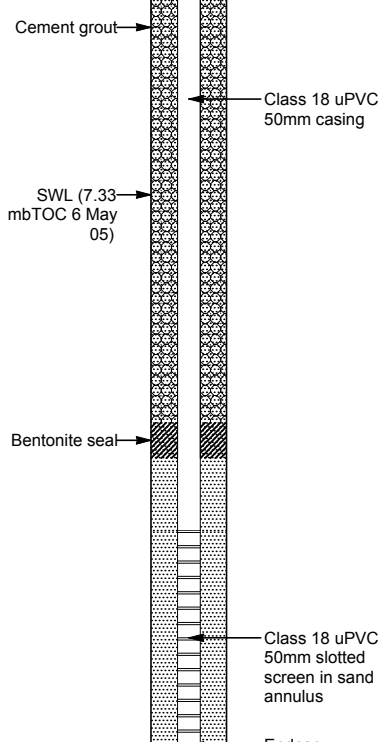
Drilling Method:  
**Down Hole Hammer (DHH)**

Logged By: **Tim Ezzy**  
Checked By: **Tim Ezzy**  
Date Started: **02-05-06**  
Date Finished: **02-05-06**

Relative Level: **mRL**  
Coordinates: **7361439.000 mN**  
**314117.000 mE**  
Permit No:

Client:  
**Gladstone Pacific Nickel**

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		Depth (m)	DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)				Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
					0		SANDY GRAVEL, yellow-brown	LO	G	C	A	P		D	GC
					1										
					2										
					3		CLAY, grey to yellow-brown	ST					M	D	CH
					4										
					5										
					6										
					7										
					8										
					9										
					10		SANDY GRAVEL, water bearing unit	LO	G	C	A	P		S	GC
					11										
					12										
					13										
					14										
					15										
					16										
					17										
					18										
					19										



MONITORING WELL GPN\_PLA\_LOGS.GPJ WCC\_AUS.GDT 12/05/06 This drawing is subject to COPYRIGHT. It remains the property of URS Australia Pty Ltd.

**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
SWL: Static Water Level IWL: Initial Water Level

# URS Australia Pty Ltd

# Monitoring Well Y4

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001  
Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

Drilling Contractor: **Geoprobe**

Drilling Method: **Down Hole Hammer (DHH)**  
 Logged By: **Tim Ezzy**  
 Checked By: **Tim Ezzy**  
 Date Started: **02-05-06**  
 Date Finished: **02-05-06**

Relative Level: **mRL**  
 Coordinates: **7361476.000 mN**  
**313863.000 mE**  
 Permit No:

Client:  
**Gladstone Pacific Nickel**

MONITORING WELL GPN\_PLA\_LOGS.GPJ\_WCC\_AUS.GDT 12/05/06 This drawing is subject to COPYRIGHT. It remains the property of URS Australia Pty Ltd.

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)		Depth (m)	Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
				0		SANDY GRAVEL, yellow-brown	LO	G	C	A	P		D	GC
				1										
				2										
				3										
				4										
				5										
				6										
				7		CLAYEY SANDY GRAVEL, water bearing unit	LO	G	C	A	P		S	GC
				8										
				9										
				10										
				11										
				12										
				13										
				14										
				15										
				16										
				17										
				18										
				19										

**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
 SWL: Static Water Level IWL: Initial Water Level

Appendix J.5  
RSF Groundwater Bore Logs

**J.5 RSF Groundwater Bore Logs**

# URS Australia Pty Ltd

# Monitoring Well RSF1

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001  
Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

Drilling Contractor: **Geoprobe**

Drilling Method: **Down Hole Hammer (DHH)**  
 Logged By: **Tim Ezzy**  
 Checked By: **Tim Ezzy**  
 Date Started: **01-05-06**  
 Date Finished: **01-05-06**

Relative Level: **mRL**  
 Coordinates: **7358473.000 mN**  
**300123.000 mE**  
 Permit No:

Client:  
**Gladstone Pacific Nickel**

MONITORING WELL GPN\_RS1\_LOGS.GPJ WCC\_AUS.GDT 11/05/06 This drawing is subject to COPYRIGHT. It remains the property of URS Australia Pty Ltd.

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)		Depth (m)	Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
				0	XXXX	silty CLAY, yellow-brown	ST					M	D	CF STS
				1	XXXX	SILTSTONE, grey-green	HA							
				2	XXXX									
				3	XXXX									
				4	XXXX									
				5	XXXX									
				6	XXXX									
				7	XXXX									
				8	XXXX									
				9	XXXX	MUDSTONE, grey-green	HA						D	MS
				10	XXXX									
				11	XXXX	GABBRO, dark grey/black matrix (pyroxene?) and white phenocrysts (plagioclase). Very fine grained (diabase)	HA						D	GAB
				12	XXXX									
				13	XXXX									
				14	XXXX									
				15	XXXX									
				16	XXXX									
				17	XXXX									
				18	XXXX									
				19	XXXX									
				20	XXXX									
				21	XXXX									
				22	XXXX									
				23	XXXX									
				24	XXXX	MUDSTONE, light grey-blue	HA						D	MS
				25	XXXX									
				26	XXXX									
				27	XXXX									
				28	XXXX									
				29	XXXX									
				30	XXXX									
				31	XXXX	SILTSTONE, light grey-blue	HA						SM	STS
				32	XXXX									
				33	XXXX									
				34	XXXX									
				35	XXXX									
				36	XXXX									
				37	XXXX									
				38	XXXX									
				39	XXXX									

**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
 SWL: Static Water Level IWL: Initial Water Level

# URS Australia Pty Ltd

# Monitoring Well RSF2

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001

Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

Drilling Contractor: **Geoprobe**

Drilling Method:  
**Down Hole Hammer (DHH)**

Logged By: **Tim Ezzy**  
Checked By: **Tim Ezzy**  
Date Started: **01-05-06**  
Date Finished: **01-05-06**

Relative Level: **mRL**  
Coordinates: **7357739.000 mN**  
**301384.000 mE**  
Permit No:

Client:  
**Gladstone Pacific Nickel**

MONITORING WELL GPN\_RS2\_LOGS.GPJ WCC\_AUS.GDT 11/05/06 This drawing is subject to COPYRIGHT. It remains the property of URS Australia Pty Ltd.

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		Depth (m)	DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)				Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
					0	CLAYEY SAND, yellow-brown	FI	G	F	SA	P		D	SC	
					1	MUDSTONE, brown-grey	HA						D	MS	
					2										
					3	GABBRO, dark grey/black matrix (pyroxene?) and white phenocrysts (plagioclase). Very fine grained (diabase)	HA						D	GAB	
					4										
					5										
					6										
					7										
					8										
					9										
					10										
					11										
					12										
					13										
					14										
					15										
					16										
					17										
					18										
					19										

**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
SWL: Static Water Level IWL: Initial Water Level

# URS Australia Pty Ltd

# Monitoring Well RSF3

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001

Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

Drilling Contractor: **Geoprobe**

Drilling Method:  
**Down Hole Hammer (DHH)**

Logged By: **Tim Ezzy**  
Checked By: **Tim Ezzy**  
Date Started: **01-05-06**  
Date Finished: **01-05-06**

Relative Level: **mRL**  
Coordinates: **7358691.000 mN**  
**300955.000 mE**

Client:  
**Gladstone Pacific Nickel**

Permit No:

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		Depth (m)	DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)				Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
					0		SANDY CLAY, dark to medium brown	FI	G	F	SA	P	L	D	CL
					1										
					2										
					3										
					4	x x	SILTSTONE, light grey-blue	HA						SM	STS
					5										
					6										
					7										
					8										
					9										
					10										
					11										
					12										
					13										
					14										
					15										
					16										
					17										
					18										
					19										

MONITORING WELL GPN\_RS3\_LOGS.GPJ WCC\_AUS.GDT 11/05/06 This drawing is subject to COPYRIGHT. It remains the property of URS Australia Pty Ltd.

**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
SWL: Static Water Level IWL: Initial Water Level

# URS Australia Pty Ltd

# Monitoring Well RSF4

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001

Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

Drilling Contractor: **Geoprobe**

Drilling Method:  
**Down Hole Hammer (DHH)**




Logged By: **Tim Ezzy**  
Checked By: **Tim Ezzy**  
Date Started: **01-05-06**  
Date Finished: **01-05-06**

Relative Level: **mRL**  
Coordinates: **7359012.000 mN**  
**301179.000 mE**

Client:  
**Gladstone Pacific Nickel**

Permit No:

MONITORING WELL GPN\_RS4\_LOGS.GPJ WCC\_AUS.GDT 11/05/06 This drawing is subject to COPYRIGHT. It remains the property of URS Australia Pty Ltd.

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		Depth (m)	DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)				Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
					0		silty CLAY, yellow-brown	ST					M	D	CL
					1		MUDSTONE, light grey	HA						D	MS
					2		SHALE, light grey-blue, very hard	HA						D	SH
					3										
					4										
					5										
					6										
					7										
					8										
					9										
					10										
					11										
					12										
					13										
					14										
					15										
					16										
					17										
					18										
					19										

**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
SWL: Static Water Level IWL: Initial Water Level

# URS Australia Pty Ltd

# Monitoring Well RSF5

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001  
Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

Drilling Contractor: **Geoprobe**

Drilling Method:  
**Down Hole Hammer (DHH)**

Logged By: **Tim Ezzy**  
Checked By: **Tim Ezzy**  
Date Started: **29-04-06**  
Date Finished: **29-04-06**

Relative Level: **mRL**  
Coordinates: **7356962.000 mN**  
**302836.000 mE**  
Permit No:

Client:  
**Gladstone Pacific Nickel**

MONITORING WELL GPN\_RS5\_LOGS.GPJ WCC\_AUS.GDT 11/05/06 This drawing is subject to COPYRIGHT. It remains the property of URS Australia Pty Ltd.

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)		Depth (m)	Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
				0		CLAYEY SAND, grey-brown	LO	G	F	SA	P		D	SC
				1		MUDSTONE, yellow-brown	HA						D	MS
				2		MUDSTONE, yellow-brown	HA						D	MS
				3		SHALE, light grey-blue, very hard	HA						D	SH
				4		SHALE, light grey-blue, very hard	HA						D	SH
				5		SHALE, light grey-blue, very hard	HA						D	SH
				6		SHALE, light grey-blue, very hard	HA						D	SH
				7		MUDSTONE, grey-brown	HA						D	MS
				8		MUDSTONE, grey-brown	HA						D	MS
				9		SHALE, light grey-blue, very hard	HA						D	SH
				10		SHALE, light grey-blue, very hard	HA						D	SH
				11		SHALE, light grey-blue, very hard	HA						D	SH
				12		SHALE, light grey-blue, very hard	HA						D	SH
				13		MUDSTONE, yellow-brown	HA						D	MS
				14		MUDSTONE, yellow-brown	HA						D	MS
				15		SHALE, light grey-blue, very hard	HA						D	SH
				16		SHALE, light grey-blue, very hard	HA						D	SH
				17		SHALE, light grey-blue, very hard	HA						D	SH
				18		SHALE, light grey-blue, very hard	HA						D	SH
				19		SHALE, light grey-blue, very hard	HA						D	SH

**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
SWL: Static Water Level IWL: Initial Water Level

# URS Australia Pty Ltd

# Monitoring Well RSF6

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001  
Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

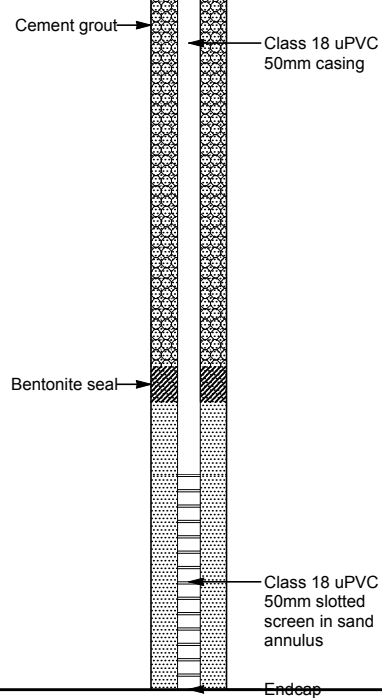
Drilling Contractor: **Geoprobe**

Drilling Method: **Down Hole Hammer (DHH)**  
 Logged By: **Tim Ezzy**  
 Checked By: **Tim Ezzy**  
 Date Started: **28-04-06**  
 Date Finished: **29-04-06**

Relative Level: **mRL**  
 Coordinates: **7356521.000 mN**  
**302309.000 mE**  
 Permit No:

Client:  
**Gladstone Pacific Nickel**

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)		Depth (m)	Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
				0		ROCKY SOIL, dark brown	LO	G	C	SA	P		D	TOPSOIL
				1		GREENSTONE, very hard (metamorphic product of gabbro), green-grey	HA						D	R
				2										
				3		SILTSTONE, yellow-brown	HA						SM	STS
				4										
				5										
				6										
				7										
				8		GREENSTONE, very hard (metamorphic product of gabbro), green-grey	HA						D	R
				9										
				10										
				11										
				12										
				13										
				14										
				15										
				16										
				17										
				18										
				19										



MONITORING WELL GPN\_RS6\_LOGS.GPJ WCC\_AUS.GDT 11/05/06 This drawing is subject to COPYRIGHT. It remains the property of URS Australia Pty Ltd.

**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
 SWL: Static Water Level IWL: Initial Water Level

# URS Australia Pty Ltd

# Monitoring Well RSF7

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001  
Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

Drilling Contractor: **Geoprobe**

Drilling Method: **Down Hole Hammer (DHH)**  
 Logged By: **Tim Ezzy**  
 Checked By: **Tim Ezzy**  
 Date Started: **29-04-06**  
 Date Finished: **30-04-06**

Relative Level: **mRL**  
 Coordinates: **7354563.000 mN**  
**303114.000 mE**  
 Permit No:

Client:  
**Gladstone Pacific Nickel**

MONITORING WELL GPN\_RS7\_LOGS.GPJ WCC\_AUS.GDT 11/05/06 This drawing is subject to COPYRIGHT. It remains the property of URS Australia Pty Ltd.

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		Depth (m)	DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)				Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
			Cement grout		0		silty CLAY, medium grey	ST					M	D	CL
			Bentonite seal		1		CLAYEY SAND, orange-brown	LO	G	M	SA	P		D	SC
				Class 18 uPVC 50mm casing	2										
					3										
					4		CLAYSTONE, moderately hard, yellow-brown	HA						D	CS
				Class 18 uPVC 50mm slotted screen in sand annulus	5										
					6		MUDSTONE, yellow-brown	HA						D	MS
					7										
				Endcap	8										
					9										
					10										
					11										
					12										
					13										
					14										
					15										
					16										
					17										
					18										
					19										

**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
 SWL: Static Water Level IWL: Initial Water Level

# URS Australia Pty Ltd

# Monitoring Well RSF8

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001

Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

Drilling Contractor: **Geoprobe**

Drilling Method:  
**Down Hole Hammer (DHH)**

Logged By: **Tim Ezzy**  
Checked By: **Tim Ezzy**  
Date Started: **29-04-06**  
Date Finished: **29-04-06**

Relative Level: **mRL**  
Coordinates: **7355871.000 mN**  
**302656.000 mE**  
Permit No:

Client:  
**Gladstone Pacific Nickel**

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)		Depth (m)	Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
			Cement grout	0		CLAYEY SAND, yellow-brown	LO	G	M	SA	P		D	SC
			Bentonite seal	1		silty CLAY, yellow-brown to grey	ST					M	D	CL
				2										
				3										
			Class 18 uPVC 50mm casing	4										
				5		MUDSTONE, yellow-brown	HA						D	MS
			Class 18 uPVC 50mm slotted screen in sand annulus	6										
				7		SHALE, light grey-blue, very hard	HA						D	SH
				8										
				9										
			Class 18 uPVC 50mm casing in sand annulus	10										
				11										
				12										
			Endcap	13										
				14										
				15										
				16										
				17										
				18										
				19										

MONITORING WELL GPN\_RS8\_LOGS.GPJ WCC\_AUS.GDT 11/05/06 This drawing is subject to COPYRIGHT. It remains the property of URS Australia Pty Ltd.

**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
SWL: Static Water Level IWL: Initial Water Level

# URS Australia Pty Ltd

# Monitoring Well RSF9

URS Australia Pty. Ltd.  
Level 240, Queen Street Brisbane, QLD, 4001  
Phone (07) 3243 2111  
Fax (07) 3242 2199

Project No.:  
**42625833**

Project Reference:  
**Gladstone Pacific Nickel: Groundwater Assessment**

Drilling Contractor: **Geoprobe**

Drilling Method: **Down Hole Hammer (DHH)**  
Logged By: **Tim Ezzy**  
Checked By: **Tim Ezzy**  
Date Started: **28-04-06**  
Date Finished: **28-04-06**

Relative Level: **mRL**  
Coordinates: **7355824.000 mN**  
**302316.000 mE**  
Permit No:

Client:  
**Gladstone Pacific Nickel**

SAMPLING DETAILS			WELL CONSTRUCTION DETAILS		DESCRIPTION OF STRATA									
Sample Type	Sampling and Observations	PID (ppm)		Depth (m)	Legend	Lithology	Consistency	Structure	Grain Size	Shape	Sorting	Plasticity	Moisture	Classification
				0		ORGANIC SOIL, brown	LO	G	M	SA	P		D	TOPSOIL
				1		SHALE, light grey-blue, very hard	HA						D	SH
				2		MUDSTONE, yellow-brown	HA						D	MS
				3										
				4										
				5		KAOLINITE MUDSTONE, white-yellow	ST					M	D	KAO
				6		SILTSTONE, yellow-brown	HA						SM	STS
				7										
				8										
				9										
				10										
				11		SHALE, light grey-blue, very hard	HA						D	SH
				12		SILTSTONE, yellow-brown	HA						SM	STS
				13										
				14										
				15										
				16		MUDSTONE, yellow-brown	HA						D	MS
				17										
				18										
				19										
				20										
				21										
				22										
				23										
				24										
				25										
				26										
				27										
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				37										
				38										
				39										

MONITORING WELL GPN\_RS9\_LOGS.GPJ WCC\_AUS.GDT 11/05/06 This drawing is subject to COPYRIGHT. It remains the property of URS Australia Pty Ltd.

**REMARKS:** NVO: No Visual or Olfactory (evidence of contamination)  
SWL: Static Water Level IWL: Initial Water Level

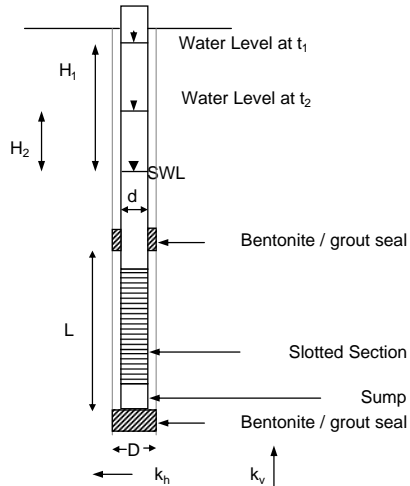
# Appendix J.6 Falling Head Tests

## J.6 Falling Head Tests

### FALLING HEAD TEST

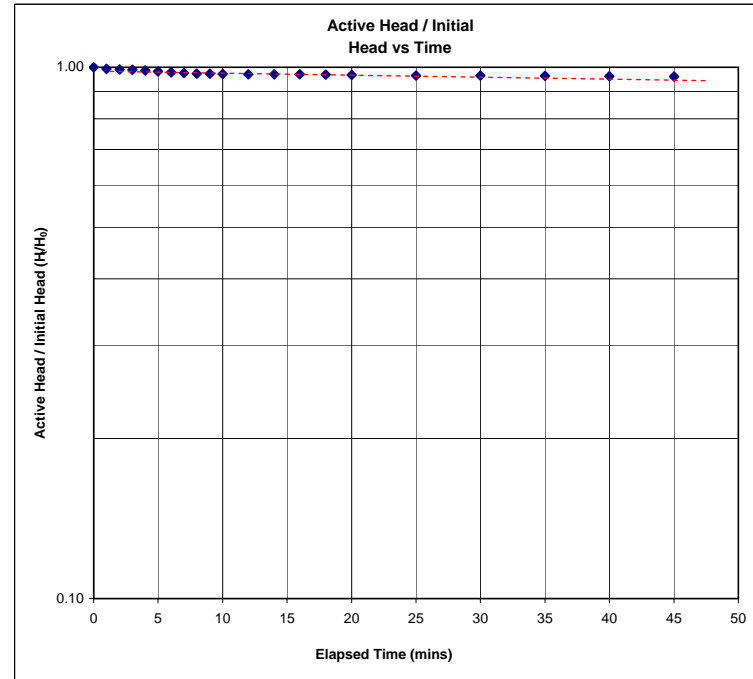
Hvorslev, 1951 - Well Point : Filter in Uniform Soil

Fixed Parameters	Unit	Value
SWL = Standing Water Level	m bGL	37.62
D = diameter of test section (hole diameter)	m	0.100
d = diameter of casing	m	0.050
L = test section (gravel pack thickness)	m	3.00
estimated $k_h/k_v$	ratio	10.00
where $k_v$ = vertical coefficient of permeability		
$k_h$ = horizontal coefficient of permeability		
$m$ = transformation ratio = $\sqrt{k_h/k_v}$	ratio	3.162
$T$ = basic time lag = $t$ when $(H_t/H_0 = 0.37)$	mins	



Chosen time $t_1$	mins	2.0
Chosen time $t_2$	mins	45.0
$H_1$ = active Head at time $t_1$	m	2.76
$H_2$ = active Head at time $t_2$	m	2.67

TEST DATA				
Elapsed Time (mins)	Depth to Water (mbGL)	Active Head (m)	Active Head/Initial Head	
0	34.84	2.78	1.00	
1	34.86	2.76	0.99	
2	34.865	2.76	0.99	
3	34.87	2.75	0.99	
4	34.88	2.74	0.99	
5	34.89	2.73	0.98	
6	34.90	2.72	0.98	
7	34.91	2.71	0.97	
8	34.92	2.71	0.97	
9	34.92	2.70	0.97	
10	34.92	2.70	0.97	
12	34.92	2.70	0.97	
14	34.93	2.70	0.97	
16	34.93	2.70	0.97	
18	34.93	2.69	0.97	
20	34.93	2.69	0.97	
25	34.94	2.68	0.96	
30	34.94	2.68	0.96	
35	34.94	2.68	0.96	
40	34.95	2.67	0.96	
45	34.95	2.67	0.96	



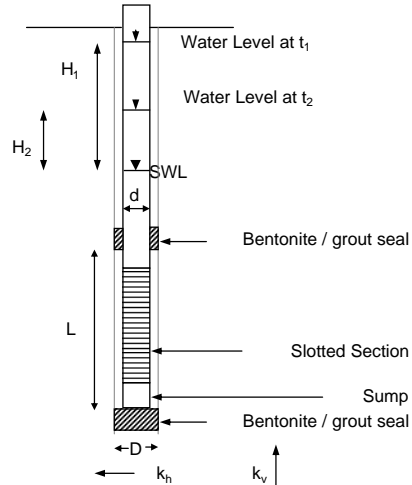
	$k_h$	$k_v$	$k_{mean}$	$k_h$	$k_v$	$k_{mean}$
	$m^3/m^2/s = m/s$			$m^3/m^2/day = m/day$		
Variable Head Determination $k_h = \frac{d^2 \ln(2mL/D)}{8L(t_2 - t_1)} \ln(H_1/H_2)$	7.02E-09	7.02E-10	2.22E-09	6.07E-04	6.07E-05	1.92E-04
Basic Time Lag Determination $k_h = \frac{d^2 \ln(2mL/D)}{8LT}$	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Hole ID: RSF1  
Date: 5-May-06  
Job Number: 42625833  
Drawn: TRE

## FALLING HEAD TEST

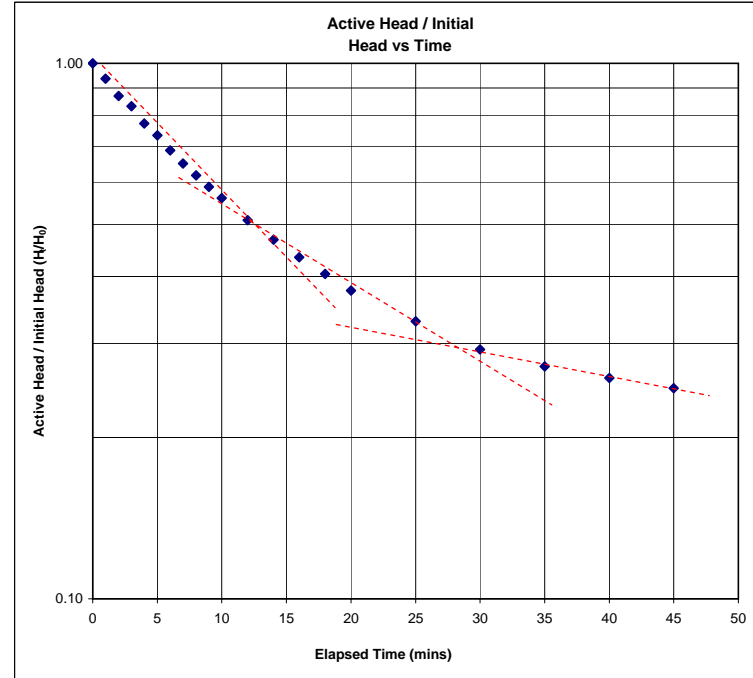
Hvorslev, 1951 - Well Point : Filter in Uniform Soil

Fixed Parameters	Unit	Value
SWL = Standing Water Level	m bGL	9.81
D = diameter of test section (hole diameter)	m	0.100
d = diameter of casing	m	0.050
L = test section (gravel pack thickness)	m	3.00
estimated $k_r/k_v$	ratio	10.00
where $k_v$ = vertical coefficient of permeability		
$k_h$ = horizontal coefficient of permeability		
$m$ = transformation ratio = $\sqrt{k_r/k_v}$	ratio	3.162
$T$ = basic time lag = $t$ when $(H_t/H_0 = 0.37)$	mins	20.0



Chosen time $t_1$	mins	12.0
Chosen time $t_2$	mins	25.0
$H_1$ = active Head at time $t_1$	m	1.36
$H_2$ = active Head at time $t_2$	m	0.88

TEST DATA				
Elapsed Time (mins)	Depth to Water (mbGL)	Active Head (m)	Active Head/Initial Head	
0	7.14	2.67	1.00	
1	7.31	2.50	0.94	
2	7.49	2.32	0.87	
3	7.59	2.22	0.83	
4	7.75	2.06	0.77	
5	7.85	1.96	0.73	
6	7.98	1.84	0.69	
7	8.08	1.74	0.65	
8	8.16	1.65	0.62	
9	8.24	1.57	0.59	
10	8.32	1.50	0.56	
12	8.45	1.36	0.51	
14	8.56	1.25	0.47	
16	8.65	1.16	0.43	
18	8.73	1.08	0.40	
20	8.81	1.01	0.38	
25	8.93	0.88	0.33	
30	9.03	0.78	0.29	
35	9.09	0.73	0.27	
40	9.12	0.69	0.26	
45	9.15	0.66	0.25	



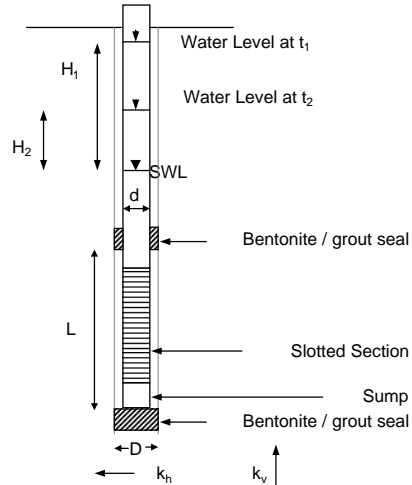
	$k_h$	$k_v$	$k_{mean}$	$k_h$	$k_v$	$k_{mean}$
	$m^3/m^2/s = m/s$			$m^3/m^2/day = m/day$		
Variable Head Determination $k_h = \frac{d^2 \ln(2mL/D)}{8L} \ln(H_1/H_2)$	3.05E-07	3.05E-08	9.64E-08	2.63E-02	2.63E-03	8.33E-03
Basic Time Lag Determination $k_h = \frac{d^2 \ln(2mL/D)}{8LT}$	4.55E-07	4.55E-08	1.44E-07	3.93E-02	3.93E-03	1.24E-02

Hole ID: RSF2  
 Date: 5-May-06  
 Job Number: 42625833  
 Drawn: TRE

### FALLING HEAD TEST

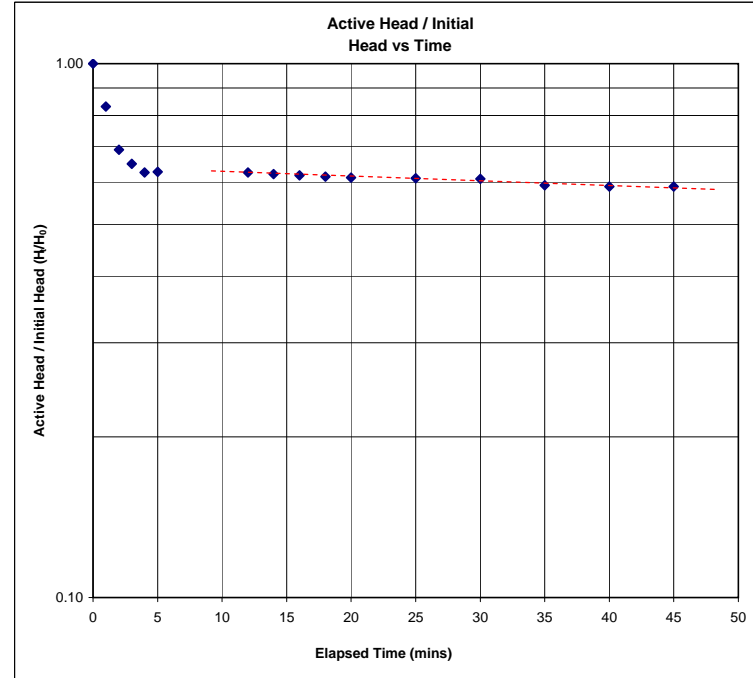
Hvorslev, 1951 - Well Point : Filter in Uniform Soil

Fixed Parameters	Unit	Value
SWL = Standing Water Level	m bGL	4.21
D = diameter of test section (hole diameter)	m	0.100
d = diameter of casing	m	0.050
L = test section (gravel pack thickness)	m	3.00
estimated $k_r/k_v$	ratio	10.00
where $k_v$ = vertical coefficient of permeability		
$k_h$ = horizontal coefficient of permeability		
$m$ = transformation ratio = $\sqrt{k_h/k_v}$	ratio	3.162
$T$ = basic time lag = $t$ when $(H_t/H_0 = 0.37)$	mins	



Chosen time $t_1$	mins	12.0
Chosen time $t_2$	mins	45.0
$H_1$ = active Head at time $t_1$	m	1.71
$H_2$ = active Head at time $t_2$	m	1.60

TEST DATA			
Elapsed Time (mins)	Depth to Water (mbGL)	Active Head (m)	Active Head/ Initial Head
0	1.49	2.72	1.00
1	1.95	2.26	0.83
2	2.195	1.88	0.69
3	2.34	1.77	0.65
4	2.45	1.70	0.63
5	2.51	1.71	0.63
6			
7			
8			
9			
10			
12	2.51	1.70	0.63
14	2.51	1.69	0.62
16	2.52	1.68	0.62
18	2.53	1.67	0.61
20	2.54	1.67	0.61
25	2.55	1.66	0.61
30	2.55	1.66	0.61
35	2.56	1.61	0.59
40	2.60	1.60	0.59
45	2.61	1.60	0.59



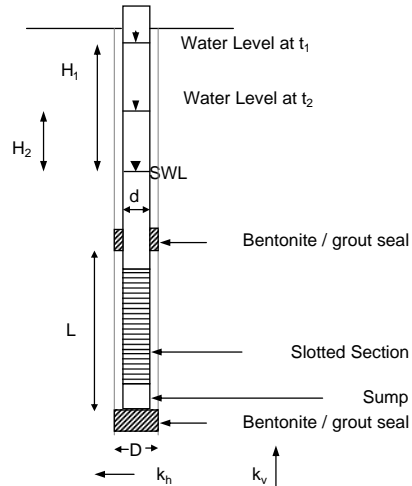
	$k_h$	$k_v$	$k_{mean}$	$k_h$	$k_v$	$k_{mean}$
	$m^3/m^2/s = m/s$			$m^3/m^2/day = m/day$		
Variable Head Determination $k_h = \frac{d^2 \ln(2mL/D)}{8L(t_2 - t_1)} \ln(H_1/H_2)$	1.83E-08	1.83E-09	5.80E-09	1.59E-03	1.59E-04	5.01E-04
Basic Time Lag Determination $k_h = \frac{d^2 \ln(2mL/D)}{8LT}$	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Hole ID: RSF3  
Date: 5-May-06  
Job Number: 42625833  
Drawn: TRE

### FALLING HEAD TEST

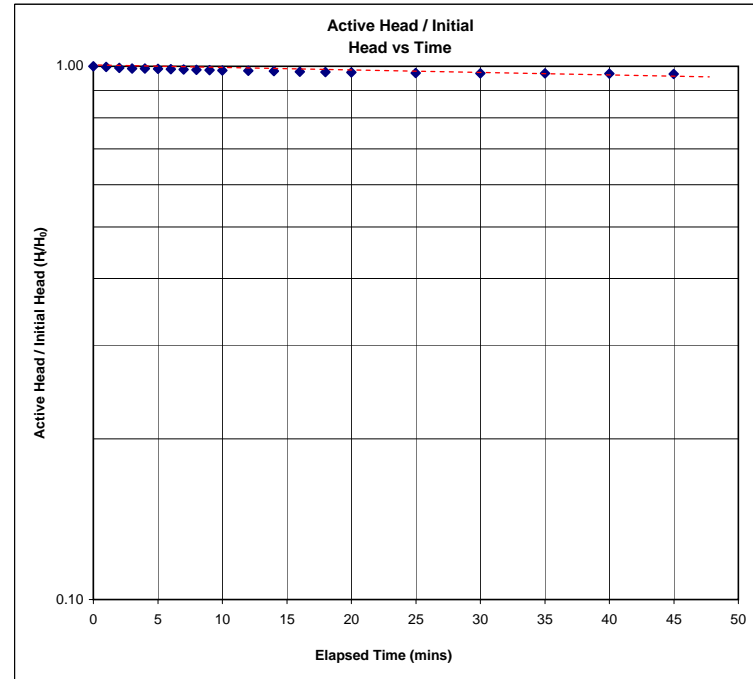
Hvorslev, 1951 - Well Point : Filter in Uniform Soil

Fixed Parameters	Unit	Value
SWL = Standing Water Level	m bGL	10.06
D = diameter of test section (hole diameter)	m	0.100
d = diameter of casing	m	0.050
L = test section (gravel pack thickness)	m	3.50
estimated $k_h/k_v$	ratio	10.00
where $k_v$ = vertical coefficient of permeability		
$k_h$ = horizontal coefficient of permeability		
$m$ = transformation ratio = $\sqrt{k_h/k_v}$	ratio	3.162
$T$ = basic time lag = $t$ when $(H_1/H_0 = 0.37)$	mins	



Chosen time $t_1$	mins	1.0
Chosen time $t_2$	mins	45.0
$H_1$ = active Head at time $t_1$	m	3.19
$H_2$ = active Head at time $t_2$	m	3.10

TEST DATA				
Elapsed Time (mins)	Depth to Water (mbGL)	Active Head (m)	Active Head/Initial Head	
0	6.86	3.20	1.00	
1	6.87	3.19	1.00	
2	6.88	3.18	0.99	
3	6.89	3.17	0.99	
4	6.89	3.17	0.99	
5	6.90	3.17	0.99	
6	6.90	3.16	0.99	
7	6.91	3.16	0.99	
8	6.91	3.15	0.98	
9	6.91	3.15	0.98	
10	6.92	3.15	0.98	
12	6.92	3.14	0.98	
14	6.93	3.14	0.98	
16	6.93	3.13	0.98	
18	6.94	3.12	0.98	
20	6.94	3.12	0.97	
25	6.95	3.11	0.97	
30	6.96	3.11	0.97	
35	6.96	3.10	0.97	
40	6.96	3.10	0.97	
45	6.96	3.10	0.97	



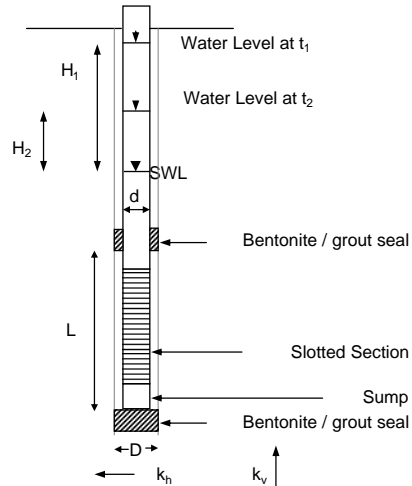
	$k_h$	$k_v$	$k_{mean}$	$k_h$	$k_v$	$k_{mean}$
	$m^3/m^2/s = m/s$			$m^3/m^2/day = m/day$		
Variable Head Determination $k_h = \frac{d^2 \ln(2mL/D)}{8L} \ln(H_1/H_2)$	5.23E-09	5.23E-10	1.65E-09	4.52E-04	4.52E-05	1.43E-04
Basic Time Lag Determination $k_h = \frac{d^2 \ln(2mL/D)}{8LT}$	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Hole ID: RSF4  
Date: 5-May-06  
Job Number: 42625833  
Drawn: TRE

## FALLING HEAD TEST

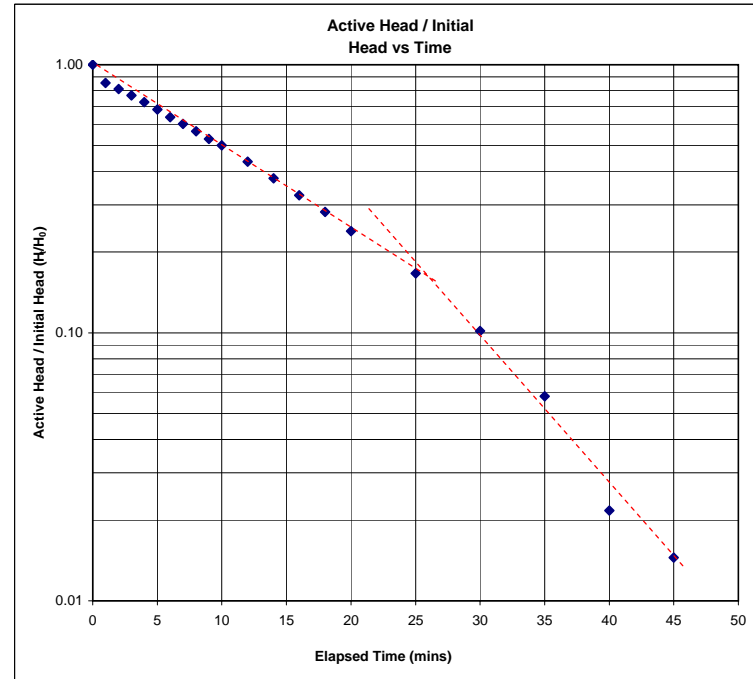
Hvorslev, 1951 - Well Point : Filter in Uniform Soil

Fixed Parameters	Unit	Value
SWL = Standing Water Level	m bGL	18.73
D = diameter of test section (hole diameter)	m	0.100
d = diameter of casing	m	0.050
L = test section (gravel pack thickness)	m	1.50
estimated $k_r/k_v$	ratio	10.00
where $k_v$ = vertical coefficient of permeability		
$k_h$ = horizontal coefficient of permeability		
$m$ = transformation ratio = $\sqrt{k_r/k_v}$	ratio	3.162
$T$ = basic time lag = $t$ when $(H_t/H_0 = 0.37)$	mins	14.0



Chosen time $t_1$	mins	25.0
Chosen time $t_2$	mins	45.0
$H_1$ = active Head at time $t_1$	m	0.12
$H_2$ = active Head at time $t_2$	m	0.01

TEST DATA				
Elapsed Time (mins)	Depth to Water (mbGL)	Active Head (m)	Active Head/Initial Head	
0	18.04	0.69	1.00	
1	18.14	0.59	0.86	
2	18.17	0.56	0.81	
3	18.20	0.53	0.77	
4	18.23	0.50	0.72	
5	18.26	0.47	0.68	
6	18.29	0.44	0.64	
7	18.32	0.41	0.60	
8	18.34	0.39	0.57	
9	18.37	0.37	0.53	
10	18.39	0.34	0.50	
12	18.43	0.30	0.43	
14	18.47	0.26	0.38	
16	18.51	0.23	0.33	
18	18.54	0.20	0.28	
20	18.57	0.16	0.24	
25	18.62	0.12	0.17	
30	18.66	0.07	0.10	
35	18.69	0.04	0.06	
40	18.72	0.02	0.02	
45	18.72	0.01	0.01	



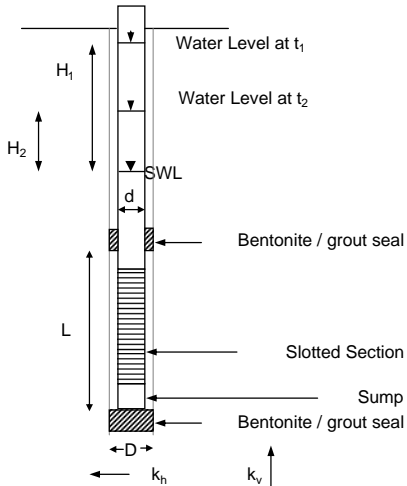
	$k_h$	$k_v$	$k_{mean}$	$k_h$	$k_v$	$k_{mean}$
	$m^3/m^2/s = m/s$			$m^3/m^2/day = m/day$		
Variable Head Determination $k_h = \frac{d^2 \ln(2mL/D)}{8L} \ln(H_1/H_2)$	1.96E-06	1.96E-07	6.21E-07	1.70E-01	1.70E-02	5.37E-02
Basic Time Lag Determination $k_h = \frac{d^2 \ln(2mL/D)}{8LT}$	1.13E-06	1.13E-07	3.57E-07	9.76E-02	9.76E-03	3.08E-02

Hole ID: RSF5  
 Date: 4-May-06  
 Job Number: 42625833  
 Drawn: TRE

### FALLING HEAD TEST

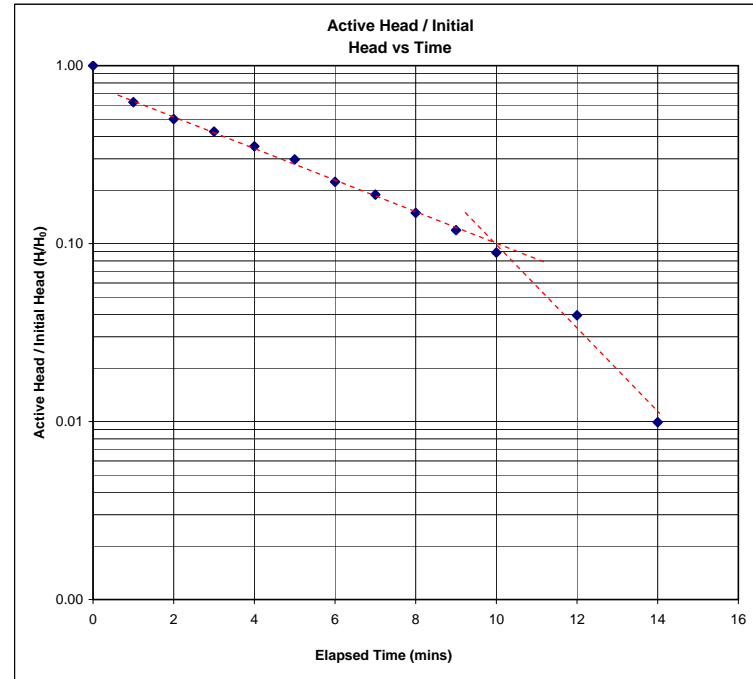
Hvorslev, 1951 - Well Point : Filter in Uniform Soil

Fixed Parameters	Unit	Value
SWL = Standing Water Level	m bGL	15.79
D = diameter of test section (hole diameter)	m	0.100
d = diameter of casing	m	0.050
L = test section (gravel pack thickness)	m	1.00
estimated $k_h/k_v$	ratio	10.00
where $k_v$ = vertical coefficient of permeability		
$k_h$ = horizontal coefficient of permeability		
$m$ = transformation ratio = $\sqrt{k_h/k_v}$	ratio	3.162
$T$ = basic time lag = $t$ when $(H_1/H_0 = 0.37)$	mins	4.0



Chosen time $t_1$	mins	2.0
Chosen time $t_2$	mins	10.0
$H_1$ = active Head at time $t_1$	m	0.50
$H_2$ = active Head at time $t_2$	m	0.09

TEST DATA				
Elapsed Time (mins)	Depth to Water (mbGL)	Active Head (m)	Active Head/Initial Head	
0	14.78	1.01	1.00	
1	15.16	0.63	0.62	
2	15.29	0.50	0.50	
3	15.36	0.43	0.43	
4	15.44	0.35	0.35	
5	15.49	0.30	0.30	
6	15.57	0.23	0.22	
7	15.60	0.19	0.19	
8	15.64	0.15	0.15	
9	15.67	0.12	0.12	
10	15.70	0.09	0.09	
12	15.75	0.04	0.04	
14	15.78	0.01	0.01	



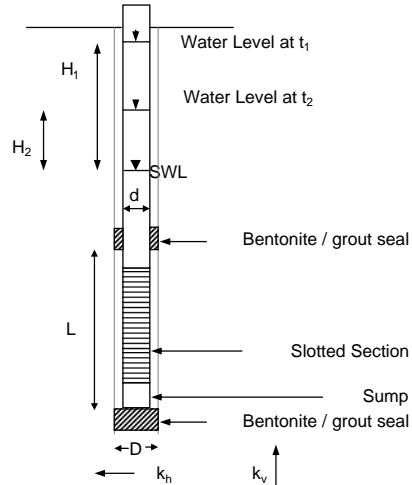
	$k_h$	$k_v$	$k_{mean}$	$k_h$	$k_v$	$k_{mean}$
	$m^3/m^2/s = m/s$			$m^3/m^2/day = m/day$		
Variable Head Determination $k_h = \frac{d^2 \ln(2mL/D)}{8L(t_2 - t_1)} \ln(H_1/H_2)$	4.63E-06	4.63E-07	1.46E-06	4.00E-01	4.00E-02	1.26E-01
Basic Time Lag Determination $k_h = \frac{d^2 \ln(2mL/D)}{8LT}$	5.40E-06	5.40E-07	1.71E-06	4.67E-01	4.67E-02	1.48E-01

Hole ID: RSF6  
Date: 5-May-06  
Job Number: 42625833  
Drawn: TRE

## FALLING HEAD TEST

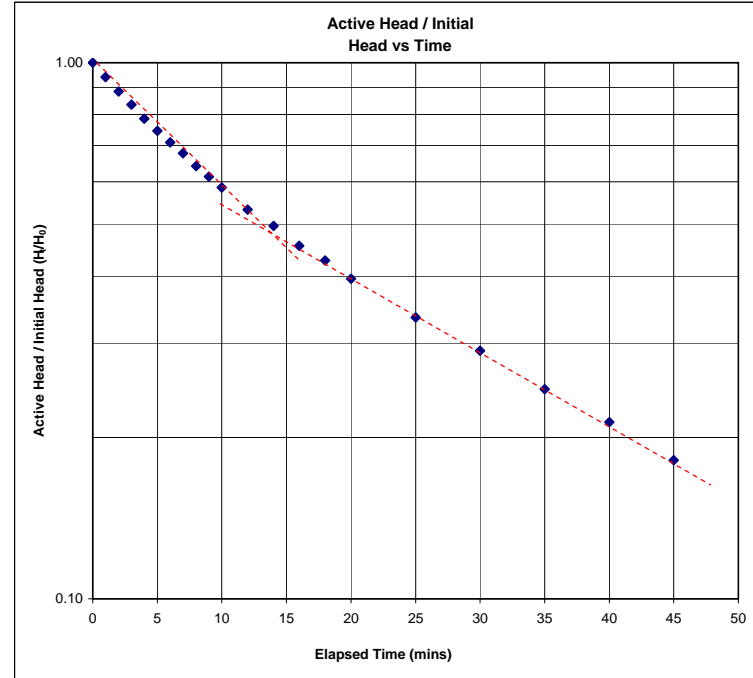
Hvorslev, 1951 - Well Point : Filter in Uniform Soil

Fixed Parameters	Unit	Value
SWL = Standing Water Level	m bGL	8.93
D = diameter of test section (hole diameter)	m	0.100
d = diameter of casing	m	0.050
L = test section (gravel pack thickness)	m	1.50
estimated $k_h/k_v$	ratio	10.00
where $k_v$ = vertical coefficient of permeability		
$k_h$ = horizontal coefficient of permeability		
$m$ = transformation ratio = $\sqrt{k_h/k_v}$	ratio	3.162
$T$ = basic time lag = $t$ when $(H_t/H_0 = 0.37)$	mins	22.0



Chosen time $t_1$	mins	16.0
Chosen time $t_2$	mins	45.0
$H_1$ = active Head at time $t_1$	m	0.57
$H_2$ = active Head at time $t_2$	m	0.18

TEST DATA				
Elapsed Time (mins)	Depth to Water (mbGL)	Active Head (m)	Active Head/Initial Head	
0	7.69	1.24	1.00	
1	7.77	1.17	0.94	
2	7.84	1.10	0.88	
3	7.90	1.04	0.83	
4	7.96	0.98	0.79	
5	8.01	0.92	0.75	
6	8.05	0.88	0.71	
7	8.09	0.84	0.68	
8	8.14	0.80	0.64	
9	8.17	0.76	0.61	
10	8.21	0.73	0.58	
12	8.27	0.66	0.53	
14	8.32	0.62	0.50	
16	8.37	0.57	0.46	
18	8.40	0.53	0.43	
20	8.44	0.49	0.40	
25	8.52	0.41	0.33	
30	8.57	0.36	0.29	
35	8.63	0.31	0.25	
40	8.67	0.27	0.21	
45	8.71	0.23	0.18	



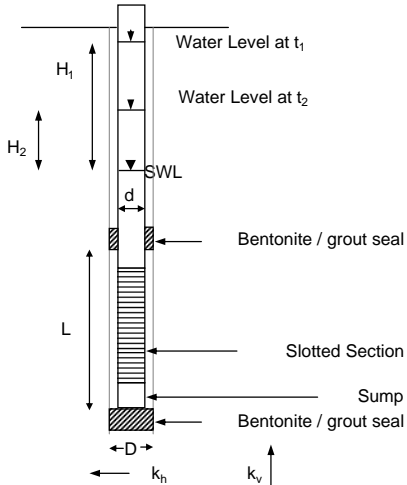
	$k_h$	$k_v$	$k_{mean}$	$k_h$	$k_v$	$k_{mean}$
	$m^3/m^2/s = m/s$			$m^3/m^2/day = m/day$		
Variable Head Determination $k_h = \frac{d^2 \ln(2mL/D)}{8L} \ln(H_1/H_2)$	6.28E-07	6.28E-08	1.99E-07	5.43E-02	5.43E-03	1.72E-02
Basic Time Lag Determination $k_h = \frac{d^2 \ln(2mL/D)}{8LT}$	7.19E-07	7.19E-08	2.27E-07	6.21E-02	6.21E-03	1.96E-02

Hole ID: RFS7  
 Date: 4-May-06  
 Job Number: 42625833  
 Drawn: TRE

### FALLING HEAD TEST

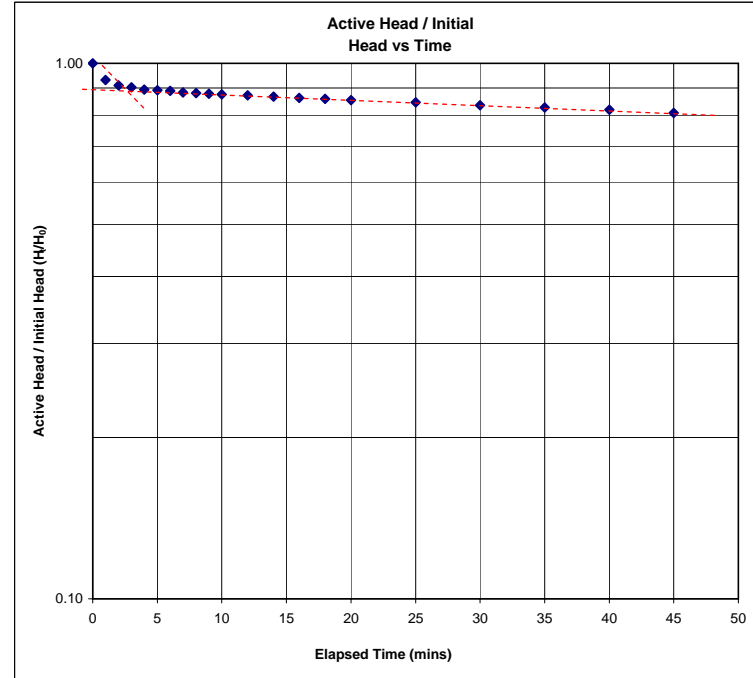
Hvorslev, 1951 - Well Point : Filter in Uniform Soil

Fixed Parameters	Unit	Value
SWL = Standing Water Level	m bGL	19.00
D = diameter of test section (hole diameter)	m	0.100
d = diameter of casing	m	0.050
L = test section (gravel pack thickness)	m	1.50
estimated $k_r/k_v$	ratio	10.00
where $k_v$ = vertical coefficient of permeability		
$k_h$ = horizontal coefficient of permeability		
$m$ = transformation ratio = $\sqrt{k_r/k_v}$	ratio	3.162
$T$ = basic time lag = $t$ when $(H_t/H_0 = 0.37)$	mins	



Chosen time $t_1$	mins	5.0
Chosen time $t_2$	mins	45.0
$H_1$ = active Head at time $t_1$	m	1.67
$H_2$ = active Head at time $t_2$	m	1.52

TEST DATA				
Elapsed Time (mins)	Depth to Water (mbGL)	Active Head (m)	Active Head/Initial Head	
0	17.12	1.88	1.00	
1	17.25	1.75	0.93	
2	17.29	1.71	0.91	
3	17.31	1.69	0.90	
4	17.32	1.68	0.89	
5	17.33	1.67	0.89	
6	17.33	1.67	0.89	
7	17.34	1.66	0.88	
8	17.35	1.65	0.88	
9	17.35	1.65	0.88	
10	17.36	1.64	0.87	
12	17.36	1.64	0.87	
14	17.37	1.63	0.87	
16	17.38	1.62	0.86	
18	17.39	1.61	0.86	
20	17.40	1.60	0.85	
25	17.41	1.59	0.85	
30	17.43	1.57	0.83	
35	17.45	1.55	0.83	
40	17.46	1.54	0.82	
45	17.48	1.52	0.81	



	$k_h$	$k_v$	$k_{mean}$	$k_h$	$k_v$	$k_{mean}$
	$m^3/m^2/s = m/s$			$m^3/m^2/day = m/day$		
Variable Head Determination $k_h = \frac{d^2 \ln(2mL/D)}{8L(t_2-t_1)} \ln(H_1/H_2)$	3.72E-08	3.72E-09	1.18E-08	3.21E-03	3.21E-04	1.02E-03
Basic Time Lag Determination $k_h = \frac{d^2 \ln(2mL/D)}{8LT}$	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Hole ID: RSF9  
Date: 4-May-06  
Job Number: 42625833  
Drawn: TRE