Appendix B. Engineering Logs

JACOBS Engineering Log - Borehole

JBH1

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 2
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	522734.0	**Elevation:**	37.86	**Started:**	03/05/2019
Plant:	EVH3300	**Northing:**	7796602.0	**Datum:**	AHD	**Finished:**	03/05/2019
Logged by:	DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	000°

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	Field Test Data & Other Observations
AD/T CASING		Not Encountered					CL	**TOPSOIL: Silty CLAY:** low plasticity, dark brown; with some fine grained sand; with some roots and rootlets.		F	TOPSOIL
							CL	**Silty CLAY:** low plasticity, brown; with some fine grained sand; trace of roots and rootlets.			ALLUVIUM
			SPT 4, 5, 6 N=11	37	1					St	
			SPT 5, 9, 12 N=31	36	2		CL-CI	**Silty CLAY:** low to medium plasticity, grey-brown; with some fine grained sand; trace of rootlets. ...colour becoming brown.	M	H	
			SPT 4, 4, 5 N=9	35	3					F	
			SPT 4, 5, 8 N=13	34	4					St	
		Not Observed	SPT 6, 7, 8 N=15	33	5		CL-CI	**Sandy CLAY:** low to medium plasticity, brown; fine grained sand.	D - M	St - VSt	
			SPT 4, 6, 8 N=14	32	6		CL-CI	**Silty CLAY:** low to medium plasticity, brown; with some fine grained sand.	M	St	
WB			SPT 6, 8, 10 N=18	31	7		SC	**Clayey SAND:** fine to medium grained, brown; low to medium plasticity clay.	D - M	MD	
							CL-CI	**Silty CLAY:** low to medium plasticity, brown; with some fine to medium grained sand.	M	VSt	
			SPT 8, 14, 15 N=29	30	8					VSt - H	
							SC	**Clayey SAND:** fine to medium grained, brown; low to medium plasticity clay.		D	
			SPT 16, 23, 33 N=55	29	9		CL-CI	**Sandy CLAY:** low to medium plasticity, brown; fine grained sand with minor medium grained fraction.	D - M	H	
							CI-CH	**Gravelly CLAY:** medium to high plasticity, brown-grey; fine grained, angular to sub-angular rhyodacite gravel; trace of fine to coarse grained sand.			RESIDUAL SOIL
			SPT 14, 32, 37 N=69	28			CI	**Gravelly CLAY with Clayey GRAVEL layers (up to 50mm thick):** medium plasticity, pale grey mottled orange-brown; fine to medium grained, angular to sub-angular gravel; trace of			EXTREMELY WEATHERED MATERIAL

METHOD & SUPPORT
HA Hand Auger
AS Auger
AD/V Auger - V-bit
AD/T Auger - TC-bit
WB Washbore
RR Rock Roller
AH Air Hammer
C Casing

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (static)
= Water level (during drilling)
= Water inflow
= Water outflow

SAMPLES & FIELD TESTS

D	Disturbed Sample	N	SPT blows per 300mm
B	Bulk Sample	HW	SPT penetration by hammer weight
SPT	SPT Sample	RW	SPT penetration by rod weight
U	Undisturbed Sample	HP	Hand Penetrometer
E	Enviro Sample	HV	Hand Vane Shear
W	Water Sample	(P: Peak Su R: Residual Su)	

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS 3.01.3 LIB.GLB Log JACOBS AU BOREHOLE LOG IH175200-HAUGHTON PIPELINE STAGE 2 - FIELD INVESTIGATION_DM.GPJ <<DrawingFile>> 29/05/2019 21:22 8.30.003 Datgel Lab and In Situ Tool - DGD | Lib: Jacobs 3.01.2 2017-03-09 Prj: Jacobs 3.00.0 2016-07-17

JACOBS Engineering Log - Borehole

JBH1

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 2 of 2
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	522734.0	**Elevation:**	37.86	**Started:**	03/05/2019
Plant:	EVH3300	**Northing:**	7796602.0	**Datum:**	AHD	**Finished:**	03/05/2019
Logged by:	DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	000°

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	Field Test Data & Other Observations
WB		Not Observed	SPT 13, 25, 31 N=56	27	11		CL-CI	fine to coarse grained sand; Clayey GRAVEL layers: fine to medium grained, angular to sub-angular, grey speckled brown, pink and orange; medium plasticity clay; trace of fine to coarse grained sand. **Gravelly CLAY with Clayey GRAVEL layers (up to 50mm thick):** low to medium plasticity, pale grey mottled orange-brown; fine to medium grained, angular to sub-angular gravel; trace of fine to coarse grained sand; Clayey GRAVEL layers: fine to medium grained, angular to sub-angular, grey speckled brown, pink and orange; low to medium plasticity clay; trace of fine to coarse grained sand. *(continued)*	D - M	H	EXTREMELY WEATHERED MATERIAL
			SPT 12, 12, 16 N=28	26	12		CL	**Gravelly CLAY:** low plasticity, pale grey mottled orange-brown; fine to medium grained, angular to sub-angular granite gravel; trace of fine to coarse grained sand;		VSt - H	RESIDUAL SOIL
			SPT 12, 20, 30 N=50	25	13		CL	**Sandy CLAY:** low plasticity, grey mottled orange-brown; fine to coarse grained sand; trace of fine grained, angular to sub-angular granite gravel.	M	H	
			SPT 6, 14, 33 N=47	24	14		SC	**Clayey SAND:** fine to coarse grained, orange banded black and grey; low plasticity clay; with some fine grained, angular to sub-angular granite gravel. ...colour becoming dark grey banded orange-brown.	D - M	D	RESIDUAL SOIL TO EXTREMELY WEATHERED MATERIAL
			SPT 30, 25/50mm (HB) N=R	23	15						
			SPT 23, 38, 30/50mm N=R	22	16			...colour becoming dark orange-brown mottled grey.			
				21	17					VD	
			SPT 19, 30/90mm (HB) N=R	20	18			...colour becoming orange-brown mottled grey.			
				19	19						
			SPT 30/80mm (HB) N=R	18				Hole Terminated at 19.58 m Target depth			

METHOD & SUPPORT
HA Hand Auger
AS Auger
AD/V Auger - V-bit
AD/T Auger - TC-bit
WB Washbore
RR Rock Roller
AH Air Hammer
C Casing

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (static)
= Water level (during drilling)
= Water inflow
= Water outflow

SAMPLES & FIELD TESTS

D	Disturbed Sample	N	SPT blows per 300mm
B	Bulk Sample	HW	SPT penetration by hammer weight
SPT	SPT Sample	RW	SPT penetration by rod weight
U	Undisturbed Sample	HP	Hand Penetrometer
E	Enviro Sample	HV	Hand Vane Shear
W	Water Sample	(P: Peak Su R: Residual Su)	

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

Engineering Log - Borehole

JBH2

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 2
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	522765.0	**Elevation:**	37.70	**Started:**	03/05/2019
Plant:	EVH3300	**Northing:**	7796545.0	**Datum:**	AHD	**Finished:**	07/05/2019
Logged by:	DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	000°

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	Field Test Data & Other Observations
AD/T CASING		Not Encountered					CL	**TOPSOIL: Silty CLAY:** low plasticity, dark brown; with some fine grained sand; with some roots and rootlets.	M	F	TOPSOIL
							CL	**Silty CLAY:** low plasticity, pale brown; with some fine grained sand; trace of roots and rootlets.	D - M	St	ALLUVIUM
			SPT 9, 11, 15 N=24	37	1		CI	**Silty CLAY:** medium plasticity, dark brown; with some fine grained sand; trace of rootlets.	M	VSt	
							CL	**Silty CLAY:** low plasticity, brown; with some fine grained sand; trace of roots and rootlets.			
			SPT 12, 17, 16 N=33	36	2						
			SPT 11, 16, 16 N=32	35	3			**Silty CLAY:** low to medium plasticity, brown; with some fine grained sand.			
WB		Not Observed	SPT 9, 15, 16 N=31	34	4						
			SPT 6, 14, 16 N=30	33	5		CL-CI		D - M	H	
			SPT 10, 17, 23 N=40	32	6						
			SPT 12, 20, 26 N=46	31	7			...colour becoming brown with minor black speckling, trace of organic material present.			
			SPT 14, 24, 34 N=58	30	8			**Sandy CLAY:** low to medium plasticity, grey-brown; fine grained sand.			
			SPT 20, 36, 30/100mm N=R	29	9		CL-CI				
			SPT 30/80mm (HB) N=R	28			GC	**Clayey GRAVEL:** fine to medium grained, angular to sub-angular granite, grey speckled orange-brown, pink and dark brown; medium to high plasticity clay; with some fine to coarse grained sand.	M	VD	EXTREMELY WEATHERED MATERIAL WEATHERED ROCK

METHOD & SUPPORT
HA Hand Auger
AS Auger
AD/V Auger - V-bit
AD/T Auger - TC-bit
WB Washbore
RR Rock Roller
AH Air Hammer
C Casing

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (static)
= Water level (during drilling)
= Water inflow
= Water outflow

SAMPLES & FIELD TESTS

D	Disturbed Sample	N	SPT blows per 300mm
B	Bulk Sample	HW	SPT penetration by hammer weight
SPT	SPT Sample	RW	SPT penetration by rod weight
U	Undisturbed Sample	HP	Hand Penetrometer
E	Enviro Sample	HV	Hand Vane Shear
W	Water Sample	(P: Peak Su R: Residual Su)	

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Borehole

JBH2

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 2 of 2
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	522765.0	**Elevation:**	37.70	**Started:**	03/05/2019
Plant:	EVH3300	**Northing:**	7796545.0	**Datum:**	AHD	**Finished:**	07/05/2019
Logged by:	DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	000°

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	Field Test Data & Other Observations
				27	11			**GRANITE:** highly weathered, very low strength, grey speckled orange-brown, pink and dark brown, recovered as Sandy GRAVEL: fine to medium grained, angular to sub-angular; fine to coarse grained sand; with some medium plasticity clay. Hole Terminated at 9.75 m Refusal			
				26	12						
				25	13						
				24	14						
				23	15						
				22	16						
				21	17						
				20	18						
				19	19						
				18							

METHOD & SUPPORT
HA Hand Auger
AS Auger
AD/V Auger - V-bit
AD/T Auger - TC-bit
WB Washbore
RR Rock Roller
AH Air Hammer
C Casing

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (static)
= Water level (during drilling)
= Water inflow
= Water outflow

SAMPLES & FIELD TESTS

D	Disturbed Sample	N	SPT blows per 300mm
B	Bulk Sample	HW	SPT penetration by hammer weight
SPT	SPT Sample	RW	SPT penetration by rod weight
U	Undisturbed Sample	HP	Hand Penetrometer
E	Enviro Sample	HV	Hand Vane Shear
W	Water Sample	(P: Peak Su R: Residual Su)	

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Borehole

JBH3

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 2
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	522814.0	**Elevation:**	37.86	**Started:**	07/05/2019
Plant:	EVH3300	**Northing:**	7796451.0	**Datum:**	AHD	**Finished:**	08/05/2019
Logged by:	DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	000°

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	Field Test Data & Other Observations
AD/T		Not Encountered					CL	**TOPSOIL: Silty CLAY:** low plasticity, dark brown; with some fine grained sand; with some roots and rootlets.		F	TOPSOIL
								Silty CLAY: low plasticity, brown; with some fine grained sand; trace of roots and rootlets.		F - St	ALLUVIUM
			SPT 3, 3, 4 N=7	37	1				M	St	
			SPT 5, 6, 8 N=14	36	2		CL			VSt	
			SPT 12, 18, 26 N=44	35	3			...sand content increasing, sand containing a minor medium grained fraction.		H	
			SPT 11, 15, 18 N=33	34	4		CL-CI	**Sandy CLAY:** low to medium plasticity, brown; fine grained sand; with some low plasticity silt.	D - M		
			SPT 9, 17, 17 N=34	33	5		CI	**Silty CLAY:** medium plasticity, brown; with some fine grained sand.			
		Not Observed	SPT 3, 8, 8 N=16	32	6		CL	**Sandy CLAY:** low plasticity, brown; fine grained sand.	M		
CASING			SPT 13, 25, 29 N=54	31	7		CL-CI	**Sandy CLAY:** low to medium plasticity, brown; fine grained sand; with some low plasticity silt.			
WB			SPT 18, 22, 27 N=49	30	8			...colour becoming brown with minor black speckling.	D - M		
			SPT 13, 19, 19 N=48	29	9		CL-CI	**Sandy CLAY:** low to medium plasticity, brown; fine grained sand.			
			SPT 15, 27, 32 N=59	28			CL-CI	**Silty CLAY:** low to medium plasticity, brown with minor black speckling; with some fine grained sand.			
							CL-CI	**Sandy CLAY:** low to medium plasticity, brown; fine grained sand.			

METHOD & SUPPORT
HA Hand Auger
AS Auger
AD/V Auger - V-bit
AD/T Auger - TC-bit
WB Washbore
RR Rock Roller
AH Air Hammer
C Casing

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (static)
= Water level (during drilling)
= Water inflow
= Water outflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
N SPT blows per 300mm
HW SPT penetration by hammer weight
RW SPT penetration by rod weight
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS 3.01.3 LIB.GLB Log JACOBS AU BOREHOLE LOG IH175200-HAUGHTON PIPELINE STAGE 2 - FIELD INVESTIGATION_DM.GPJ <<DrawingFile>> 29/05/2019 21:23 8.30.003 Datgel Lab and In Situ Tool - DGD | Lib: Jacobs 3.01.2 2017-03-09 Prj: Jacobs 3.00.0 2016-07-17

JACOBS Engineering Log - Borehole

JBH3

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 2 of 2
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	522814.0	**Elevation:**	37.86	**Started:**	07/05/2019
Plant:	EVH3300	**Northing:**	7796451.0	**Datum:**	AHD	**Finished:**	08/05/2019
Logged by:	DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	000°

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	Field Test Data & Other Observations
CASING								**Sandy CLAY:** low to medium plasticity, brown; fine grained sand. *(continued)*			ALLUVIUM
			SPT 12, 15, 19 N=34	27	11			...sand content increasing.	D - M	H	
			SPT 12, 16, 23 N=39	26	12		CL-CI	...becoming pale brown.		VSt - H	
			SPT 10, 13, 15 N=28	25	13			...colour becoming pale-brown with minor orange and brown staining.			
							CI-CH	**CLAY:** medium to high plasticity, grey; trace of fine grained sand.			RESIDUAL SOIL
WB		Not Observed	SPT 12, 14, 17 N=31	24	14		CI	**Sandy CLAY with Clayey SAND layers (up to 250mm thick):** medium plasticity, grey with minor orange-brown mottling; fine to medium grained sand; Clayey SAND layers: fine to medium grained, orange-brown mottled dark brown and grey; low to medium plasticity clay.	M	H	
			SPT 17, 42, 30/90mm (HB) N=R	23	15			**Clayey SAND:** fine to medium grained, grey-brown mottled orange-brown; low to medium plasticity clay.			EXTREMELY WEATHERED MATERIAL
			SPT 50/140mm (HB) N=R	22	16		SC	...colour becoming grey-brown mottled orange-brown with minor grey-blue staining.			
			SPT 30/80mm (HB) N=R	21	17			...colour becoming dark brown mottled grey and orange-brown.	D - M	VD	
			SPT 30/70mm (HB) N=R	20	18		SC	**Clayey SAND:** fine to coarse grained, dark grey with grey and orange-brown stainng; medium plasticity clay; trace of fine grained, angular granite gravel.			
							GC	**Clayey GRAVEL:** fine grained, angular granite, grey mottled orange-brown and dark grey; medium plasticity clay; with some fine to coarse grained sand.			
											WEATHERED ROCK
			SPT 8/10mm (HB) N=R	19	19			**GRANITE:** highly weathered, very low strength, grey speckled pink and orange-brown, recovered as Sandy GRAVEL: fine grained, angular; fine to coarse grained sand; with some medium plasticity clay.			
				18				Hole Terminated at 18.41 m Refusal			

METHOD & SUPPORT
HA Hand Auger
AS Auger
AD/V Auger - V-bit
AD/T Auger - TC-bit
WB Washbore
RR Rock Roller
AH Air Hammer
C Casing

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (static)
= Water level (during drilling)
= Water inflow
= Water outflow

SAMPLES & FIELD TESTS

D	Disturbed Sample	N	SPT blows per 300mm
B	Bulk Sample	HW	SPT penetration by hammer weight
SPT	SPT Sample	RW	SPT penetration by rod weight
U	Undisturbed Sample	HP	Hand Penetrometer
E	Enviro Sample	HV	Hand Vane Shear
W	Water Sample	(P: Peak Su R: Residual Su)	

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Borehole

JBH4

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	512265.0	**Elevation:**	34.11	**Started:**	09/05/2019
Plant:	EVH3300	**Northing:**	7803040.0	**Datum:**	AHD	**Finished:**	09/05/2019
Logged by:	DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	000°

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	Field Test Data & Other Observations
AD/T CASING		Not Encountered		34	0		CL-CI	**TOPSOIL: Silty CLAY:** low to medium plasticity, dark brown with minor pale orange mottling; with some rootlets; trace of fine grained sand.		F	TOPSOIL ALLUVIUM
			SPT 2, 4, 4 N=8	33	1		CI	**CLAY:** medium plasticity, dark brown mottled brown with minor dark grey mottling; with some low plasticity silt; trace of fine to medium grained sand; trace of rootlets. ...colour becoming dark grey with minor pale orange and brown mottling. ...colour becoming brown mottled dark brown, trace of fine grained, sub-rounded gravel present.		St	
			SPT 4, 7, 7 N=14	32	2		CL-CI	**Sandy CLAY:** low to medium plasticity, grey-brown with minor orange and brown mottling; fine to medium grained sand with minor coarse grained fraction; trace of fine grained, sub-rounded gravel.		St - VSt	
			SPT 17, 34, 16/50mm (HB) N=R	31	3		CL	**Sandy CLAY with Clayey SAND layers (up to 50mm thick):** low plasticity, grey with minor black speckling and orange-brown mottling; fine to medium grained sand; trace of organic material; Clayey SAND layers: fine to medium grained, weakly cemented; low to medium plasticity clay.		H	ALLUVIUM / RESIDUAL SOIL?
			SPT 23, 30/110mm (HB) N=R	30	4		SC	**Clayey SAND:** fine to coarse grained, brown mottled orange, some weakly cemented layers (up to 50mm thick); low plasticity clay; trace of fine grained, sub-rounded gravel.		VD	
		Not Observed	SPT 18, 29, 23 N=52				SC	**Clayey SAND:** fine to coarse grained, brown-orange with minor brown mottling; low plasticity clay; trace of fine to medium grained, rounded gravel.			
WB				29	5		CI	**Sandy CLAY:** medium plasticity, brown-grey mottled orange; fine to medium grained sand with minor coarse grained fraction; trace of fine grained, sub-angular granite gravel.	M	H	RESIDUAL SOIL
			SPT 9, 12, 19 N=31	28	6		CI-CH	**CLAY:** medium to high plasticity, grey mottled orange; with some fine to coarse grained sand; trace of fine grained, sub-angular granite gravel.		VSt - H	
			SPT 8, 11, 16 N=27	27	7		CL-CI	**Sandy CLAY:** low to medium plasticity, grey mottled orange; fine to coarse grained sand; trace of fine grained, sub-angular granite gravel.		H	
			SPT 8, 12, 20 N=32	26	8			...layer of Clayey GRAVEL (50mm thick): fine grained, sub-angular granite; medium plasticity clay.			
			SPT 14, 20, 27 N=47	25	9		CI-CH	**Sandy CLAY:** medium to high plasticity, grey mottled orange-brown with minor black speckling; fine to coarse grained sand; with some fine to medium grained, angular to sub-angular granite gravel.			RESIDUAL SOIL TO EXTREMELY WEATHERED MATERIAL
			SPT 11, 19, 32 N=51				CL-CI	**Sandy CLAY:** low to medium plasticity, grey with pale grey and minor orange mottling; fine to coarse grained sand; trace of fine grained, angular to sub-angular granite gravel.			

Hole Terminated at 9.95 m
Target depth

METHOD & SUPPORT: HA Hand Auger; AS Auger; AD/V Auger - V-bit; AD/T Auger - TC-bit; WB Washbore; RR Rock Roller; AH Air Hammer; C Casing

PENETRATION: No resistance ranging to refusal

GROUNDWATER: = Water level (static); = Water level (during drilling); = Water inflow; = Water outflow

D Disturbed Sample; B Bulk Sample; SPT SPT Sample; U Undisturbed Sample; E Enviro Sample; W Water Sample
N SPT blows per 300mm; HW SPT penetration by hammer weight; RW SPT penetration by rod weight; HP Hand Penetrometer; HV Hand Vane Shear; (P: Peak Su R: Residual Su)

MOISTURE: D = Dry; M = Moist; W = Wet; Wp = Plastic Limit; Wl = Liquid Limit

DENSITY (N-value): VL Very Loose 0 - 4; L Loose 4 - 10; MD Medium Dense 10 - 30; D Dense 30 - 50; VD Very Dense 50 - 100

CONSISTENCY (Su) {N-value}: VS Very Soft < 12 kPa {0-2}; S Soft 12 - 25 {2-4}; F Firm 25 - 50 {4-8}; St Stiff 50 - 100 {8-15}; VSt Very Stiff 100 - 200 {15-30}; H Hard > 200 kPa {>30}

JACOBS Engineering Log - Borehole

JBH5

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	511518.0	**Elevation:**	34.41	**Started:**	09/05/2019
Plant:	EVH3300	**Northing:**	7804152.0	**Datum:**	AHD	**Finished:**	09/05/2019
Logged by:	DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	000°

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	Field Test Data & Other Observations
AD/T CASING		Not Encountered					SM	**TOPSOIL: Silty SAND:** low plasticity, dark brown; with some fine grained sand; trace of rootlets.		L	TOPSOIL
			SPT 12, 10, 12 N=22	34	1		CL	**Sandy CLAY:** low plasticity, dark brown; fine to medium grained sand; with some low plasticity silt; trace of rootlets. ...colour becoming brown.	D		ALLUVIUM
				33			CI	**Silty CLAY:** medium plasticity, brown mottled orange and dark brown; with some fine to medium grained sand; trace fine grained, sub-rounded to rounded gravel.	D - M	VSt	
			SPT 7, 9, 15/120mm (HB) N=R		2		CI	**Silty CLAY:** medium plasticity, grey mottled dark grey and orange; with some fine to medium grained sand.		H	RESIDUAL SOIL
							SC	**Clayey SAND:** fine to medium grained, grey speckled pink and orange, strongly cemented; low plasticty clay.	D	VD	CEMENTED MATERIAL
			SPT 20, 24, 26 N=50	32	3		SC	**Clayey SAND:** fine to medium grained, grey mottled pale pink and orange, weakly cemented; low plasticty clay.			
							CI	**Silty CLAY:** medium plasticity, grey mottled orange, weakly cemented; with some fine to medium grained sand.	D - M	H	
WB		Not Observed	SPT 15/40mm (HB) N=R	31	4		SC	**Clayey SAND:** fine to coarse grained, grey speckled pink and orange; low to medium plasticty clay; trace of fine grained, angular to sub-angular granite gravel. ...colour becoming grey and orange with minor pink speckling.	D	VD	EXTREMELY WEATHERED MATERIAL
			SPT 30/110mm (HB) N=R	30	5			...colour becoming orange mottled pink with minor grey mottling.	D - M		
			SPT 9, 20, 38 N=58	29	6		CI	**Sandy CLAY with Clayey SAND layers (up to 50mm thick):** medium plasticity, grey mottled pink and orange; fine to coarse grained sand; trace of fine grained, angular to sub-angular granite gravel; Clayey SAND layers: fine to coarse grained, dark red and orange; medium plasticity clay; trace of fine grained, angular to sub-angular granite gravel.	M	H	RESIDUAL SOIL TO EXTREMELY WEATHERED MATERIAL
			SPT 15, 16, 20 N=36	28	7						
			SPT 6, 13, 14 N=27	27	8		SC	**Clayey SAND with Sandy CLAY layers (up to 100mm thick):** fine to coarse grained, brown-grey mottled brown and pink; low to medium plasticty clay; trace of fine grained, angular to sub-angular granite gravel; Sandy CLAY layers: medium plasticity; dark grey mottled grey and dark brown; fine to coarse grained sand.		D	
			SPT 5, 23, 33 N=56	26	9					VD	
			SPT 23,35/ 110mm (HB) N=R	25				Hole Terminated at 9.76 m Target depth			

METHOD & SUPPORT
HA Hand Auger
AS Auger
AD/V Auger - V-bit
AD/T Auger - TC-bit
WB Washbore
RR Rock Roller
AH Air Hammer
C Casing

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (static)
= Water level (during drilling)
= Water inflow
= Water outflow

SAMPLES & FIELD TESTS

D	Disturbed Sample	N	SPT blows per 300mm
B	Bulk Sample	HW	SPT penetration by hammer weight
SPT	SPT Sample	RW	SPT penetration by rod weight
U	Undisturbed Sample	HP	Hand Penetrometer
E	Enviro Sample	HV	Hand Vane Shear
W	Water Sample	(P: Peak Su R: Residual Su)	

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Borehole

JBH6

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	510896.0	**Elevation:**	31.60	**Started:**	10/05/2019
Plant:	EVH3300	**Northing:**	7807858.0	**Datum:**	AHD	**Finished:**	10/05/2019
Logged by:	DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	000°

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency / Relative Density	Field Test Data & Other Observations
AD/T CASING		Not Encountered	SPT 2, 1, 3 N=4	31	0		ML	**TOPSOIL: Sandy SILT:** low plasticity, dark brown; fine to coarse grained sand; with some rootlets.	D	S	TOPSOIL
							SC				ALLUVIUM
							SP	**Clayey SAND:** fine to medium grained, dark brown; low plasticity clay; trace of rootlets.		L	
								SAND: fine to medium grained, brown; with some low plasticity clay; trace of rootlets.			
							CL-CI			F	
				30	1			**Sandy CLAY:** low to medium plasticity, dark grey; fine to medium grained sand; trace of rootlets.	M	L - MD	
			SPT 4, 6, 8 N=14				SP	**SAND:** fine to coarse grained, pale grey-brown; with some low plasticity clay; trace of rootlets.			
					2		CI	**Sandy CLAY:** medium plasticity, grey with minor orange mottling; fine to coarse grained sand; with some low plasticity silt.		St	RESIDUAL SOIL
			SPT 10/30mm (HB) N=R	29	3		CL	**Sandy CLAY:** low plasticity, pale grey with minor pink and orange speckling, strongly cemented; fine to coarse grained sand.	D		CEMENTED MATERIAL
			SPT 20/60mm (HB) N=R	28	4		CL	**Sandy CLAY with Sandy GRAVEL layers (up to 200mm thick):** low plasticity, grey with minor pink and orange speckling; fine to coarse grained sand; Sandy GRAVEL layers: fine grained, angular to subangular granite, red with white, pink and orange speckling; fine to coarse grained sand; with some low plasticity clay.		H	RESIDUAL SOIL TO EXTREMELY WEATHERED MATERIAL
WB		Not Observed	SPT 30/70mm (HB) N=R	27	5						
			SPT 30/80mm (HB) N=R	26	6				D - M		
			SPT 30/70mm (HB) N=R	25	7		SC	...colour becoming grey speckled pink and orange.		VD	
			SPT 30/100mm (HB) N=R	24	8						
			SPT 30/100mm (HB) N=R	23	9		SC	**Clayey SAND:** fine to coarse grained, pink mottled grey with minor orange speckling; low plasticity clay; trace of fine grained, angular to sub-angular granite gravel.			
			SPT 30/100mm (HB) N=R	22				Hole Terminated at 9.60 m Target depth			

METHOD & SUPPORT
HA Hand Auger
AS Auger
AD/V Auger - V-bit
AD/T Auger - TC-bit
WB Washbore
RR Rock Roller
AH Air Hammer
C Casing

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (static)
= Water level (during drilling)
= Water inflow
= Water outflow

SAMPLES & FIELD TESTS

D	Disturbed Sample	N	SPT blows per 300mm
B	Bulk Sample	HW	SPT penetration by hammer weight
SPT	SPT Sample	RW	SPT penetration by rod weight
U	Undisturbed Sample	HP	Hand Penetrometer
E	Enviro Sample	HV	Hand Vane Shear
W	Water Sample	(P: Peak Su R: Residual Su)	

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Borehole

JBH7

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	509906.0	**Elevation:**	33.39	**Started:**	10/05/2019
Plant:	EVH3300	**Northing:**	7809257.0	**Datum:**	AHD	**Finished:**	11/05/2019
Logged by:	DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	000°

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	Field Test Data & Other Observations
							ML	**TOPSOIL: Sandy SILT:** low plasticity, dark grey-brown; fine to medium grained sand; with some rootlets.	D - M	S - F	TOPSOIL
				33			CL	**Silty CLAY:** low plasticity, dark brown; with some fine to medium grained sand; trace of rootlets.			ALLUVIUM
			SPT 2, 3, 3 N=6				CL	**Sandy CLAY:** low plasticity, dark brown; fine to medium grained sand; with some low plasticity silt; trace of rootlets.		F	
AD/T CASING		Not Encountered			1						
				32			CL	**Silty CLAY:** low plasticity, dark brown; with some fine to medium grained sand; trace of rootlets.		S - F	
							SC	**Clayey SAND:** fine to coarse grained, brown; low plasticity clay; trace of rootlets.		L	
			SPT 1, 1, 1 N=2		2			**Sandy CLAY:** low plasticity, dark brown; fine to coarse grained sand; trace of fine to medium grained, sub-rounded gravel; trace of rootlets. ...becoming with lenses of Silty CLAY (up to 50mm thick): low to medium plasticity, dark grey and yellow-brown; with some fine to medium grained sand.			
				31			CL			S - F	
			SPT 2, 2, 2 N=4								
					3						
				30			SC	**Clayey SAND:** fine to coarse grained, brown speckled pink and white; low plasticity clay; trace of fine to medium grained, sub-rounded granite gravel.		L - MD	
			SPT 2, 2, 2 N=4								
					4						
				29			SC	**Clayey SAND:** fine to medium grained, grey mottled pale brown; low plasticity clay.		D	
			SPT 9, 13, 17 N=30								
					5				M		
				28			CL	**Sandy CLAY:** low plasticity, grey speckled pink; fine to coarse grained sand.			
							CL-CI	**CLAY:** low to medium plasticity, dark grey; with some low plasticity silt; trace of fine to coarse grained sand.			
			SPT 8, 13, 27 N=40		6			**Silty CLAY:** low plasticity, grey with minor black speckling; trace of fine to medium grained sand.			
				27			CL			H	
			SPT 16, 28, 30/80mm (HB) N=R		7			**Silty CLAY:** low plasticity, grey with minor black speckling; with some fine to coarse grained sand.			
				26			CL				
			SPT 24, 40/110mm (HB) N=R		8						
				25			SC	**Clayey SAND:** fine to medium grained with minor coarse fraction, brown-grey with minor black speckling; low plasticity clay.		VD	
			SPT 20, 37, 13/30mm (HB) N=R		9						
				24			SC	**Clayey SAND:** fine to coarse grained, grey; low plasticity clay.		H	RESIDUAL SOIL
WB		Not Observed	SPT 41,36/ 100mm (HB) N=R					Hole Terminated at 9.75 m Target depth			

METHOD & SUPPORT	PENETRATION	GROUNDWATER	SAMPLES & FIELD TESTS	MOISTURE	DENSITY (N-value)	CONSISTENCY (Su) {N-value}
HA Hand Auger AS Auger AD/V Auger - V-bit AD/T Auger - TC-bit WB Washbore RR Rock Roller AH Air Hammer C Casing	No resistance ranging to refusal	= Water level (static) = Water level (during drilling) = Water inflow = Water outflow	D Disturbed Sample B Bulk Sample SPT SPT Sample U Undisturbed Sample E Enviro Sample W Water Sample N SPT blows per 300mm HW SPT penetration by hammer weight RW SPT penetration by rod weight HP Hand Penetrometer HV Hand Vane Shear (P: Peak Su R: Residual Su)	D = Dry M = Moist W = Wet Wp = Plastic Limit Wl = Liquid Limit	VL Very Loose 0 - 4 L Loose 4 - 10 MD Medium Dense 10 - 30 D Dense 30 - 50 VD Very Dense 50 - 100	VS Very Soft < 12 kPa {0-2} S Soft 12 - 25 {2-4} F Firm 25 - 50 {4-8} St Stiff 50 - 100 {8-15} VSt Very Stiff 100 - 200 {15-30} H Hard > 200 kPa {>30}

JACOBS 3.01.3 LIB.GLB Log JACOBS AU BOREHOLE LOG IH175200-HAUGHTON PIPELINE STAGE 2 - FIELD INVESTIGATION_DM.GPJ <<DrawingFile>> 29/05/2019 21:25 8.30.003 Datgel Lab and In Situ Tool - DGD | Lib: Jacobs 3.01.2 2017-03-09 Prj: Jacobs 3.00.0 2016-07-17

JACOBS Engineering Log - Borehole

JBH8

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 2
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	510259.0	**Elevation:**	28.59	**Started:**	11/05/2019
Plant:	EVH3300	**Northing:**	7811103.0	**Datum:**	AHD	**Finished:**	11/05/2019
Logged by:	DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	000°

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	Field Test Data & Other Observations
AD/T CASING		Not Encountered	SPT 7, 16, 32 N=48	28	0		ML	**TOPSOIL: Sandy SILT:** low plasticity, dark brown; fine to coarse grained sand; with some rootlets; trace of fine grained, sub-rounded gravel.	D	F - St	TOPSOIL
							CI		M	VSt	ALLUVIUM
							CL-CI	**Silty CLAY:** medium plasticity, dark brown and grey-brown; trace of fine to coarse grained sand.	D - M	VSt - H	
								Silty CLAY: low to medium plasticity, dark brown and grey-brown; trace of fine to coarse grained sand.			CEMENTED MATERIAL
					1		CL	**Sandy CLAY:** low plasticity, grey mottled dark grey and pale orange brown, weakly cemented; fine to medium grained sand.		H	
			SPT 22, 32/110mm (HB) N=R	27			SC	**Sandy CLAY:** low plasticity, grey with minor pale orange-brown mottling, weakly cemented; fine to medium grained sand.	D		
					2					VD	
			SPT 30/110mm (HB) N=R	26			CL	**Sandy CLAY:** low plasticity, grey with minor pale orange-brown mottling; strongly cemented; fine to medium grained sand; with some low plasticity silt.			
					3		CL-CI	**Clayey SAND:** fine to coarse grained, grey with minor pale grey mottling and minor pink speckling; low to medium plasticity clay; trace of fine grained, angular to sub-angular gravel.	M	H	RESIDUAL SOIL TO EXTREMELY WEATHERED MATERIAL
			SPT 16, 17, 17 N=34	25							
					4		CI	**CLAY:** medium plasticity, dark grey with minor black and orange staining; with some fine to coarse grained sand.			
							CL-CI	**Sandy CLAY:** low to medium plasticity, grey with minor orange and pink speckling; fine to coarse grained sand; trace of fine grained, angular to sub-angular granite gravel.			
			SPT 9, 15, 17 N=32	24	5		CL-CI	**Silty CLAY:** low to medium plasticity, grey with orange-brown and minor pale red mottling; with some fine to coarse grained sand.			
										VSt - H	
			SPT 7, 14, 15 N=29	23	6						
			SPT 30/130mm (HB) N=R	22	7		CL	**Sandy CLAY:** low plasticity, grey with dark grey and minor pale orange-brown mottling; fine to coarse grained sand; with some low plasticity silt; trace of fine grained, sub-angular granite gravel.			
								CLAY: low plasticity, grey mottled dark grey and pale orange-brown; with some fine to medium grained sand with minor coarse fraction; with some low plasticity silt.		H	
			SPT 22, 30/100mm (HB) N=R	21	8		CL		D - M		
					9						
			SPT 7, 13, 13 N=26	19			SC	**Clayey SAND:** fine to medium grained, grey with minor orange bandings; low plasticity clay; trace of low plasticity silt.	M	D	
WB		Not Observed									

METHOD & SUPPORT
HA Hand Auger
AS Auger
AD/V Auger - V-bit
AD/T Auger - TC-bit
WB Washbore
RR Rock Roller
AH Air Hammer
C Casing

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (static)
= Water level (during drilling)
= Water inflow
= Water outflow

SAMPLES & FIELD TESTS

D	Disturbed Sample	N	SPT blows per 300mm
B	Bulk Sample	HW	SPT penetration by hammer weight
SPT	SPT Sample	RW	SPT penetration by rod weight
U	Undisturbed Sample	HP	Hand Penetrometer
E	Enviro Sample	HV	Hand Vane Shear
W	Water Sample	(P: Peak Su R: Residual Su)	

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Borehole

JBH8

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 2 of 2
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	510259.0	**Elevation:**	28.59	**Started:**	11/05/2019
Plant:	EVH3300	**Northing:**	7811103.0	**Datum:**	AHD	**Finished:**	11/05/2019
Logged by:	DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	000°

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	Field Test Data & Other Observations
WB		Not Observed	SPT 10, 13, 26 N=39	18			SC	**Clayey SAND:** fine to medium grained, grey with minor orange bandings; low plasticity clay; trace of low plasticity silt. *(continued)* ...colour becoming grey.	M	D	RESIDUAL SOIL TO EXTREMELY WEATHERED MATERIAL
							CL	**Sandy CLAY:** low plasticity, grey speckled orange and pale red; fine to coarse grained sand; trace of fine grained, angular to sub-angular granite gravel.		H	
				17	11			Hole Terminated at 10.95 m Target depth			
				16	12						
				15	13						
				14	14						
				13	15						
				12	16						
				11	17						
				10	18						
				9	19						

METHOD & SUPPORT
HA Hand Auger
AS Auger
AD/V Auger - V-bit
AD/T Auger - TC-bit
WB Washbore
RR Rock Roller
AH Air Hammer
C Casing

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (static)
= Water level (during drilling)
= Water inflow
= Water outflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
N SPT blows per 300mm
HW SPT penetration by hammer weight
RW SPT penetration by rod weight
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Borehole

JBH9

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Geo-Investigate	**Easting:**	509031.0	**Elevation:**	28.18	**Started:**	15/05/2019
Plant:	EVH3300	**Northing:**	7817337.0	**Datum:**	AHD	**Finished:**	15/05/2019
Logged by:	MIBW/TAM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	

DRILLING INFORMATION | MATERIAL SUBSTANCE

Method & Support	Penetration	Groundwater Levels	Samples & SPT Data	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	Field Test Data & Other Observations
AD/T CASING		Not Observed		28			CL	**TOPSOIL: CLAY:** low plasticity, brown-grey; with some fine grained sand with minor medium grained fraction; with some rootlets.	D - M	F - St	TOPSOIL
			D								ALLUVIUM
			SPT 5, 10, 16 N=26		1		CL	**CLAY:** low plasticity, brown; with some fine to medium grained sand; trace of rootlets. ...sand content increasing.	M	VSt	0.50: PP = >600 kPa (D) 0.70: PP = >600 kPa (D) 0.90: PP = >600 kPa (D)
				27				...colour becoming brown mottled grey.			
			SPT 13, 16, 24 N=40				CL-CI	**CLAY:** low to medium plasticity, dark brown; with some fine to medium grained sand with minor coarse grained fraction.		H	1.50: PP = >600 kPa (D) 1.70: PP = >600 kPa (D)
					2		SW	**SAND:** fine to coarse grained, pale brown mottled dark brown and pale pink; with some low plasticity clay; with some fine to medium grained gravel with minor coarse fraction.		VD	1.90: PP = >600 kPa (D)
				26			CL	**CLAY:** low plasticity, dark brown; with some fine to coarse grained sand; trace of fine grained, sub-angular to sub-rounded gravel.			
			SPT 9, 16, 18 N=34								2.50: PP = >600 kPa (D) 2.70: PP = >600 kPa (D)
					3			**Sandy CLAY:** low plasticity, pale brown; fine to coarse grained sand; trace of fine grained, sub-angular to sub-rounded gravel.			2.90: PP = >600 kPa (D)
				25				...colour becoming pale brown-pink.		H	
			SPT 9, 11, 19 N=30					...colour becoming pale brown.			3.50: PP = >600 kPa (D) 3.70: PP = >600 kPa (D)
					4			...trace of coarse grained gravel present.			3.90: PP = >600 kPa (D)
				24							
			SPT 7, 11, 16 N=27					...no coarse grained gravel present.			4.50: PP = >600 kPa (D) 4.70: PP = >600 kPa (D)
					5						4.90: PP = >600 kPa (D)
				23					D - M		
			SPT 6, 9, 11 N=20				CL			VSt - H	5.50: PP = 490 kPa (D) 5.70: PP = 510 kPa (D)
					6						5.90: PP = 510 kPa (D)
				22							
			SPT 9, 11, 14 N=25					...colour becoming orange-brown mottled pale brown, sand fraction becoming fine to medium grained.			6.50: PP = 330 (friable) kPa (D) 6.70: PP = 500 kPa (D)
					7						6.90: PP > 600 kPa (D)
				21							
			SPT 8, 16, 21 N=37					...colour becoming orange-brown and grey, trace of fine grained, sub-angular to sub-rounded gravel present. ...layer of Clayey SAND (50mm thick): fine to coarse grained, pale brown; low plasticity clay.			7.50: PP = 480 (friable) kPa (D) 7.70: PP = 590 (friable) kPa (D)
					8						7.90: PP > 600 kPa (D)
				20							
			SPT 9, 14, 17 N=31					**Sandy CLAY:** low to medium plasticity, grey speckled orange-brown; fine to coarse grained sand.		H	8.50: PP > 600 kPa (D) 8.70: PP > 600 kPa (D)
					9						8.90: PP > 600 kPa (D)
				19			CL-CI		M		
			SPT 8, 15, 18 N=33					...sand fraction becoming fine to medium grained.			9.50: PP > 600 kPa (D) 9.70: PP > 600 kPa (D) 9.90: PP > 600 kPa (D)
WB								Hole Terminated at 9.95m Target depth			

METHOD & SUPPORT: HA Hand Auger; AS Auger; AD/V Auger - V-bit; AD/T Auger - TC-bit; WB Washbore; RR Rock Roller; AH Air Hammer; C Casing

PENETRATION: No resistance ranging to refusal

GROUNDWATER: = Water level (static); = Water level (during drilling); = Water inflow; = Water outflow

SAMPLES & FIELD TESTS: D Disturbed Sample; B Bulk Sample; SPT SPT Sample; U Undisturbed Sample; E Enviro Sample; W Water Sample; N SPT blows per 300mm; HW SPT penetration by hammer weight; RW SPT penetration by rod weight; HP Hand Penetrometer; HV Hand Vane Shear; (P: Peak Su R: Residual Su)

MOISTURE: D = Dry; M = Moist; W = Wet; Wp = Plastic Limit; Wl = Liquid Limit

DENSITY (N-value): VL Very Loose 0 - 4; L Loose 4 - 10; MD Medium Dense 10 - 30; D Dense 30 - 50; VD Very Dense 50 - 100

CONSISTENCY (Su) {N-value}: VS Very Soft < 12 kPa {0-2}; S Soft 12 - 25 {2-4}; F Firm 25 - 50 {4-8}; St Stiff 50 - 100 {8-15}; VSt Very Stiff 100 - 200 {15-30}; H Hard > 200 kPa {>30}

JACOBS 3.01.3 LIB.GLB Log JACOBS AU BOREHOLE LOG IH175200-HAUGHTON PIPELINE STAGE 2 - FIELD INVESTIGATION.GPJ <<DrawingFile>> 30/05/2019 12:36 8.30.003 Datgel Lab and In Situ Tool - DGD | Lib: Jacobs 3.01.2 2017-03-09 Prj: Jacobs 3.00.0 2016-07-17

JACOBS Engineering Log - Excavation

JTP1

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	522781.0	**Elevation:**	37.38	**Started:**	02/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7796526.0	**Datum:**	AHD	**Finished:**	02/05/2019
Logged by:	MIBW/DFM **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	312°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		37.0	0.0		CL	**TOPSOIL: Sandy CLAY:** low plasticity, dark brown, fine grained sand; with some roots and rootlets; trace of low liquid limit silt.	M	F		TOPSOIL
					0.5			**Sandy CLAY:** low to medium plasticity, brown, fine grained sand; trace of roots and rootlets.				ALLUVIUM 0.30: PP = 500, >600, >600 kPa
			D	36.5	1.0			...becoming low plasticty and colour changing to grey-brown from 0.75m. ...colour changing to brown from 0.85m. ...roots disappearing from 0.95m.	M			0.75: PP = 500, >600, >600 kPa
			D	36.0	1.5		CL-CI	...colour changing to orange-brown from 1.8m.		H		1.35: PP = 600, >600, >600 kPa
			D	35.5	2.0			...colour changing to pale brown from 2.0m. ...colour changing to orange-brown from 2.1m.	D - M			1.90: PP = 600, >600, >600 kPa 2.00: PP = 400, 550, 400 kPa (friable)
				35.0	2.5			...colour changing to orange-pale brown from 2.5m.				2.40: PP > 600, >600, >600 kPa
				34.5	3.0			...becoming low to medium plasticty and colour changing to red-brown from 2.9m. ...becoming low plasticity, pale brown, fine grained sand from 3.0m.	M			2.80: PP > 600, >600, >600 kPa 3.00: PP > 600, >600, >600 kPa
			D	34.0								3.30: PP > 600, >600, >600 kPa
				33.5	3.5			Hole Terminated at 3.40 m Refusal				

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP2

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	522816.0	**Elevation:**	41.58	**Started:**	02/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7796168.0	**Datum:**	AHD	**Finished:**	02/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	243°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		41.5	0		CL	**TOPSOIL: Sandy CLAY:** low plasticity, dark brown, fine to coarse grained sand, fine to coarse grained, angular to sub-angular gravel; with some angular to sub-angular cobbles and boulders; with some rootlets.	D - M	St		TOPSOIL
				41.0	0.5		CL-CI	**Gravelly CLAY:** low to medium plasticity, yellow-brown, fine to medium grained, angular to sub-angular granite gravel; with some fine to coarse grained sand; trace of rootlets.	M	H		EXTREMELY WEATHERED MATERIAL 0.50: PP > 600, >600, >600 kPa
			D				CL-CI	**CLAY:** high plasticity, grey mottled yellow-brown; with some fine to medium grained sand; with some fine to coarse grained angular to sub-angular granite gravel. ...colour changing to grey-brown; trace of sub-angular to angular cobbles from 0.9m.				0.70: PP > 600, >600, >600 kPa 0.90: PP = 450, 430, 440 kPa
			D	40.5	1.0		GC	**CLAYEY GRAVEL:** fine to medium grained, angular to sub-angular, granite, pale brown mottled light grey, low plasticity clay, with some fine to coarse grained sand (minor fine grained content).		D		1.17: DCP refusal 1.20: PP = 510, 580, 460 kPa
			D	40.0	1.5		CL	**Gravelly CLAY:** low plasticity, grey-brown, fine to coarse grained angular to sub-angular, granite gravel (minor coarse grained content); with some fine to coarse grained sand (minor coarse grained content).		H		1.70: PP = 520, 530, 550 kPa
				39.5	2.0		GC	**MODERATELY TO HIGHLY WEATHERED, MEDIUM TO HIGH STRENGTH GRANITE excavated as CLAYEY GRAVEL:** fine to coarse grained, pale brown, angular to sub-angular, granite, low plasticity clay; with some medium to coarse grained sand; trace of sub-angular to angular, granite cobbles.		VD		
				39.0	2.5			Hole Terminated at 2.40 m Refusal				
				38.5	3.0							
				38.0	3.5							

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP3

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	522235.0	**Elevation:**	38.32	**Started:**	07/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7796529.0	**Datum:**	AHD	**Finished:**	07/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	137°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		38.0	0.0		CL	**TOPSOIL: CLAY:** low plasticity, dark brown; with some rootlets; trace of fine grained sand.	D - M	VSt		TOPSOIL
			D		0.5			**Sandy CLAY:** low plasticity, grey-dark brown, fine grained sand; trace of rootlets; trace of fine grained gravel.		H		RESIDUAL SOIL 0.50: PP > 600, >600, >600 kPa
				37.5					M	VSt		0.68: DCP refusal 0.70: PP = 300, 310, 340 kPa
			D		1.0			...gravel becoming fine to medium grained and sub-angular to sub-rounded from 0.8m.				0.90: PP > 600, >600, >600 kPa
				37.0			CL	...colour changed to grey brown, fine to medium grained sand; trace of fine grained, sub-angular to sub-rounded gravel from 1.20m.				1.10: PP > 600, >600, >600 kPa 1.30: PP > 600, >600, >600 kPa
					1.5			...sand becoming fine to coarse grained from 1.5m.	D - M			1.50: PP > 600, >600, >600 kPa
				36.5				...no gravels present from 1.8m.		H		1.70: PP > 600, >600, >600 kPa
					2.0							2.00: PP > 600, >600, >600 kPa
			D	36.0				**CLAY:** medium to high plasticity, pale brown mottled.	M			2.20: PP > 600, >600, >600 kPa
					2.5		CI-CH	...colour changing to pale brown from 2.5m.				2.40: PP > 600, >600, >600 kPa
								...with some fine grained sand; with some sub-angular to angular granodiorite gravel; with some granodiorite cobbles from 2.6m.				2.60: PP > 600, >600, >600 kPa 2.70: PP > 600, >600, >600 kPa
				35.5				Hole Terminated at 2.80 m Refusal				
					3.0							
				35.0								
					3.5							
				34.5								

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP4

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	521965.0	**Elevation:**	37.45	**Started:**	03/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7797058.0	**Datum:**	AHD	**Finished:**	03/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	143°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered	D	37.0	0.5		CL-CI	**TOPSOIL: CLAY:** low to medium plasticity, grey-dark brown; with some fine to medium grained sand; with some rootlets.	D - M	VSt		TOPSOIL
								CLAY: low to medium plasticity, dark brown; with some fine to medium grained sand; with some rootlets.				RESIDUAL SOIL 0.30: PP > 600, >600, >600 kPa
				36.5	1.0			...trace of rootlets from 0.7m.				0.60: PP > 600, >600, >600 kPa 0.80: PP = 550, 530, 520 kPa
			D	36.0	1.5			...rootlets disappearing from 1.3m.				1.10: PP > 600, >600, >600 kPa 1.30: PP > 600, 530, 500 kPa 1.50: PP = 480, 450, 460 kPa
				35.5	2.0		CL-CI		M	H		1.70: PP > 600, >600, >600 kPa 2.00: PP > 600, >600, >600 kPa
				35.0	2.5			...becoming medium plasticity, red-brown from 2.7m.				2.20: PP > 600, >600, >600 kPa 2.50: PP = 550, 500, 520 kPa 2.70: PP = 550, 530, >600 kPa
			D	34.5	3.0			...increasing moisture content from 3.0m. ...colour changing to red-brown mottled back and white from 3.2m.				3.00: PP = 480, 460, 420 kPa 3.20: PP = 420, 450, 400 kPa
				34.0	3.5			Hole Terminated at 3.50 m Machine Limit				3.40: PP = 550, 520, 570 kPa 3.47: DCP hammer double bouncing
				33.5								

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP5

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	521834.0	**Elevation:**	38.88	**Started:**	07/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7797366.0	**Datum:**	AHD	**Finished:**	07/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	162°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		38.88	0.0		CL	**TOPSOIL: CLAY:** low plasticity, dark brown; with some fine to medium grained sand; with some rootlets.		St		TOPSOIL
			D	38.5	0.5		CL	**CLAY:** low plasticity, brown; with some fine to medium grained sand; with some rootlets. ...colour changing to orange-brown from 0.7m.		H		RESIDUAL SOIL 0.40: PP > 600, >600, >600 kPa 0.60: PP > 600, >600, >600 kPa 0.80: PP = 520, 500, 400 kPa 1.00: PP = 400, 410, 430 kPa 1.20: PP = 410, 420, 410 kPa
			D	37.5	1.5			**Sandy CLAY:** low plasticity, pale brown mottled white, fine to coarse grained sand; with some fine to coarse grained, sub-angular to angular gravel.	M			1.50: PP = 500, 520, 490 kPa
			D	37.0	2.0			...becoming low to medium plasticity, grey-brown mottled dark brown from 1.9m. ...sand becoming fine to medium grained; no presence of gravel from 2.1m.		VSt		1.90: PP = 300, 240, 210 kPa 2.10: PP = 350, 330, 280 kPa 2.30: PP = 330, 330, 330 kPa (friable)
				36.5	2.5		CL					
				36.0	3.0			...colour changing to grey brown from 2.9m.		H		2.60: PP = 440, 410, 380 kPa 2.90: PP = 400, 410, 420 kPa
			D	35.5	3.5			...colour changing to pale brown from 3.4m.		VSt		3.20: PP = 430, 410, 420 kPa (friable) 3.40: PP = 260, 290, 300 kPa 3.50: PP = 450, 400, 355 kPa (friable)
				35.0				Hole Terminated at 3.60 m Machine Limit				

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP6

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	521250.0	**Elevation:**	36.72	**Started:**	03/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7798266.0	**Datum:**	AHD	**Finished:**	03/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	120°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered	D	36.5	0.5		CI-CH	**TOPSOIL: CLAY:** medium to high plasticity, pale grey; with some fine grained sand; with some rootlets.	D - M	St		TOPSOIL
								Sandy CLAY: low to medium plasticity, pale grey, fine to medium grained sand; trace of rootlets.				RESIDUAL SOIL
												0.40: PP > 600, >600, >600 kPa
				36.0								0.59: DCP Refusal 0.60: PP > 600, >600, >600 kPa
			D		1.0		CL-CI	...becoming low plasticity, brown mottled red and black, fine to coarse grained sand (minor fine grained content); with some fine to medium grained, sub-angular to sub-rounded granodiorite gravel.	M	H		1.00: PP > 600, >600, >600 kPa
				35.5								1.20: PP > 600, >600, >600 kPa
					1.5							1.50: PP > 600, >600, >600 kPa
			D	35.0				...becoming low to medium plasticity, pale brown, fine grained sand and cemented from 1.6m.				CEMENTED MATERIAL 1.70: PP > 600, >600, >600 kPa
								...becoming highly cemented from 1.9m.				1.90: PP > 600, >600, >600 kPa
					2.0			Hole Terminated at 2.00 m Refusal				
				34.5	2.5							
				34.0								
					3.0							
				33.5								
					3.5							
				33.0								

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP7

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	520973.0	**Elevation:**	36.04	**Started:**	03/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7798703.0	**Datum:**	AHD	**Finished:**	03/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	129°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered	D	36.0	0		CL-CI	**TOPSOIL: CLAY:** low to medium plasticity, grey-brown; with some fine to medium grained sand; with some rootlets.		St		TOPSOIL
			D	35.5	0.5			**CLAY:** low to medium plasticity, brown; with some fine to coarse grained sand; trace of rootlets.	D - M			RESIDUAL SOIL 0.40: PP > 600, >600, 570 kPa 0.60: PP > 600, >600, >600 kPa
				35.0	1.0			...colour changing to grey-pale brown from 0.9m. ...rootlets disappearing from 1.1m.				0.90: PP > 600, >600, >600 kPa
				34.5	1.5			...sand becoming fine to medium grained from 1.4m.				1.30: PP > 600, >600, >600 kPa 1.50: PP > 600, 580, 500 kPa (friable)
			D	34.0	2.0		CL-CI	...becoming high plasticity from 1.9m.	M	H		1.80: PP > 600, 580, 560 kPa (friable) 2.10: PP > 600, 520, 550 kPa (friable)
				33.5	2.5							2.40: PP > 600, >600, 570 kPa 2.70: PP = 560, 520, 540 kPa
				33.0	3.0			...colour changing to pale grey mottled brown from 3.1m.				3.00: PP = 480, 470, 520 kPa 3.20: PP > 600, 590, >600 kPa
				32.5	3.5			Hole Terminated at 3.50 m Machine Limit				3.50: PP = 530, 520, 500 kPa 3.69: DCP refusal

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP8

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	520582.0	**Elevation:**	35.90	**Started:**	03/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7799239.0	**Datum:**	AHD	**Finished:**	03/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	146°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		35.90	0.0							
							CL	**TOPSOIL: CLAY:** low plasticity, grey-pale brown; with some fine to coarse grained sand; with some rootlets; trace of fine grained gravel.	D - M	VSt		TOPSOIL
			D	35.5	0.5		CL-CI	**Sandy CLAY:** low to medium plasticity, pale brown, fine to medium grained sand; trace of rootlets.				RESIDUAL SOIL 0.40: PP = 370, 280, 320 kPa
				35.0	1.0			...colour changing to yellow-brown from 0.9m.		H		0.60: PP > 600, >600, 500 kPa 0.86: DCP refusal 0.90: PP > 600, >600, >600 kPa
			D	34.5	1.5		SC	**CLAYEY SAND:** fine to coarse grained, yellow-brown, low plasticity; with some fine to medium grained, sub-angular to sub-rounded granodiorite gravel.	M	D		
				34.0	2.0			...increasing clay content from 2.0m.				
				33.5	2.5		SP	**Gravelly SAND:** medium to coarse grained, yellow-brown, fine grained, sub-angular to sub-rounded granodiorite gravel; with some medium plasticity clay; trace of medium liquid limit silt.		VSt		EXTREMELY WEATHERED MATERIAL 2.60: PP = 300, 280, 260 kPa (friable) 2.80: PP = 250, 240, 300 kPa (friable)
			D	33.0	3.0		SC	**CLAYEY SAND:** fine to coarse grained, yellow-brown, low plasticity; with some fine to medium grained, sub-angular to sub-rounded granodiorite gravel.		D - VD		
				32.5	3.5			Hole Terminated at 3.50 m Machine Limit				
				32.0								

METHOD & SUPPORT	PENETRATION	GROUNDWATER	SAMPLES & FIELD TESTS	MOISTURE
N Natural/Existing cutting E Excavator BH Backhoe Bucket B Buldozer R Ripper	No resistance ranging to refusal	= Water level (during test pitting) = Water inflow	D Disturbed Sample B Bulk Sample SPT SPT Sample U Undisturbed Sample E Enviro Sample W Water Sample HP Hand Penetrometer HV Hand Vane Shear (P: Peak Su R: Residual Su)	D = Dry M = Moist W = Wet Wp = Plastic Limit Wl = Liquid Limit

DENSITY (N-value)		
VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}		
VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

Engineering Log - Excavation

JTP9

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	520277.0	**Elevation:**	35.79	**Started:**	03/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7799718.0	**Datum:**	AHD	**Finished:**	03/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	145°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		35.5	0		CL	**TOPSOIL: CLAY:** low plasticity, pale brown; with some medium to coarse grained sand; with some rootlets; trace of fine grained gravel.		VSt		TOPSOIL
			D		0.5		ML	**SILT:** low liquid limit, pale brown; with some fine to medium grained sand; with some rootlets; trace of fine grained sub-angular to sub-rounded gravel; trace of low plasticity clay.	D - M	H		RESIDUAL SOIL 0.27: DCP refusal
			D	35.0	1.0		CL-CI	**Sandy CLAY:** low to medium plasticity; yellow-brown mottled red and brown, fine to coarse grained sand (minor medium grained content); trace of angular to sub-angular, fin e grained gravel.				0.60: PP > 600, >600, >600 kPa 0.80: PP > 600, >600, >600 kPa
								ROCK: GRANODIORITE: Moderately to highly weathered, medium to high strength, grey-pale brown.	D	VD		1.00: PP > 600, >600, >600 kPa WEATHERED ROCK
				34.5	1.5			Hole Terminated at 1.10 m Refusal				
				34.0	2.0							
				33.5	2.5							
				33.0	3.0							
				32.5	3.5							
				32.0								

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP10

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	519470.0	**Elevation:**	35.75	**Started:**	02/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7800260.0	**Datum:**	AHD	**Finished:**	02/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	155°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		35.5	0.0		SC	**TOPSOIL: CLAYEY SAND:** fine grained, grey-pale brown; with some rootlets.	D - M	L MD		TOPSOIL
			D	35.0	0.5		CL-CI	**Sandy CLAY:** low to medium plasticity, grey-pale brown, fine to medium grained sand; with some rootlets.	M	H		RESIDUAL SOIL 0.60: PP > 600, >600, >600 kPa
				34.5	1.0			...rootlets disappearing.				1.00: PP > 600, >600, >600 kPa 1.11: DCP refusal
								ROCK: GRANODIORITE: Moderately to highly weathered, medium to high strength, grey-pale brown.	D	VD		1.30: PP > 600, >600, >600 kPa WEATHERED ROCK
				34.0	1.5			Hole Terminated at 1.40 m Refusal				
				33.5	2.0							
				33.0	2.5							
				32.5	3.0							
				32.0	3.5							

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP11

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	518841.0	**Elevation:**	35.62	**Started:**	02/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7801109.0	**Datum:**	AHD	**Finished:**	02/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	202°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered	D	35.5	0.0		CI-CH	**TOPSOIL: CLAY:** medium to high plasticity, dark brown; with some fine to medium grained sand; with some rootlets; trace of fine sub-angular to angular gravel.		F		TOPSOIL
										St		
			D				CL-CI	**CLAY:** low to medium plasticity, dark brown; with some fine to medium grained sand; with some rootlets.		F		ALLUVIUM
			B	35.0	0.5			**Sandy CLAY:** low plasticity; grey-dark brown, fine to medium grained; trace of fine grained sub-angular to angular granodiorite gravel.		St		RESIDUAL SOIL 0.65: PP = 150, 150, 180 kPa
				34.5	1.0			...becoming low plasticty clay, pale brown; no gravels present from 1.0m.				0.90: PP = 100, 110, 120 kPa
				34.0	1.5			...becoming low to medium plasticity, pale brown mottled brown from 1.5m.	M	VSt		1.30: PP = 300, 330, 340 kPa 1.40: DCP refusal
			D				CL-CI	...colour changing to pale brown mottled grey and pink, fine to coarse grained sand from 1.7m.				
				33.5	2.0			...becoming low plasticity, grey-pale brown, fine to medium grained sand from 2.0m.				2.00: PP = 520, 550, 570 kPa
												2.30: PP > 600, >600, >600 kPa
			D	33.0	2.5			...becoming low plasticity, pale grey, fine grained sand from 2.5m.		H		2.50: PP > 600, >600, >600 kPa
												2.90: PP = 420, 430, 450 kPa 3.00: PP = 400, 430, 450 kPa 3.10: PP = 400, 420, 430 kPa
				32.5	3.0							
				32.0	3.5			Hole Terminated at 3.20 m Refusal				

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

Engineering Log - Excavation

JTP12

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	518115.0	**Elevation:**	35.01	**Started:**	07/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7801316.0	**Datum:**	AHD	**Finished:**	07/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	266°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered	D	34.5	0.5		CL-CI	**TOPSOIL: CLAY:** low to medium plasticty, grey mottled brown; with some rootlets; trace of fine grained sand.	M	St		TOPSOIL
							CL-CI	**CLAY:** low to medium plasticty, grey mottled brown; trace of fine grained sand; trace of rootlets.		VSt		ALLUVIUM 0.40: PP = 240, 260, 300 kPa
										St		0.60: PP = 120, 150, 180 kPa
			D				CL-CI	**Sandy CLAY:**low to medium plasticity, grey mottled orange, fine to medium grained sand.		VSt		RESIDUAL SOIL 0.80: PP = 210, 220, 250 kPa
			D	34.0	1.0		SC	**CLAYEY SAND:** medium to coarse grained, pale pink mottled white, low plasticity clay.		MD		WEATHERED ROCK
			D							D - VD		1.05: DCP refusal
								...becoming highly cemeted material from 1.25m.				CEMENTED MATERIAL
				33.5	1.5			Hole Terminated at 1.30 m Refusal				
				33.0	2.0							
				32.5	2.5							
				32.0	3.0							
				31.5	3.5							

METHOD & SUPPORT	PENETRATION	GROUNDWATER	SAMPLES & FIELD TESTS	MOISTURE	DENSITY (N-value)	CONSISTENCY (Su) {N-value}
N Natural/Existing cutting E Excavator BH Backhoe Bucket B Buldozer R Ripper	No resistance ranging to refusal	= Water level (during test pitting) = Water inflow	D Disturbed Sample B Bulk Sample SPT SPT Sample U Undisturbed Sample E Enviro Sample W Water Sample HP Hand Penetrometer HV Hand Vane Shear (P: Peak Su R: Residual Su)	D = Dry M = Moist W = Wet Wp = Plastic Limit Wl = Liquid Limit	VL Very Loose 0 - 4 L Loose 4 - 10 MD Medium Dense 10 - 30 D Dense 30 - 50 VD Very Dense 50 - 100	VS Very Soft < 12 kPa {0-2} S Soft 12 - 25 {2-4} F Firm 25 - 50 {4-8} St Stiff 50 - 100 {8-15} VSt Very Stiff 100 - 200 {15-30} H Hard > 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP13

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	517621.0	**Elevation:**	36.13	**Started:**	07/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7801412.0	**Datum:**	AHD	**Finished:**	07/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	288°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		36.0	0.0		SC	**TOPSOIL: CLAYEY SAND:** fine to medium grained, pale brown, low plasticity clay; with some rootlets.	D - M	L		TOPSOIL
			D				SC	**CLAYEY SAND:** fine to medium grained, pale brown, low plasticity clay; trace of rootlets.		MD		ALLUVIUM
			D	35.5	0.5		CL	**Sandy CLAY:** low plasticity, grey-brown, fine to medium grained sand. ...colour changing to grey-brown mottled orange; trace of fine to medium grained sub-angular to subrounded gravel from 0.8m.	M	H		RESIDUAL SOIL 0.60: PP >600, >600, >600 kPa EXTREMELY WEATHERED ROCK 0.80: PP >600, >600, >600 kPa
				35.0	1.0			Hole Terminated at 0.95 m Refusal				0.88: DCP hammer double bouncing 0.90: PP >600, >600, >600 kPa
				34.5	1.5							
				34.0	2.0							
				33.5	2.5							
				33.0	3.0							
				32.5	3.5							

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP14

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	515032.0	**Elevation:**	35.68	**Started:**	08/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7801363.0	**Datum:**	AHD	**Finished:**	08/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	278°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered	D	35.5	0		CL	**TOPSOIL: Sandy CLAY:** low plasticity, grey-pale brown, fine to medium grained sand; with some rootlets.		St		TOPSOIL
			D	35.0	0.5		SC	**CLAYEY SAND:** fine to medium grained, brown mottled orange, low plasticity clay; with some rootlets. ...becoming fine to coarse grained, red-brown, low plasticty clay; with some fine to coarse sub-angular to sub-rounded gravel; with some sub-angular to sub-rounded cobbles from 0.5m.	M	MD D		ALLUVIUM 0.58: DCP refusal
			D D	34.5	1.0		CL	**Sandy CLAY:** low, grey mottled orange, fine to coarse grained sand; trace of fine to medium grained sub-angular to sub-rounded gravel. ...colour changing to pale brown mottled grey and orange, fine to medium grained sand. ...becoming highly cemented from 1.3m.		VSt - H		RESIDUAL SOIL 0.80: PP = 340, 400, 440 kPa 1.00: PP = 300, 340, 360 kPa 1.20: PP = 350, 380, 400 kPa
				34.0 33.5 33.0 32.5 32.0	1.5 2.0 2.5 3.0 3.5			Hole Terminated at 1.30 m Refusal				CEMENTED MATERIAL

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP15

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	514577.0	**Elevation:**	35.39	**Started:**	08/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7801397.0	**Datum:**	AHD	**Finished:**	08/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	284°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		35.0	0.0		CL-CI	**TOPSOIL: CLAY:** low to medium plasticity, pale brown; with some rootlets: trace of fine grained sand.		VSt		TOPSOIL
								CLAY: low to medium plasticity, brown-grey: with some fine to medium grained sand; with some rootlets.	D - M	VSt		ALLUVIUM 0.30: PP = 320, 340, 400 kPa
			D		0.5				M			0.50: PP = >600, >600, >600 kPa 0.60: DCP refusal
				34.5	1.0		CL-CI	...colour changing to dark grey brown mottled orange from 0.7m.	D - M	H		0.70: PP = >600, >600, >600 kPa 0.90: PP = >600, >600, >600 kPa 1.10: PP = >600, >600, >600 kPa
			D	34.0	1.5			**Sandy CLAY:** low plasticty, pale brown mottled orange grey and black, fine to coarse grained sand (minor coarse fraction).				RESIDUAL SOIL 1.30: PP = >600, >600, >600 kPa 1.40: PP = 520 (Friable), >600, >600 kPa 1.65: PP = >600, >600, >600 kPa
								...becoming highly cemented from 1.75m.				CEMENTED MATERIAL
				33.5	2.0			Hole Terminated at 1.75 m Refusal				
				33.0	2.5							
				32.5	3.0							
				32.0	3.5							
				31.5								

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP16

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	513823.0	**Elevation:**	35.56	**Started:**	08/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7801830.0	**Datum:**	AHD	**Finished:**	08/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	313°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered	D	35.5	0		CL	**TOPSOIL: Sandy CLAY:** low plasticity, grey pale brown, fine grained sand; with some rootlets.	D - M	VSt		TOPSOIL
				35.0	0.5			**Silty CLAY:** low plasticity, pale brown mottled orange and white; low liquid limit silt; with some fine grained sand; trace of rootlets.				ALLUVIUM 0.40: PP > 600, >600, >600 kPa 0.50: DCP refusal 0.60: PP > 600, >600, >600 kPa
							CL	...no rootlets present from 0.8m.		H		0.80: PP > 600, >600, >600 kPa
			D	34.5	1.0			...colour changing to pale grey mottled white from 1.1m.				1.00: PP > 600, >600, >600 kPa CEMENTED MATERIAL
								...becoming highly cemented from 1.4m.				1.30: PP > 600, >600, >600 kPa
				34.0	1.5			Hole Terminated at 1.40 m Refusal				
				33.5	2.0							
				33.0	2.5							
				32.5	3.0							
				32.0	3.5							

METHOD & SUPPORT	PENETRATION	GROUNDWATER	SAMPLES & FIELD TESTS	MOISTURE	DENSITY (N-value)	CONSISTENCY (Su) {N-value}
N Natural/Existing cutting E Excavator BH Backhoe Bucket B Buldozer R Ripper	No resistance ranging to refusal	= Water level (during test pitting) = Water inflow	D Disturbed Sample B Bulk Sample SPT SPT Sample U Undisturbed Sample E Enviro Sample W Water Sample HP Hand Penetrometer HV Hand Vane Shear (P: Peak Su R: Residual Su)	D = Dry M = Moist W = Wet Wp = Plastic Limit Wl = Liquid Limit	VL Very Loose 0 - 4 L Loose 4 - 10 MD Medium Dense 10 - 30 D Dense 30 - 50 VD Very Dense 50 - 100	VS Very Soft < 12 kPa {0-2} S Soft 12 - 25 {2-4} F Firm 25 - 50 {4-8} St Stiff 50 - 100 {8-15} VSt Very Stiff 100 - 200 {15-30} H Hard > 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP17

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	512551.0	**Elevation:**	33.87	**Started:**	08/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7802854.0	**Datum:**	AHD	**Finished:**	08/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	30°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		33.5	0.5		CL-CI	**TOPSOIL: CLAY:** low to medium plasticity, dark brown-black; with some fine to medium grained sand; with some rootlets.		F		TOPSOIL
			D					**CLAY:** medium to high plasticity, dark brown-grey; with some rootlets; trace of fine grained sand.		St		ALLUVIUM 0.60: PP = 130, 140, 190 kPa
				33.0	1.0		CL-CI	...with some fine to medium grained sand from 1.2m.				0.90: PP = 220, 280, 310 kPa 1.10: PP = 240, 290, 350 kPa
				32.5	1.5					VSt		1.30: PP = 290, 310, 350 (friable) kPa 1.40: DCP refusal 1.50: PP = 280, 290, 300 kPa
			D	32.0	2.0		CI-CH	**Sandy CLAY:** medium to high plasticity, dark grey, fine to medium grained sand; trace of rootlets.	M			1.70: PP = 290, 310, 340 kPa 1.90: PP = 260, 280, 310 kPa
			D				CL	**Sandy CLAY:** low plasticity, grey mottled orange-brown; fine to medium grained sand.		H		RESIDUAL SOIL 2.10: PP = 410 (friable), 480, 520 kPa
				31.5	2.5							2.30: PP = 380, 400, 450 kPa
			D	31.0	3.0		SC	**CLAYEY SAND:** fine to coarse grained, brown-grey, low plasticity clay; with some fine grained, sub-rounded gravel.		D - VD		
				30.5				...becoming fine to medium grained, grey-pale brown; no gravel present from 3.2m.		D		
					3.5			Hole Terminated at 3.40 m Machine Limit				
				30.0								

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP18

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	511286.0	**Elevation:**	33.76	**Started:**	08/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7804595.0	**Datum:**	AHD	**Finished:**	08/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	333°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered	D	33.5	0.0		SC	**TOPSOIL: CLAYEY SAND:** fine grained, pink-pale brown, low plasticity clay; with some rootlets.				TOPSOIL
			D		0.5		SC	**CLAYEY SAND:** fine grained, pink-pale brown, low plasticity clay; with some low liquid limit silt; trace of rootlets.	D - M	L		ALLUVIUM
			D	33.0			GC	**CLAYEY GRAVEL:** fine to medium grained, sub-rounded to rounded gravel, low plasticity clay; orange-brown mottled red; with some fine to coarse grained sand.		MD		
			D		1.0		CL-CI	**Sandy CLAY:** low to medium plasticity, grey mottled brown, fine to coarse grained sand.	M	H		RESIDUAL SOIL 1.07: DCP refusal 1.10: PP > 600, > 600, > 600 kPa
				32.5				...colour changing to brown mottled orange and grey from 1.3m. ...becoming highly cemented from 1.4m.				1.30: PP > 600, > 600, > 600 kPa 1.35: CEMENTED MATERIAL
					1.5			Hole Terminated at 1.40 m Refusal				
				32.0	2.0							
				31.5	2.5							
				31.0	3.0							
				30.5	3.5							
				30.0								

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP19

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	511112.0	**Elevation:**	34.02	**Started:**	09/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7805040.0	**Datum:**	AHD	**Finished:**	09/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	8°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		34.0			CL	**TOPSOIL: Sandy CLAY:** low plasticity, grey brown, fine to medium grained sand; with some rootlets.	M	VSt		TOPSOIL
			D	33.5	0.5		CL	**Sandy CLAY:** low plasticity, pink pale brown, fine grained sand; with some rootlets.	D - M	VSt to H		ALLUVIUM 0.50: DCP refusal
			D				CL-CI	**Silty CLAY:** low to medium plasticity, brown mottled orange, low liquid limit silt; with some fine to coarse grained (minor fine grained content); trace of rootlets.	M	H		RESIDUAL SOIL 0.80: PP >600, >600, >600 kPa
				33.0	1.0			**ROCK: GRANODIORITE:** slightly to moderately weathered, medium to high strength, grey-brown.		VD		WEATHERED ROCK
								Hole Terminated at 1.00 m Refusal				1.00: PP >600, >600, >600 kPa
				32.5	1.5							
				32.0	2.0							
				31.5	2.5							
				31.0	3.0							
				30.5	3.5							

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

Engineering Log - Excavation

JTP20

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	511390.0	**Elevation:**	39.37	**Started:**	09/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7806475.0	**Datum:**	AHD	**Finished:**	09/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	16°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		▶	D	39.0	0.5		SC	**TOPSOIL: CLAYEY SAND:** fine to medium grained, grey-pale brown, low plasticity clay; with some rootlets.				TOPSOIL
			D	38.5	1.0		SC	**CLAYEY SAND:** fine to medium grained, pale brown, low plasticity clay; trace of rootlets. ...becoming fine to coarse grained sand (minor coarse grained content), colour changed to pale brown mottled orange; no rootlets present from 1.0m.	M	L MD		ALLUVIUM
				38.0	1.5		SC	**CLAYEY SAND:** fine to coarse grained, grey mottled orange, low plasticity clay; with some fine grained, sub-angular to sub-rounded granodiorite gravel.	M	D - VD		RESIDUAL SOIL 1.30: DCP refusal
								ROCK: GRANODIORITE: slightly to moderately weathered, medium to high strength, grey-brown.	M	VD		1.50: Water inflow through eastern wall of test pit.
				37.5	2.0			Hole Terminated at 1.60 m Refusal				
				37.0	2.5							
				36.5	3.0							
				36.0	3.5							
				35.5								

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
▽ = Water level (during test pitting)
▶ = Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP21

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	510282.0	**Elevation:**	32.81	**Started:**	09/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7808472.0	**Datum:**	AHD	**Finished:**	09/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	319°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered					CL	**TOPSOIL: Sandy CLAY:** low plasticity, grey-brown, fine grained sand; with some rootlets.	M	F		TOPSOIL
			D	32.5	0.5		CL	**Sandy CLAY:** low plasticity, brown mottled orange and dark brown, fine grained sand; trace of rootlets.		St		ALLUVIUM 0.40: PP = 100, 120, 140 kPa
				32.0	1.0			...colour changing to yellow-brown; no trace of rootlets from 0.8m.		VSt		0.60: PP = 140, 140, 200 kPa 0.80: PP = 280, 310, 350 kPa
				31.5	1.5			...colour changed to grey-brown from 1.4m.		St		1.10: PP = 210, 230, 240 kPa 1.40: PP = 100, 110, 150 kPa
			D				SC	**CLAYEY SAND:** fine grained sand, grey-brown, low plasticity clay; trace of fine grained, sub-angular to angular gravel.		VSt		1.70: PP = 110, 120, 130 kPa 1.80: PP = 300 (friable), 320, 340 kPa
			D	31.0	2.0			...colour changed to grey-brown mottled orange and becoming highly cemented from 2.1m.		H		CEMENTED MATERIAL 2.10: PP >600, >600, >600 kPa
								Hole Terminated at 2.20 m Refusal				
				30.5	2.5							
				30.0	3.0							
				29.5	3.5							
				29.0								

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP22

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	510062.0	**Elevation:**	29.71	**Started:**	09/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7810514.0	**Datum:**	AHD	**Finished:**	09/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	350°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		29.5	0.0		CL	**TOPSOIL: Sandy CLAY:** low plasticity, grey-brown, fine grained sand; with some rootlets.		St		TOPSOIL
								Sandy CLAY: low plasticity, grey-brown, fine grained sand.	M			ALLUVIUM 0.30: PP >600, >600, >600 kPa
			D	29.0	0.5			...colour changing to brown, fine to coarse grained sand from 0.6m.				0.50: PP >600, >600, >600 kPa
								...colour changing to grey-brown from 0.8m.				0.70: PP >600, >600, >600 kPa
					1.0			...becoming low to medium plasticity from 1.0m.				0.90: PP >600, >600, >600 kPa
				28.5			CL-CI	...colour changing to pale brown mottled red, fine to medium grained sand from 1.2m.		H		1.10: PP >600, >600, >600 kPa
			D		1.5				D - M			1.30: PP >600, >600, >600 kPa
				28.0				...colour changing to pale brown mottled orange and white from 1.7m.				1.50: PP >600, >600, >600 kPa
					2.0							1.70: PP >600, >600, >600 kPa CEMENTED MATERIAL 1.90: PP >600, >600, >600 kPa
								...becoming highly cemented from 2.1m				2.10: PP >600, >600, >600 kPa
				27.5				Hole Terminated at 2.20 m Refusal				
				27.0	2.5							
				26.5	3.0							
				26.0	3.5							

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

Engineering Log - Excavation

JTP23

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	509646.0	**Elevation:**	30.15	**Started:**	10/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7812609.0	**Datum:**	AHD	**Finished:**	10/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	349°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered	D	30.0	0.0		SC	**TOPSOIL: CLAYEY SAND:** fine to medium grained, pale brown, low plasticity clay; with some rootlets.	D - M	MD - D		TOPSOIL
			D	29.5	0.5		CL	**Sandy CLAY:** low plasticity, brown; fine to medium grained sand; with some rootlets.	M	H		ALLUVIUM 0.40: PP >600, >600, >600 kPa 0.60: PP >600, >600, >600 kPa 0.80: PP >600, >600, >600 kPa
				29.0	1.0			...colour changing to dark brown mottled brown from 1.2m.				1.00: PP >600, >600, >600 kPa 1.20: PP >600, >600, >600 kPa
					1.5			...colour changing to brown from 1.5m.				1.40: PP >600, >600, >600 kPa
			D	28.5				...becoming low plasticity, orange-brown, fine to medium grained sand (minor fine grained content); rootlets not present from 1.6m.				1.60: PP >600, >600, >600 kPa
					2.0			...colour changing to grey-brown speckled black from 2.0m.				1.80: PP >600, >600, >600 kPa 2.00: PP >600, >600, >600 kPa
				28.0								2.20: PP >600, >600, >600 kPa
					2.5							2.40: PP >600, >600, >600 kPa
			D	27.5				**SAND:** fine to coarse grained, pale brown; trace of low liquid limit silt; trace of fine grained sub-rounded to sub-angular gravel.	D	MD - D		2.60: PP >600, >600, >600 kPa
					3.0		SP		D - M			
				27.0				...with some low plasticity clay from 3.2m.	M	D - VD		LIGHTLY CEMENTED MATERIAL
				26.5	3.5			Hole Terminated at 3.40 m Machine Limit				

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

Engineering Log - Excavation

JTP24

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	509339.0	**Elevation:**	30.60	**Started:**	10/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7814165.0	**Datum:**	AHD	**Finished:**	10/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	345°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/ 100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		30.5			CL	**TOPSOIL: Sandy CLAY:** low plasticity, grey-brown, fine to coarse grained sand (minor coarse grained content); with some rootlets.	D - M	St - VSt		TOPSOIL
			D	30.0	0.5		CL-CI	**Sandy CLAY:** low plasticity, grey-brown, fine to coarse grained sand (minor coarse grained content); with some rootlets. ...becoming low to medium plasticity, orange-brown from 0.5m.				ALLUVIUM 0.50: PP >600, >600, >600 kPa
												0.70: PP >600, >600, >600 kPa
					1.0			...colour changing to orange-brown mottled grey-brown from 0.8m.	M			0.90: PP >600, >600, >600 kPa
				29.5				...colour changing to orange-brown speckled dark brown from 1.1m.				1.10: PP = 400, 410, 440 kPa
					1.5							1.30: PP = 500, >600, 540 kPa
				29.0					D - M	H		1.50: PP >600, >600, >600 kPa
												1.70: PP >600, >600, >600 kPa
					2.0							1.90: PP >600, >600, >600 kPa
				28.5								2.00: PP >600, >600, >600 kPa
												2.10: PP >600, >600, >600 kPa
								...colour changed to red-brown speckled dark brown from 2.2m.				
					2.5				M			2.40: PP >600, >600, >600 kPa
			D	28.0				**CLAY:** medium plasticity, red-brown speckled dark brown, fine to coarse grained sand. ...with some medium to coarse grained sand; trace of fine grained, sub-rounded gravel from 2.7m.				2.60: PP >600, >600, >600 kPa
							CI					2.80: PP >600, >600, >600 kPa
					3.0							3.00: PP >600, >600, >600 kPa
				27.5				Hole Terminated at 3.10 m Refusal				3.01: Test pit becoming too tight to dig futher
				27.0	3.5							

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP25

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor:	Markwell	**Easting:**	509087.0	**Elevation:**	29.95	**Started:**	10/05/2019
Plant:	John Deere 3155kK Backhoe	**Northing:**	7815882.0	**Datum:**	AHD	**Finished:**	10/05/2019
Logged by:	MIBW **Checked by:** RED	**Grid:**	MGA94 Zone 55	**Inclination:**	-90°	**Orientation:**	8°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		29.5	0.5		CL-CI	**TOPSOIL: Sandy CLAY:** low to medium plasticity, grey-pale brown, fine to medium grained sand; with some rootlets.	D - M	St - VSt		TOPSOIL
			D				CI	**CLAY:** medium plasticty, grey-brown; with some fine to medium grained sand; with some rootlets. ... colour changing to brown from 0.6m.	M			ALLUVIUM 0.40: PP >600, >600, >600 kPa 0.60: PP = 480, 500, 510 kPa 0.80: PP >600, >600, = 540 kPa
			D	29.0	1.0			**Sandy CLAY:** medium plasticity, grey-brown mottled dark brown, fine to coarse grained sand (minor coarse grained content); trace of rootlets.				1.00: PP >600, >600, >600 kPa
				28.5	1.5		CI	...trace of fine grained gravel from 1.7m.	D - M	H		1.30: PP = 520, 540 (friable), >600 kPa 1.50: PP >600, >600, >600 kPa 1.70: PP = 500, 510 (friable), 520 kPa
			D	28.0	2.0			**CLAY:** medium plasticity, grey-brown; with some fine to medium grained sand.				RESIDUAL SOIL 2.00: PP = 530, 540, >600 kPa 2.30: PP = 510, 520, 540 kPa
			D	27.5	2.5		CI	...becoming low to medium plasticity, orange-brown mottled grey-brown; with some fine to coarse grained sand (minor coarse grained content) from 2.7m.	M			2.60: PP >600, >600, >600 kPa 2.70: PP = 480, 500, 510 (friable) kPa 2.90: PP >600, >600, >600 kPa 3.10: PP >600, >600, >600 kPa 3.30: PP >600, >600, >600 kPa 3.40: PP >600, >600, >600 kPa
				27.0	3.0							
				26.5	3.5			Hole Terminated at 3.50 m Machine Limit				
				26.0								

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

JACOBS Engineering Log - Excavation

JTP26

Project: Stage 2 Haughton Pipeline Project
Client: Department of IRDC
Location: see Figure 1
Page: 1 of 1
Project No: IH175200

Contractor: Markwell
Plant: John Deere 3155kK Backhoe
Logged by: MIBW **Checked by:** RED
Easting: 508429.0
Northing: 7818500.0
Grid: MGA94 Zone 55
Elevation: 29.10
Datum: AHD
Inclination: -90°
Started: 10/05/2019
Finished: 10/05/2019
Orientation: 19°

EXCAVATION INFORMATION | MATERIAL SUBSTANCE

Method	Penetration	Groundwater Levels	Samples	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL TYPE: Plasticity or Particle Characteristics, Colour, Secondary and Minor Components	Moisture	Consistency Relative Density	DCP (blows/100mm) 5 10 15 20	Field Test Data & Other Observations
BH		Not Encountered		29.0	0.0		CI	**TOPSOIL: CLAY:** medium plasticity, grey-brown; with some fine to medium grained sand; with some rootlets.	M	S - F		TOPSOIL
			D					**Sandy CLAY:** medium plasticity, grey-brown mottled orange, coarse grained sand (minor coarse grained content); with some rootlets.		F		ALLUVIUM 0.40: PP = 30, 40, 40 kPa
			D	28.5	0.5			...colour changing to grey mottled pale brown; trace of rootlets from 0.6m.		St		0.60: PP = 120, 140, 150 kPa
					1.0							0.90: PP = 90, 110, 140 kPa
			D	28.0				...colour changing to grey-brown, fine to corase grained sand; trace of fine grained, sub-rounded gravel from 1.1m.		VSt		RESIDUAL SOIL 1.20: PP = 240, 280, 290 kPa
			D		1.5			...colour changing to pale brown speckled black, fine to medium grained sand from 1.35m.				1.40: PP >600, >600, >600 kPa
				27.5			CI					1.60: PP >600, >600, >600 kPa 1.70: PP >600, >600, >600 kPa
					2.0					H		1.90: PP = 520, 540 (friable), >600 kPa
				27.0								2.10: PP = 500, 510, 520 (friable) kPa
			D					...colour changing to pale brown mottled orange from 2.2m.				
					2.5							2.40: PP = 480 (friable), 500, 510 kPa
				26.5								2.70: PP = 480 (friable), 500 (friable), >600 kPa
												2.90: DCP refusal
					3.0					VSt - H		3.00: PP = 380, 400, 410 kPa
				26.0						VSt		3.30: PP = 300, 310, 310 kPa
				25.5	3.5			Hole Terminated at 3.40 m Machine Limit				

METHOD & SUPPORT
N Natural/Existing cutting
E Excavator
BH Backhoe Bucket
B Buldozer
R Ripper

PENETRATION
No resistance ranging to refusal

GROUNDWATER
= Water level (during test pitting)
= Water inflow

SAMPLES & FIELD TESTS
D Disturbed Sample
B Bulk Sample
SPT SPT Sample
U Undisturbed Sample
E Enviro Sample
W Water Sample
HP Hand Penetrometer
HV Hand Vane Shear
(P: Peak Su R: Residual Su)

MOISTURE
D = Dry
M = Moist
W = Wet
Wp = Plastic Limit
Wl = Liquid Limit

DENSITY (N-value)

VL	Very Loose	0 - 4
L	Loose	4 - 10
MD	Medium Dense	10 - 30
D	Dense	30 - 50
VD	Very Dense	50 - 100

CONSISTENCY (Su) {N-value}

VS	Very Soft	< 12 kPa {0-2}
S	Soft	12 - 25 {2-4}
F	Firm	25 - 50 {4-8}
St	Stiff	50 - 100 {8-15}
VSt	Very Stiff	100 - 200 {15-30}
H	Hard	> 200 kPa {>30}

Appendix C. Dynamic Cone Penetrometer (DCP) Results

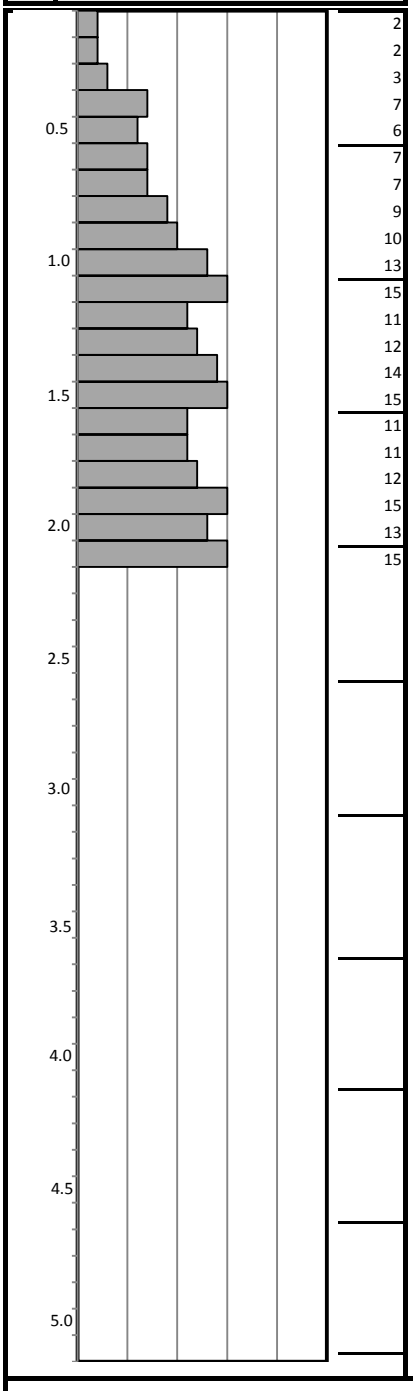
Dynamic Cone Penetrometer Test Report

JACOBS

Project Name:	Stage 2 - Haughton Pipeline	**Reported By:**	MIBW
Project No:	IH175200	**Checked:**	RED
Client:	Department of Infrastructure, Regional Development and Cities	**Checked Date:**	31/05/2019
Location:	Upper Haughton - Clare	**Test Method:**	AS1289.6.3.2

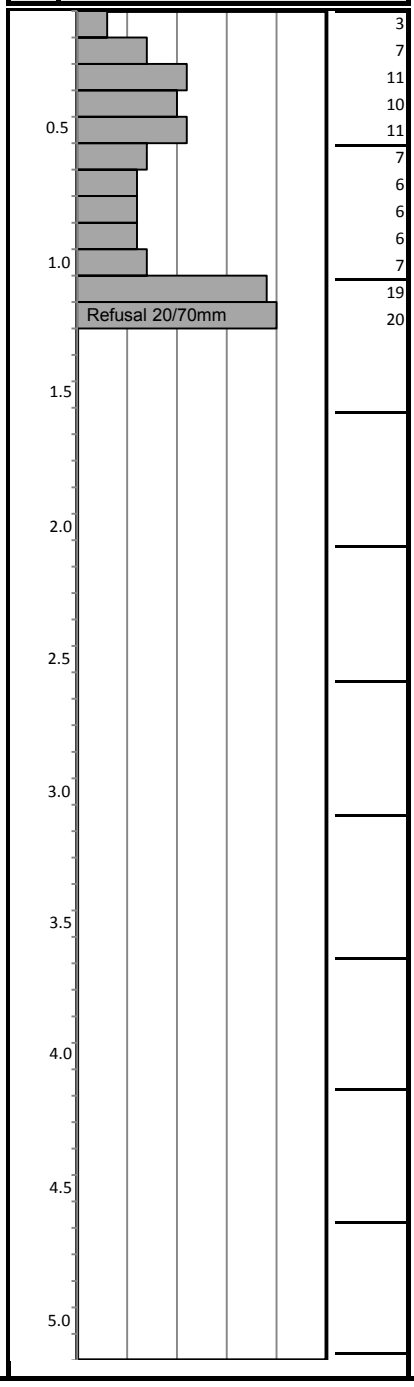
JTP1

Tested:	MIBW
Date:	2/05/2019
Surface RL:	N/A
MGA94 55	522781 m E / 7796526 m N



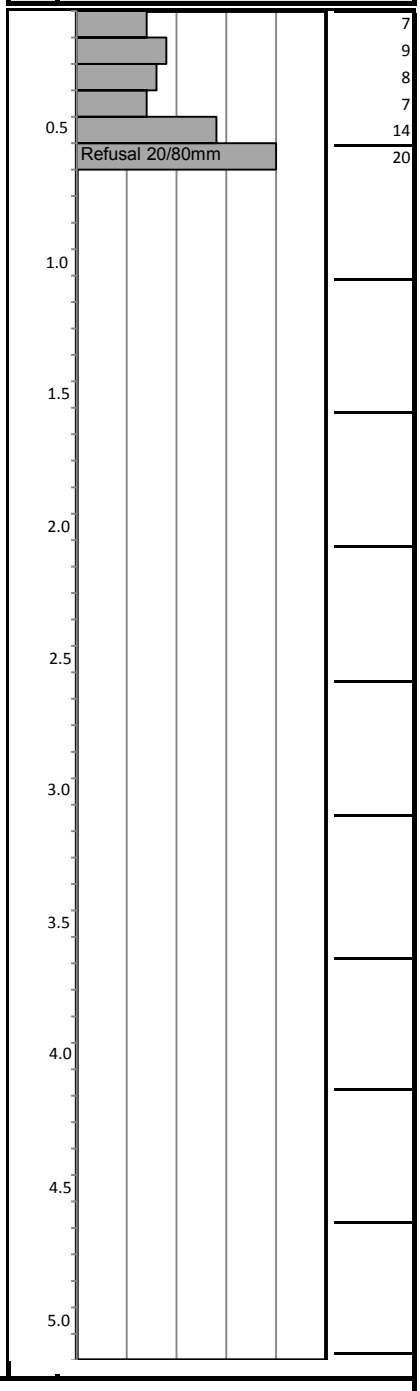
JTP2

Tested:	MIBW
Date:	2/05/2019
Surface RL:	N/A
MGA94 55	522816 m E / 7796168 m N



JTP3

Tested:	MIBW
Date:	7/05/2019
Surface RL:	N/A
MGA94 55	522235 m E / 7796529 m N



This Dynamic Cone Penetration Report must be read with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination.

Dynamic Cone Penetrometer Test Report

JACOBS

Project Name:	Stage 2 - Haughton Pipeline	**Reported By:**	MIBW
Project No:	IH175200	**Checked:**	RED
Client:	Department of Infrastructure, Regional Development and Cities	**Checked Date:**	31/05/2019
Location:	Upper Haughton - Clare	**Test Method:**	AS1289.6.3.2

JTP4

Tested:	MIBW
Date:	3/05/2019
Surface RL:	37.45
MGA94 55	521965 m E / 7797058 m N

Depth (metres)	Blows per 100 mm	
0	8	
	8	
	10	
	10	
0.5	15	
	10	
	10	
	9	
	10	
1.0	9	
	13	
	10	
	10	
	9	
1.5	10	
	14	
	13	
	12	
	11	
2.0	12	
	11	
	10	
	11	
	8	
2.5	7	
	8	
	8	
	15	
	11	
3.0	12	
	11	
	12	
	15	
3.5	15/75mm	15
4.0		
4.5		
5.0		

JTP5

Tested:	MIBW
Date:	7/05/2019
Surface RL:	38.88
MGA94 55	521834 m E / 7797366 m N

Depth (metres)	Blows per 100 mm	
0	4	
	4	
	7	
	9	
0.5	7	
	7	
	6	
	8	
	5	
1.0	6	
	7	
	7	
	6	
	6	
1.5	14	
	8	
	7	
	6	
	6	
2.0	6	
	6	
	6	
	6	
	6	
2.5	6	
	7	
	6	
	7	
	7	
3.0	8	
	9	
	8	
	6	
	7	
3.5	8	
4.0		
4.5		
5.0		

JTP6

Tested:	MIBW
Date:	3/05/2019
Surface RL:	36.72
MGA94 55	521250 m E / 7798266 m N

Depth (metres)	Blows per 100 mm	
0	5	
	5	
	9	
	9	
0.5	15	
	Refusal 20/90mm	20
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		

This Dynamic Cone Penetration Report must be read with accompanying notes and abbreviations. It has been prepared for geotechnical purposes only, without attempt to assess possible contamination.

Dynamic Cone Penetrometer Test Report

JACOBS

Project Name:	Stage 2 - Haughton Pipeline	**Reported By:**	MIBW
Project No:	IH175200	**Checked:**	RED
Client:	Department of Infrastructure, Regional Development and Cities	**Checked Date:**	31/05/2019
Location:	Upper Haughton - Clare	**Test Method:**	AS1289.6.3.2

JTP7

Tested:	MIBW		
Date:	3/05/2019		
Surface RL:	36.04	**MGA94 55**	
	520973 m E	7798703 m N	

Depth (metres)	Blows per 100 mm						
	0	5	10	15	20	25	
0.5	4	7	6	6	8		
1.0	11	12	13	12	10		
1.5	8	9	7	7	7		
2.0	6	8	6	8	9		
2.5	8	10	9	7	11		
3.0	12	10	9	10	10		
3.5	11	9	7	9	10		
4.0	11	20	Refusal 20/70mm				
4.5							
5.0							

JTP8

Tested:	MIBW		
Date:	3/05/2019		
Surface RL:	35.9	**MGA94 55**	
	520582 m E	7799239 m N	

Depth (metres)	Blows per 100 mm						
	0	5	10	15	20	25	
0.5	9	8	9	8	12		
1.0	13	15	20	Refusal 20/60mm			
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							

JTP9

Tested:	MIBW		
Date:	3/05/2019		
Surface RL:	35.79	**MGA94 55**	
	520277 m E	7799718 m N	

Depth (metres)	Blows per 100 mm						
	0	5	10	15	20	25	
0.5	7	14	25	Refusal 25/70mm			
1.0							
1.5							
2.0							
2.5							
3.0							
3.5							
4.0							
4.5							
5.0							

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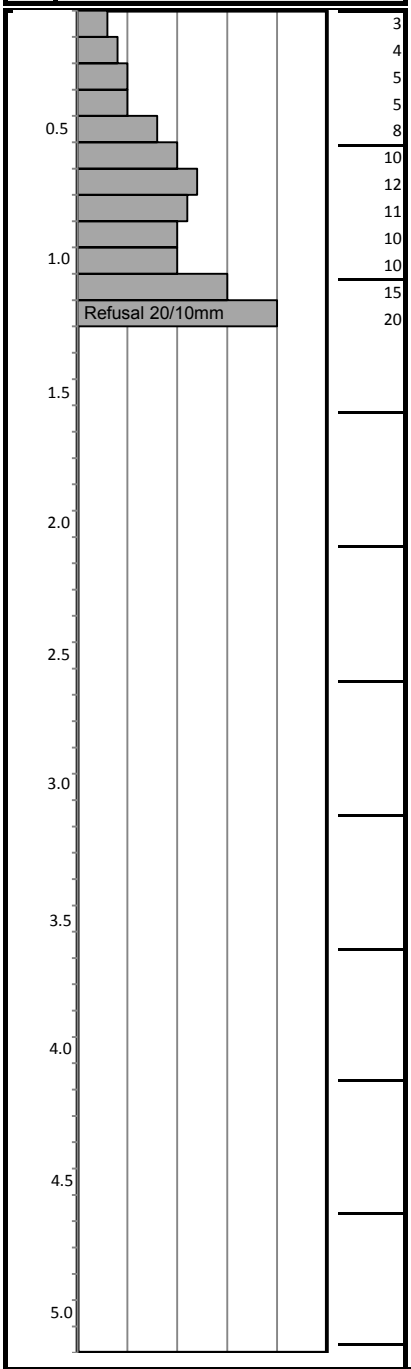
Dynamic Cone Penetrometer Test Report

JACOBS

Project Name:	Stage 2 - Haughton Pipeline	**Reported By:**	MIBW
Project No:	IH175200	**Checked:**	RED
Client:	Department of Infrastructure, Regional Development and Cities	**Checked Date:**	31/05/2019
Location:	Upper Haughton - Clare	**Test Method:**	AS1289.6.3.2

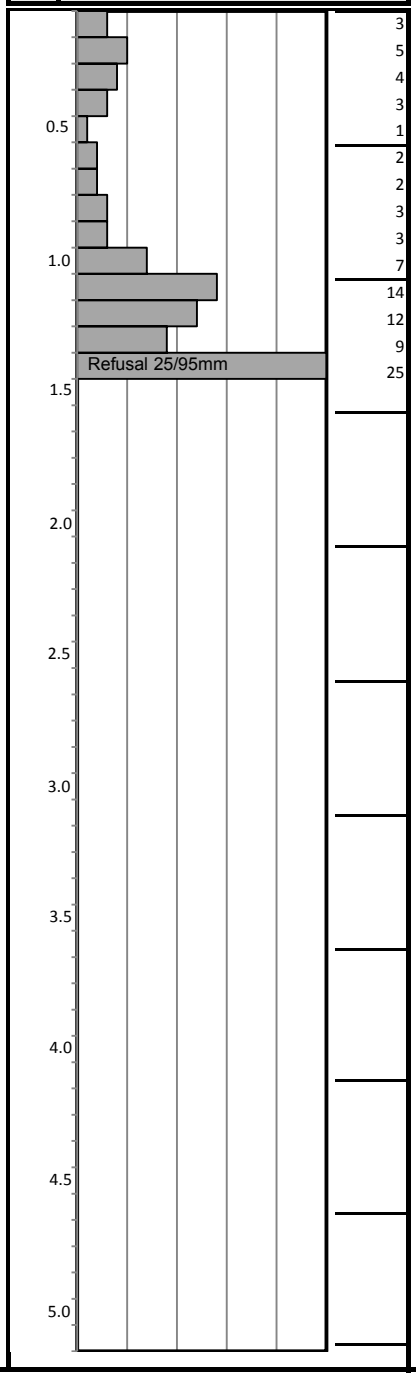
JTP10

Tested:	MIBW
Date:	2/05/2019
Surface RL:	35.75
MGA94 55	519470 m E / 7800260 m N



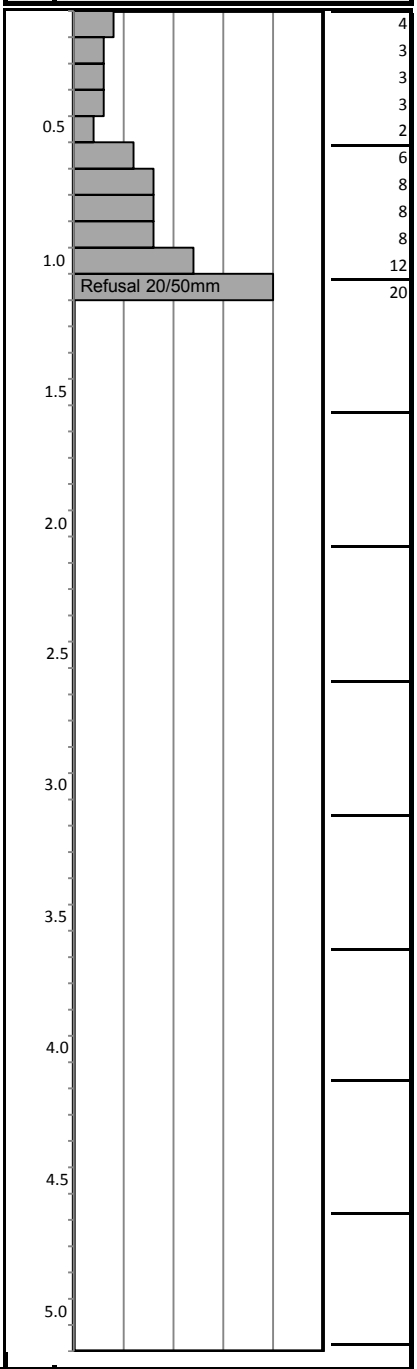
JTP11

Tested:	MIBW
Date:	2/05/2019
Surface RL:	35.62
MGA94 55	518841 m E / 7801109 m N



JTP12

Tested:	MIBW
Date:	7/05/2019
Surface RL:	35.01
MGA94 55	518115 m E / 7801316 m N



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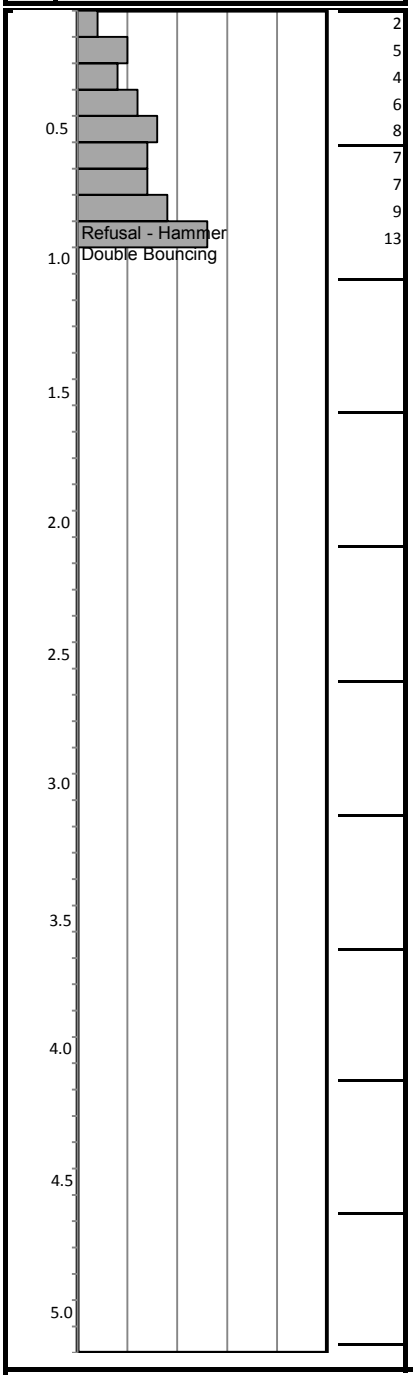
Dynamic Cone Penetrometer Test Report

JACOBS

Project Name:	Stage 2 - Haughton Pipeline	**Reported By:**	MIBW
Project No:	IH175200	**Checked:**	RED
Client:	Department of Infrastructure, Regional Development and Cities	**Checked Date:**	31/05/2019
Location:	Upper Haughton - Clare	**Test Method:**	AS1289.6.3.2

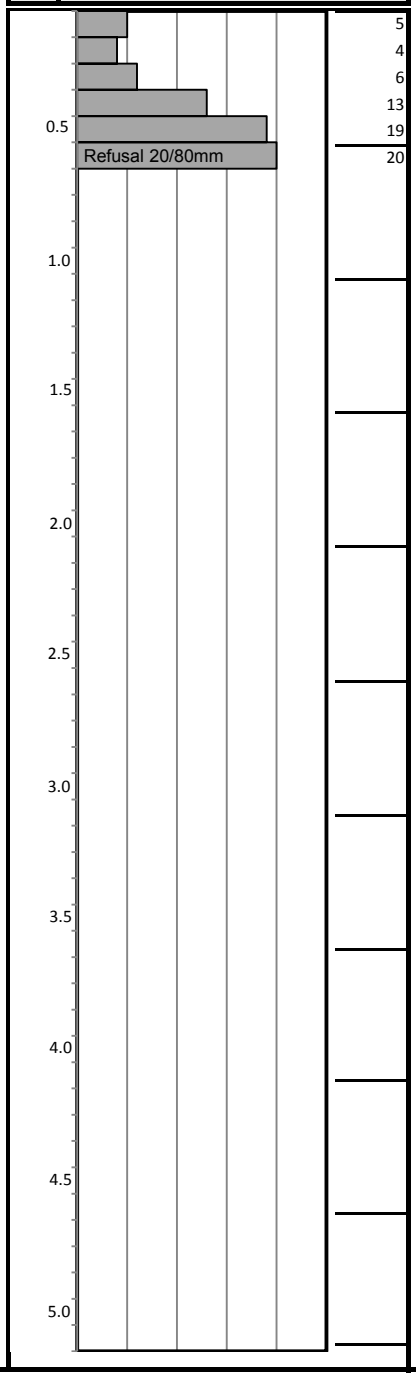
JTP13

Tested:	MIBW
Date:	7/05/2019
Surface RL:	36.13
MGA94 55	517621 m E / 7801412 m N



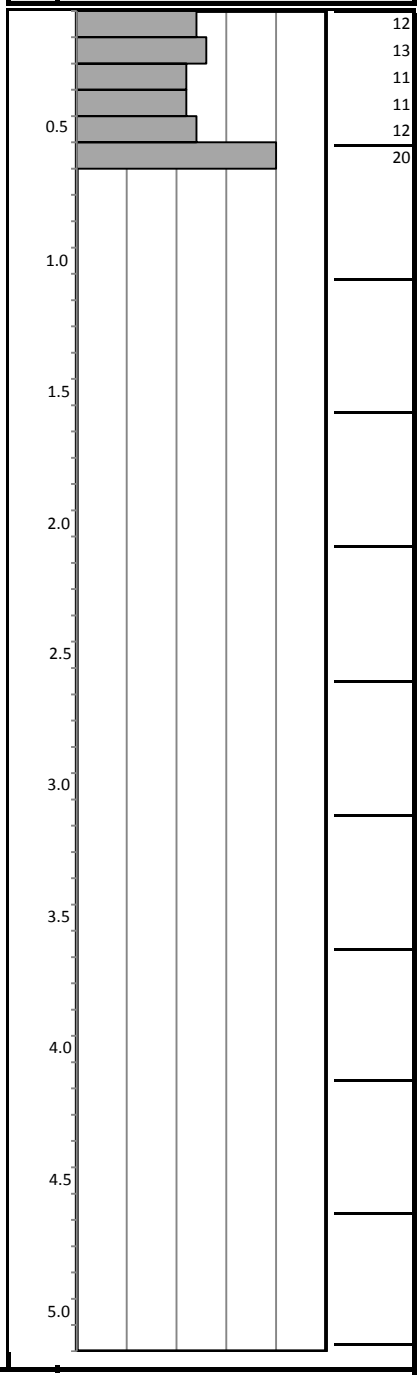
JTP14

Tested:	MIBW
Date:	8/05/2019
Surface RL:	35.68
MGA94 55	515032 m E / 7801363 m N



JTP15

Tested:	MIBW
Date:	8/05/2019
Surface RL:	35.39
MGA94 55	514577 m E / 7801397 m N



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Dynamic Cone Penetrometer Test Report

JACOBS

Project Name:	Stage 2 - Haughton Pipeline	**Reported By:**	MIBW
Project No:	IH175200	**Checked:**	RED
Client:	Department of Infrastructure, Regional Development and Cities	**Checked Date:**	31/05/2019
Location:	Upper Haughton - Clare	**Test Method:**	AS1289.6.3.2

Tested:	MIBW		**JTP16**
Date:	8/05/2019		
Surface RL:	35.56	MGA94 55	
	513823 m E	7801830 m N	

Depth (metres)	Blows per 100 mm	
	0 5 10 15 20 25	
0.5		13
		12
		12
		15
		20
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		

Tested:	MIBW		**JTP17**
Date:	8/05/2019		
Surface RL:	33.87	MGA94 55	
	512551 m E	7802854 m N	

Depth (metres)	Blows per 100 mm	
	0 5 10 15 20 25	
0.5		2
		1
		1
		1
		3
1.0		3
		6
		7
		9
		11
1.5		12
		15
		16
		20
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		

Tested:	MIBW		**JTP18**
Date:	8/05/2019		
Surface RL:	33.76	MGA94 55	
	511286 m E	7804595 m N	

Depth (metres)	Blows per 100 mm	
	0 5 10 15 20 25	
0.5		3
		3
		3
		4
		5
1.0		15
		7
		7
		7
		6
1.5	Refusal 20/65mm	20
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		

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Dynamic Cone Penetrometer Test Report

JACOBS

Project Name:	Stage 2 - Haughton Pipeline	**Reported By:**	MIBW
Project No:	IH175200	**Checked:**	RED
Client:	Department of Infrastructure, Regional Development and Cities	**Checked Date:**	31/05/2019
Location:	Upper Haughton - Clare	**Test Method:**	AS1289.6.3.2

JTP19

Tested:	MIBW		
Date:	9/05/2019		
Surface RL:	34.02	MGA94 55	
	511112 m E	7805040 m N	

Depth (metres)	Blows per 100 mm	
	0 5 10 15 20 25	
0.5	Refusal 20/95mm	11 14 16 19 20
1.0		
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		

JTP20

Tested:	MIBW		
Date:	9/05/2019		
Surface RL:	39.37	MGA94 55	
	511390 m E	7806475 m N	

Depth (metres)	Blows per 100 mm	
	0 5 10 15 20 25	
0.5		3 4 3 3 2
1.0		3 3 2 3 3
1.5		3 6 20
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		

JTP21

Tested:	MIBW		
Date:	9/05/2019		
Surface RL:	32.81	MGA94 55	
	510282 m E	7808472 m N	

Depth (metres)	Blows per 100 mm	
	0 5 10 15 20 25	
0.5		3 2 2 2 2
1.0		0 2 3 4 5 7 10 10 18 17 16 18
1.5		
2.0		
2.5		
3.0		
3.5		
4.0		
4.5		
5.0		

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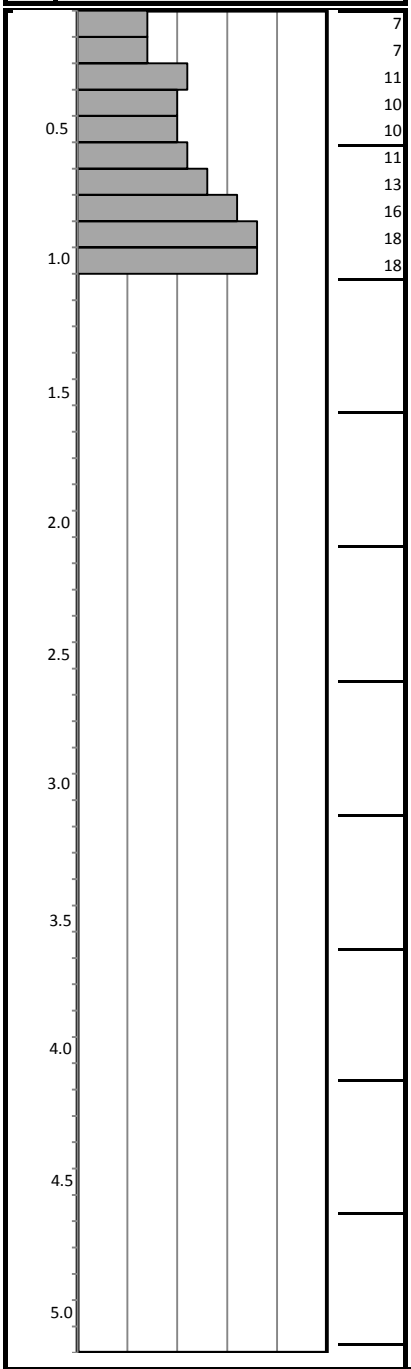
Dynamic Cone Penetrometer Test Report

JACOBS

Project Name:	Stage 2 - Haughton Pipeline	**Reported By:**	MIBW
Project No:	IH175200	**Checked:**	RED
Client:	Department of Infrastructure, Regional Development and Cities	**Checked Date:**	31/05/2019
Location:	Upper Haughton - Clare	**Test Method:**	AS1289.6.3.2

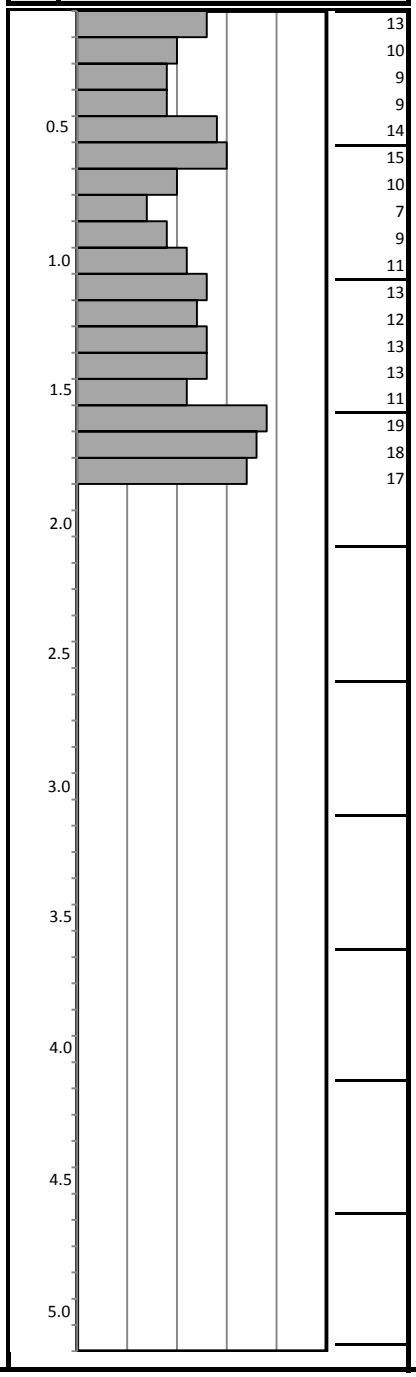
JTP22

Tested:	MIBW
Date:	9/05/2019
Surface RL:	29.71
MGA94 55	510062 m E / 7810514 m N



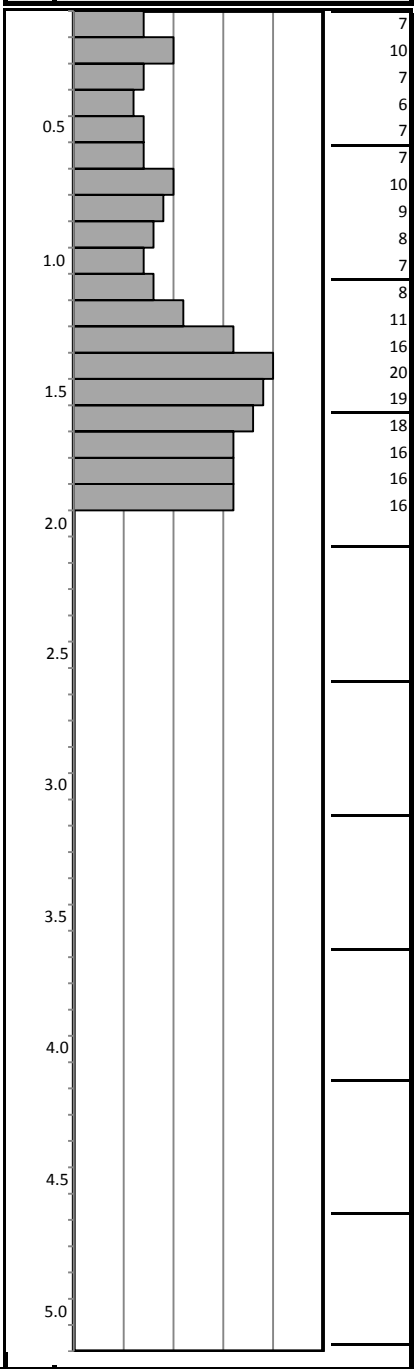
JTP23

Tested:	MIBW
Date:	10/05/2019
Surface RL:	30.15
MGA94 55	509646 m E / 7812609 m N



JTP24

Tested:	MIBW
Date:	10/05/2019
Surface RL:	30.60
MGA94 55	509339 m E / 7814165 m N



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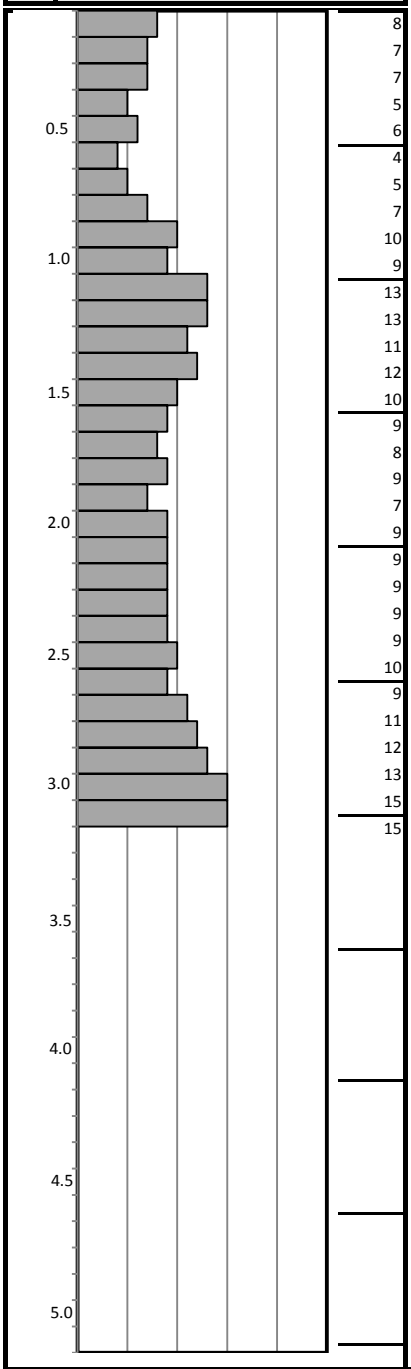
Dynamic Cone Penetrometer Test Report

JACOBS

Project Name:	Stage 2 - Haughton Pipeline	**Reported By:**	MIBW
Project No:	IH175200	**Checked:**	RED
Client:	Department of Infrastructure, Regional Development and Cities	**Checked Date:**	31/05/2019
Location:	Upper Haughton - Clare	**Test Method:**	AS1289.6.3.2

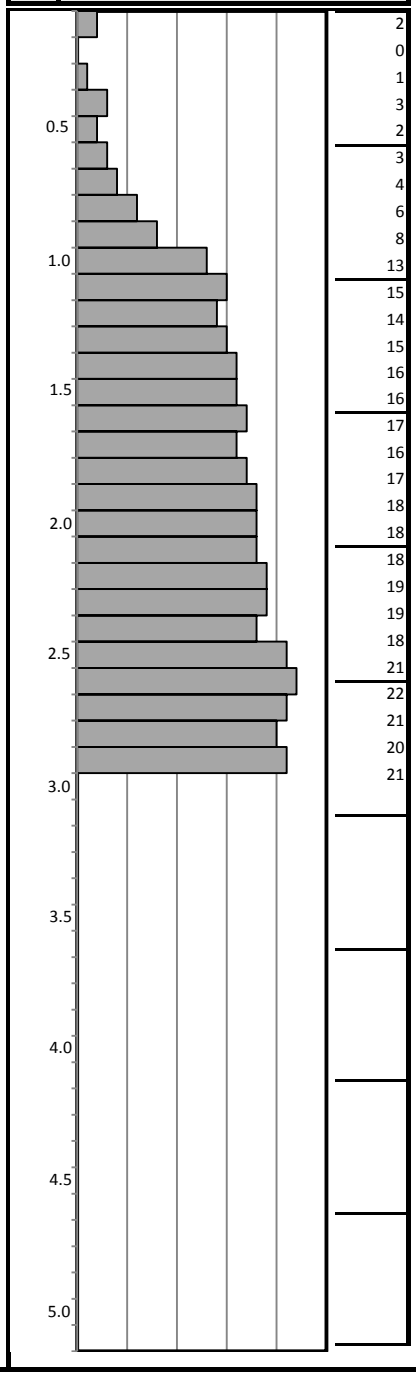
JTP25

Tested:	MIBW		
Date:	10/05/2019		
Surface RL:	29.95	**MGA94 55**	
	509087 m E	**7815882 m N**	



JTP26

Tested:	MIBW		
Date:	10/05/2019		
Surface RL:	29.10	**MGA94 55**	
	508429 m E	**7818500 m N**	



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Appendix D. Laboratory Test Certificates

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
37 Carmel Street,
Garbutt QLD 4814

Laboratory: **Townsville Laboratory**
Phone: 0747288023
Fax: 0747288024
Email: Townsville@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH1
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 1 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1		
Sample Number	10599/S/206012	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH1
Date Sampled	3/05/2019	Depth (m)	1.5-1.95m
Sampled By	Client Sampled		
Date Tested	23/05/2019		
Att. Drying Method	Air Dried	Material Source	EXISTING
Atterberg Preparation	Dry Sieved	Material Type	EXISTING
Material Description	Existing		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**33**	
Plastic Limit (%)		**15**	
Plasticity Index (%)		**18**	
Linear Shrinkage (%)		**9.0**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

NATA

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation Number: 1986
Corporate Site Number: 10599

K. Rutherford

Approved Signatory: Kimberly Rutherford
Form ID: W11bRep Rev 1

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
37 Carmel Street,
Garbutt QLD 4814

Laboratory: **Townsville Laboratory**
Phone: 0747288023
Fax: 0747288024
Email: Townsville@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH6
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 2 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1		
Sample Number	10599/S/206020	Sample Location	
Sampling Method	Tested As Received	Location	(Borehole) JBH6
Date Sampled	10/05/2019	Depth	(m) 1.5-1.95m
Sampled By	Client Sampled		
Date Tested	23/05/2019		
Att. Drying Method	Oven Dried	Material Source	EXISTING
Atterberg Preparation	Dry Sieved	Material Type	EXISTING
Material Description	-		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**36**	
Plastic Limit (%)		**15**	
Plasticity Index (%)		**21**	
Linear Shrinkage (%)		**9.0**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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Phone: 0747288023
Fax: 0747288024
Email: Townsville@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP1
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 3 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206025	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP1
Date Sampled	2/05/2019	Test Depth	m	0.8-1.0m
Sampled By	Client Sampled			
Date Tested	20/05/2019			
Att. Drying Method	Oven Dried	Material Source	EXISTING	
Atterberg Preparation	Dry Sieved	Material Type	EXISTING	
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**25**	
Plastic Limit (%)		**16**	
Plasticity Index (%)		**9**	
Linear Shrinkage (%)		**6.0**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

NATA

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Address:
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Garbutt QLD 4814

Laboratory: **Townsville Laboratory**
Phone: 0747288023
Fax: 0747288024
Email: Townsville@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP1
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 4 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206026	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP1
Date Sampled	2/05/2019	Test Depth	m	3.1-3.2m
Sampled By	Client Sampled			
Date Tested	20/05/2019			
Att. Drying Method	Oven Dried	Material Source	EXISTING	
Atterberg Preparation	Dry Sieved	Material Type	EXISTING	
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**27**	
Plastic Limit (%)		**17**	
Plasticity Index (%)		**10**	
Linear Shrinkage (%)		**7.0**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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Laboratory: **Townsville Laboratory**
Phone: 0747288023
Fax: 0747288024
Email: Townsville@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP2
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 5 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206027	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP2
Date Sampled	2/05/2019	Test Depth	m	0.6-0.7m
Sampled By	Client Sampled			
Date Tested	20/05/2019			
Att. Drying Method	Oven Dried	Material Source	EXISTING	
Atterberg Preparation	Dry Sieved	Material Type	EXISTING	
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**54**	
Plastic Limit (%)		**23**	
Plasticity Index (%)		**31**	
Linear Shrinkage (%)		**18.0**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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Corporate Site Number: 10599

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Construction Sciences

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Laboratory: **Townsville Laboratory**
Phone: 0747288023
Fax: 0747288024
Email: Townsville@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP3
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 6 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1		
Sample Number	10599/S/206029	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP3
Date Sampled	3/05/2019	Test Depth m	2.3-2.4m
Sampled By	Client Sampled		
Date Tested	20/05/2019		
Att. Drying Method	Oven Dried	Material Source	EXISTING
Atterberg Preparation	Dry Sieved	Material Type	EXISTING
Material Description	Existing		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**50**	
Plastic Limit (%)		**17**	
Plasticity Index (%)		**33**	
Linear Shrinkage (%)		**16.0**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 249.9mm / Curling		

Remarks	Results apply to sample(s) tested as received.

NATA

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Accreditation Number: 1986
Corporate Site Number: 10599

K. Rutherford

Approved Signatory: Kimberly Rutherford
Form ID: W11bRep Rev 1

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Garbutt QLD 4814

Laboratory: **Townsville Laboratory**
Phone: 0747288023
Fax: 0747288024
Email: Townsville@constructionsciences.net

ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP4
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 7 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206030	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP4
Date Sampled	3/05/2019	Test Depth	m	2.8-2.9m
Sampled By	Client Sampled			
Date Tested	23/05/2019			
Att. Drying Method	Oven Dried	Material Source	EXISTING	
Atterberg Preparation	Dry Sieved	Material Type	EXISTING	
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**37**	
Plastic Limit (%)		**15**	
Plasticity Index (%)		**22**	
Linear Shrinkage (%)		**8.0**	
Linear Shrinkage Mould Length / Defects:	Mould Length: 249.9mm / Some Curling		

Remarks	Results apply to sample(s) tested as received.

NATA

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Approved Signatory: Kimberly Rutherford
Form ID: W11bRep Rev 1

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP5
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 8 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206031	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP5
Date Sampled	3/05/2019	Test Depth	m	0.5-0.6m
Sampled By	Client Sampled			
Date Tested	20/05/2019			
Att. Drying Method	Oven Dried	Material Source		EXISTING
Atterberg Preparation	Dry Sieved	Material Type		EXISTING
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**27**	
Plastic Limit (%)		**20**	
Plasticity Index (%)		**7**	
Linear Shrinkage (%)		**4.0**	
Linear Shrinkage Defects:	Curling		

Remarks: Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP7
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 9 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206033	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP7
Date Sampled	3/05/2019	Test Depth	m	1.9-2.0m
Sampled By	Client Sampled			
Date Tested	20/05/2019			
Att. Drying Method	Oven Dried	Material Source	EXISTING	
Atterberg Preparation	Dry Sieved	Material Type	EXISTING	
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**88**	
Plastic Limit (%)		**19**	
Plasticity Index (%)		**69**	
Linear Shrinkage (%)		**17.0**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP8
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 10 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206034	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP8
Date Sampled	3/05/2019	Test Depth	m	2.5-2.6m
Sampled By	Client Sampled			
Date Tested	20/05/2019			
Att. Drying Method	Oven Dried	Material Source	EXISTING	
Atterberg Preparation	Dry Sieved	Material Type	EXISTING	
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**47**	
Plastic Limit (%)		**30**	
Plasticity Index (%)		**17**	
Linear Shrinkage (%)		**10.5**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP9
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 11 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206035	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP9
Date Sampled	3/05/2019	Test Depth	m	0.4-0.5m
Sampled By	Client Sampled			
Date Tested	23/05/2019			
Att. Drying Method	Oven Dried	Material Source		EXISTING
Atterberg Preparation	Dry Sieved	Material Type		EXISTING
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**18**	
Plastic Limit (%)		**15**	
Plasticity Index (%)		**3**	
Linear Shrinkage (%)		**2.0**	
Linear Shrinkage Defects:	No Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP11
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 12 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206036	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP11
Date Sampled	2/05/2019	Test Depth	m	0.6-0.8m
Sampled By	Client Sampled			
Date Tested	24/05/2019			
Att. Drying Method	Oven Dried	Material Source		EXISTING
Atterberg Preparation	Dry Sieved	Material Type		EXISTING
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**26**	
Plastic Limit (%)		**13**	
Plasticity Index (%)		**13**	
Linear Shrinkage (%)		**9.0**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP14
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 13 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1		
Sample Number	10599/S/206037	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP14
Date Sampled	8/05/2019	Test Depth m	0.9-1.0m
Sampled By	Client Sampled		
Date Tested	23/05/2019		
Att. Drying Method	Oven Dried	Material Source	EXISTING
Atterberg Preparation	Dry Sieved	Material Type	EXISTING
Material Description	Existing		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**28**	
Plastic Limit (%)		**13**	
Plasticity Index (%)		**15**	
Linear Shrinkage (%)		**11.5**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP16
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 14 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206038	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP16
Date Sampled	8/05/2019	Test Depth	m	0.4-0.5m
Sampled By	Client Sampled			
Date Tested	24/05/2019			
Att. Drying Method	Oven Dried	Material Source		EXISTING
Atterberg Preparation	Dry Sieved	Material Type		EXISTING
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**21**	
Plastic Limit (%)		**13**	
Plasticity Index (%)		**8**	
Linear Shrinkage (%)		**7.0**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP17
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 15 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206040	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP17
Date Sampled	8/05/2019	Test Depth	m	2.6-2.7m
Sampled By	Client Sampled			
Date Tested	24/05/2019			
Att. Drying Method	Oven Dried	Material Source	EXISTING	
Atterberg Preparation	Dry Sieved	Material Type	EXISTING	
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**30**	
Plastic Limit (%)		**16**	
Plasticity Index (%)		**14**	
Linear Shrinkage (%)		**10.5**	
Linear Shrinkage Defects:	Slight Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP19
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 16 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206043	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP19
Date Sampled	9/05/2019	Test Depth	m	0.8-0.9m
Sampled By	Client Sampled			
Date Tested	24/05/2019			
Att. Drying Method	Oven Dried	Material Source		EXISTING
Atterberg Preparation	Dry Sieved	Material Type		EXISTING
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**23**	
Plastic Limit (%)		**11**	
Plasticity Index (%)		**12**	
Linear Shrinkage (%)		**8.0**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP21
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 17 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206045	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP21
Date Sampled	9/05/2019	Test Depth	m	0.3-0.4m
Sampled By	Client Sampled			
Date Tested	24/05/2019			
Att. Drying Method	Oven Dried	Material Source		EXISTING
Atterberg Preparation	Dry Sieved	Material Type		EXISTING
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**22**	
Plastic Limit (%)		**17**	
Plasticity Index (%)		**5**	
Linear Shrinkage (%)		**3.5**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP21
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 18 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206046	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP21
Date Sampled	9/05/2019	Test Depth	m	2.1-2.2m
Sampled By	Client Sampled			
Date Tested	24/05/2019			
Att. Drying Method	Oven Dried	Material Source	EXISTING	
Atterberg Preparation	Dry Sieved	Material Type	EXISTING	
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**20**	
Plastic Limit (%)		**12**	
Plasticity Index (%)		**8**	
Linear Shrinkage (%)		**6.0**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP23
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 19 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206047	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP23
Date Sampled	10/05/2019	Test Depth	m	0.5-0.6m
Sampled By	Client Sampled			
Date Tested	27/05/2019			
Att. Drying Method	Oven Dried	Material Source		EXISTING
Atterberg Preparation	Dry Sieved	Material Type		EXISTING
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**34**	
Plastic Limit (%)		**16**	
Plasticity Index (%)		**18**	
Linear Shrinkage (%)		**12.5**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP24
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 20 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1		
Sample Number	10599/S/206049	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP24
Date Sampled	10/05/2019	Test Depth m	2.6-2.7m
Sampled By	Client Sampled		
Date Tested	24/05/2019		
Att. Drying Method	Oven Dried	Material Source	EXISTING
Atterberg Preparation	Dry Sieved	Material Type	EXISTING
Material Description	Existing		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**49**	
Plastic Limit (%)		**16**	
Plasticity Index (%)		**33**	
Linear Shrinkage (%)		**16.0**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

NATA

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Accreditation Number: 1986
Corporate Site Number: 10599

K. Rutherford

Approved Signatory: Kimberly Rutherford
Form ID: W11bRep Rev 1

Construction Sciences

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Laboratory: **Townsville Laboratory**
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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP25
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 21 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1		
Sample Number	10599/S/206050	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP25
Date Sampled	10/05/2019	Test Depth m	1.2-1.3m
Sampled By	Client Sampled		
Date Tested	27/05/2019		
Att. Drying Method	Oven Dried	Material Source	EXISTING
Atterberg Preparation	Dry Sieved	Material Type	EXISTING
Material Description	Existing		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**42**	
Plastic Limit (%)		**21**	
Plasticity Index (%)		**21**	
Linear Shrinkage (%)		**15.0**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP25
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 22 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1		
Sample Number	10599/S/206051	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP25
Date Sampled	10/05/2019	Test Depth m	2.7-2.8m
Sampled By	Client Sampled		
Date Tested	27/05/2019		
Att. Drying Method	Oven Dried	Material Source	EXISTING
Atterberg Preparation	Dry Sieved	Material Type	EXISTING
Material Description	Existing		

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**41**	
Plastic Limit (%)		**18**	
Plasticity Index (%)		**23**	
Linear Shrinkage (%)		**14.5**	
Linear Shrinkage Defects:	Curling		

Remarks	Results apply to sample(s) tested as received.

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ATTERBERG LIMITS REPORT

Client:	Jacobs	Report Number:	10599/R/86240-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP26
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 23 of 23

Test Procedures:	AS1289.3.1.2, AS 1289.3.3.1, AS1289.3.2.1, AS1289.3.4.1, AS1289.2.1.1			
Sample Number	10599/S/206052	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP26
Date Sampled	10/05/2019	Test Depth	m	0.3-0.4m
Sampled By	Client Sampled			
Date Tested	27/05/2019			
Att. Drying Method	Oven Dried	Material Source	EXISTING	
Atterberg Preparation	Dry Sieved	Material Type	EXISTING	
Material Description	Existing			

Atterberg Limits Results

Atterberg Limit	Specification Minimum	Test Result	Specification Maximum
Liquid Limit (%)		**24**	
Plastic Limit (%)		**12**	
Plasticity Index (%)		**12**	
Linear Shrinkage (%)		**8.0**	
Linear Shrinkage Defects:	-		

Remarks	Results apply to sample(s) tested as received.

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EMERSON CLASS NUMBER REPORT

Client:	Jacobs	Report Number:	10599/R/86239-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 1 of 10

Test Procedures:	AS1289.3.8.1

Sample Number	10599/S/206011	10599/S/206012	10599/S/206013	10599/S/206014
ID / Client ID	-	-	-	-
Lot Number	JBH1	JBH1	JBH2	JBH3
Date / Time Sampled	3/05/2019	3/05/2019	7/05/2019	8/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Water Type	Distilled Water	Distilled Water	Distilled Water	Distilled Water
Water Temperature (C°)	25	26	26	25
Location (Borehole)	JBH1	JBH1	JBH2	JBH3
Depth	0.5-0.95m	1.5-1.95m	1.5-1.95m	1.5-1.95m
Soil Description	Existing	Existing	Existing	Existing
Emerson Class Number	**2**	**2**	**2**	**2**

Remarks	Results apply to sample(s) tested as received.

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EMERSON CLASS NUMBER REPORT

Client:	Jacobs	Report Number:	10599/R/86239-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 2 of 10

Test Procedures:	AS1289.3.8.1

Sample Number	10599/S/206017	10599/S/206018	10599/S/206021	10599/S/206022
ID / Client ID	-	-	-	-
Lot Number	JBH4	JBH4	JBH7	JBH7
Date / Time Sampled	9/05/2019	9/05/2019	9/05/2019	9/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Water Type	Distilled water	Distilled Water	Distilled Water	Distilled Water
Water Temperature (C°)	24	24	26	26
Location (Borehole)	JBH4	JBH4	JBH7	JBH7
Depth	1.5-1.95m	5.5-5.95m	1.5-1.92m	4.5-4.95m
Soil Description	Existing	Existing	Existing	Existing
Emerson Class Number	**2**	**2**	**2**	**2**

Remarks	Results apply to sample(s) tested as received.

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EMERSON CLASS NUMBER REPORT

Client:	Jacobs	Report Number:	10599/R/86239-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 3 of 10

Test Procedures:	AS1289.3.8.1

Sample Number		10599/S/206024	10599/S/206025	10599/S/206026	10599/S/206027
ID / Client ID		-	-	-	-
Lot Number		JBH8	JTP1	JTP1	JTP2
Date / Time Sampled		10/05/2019	2/05/2019	2/05/2019	2/05/2019
Material Source		EXISTING	EXISTING	EXISTING	EXISTING
Material Type		EXISTING	EXISTING	EXISTING	EXISTING
Sampling Method		Tested As Received	Tested As Received	Tested As Received	Tested As Received
Water Type		Distilled Water	Distilled Water	Distilled Water	Distilled Water
Water Temperature (C°)		26	25	26	26
Location	(Borehole)	JBH8	JTP1	JTP1	JTP2
Depth		3.5-3.56m	0.8-1.0m	3.1-3.2m	0.6-0.7m
Soil Description		Existing	Existing	Existing	Existing
Emerson Class Number		**2**	**5**	**5**	**5**

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EMERSON CLASS NUMBER REPORT

Client:	Jacobs	Report Number:	10599/R/86239-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 4 of 10

Test Procedures:	AS1289.3.8.1

Sample Number	10599/S/206028	10599/S/206029	10599/S/206030	10599/S/206031
ID / Client ID	-	-	-	-
Lot Number	JTP3	JTP3	JTP4	JTP5
Date / Time Sampled	3/05/2019	3/05/2019	3/05/2019	3/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Water Type	Distilled Water	Distilled water	Distilled Water	Distilled Water
Water Temperature (C°)	25	26	26	26
Location (Borehole)	JTP3	JTP3	JTP4	JTP5
Depth	0.5-0.7m	2.3-2.4m	2.8-2.9m	0.5-0.6m
Soil Description	Existing	Existing	Existing	Existing
Emerson Class Number	**2**	**2**	**2**	**5**

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EMERSON CLASS NUMBER REPORT

Client:	Jacobs	Report Number:	10599/R/86239-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 5 of 10

Test Procedures:	AS1289.3.8.1

Sample Number		10599/S/206032	10599/S/206033	10599/S/206034	10599/S/206035
ID / Client ID		-	-	-	-
Lot Number		JTP6	JTP7	JTP8	JTP9
Date / Time Sampled		3/05/2019	3/05/2019	3/05/2019	3/05/2019
Material Source		EXISTING	EXISTING	EXISTING	EXISTING
Material Type		EXISTING	EXISTING	EXISTING	EXISTING
Sampling Method		Tested As Received	Tested As Received	Tested As Received	Tested As Received
Water Type		Distilled Water	Distilled Water	Distilled Water	Distilled Water
Water Temperature (C°)		26	25	25	26
Location	(Borehole)	JTP6	JTP7	JTP8	JTP9
Depth		0.5-0.6m	1.9-2.0m	2.5-2.6m	0.4-0.5m
Soil Description		Existing	Existing	Existing	Existing
Emerson Class Number		**2**	**2**	**3**	**3**

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EMERSON CLASS NUMBER REPORT

Client:	Jacobs	Report Number:	10599/R/86239-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 6 of 10

Test Procedures:	AS1289.3.8.1

Sample Number	10599/S/206036	10599/S/206037	10599/S/206038	10599/S/206039
ID / Client ID	-	-	-	-
Lot Number	JTP11	JTP14	JTP16	JTP17
Date / Time Sampled	2/05/2019	8/05/2019	8/05/2019	8/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Water Type	Distilled Water	Distilled Water	Distilled Water	Distilled water
Water Temperature (C°)	26	26	26	26
Location (Borehole)	JTP11	JTP14	JTP16	JTP17
Depth	0.6-0.8m	0.9-1.0m	0.4-0.5m	0.6-0.7m
Soil Description	Existing	Existing	Existing	Existing
Emerson Class Number	**5**	**3**	**5**	**5**

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EMERSON CLASS NUMBER REPORT

Client:	Jacobs	Report Number:	10599/R/86239-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 7 of 10

Test Procedures:	AS1289.3.8.1

Sample Number	10599/S/206040	10599/S/206041	10599/S/206043	10599/S/206045
ID / Client ID	-	-	-	-
Lot Number	JTP17	JTP18	JTP19	JTP21
Date / Time Sampled	8/05/2019	8/05/2019	9/05/2019	9/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Water Type	Distilled Water	Distilled Water	Distilled Water	Distilled Water
Water Temperature (C°)	26	26	25	25
Location (Borehole)	JTP17	JTP18	JTP19	JTP21
Depth	2.6-2.7m	0.4-0.5m	0.8-0.9m	0.3-0.4m
Soil Description	Existing	Existing	Existing	Existing
Emerson Class Number	**6**	**3**	**2**	**5**

Remarks	Results apply to sample(s) tested as received.

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EMERSON CLASS NUMBER REPORT

Client:	Jacobs	Report Number:	10599/R/86239-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 8 of 10

Test Procedures:	AS1289.3.8.1

Sample Number	10599/S/206046	10599/S/206047	10599/S/206048	10599/S/206049
ID / Client ID	-	-	-	-
Lot Number	JTP21	JTP23	JTP23	JTP24
Date / Time Sampled	9/05/2019	10/05/2019	10/05/2019	10/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Water Type	Distilled Water	Distilled Water	Distilled Water	Distilled Water
Water Temperature (C°)	25	25	25	25
Location (Borehole)	JTP21	JTP23	JTP23	JTP24
Depth	2.1-2.2m	0.5-0.6m	2.8-2.9m	2.6-2.7m
Soil Description	Existing	Existing	Existing	Existing
Emerson Class Number	**2**	**2**	**2**	**2**

Remarks	Results apply to sample(s) tested as received.

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EMERSON CLASS NUMBER REPORT

Client:	Jacobs	Report Number:	10599/R/86239-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 9 of 10

Test Procedures:	AS1289.3.8.1

Sample Number	10599/S/206050	10599/S/206051	10599/S/206052	10599/S/206287
ID / Client ID	-	-	-	-
Lot Number	JTP25	JTP25	JTP26	JBH9
Date / Time Sampled	10/05/2019	10/05/2019	10/05/2019	15/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Water Type	Distilled Water	Distilled Water	Distilled Water	Distilled Water
Water Temperature (C°)	25	25	25	25
Location (Borehole)	JTP25	JTP25	JTP26	JBH9
Depth	1.2-1.3m	2.7-2.8m	0.3-0.4m	0.5-0.95m
Soil Description	Existing	Existing	Existing	Existing
Emerson Class Number	**2**	**2**	**3**	**2**

Remarks	Results apply to sample(s) tested as received.

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Accreditation Number: 1986
Corporate Site Number: 10599

Approved Signatory: Kimberly Rutherford
Form ID: W34Rep Rev 1

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Laboratory: **Townsville Laboratory**
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Email: Townsville@constructionsciences.net

EMERSON CLASS NUMBER REPORT

Client:	Jacobs	Report Number:	10599/R/86239-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 10 of 10

Test Procedures:	AS1289.3.8.1

Sample Number		10599/S/206288			
ID / Client ID		-			
Lot Number		JBH9			
Date / Time Sampled		15/05/2019			
Material Source		EXISTING			
Material Type		EXISTING			
Sampling Method		Tested As Received			
Water Type		Distilled Water			
Water Temperature (C°)		25			
Location	(Borehole)	JBH9			
Depth		3.5-3.95m			
Soil Description		Existing			
Emerson Class Number		**2**			

Remarks	Results apply to sample(s) tested as received.

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EMERSON CLASS NUMBER REPORT

Client:	Jacobs	Report Number:	10599/R/86302-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH5
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	29/05/2019 Page 1 of 1

Test Procedures:	AS1289.3.8.1

Sample Number		10599/S/206019			
ID / Client ID		-			
Lot Number		JBH5			
Date / Time Sampled		9/05/2019			
Material Source		EXISTING			
Material Type		EXISTING			
Sampling Method		Tested As Received			
Water Type		Distilled Water			
Water Temperature (C°)		25			
Location	(Borehole)	JBH5			
Depth		7.5-7.95m			
Soil Description		Existing			
Emerson Class Number		**2**			

Remarks

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MOISTURE CONTENT REPORT

Client:	Jacobs	Report Number:	10599/R/86241-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 1 of 5

Test Procedures:	AS1289.2.1.1

Sample Number	10599/S/206012	10599/S/206013	10599/S/206014	10599/S/206015
ID / Client ID	-	-	-	-
Lot Number	JBH1	JBH2	JBH3	JBH3
Date / Time Sampled	3/05/2019	7/05/2019	8/05/2019	8/05/2019
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Date Tested	16/05/2019	16/05/2019	16/05/2019	16/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Location (Borehole)	JBH1	JBH2	JBH3	JBH3
Depth	1.5-1.95m	1.5-1.95m	1.5-1.95m	3.5-3.95m
Moisture Content (%)	**13.2**	**6.8**	**12.0**	**11.2**

Sample Number	10599/S/206016	10599/S/206017	10599/S/206018	10599/S/206020
ID / Client ID	-	-	-	-
Lot Number	JBH3	JBH4	JBH4	JBH6
Date / Time Sampled	8/05/2019	9/05/2019	9/05/2019	10/05/2019
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Date Tested	16/05/2019	23/05/2019	24/05/2019	23/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Location (Borehole)	JBH3	JBH4	JBH4	JBH6
Depth (m)	6.5-6.95m	1.5-1.95m	5.5-5.95m	1.5-1.95m
Moisture Content (%)	**10.2**	**12.2**	**16.8**	**12.3**

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MOISTURE CONTENT REPORT

Client:	Jacobs	Report Number:	10599/R/86241-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 2 of 5

Test Procedures:	AS1289.2.1.1

Sample Number		10599/S/206021	10599/S/206022	10599/S/206025	10599/S/206026
ID / Client ID		-	-	-	-
Lot Number		JBH7	JBH7	JTP1	JTP1
Date / Time Sampled		9/05/2019	9/05/2019	2/05/2019	2/05/2019
Sampling Method		Tested As Received	Tested As Received	Tested As Received	Tested As Received
Date Tested		23/05/2019	24/05/2019	16/05/2019	16/05/2019
Material Source		EXISTING	EXISTING	EXISTING	EXISTING
Material Type		EXISTING	EXISTING	EXISTING	EXISTING
Location	(Borehole)	JBH7	JBH7	JTP1	JTP1
Depth		1.5-1.92m	4.5-4.95m	0.8-1.0m	3.1-3.2m
Moisture Content (%)		**13.4**	**14.2**	**9.7**	**7.8**

Sample Number		10599/S/206027	10599/S/206029	10599/S/206030	10599/S/206031
ID / Client ID		-	-	-	-
Lot Number		JTP2	JTP3	JTP4	JTP5
Date / Time Sampled		2/05/2019	3/05/2019	3/05/2019	3/05/2019
Sampling Method		Tested As Received	Tested As Received	Tested As Received	Tested As Received
Date Tested		16/05/2019	16/05/2019	16/05/2019	16/05/2019
Material Source		EXISTING	EXISTING	EXISTING	EXISTING
Material Type		EXISTING	EXISTING	EXISTING	EXISTING
Location	(Borehole)	JTP2	JTP3	JTP4	JTP5
Depth	(m)	0.6-0.7m	2.3-2.4m	2.8-2.9m	0.5-0.6m
Moisture Content (%)		**14.4**	**10.3**	**13.2**	**12.0**

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MOISTURE CONTENT REPORT

Client:	Jacobs	Report Number:	10599/R/86241-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 3 of 5

Test Procedures:	AS1289.2.1.1

Sample Number	10599/S/206032	10599/S/206033	10599/S/206034	10599/S/206035
ID / Client ID	-	-	-	-
Lot Number	JTP6	JTP7	JTP8	JTP9
Date / Time Sampled	3/05/2019	3/05/2019	3/05/2019	3/05/2019
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Date Tested	16/05/2019	16/05/2019	16/05/2019	16/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Location (Borehole)	JTP6	JTP7	JTP8	JTP9
Depth	0.5-0.6m	1.9-2.0m	2.5-2.6m	0.4-0.5m
Moisture Content (%)	**7.5**	**17.1**	**8.4**	**5.5**

Sample Number	10599/S/206036	10599/S/206037	10599/S/206038	10599/S/206039
ID / Client ID	-	-	-	-
Lot Number	JTP11	JTP14	JTP16	JTP17
Date / Time Sampled	2/05/2019	8/05/2019	8/05/2019	8/05/2019
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Date Tested	16/05/2019	16/05/2019	16/05/2019	16/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Location (Borehole)	JTP11	JTP14	JTP16	JTP17
Depth (m)	0.6-0.8m	0.9-1.0m	0.4-0.5m	0.6-0.7m
Moisture Content (%)	**13.6**	**11.4**	**13.7**	**21.8**

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MOISTURE CONTENT REPORT

Client:	Jacobs	Report Number:	10599/R/86241-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 4 of 5

Test Procedures:	AS1289.2.1.1

Sample Number	10599/S/206040	10599/S/206041	10599/S/206042	10599/S/206043
ID / Client ID	-	-	-	-
Lot Number	JTP17	JTP18	JTP18	JTP19
Date / Time Sampled	8/05/2019	8/05/2019	8/05/2019	9/05/2019
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Date Tested	16/05/2019	16/05/2019	16/05/2019	17/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Location (Borehole)	JTP17	JTP18	JTP18	JTP19
Depth	2.6-2.7m	0.4-0.5m	0.8-0.9m	0.8-0.9m
Moisture Content (%)	**10.1**	**1.6**	**7.6**	**8.0**

Sample Number	10599/S/206044	10599/S/206045	10599/S/206046	10599/S/206047
ID / Client ID	-	-	-	-
Lot Number	JTP20	JTP21	JTP21	JTP23
Date / Time Sampled	9/05/2019	9/05/2019	9/05/2019	10/05/2019
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Date Tested	17/05/2019	17/05/2019	17/05/2019	17/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Location (Borehole)	JTP20	JTP21	JTP21	JTP23
Depth (m)	1.3-1.4m	0.3-0.4m	2.1-2.2m	0.5-0.6m
Moisture Content (%)	**8.0**	**15.0**	**10.3**	**9.9**

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MOISTURE CONTENT REPORT

Client:	Jacobs	Report Number:	10599/R/86241-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	Various
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 5 of 5

Test Procedures:	AS1289.2.1.1

Sample Number	10599/S/206048	10599/S/206049	10599/S/206050	10599/S/206051
ID / Client ID	-	-	-	-
Lot Number	JTP23	JTP24	JTP25	JTP25
Date / Time Sampled	10/05/2019	10/05/2019	10/05/2019	10/05/2019
Sampling Method	Tested As Received	Tested As Received	Tested As Received	Tested As Received
Date Tested	17/05/2019	17/05/2019	17/05/2019	17/05/2019
Material Source	EXISTING	EXISTING	EXISTING	EXISTING
Material Type	EXISTING	EXISTING	EXISTING	EXISTING
Location (Borehole)	JTP23	JTP24	JTP25	JTP25
Depth	2.8-2.9m	2.6-2.7m	1.2-1.3m	2.7-2.8m
Moisture Content (%)	**2.3**	**14.9**	**13.2**	**13.9**

Sample Number	10599/S/206052	10599/S/206287	10599/S/206288	
ID / Client ID	-	-	-	
Lot Number	JTP26	JBH9	JBH9	
Date / Time Sampled	10/05/2019	15/05/2019	15/05/2019	
Sampling Method	Tested As Received	Tested As Received	Tested As Received	
Date Tested	17/05/2019	23/05/2019	23/05/2019	
Material Source	EXISTING	EXISTING	EXISTING	
Material Type	EXISTING	EXISTING	EXISTING	
Location (Borehole)	JTP26	JBH9	JBH9	
Depth (m)	0.3-0.4m	0.5-0.95m	3.5-3.95m	
Moisture Content (%)	**18.0**	**10.4**	**17.8**	

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MOISTURE CONTENT REPORT

Client:	Jacobs	Report Number:	10599/R/86303-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH5
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	29/05/2019 Page 1 of 1

Test Procedures:	AS1289.2.1.1

Sample Number		10599/S/206019			
ID / Client ID		-			
Lot Number		JBH5			
Date / Time Sampled		9/05/2019			
Sampling Method		Tested As Received			
Date Tested		28/05/2019			
Material Source		EXISTING			
Material Type		EXISTING			
Location	(Borehole)	JBH5			
Depth		7.5-7.95m			
Moisture Content (%)		**14.3**			

Sample Number					
ID / Client ID					
Lot Number					
Date / Time Sampled					
Sampling Method					
Date Tested					
Material Source					
Material Type					
Location	(Borehole)				
Depth	(m)				
Moisture Content (%)					

Remarks	Results apply to sample(s) tested as received.

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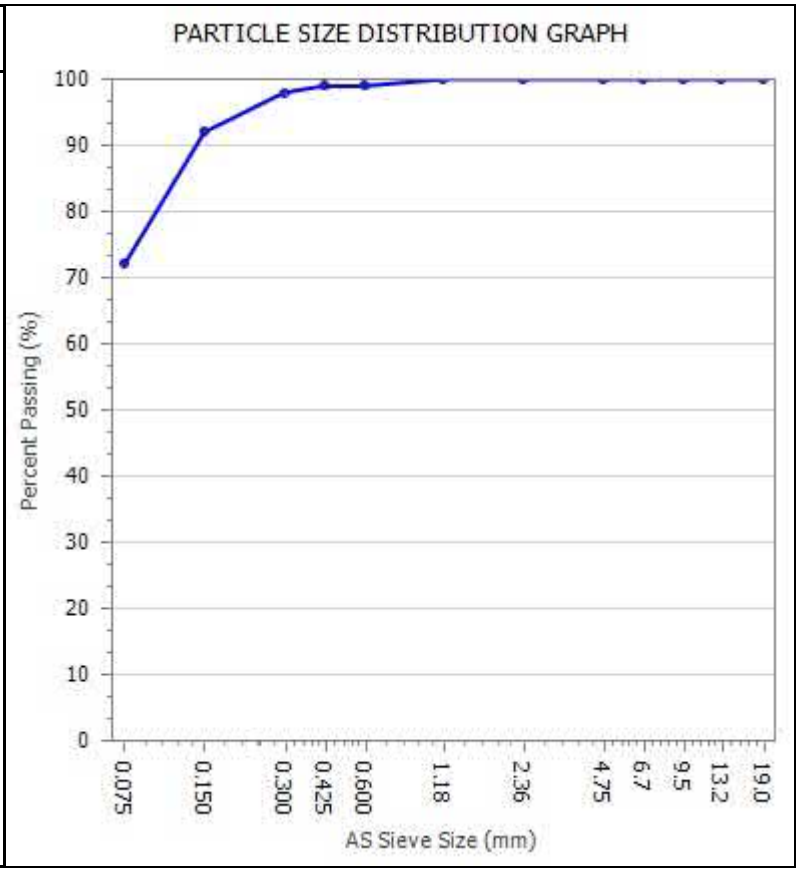
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH1
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 1 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206012	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH1
Date Sampled	3/05/2019	Depth (m)	1.5-1.95m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**100**	
1.18		**100**	
0.600		**99**	
0.425		**99**	
0.300		**98**	
0.150		**92**	
0.075		**72**	



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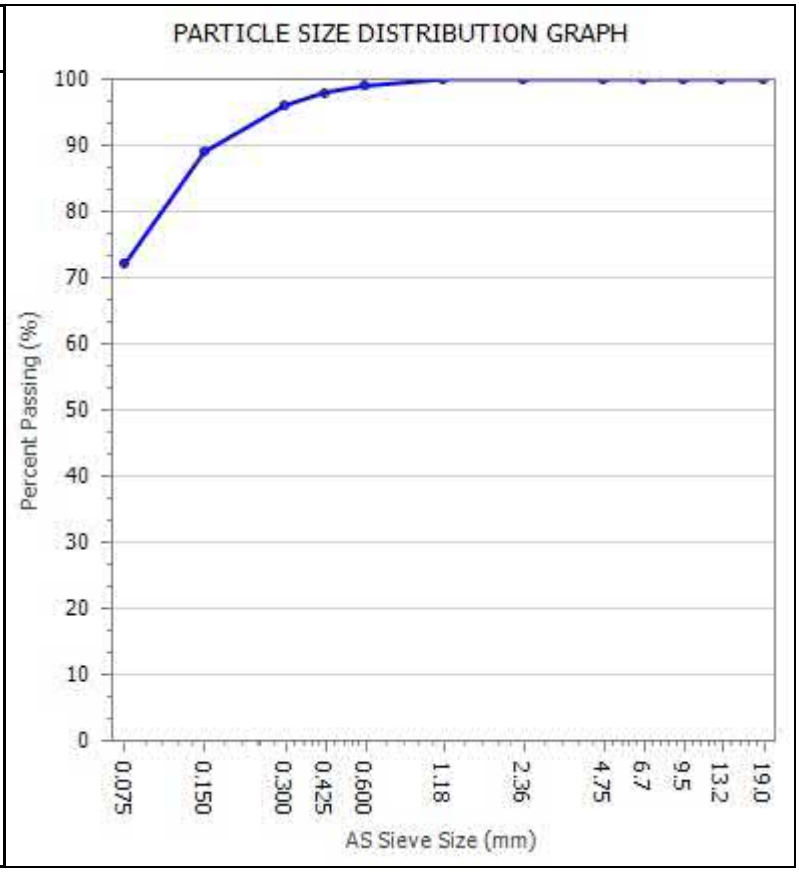
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH2
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 2 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206013	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH2
Date Sampled	7/05/2019	Depth (m)	1.5-1.95m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**100**	
1.18		**100**	
0.600		**99**	
0.425		**98**	
0.300		**96**	
0.150		**89**	
0.075		**72**	



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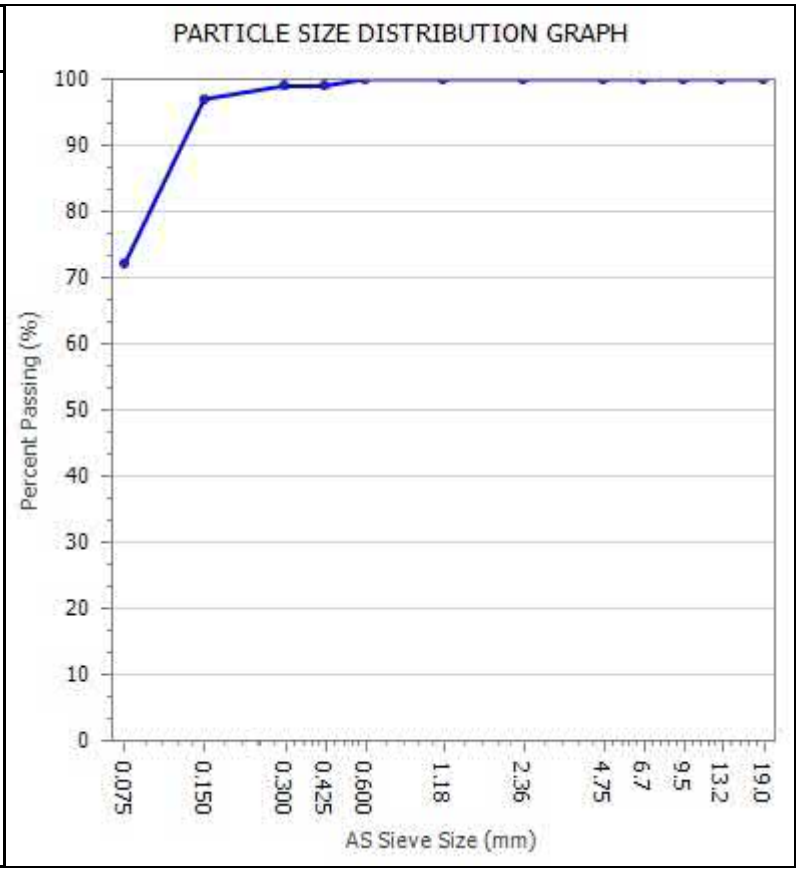
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH3
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 3 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206014	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH3
Date Sampled	8/05/2019	Depth (m)	1.5-1.95m
Sampled By	Client Sampled		
Date Tested	17/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**100**	
1.18		**100**	
0.600		**100**	
0.425		**99**	
0.300		**99**	
0.150		**97**	
0.075		**72**	



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Approved Signatory: Kimberly Rutherford
Form ID: W9Rep Rev 2

Construction Sciences

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Laboratory: **Townsville Laboratory**
Phone: 0747288023
Fax: 0747288024
Email: Townsville@constructionsciences.net

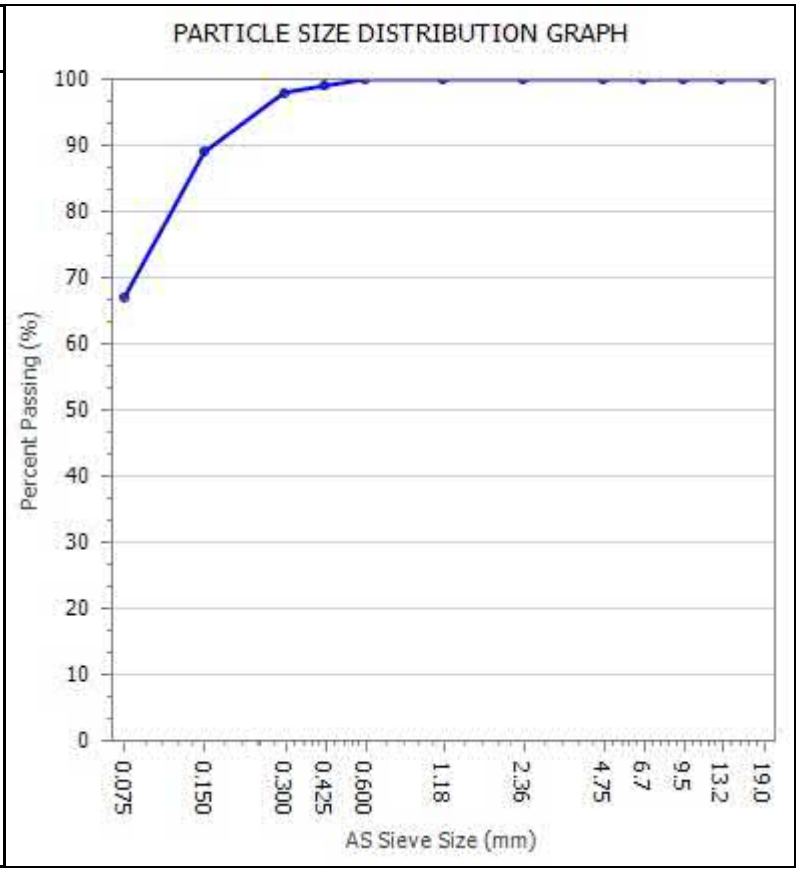
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH3
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 4 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206015	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH3
Date Sampled	8/05/2019	Depth (m)	3.5-3.95m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**100**	
1.18		**100**	
0.600		**100**	
0.425		**99**	
0.300		**98**	
0.150		**89**	
0.075		**67**	



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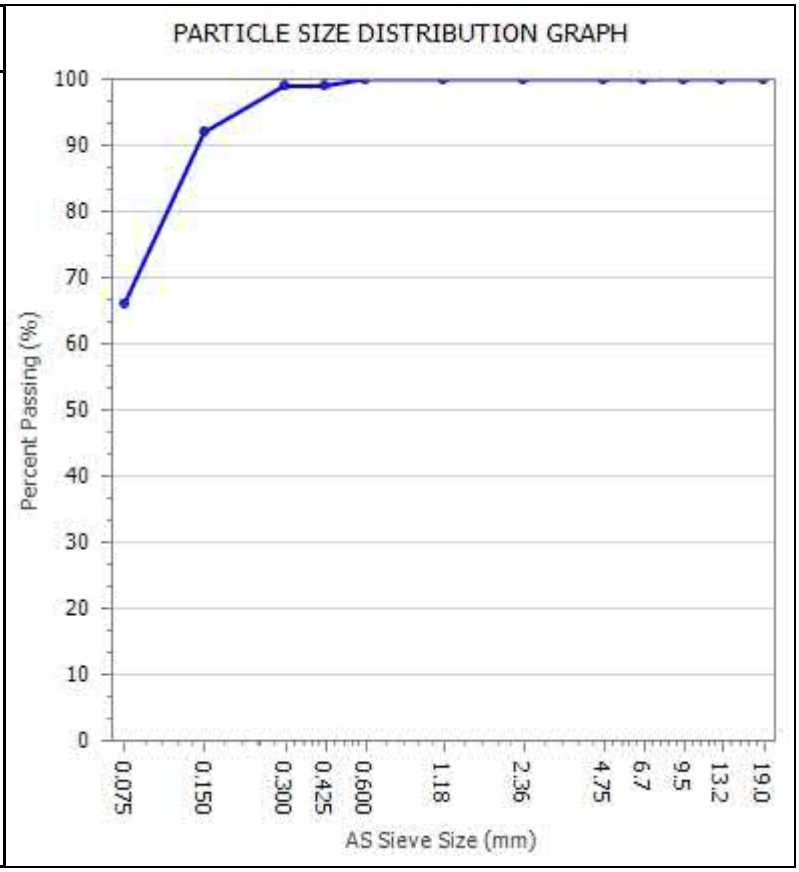
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH3
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 5 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206016	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH3
Date Sampled	8/05/2019	Depth (m)	6.5-6.95m
Sampled By	Client Sampled		
Date Tested	20/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**100**	
1.18		**100**	
0.600		**100**	
0.425		**99**	
0.300		**99**	
0.150		**92**	
0.075		**66**	



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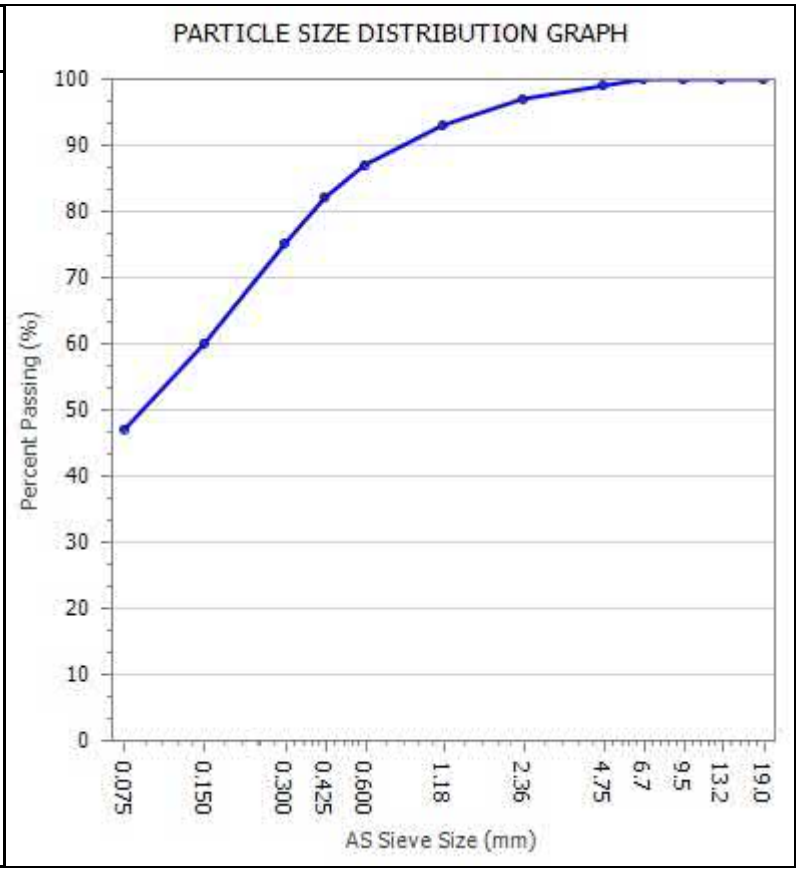
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH4
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 6 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206017	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH4
Date Sampled	9/05/2019	Depth (m)	1.5-1.95m
Sampled By	Client Sampled		
Date Tested	27/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**99**	
2.36		**97**	
1.18		**93**	
0.600		**87**	
0.425		**82**	
0.300		**75**	
0.150		**60**	
0.075		**47**	



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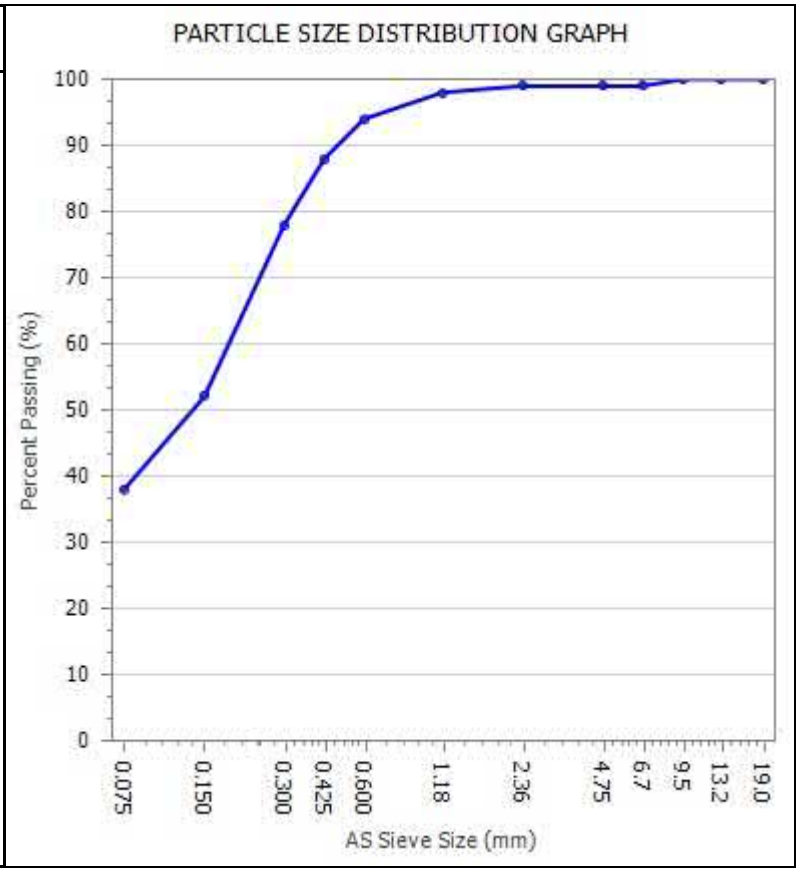
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH4
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 7 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206018	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH4
Date Sampled	9/05/2019	Depth (m)	5.5-5.95m
Sampled By	Client Sampled		
Date Tested	27/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**99**	
4.75		**99**	
2.36		**99**	
1.18		**98**	
0.600		**94**	
0.425		**88**	
0.300		**78**	
0.150		**52**	
0.075		**38**	



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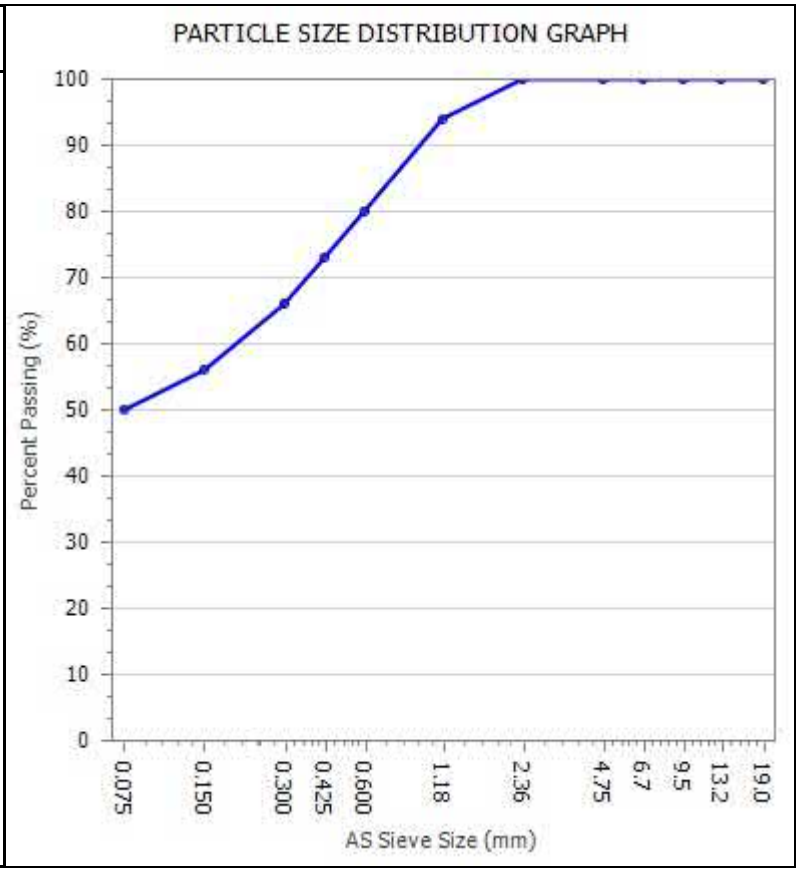
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH6
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 8 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206020	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH6
Date Sampled	10/05/2019	Depth (m)	1.5-1.95m
Sampled By	Client Sampled		
Date Tested	20/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**100**	
1.18		**94**	
0.600		**80**	
0.425		**73**	
0.300		**66**	
0.150		**56**	
0.075		**50**	



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PARTICLE SIZE DISTRIBUTION REPORT

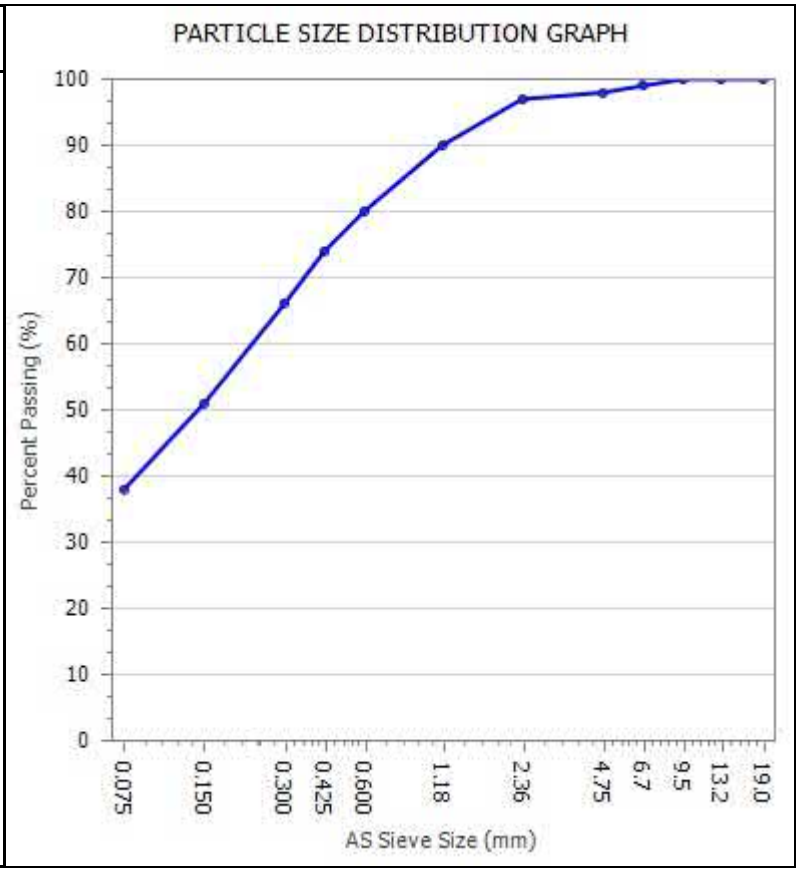
Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH7
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 9 of 39

Test Procedures:	AS1289.3.6.1
Sample Number	10599/S/206021
Sampling Method	Tested As Received
Date Sampled	9/05/2019
Sampled By	Client Sampled
Date Tested	27/05/2019
Material Source	EXISTING

Sample Location

Location	(Borehole)	JBH7
Depth	(m)	1.5-1.92m
Material Type	EXISTING	

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**99**	
4.75		**98**	
2.36		**97**	
1.18		**90**	
0.600		**80**	
0.425		**74**	
0.300		**66**	
0.150		**51**	
0.075		**38**	



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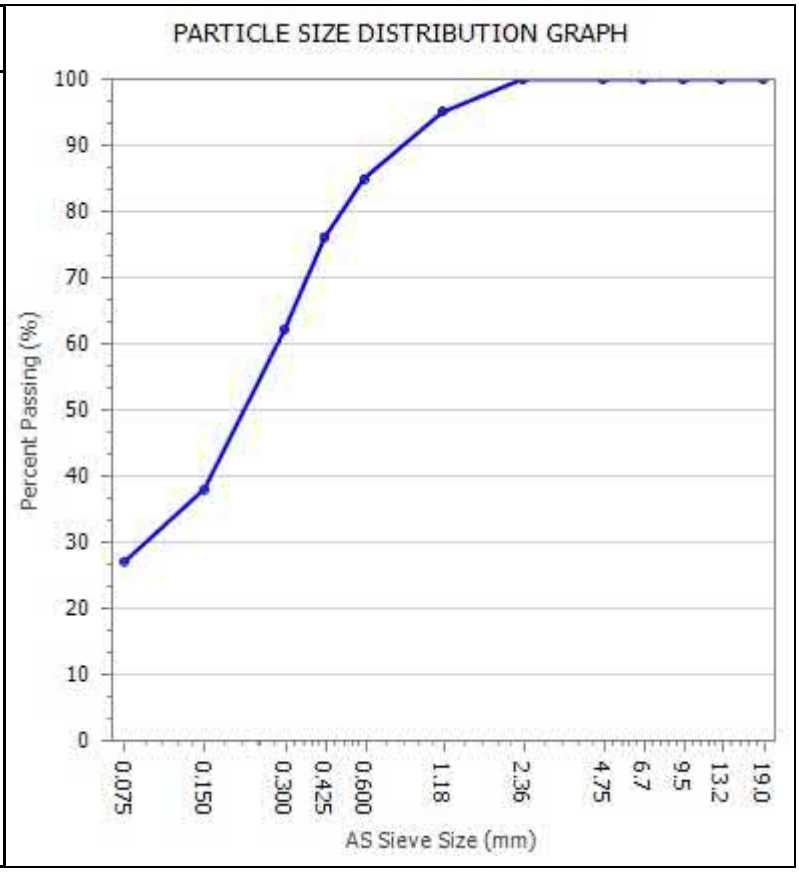
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH7
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 10 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206022	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH7
Date Sampled	9/05/2019	Depth (m)	4.5-4.95m
Sampled By	Client Sampled		
Date Tested	27/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**100**	
1.18		**95**	
0.600		**85**	
0.425		**76**	
0.300		**62**	
0.150		**38**	
0.075		**27**	



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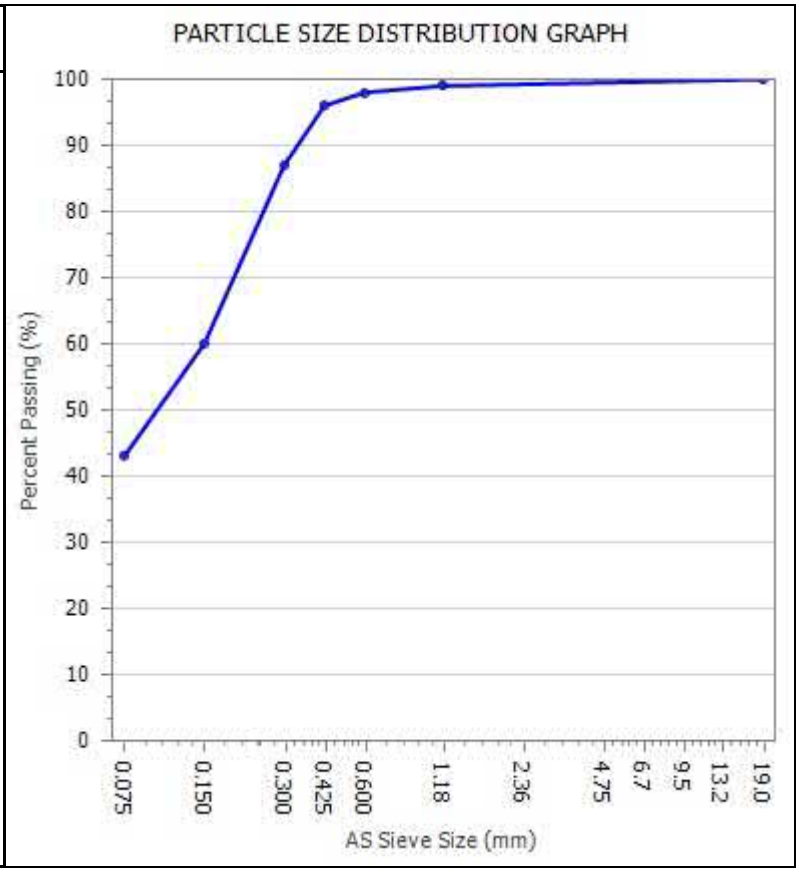
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH8
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 11 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206023	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH8
Date Sampled	10/05/2019	Depth (m)	1.55-1.95m
Sampled By	Client Sampled		
Date Tested	27/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
1.18		**99**	
0.600		**98**	
0.425		**96**	
0.300		**87**	
0.150		**60**	
0.075		**43**	



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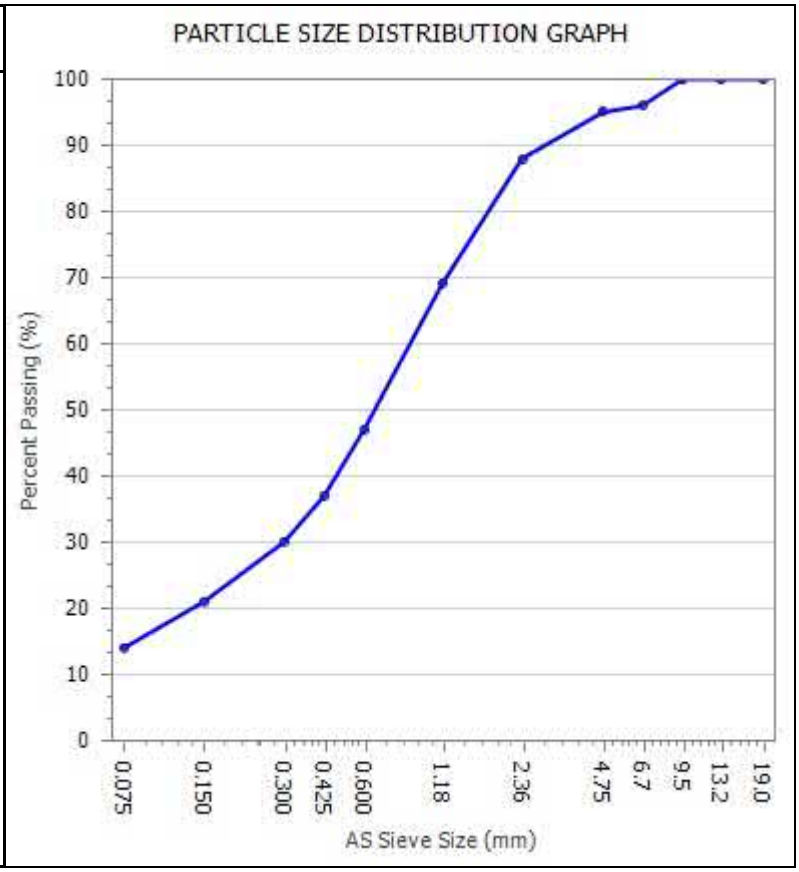
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH8
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 12 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206024	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH8
Date Sampled	10/05/2019	Depth (m)	3.5-3.56m
Sampled By	Client Sampled		
Date Tested	27/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**96**	
4.75		**95**	
2.36		**88**	
1.18		**69**	
0.600		**47**	
0.425		**37**	
0.300		**30**	
0.150		**21**	
0.075		**14**	



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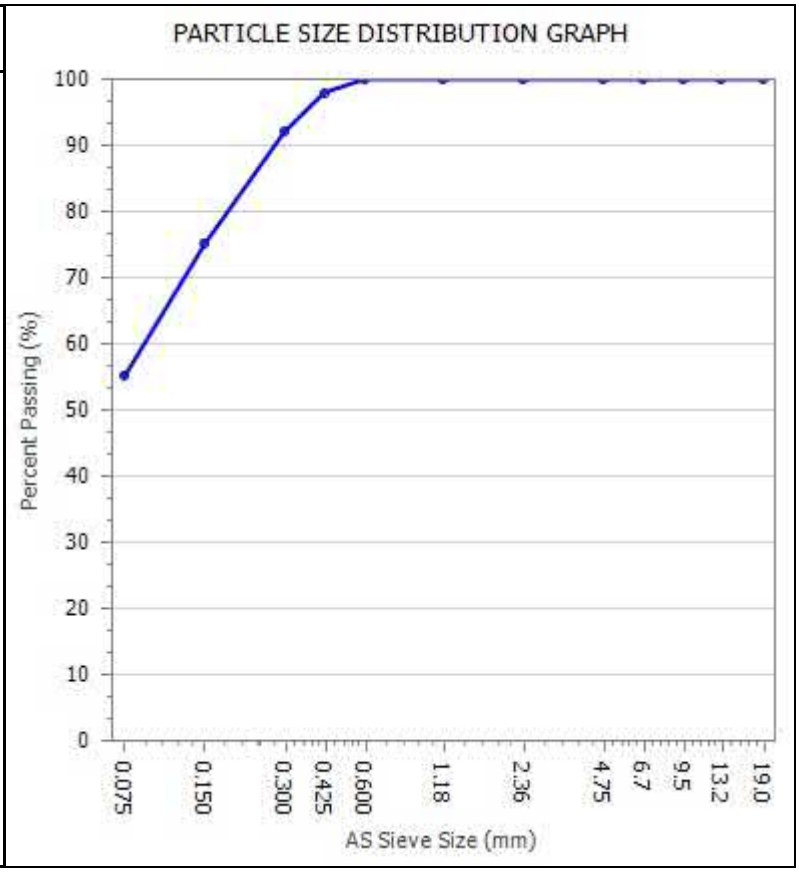
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP1
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 13 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206025	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP1
Date Sampled	2/05/2019	Test Depth m	0.8-1.0m
Sampled By	Client Sampled		
Date Tested	20/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**100**	
1.18		**100**	
0.600		**100**	
0.425		**98**	
0.300		**92**	
0.150		**75**	
0.075		**55**	



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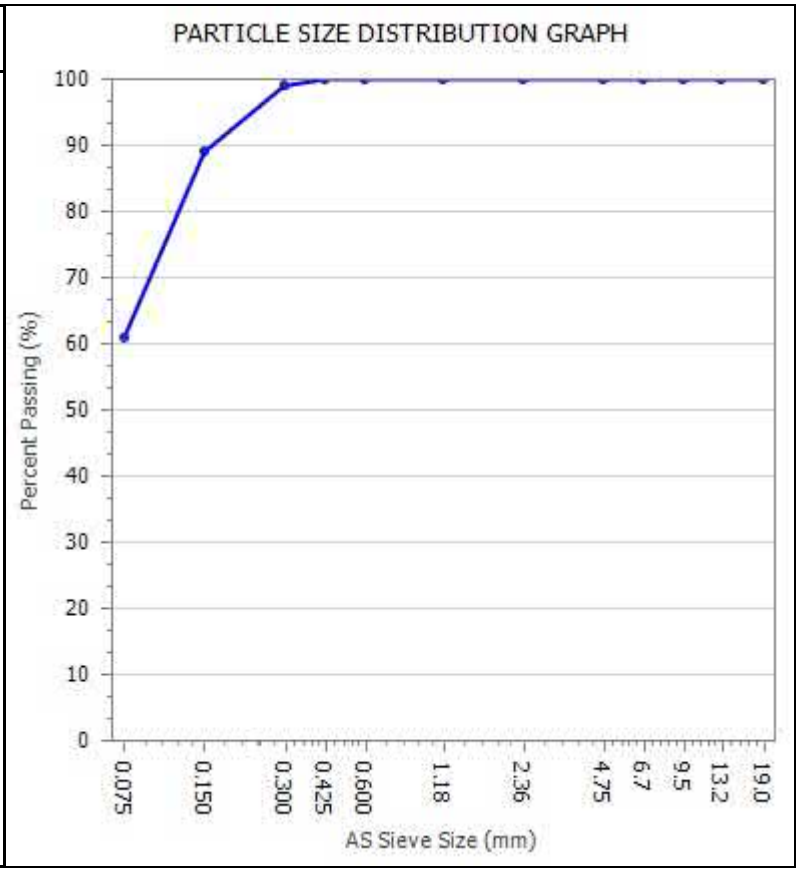
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP1
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 14 of 39

Test Procedures:	AS1289.3.6.1		
Sample Number	10599/S/206026	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP1
Date Sampled	2/05/2019	Test Depth m	3.1-3.2m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**100**	
1.18		**100**	
0.600		**100**	
0.425		**100**	
0.300		**99**	
0.150		**89**	
0.075		**61**	



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NATA

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Accreditation Number: 1986
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Approved Signatory: Kimberly Rutherford
Form ID: W9Rep Rev 2

Construction Sciences

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Laboratory: **Townsville Laboratory**
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Fax: 0747288024
Email: Townsville@constructionsciences.net

PARTICLE SIZE DISTRIBUTION REPORT

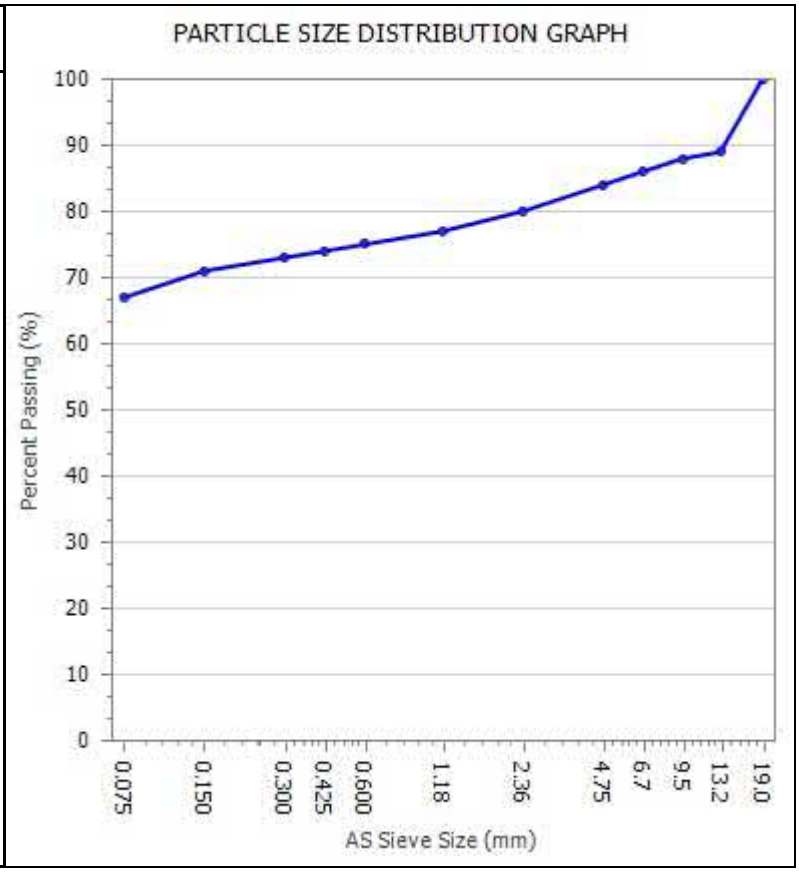
Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP2
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 15 of 39

Test Procedures:	AS1289.3.6.1
Sample Number	10599/S/206027
Sampling Method	Tested As Received
Date Sampled	2/05/2019
Sampled By	Client Sampled
Date Tested	21/05/2019
Material Source	EXISTING

Sample Location

Test Pit		JTP2
Test Depth	m	0.6-0.7m
Material Type		EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**89**	
9.5		**88**	
6.7		**86**	
4.75		**84**	
2.36		**80**	
1.18		**77**	
0.600		**75**	
0.425		**74**	
0.300		**73**	
0.150		**71**	
0.075		**67**	



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PARTICLE SIZE DISTRIBUTION REPORT

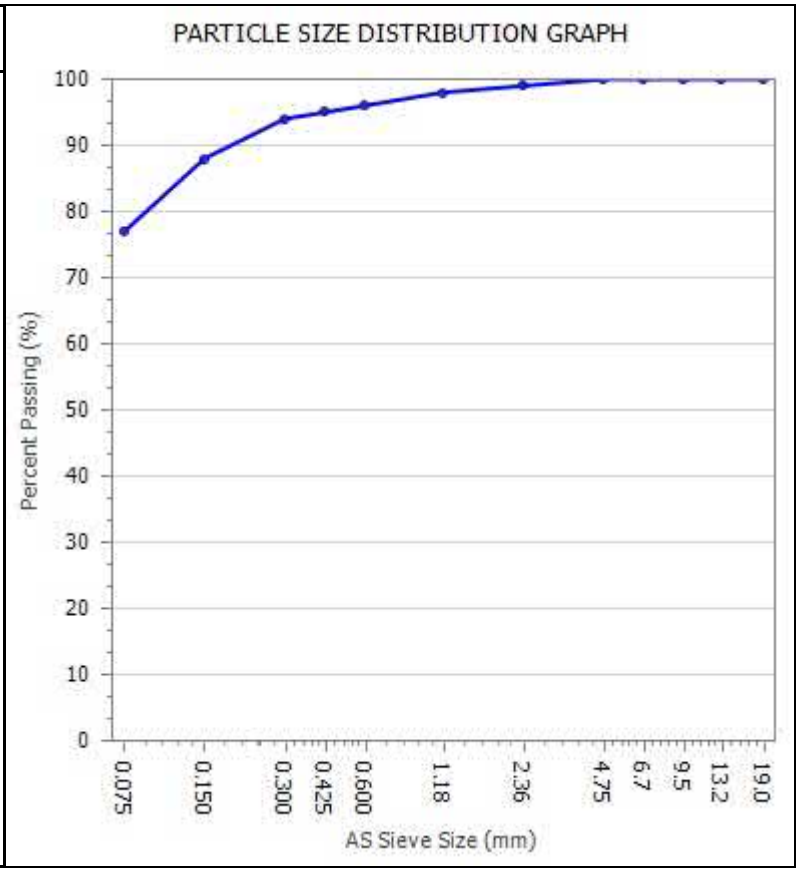
Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP3
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 16 of 39

Test Procedures:	AS1289.3.6.1
Sample Number	10599/S/206029
Sampling Method	Tested As Received
Date Sampled	3/05/2019
Sampled By	Client Sampled
Date Tested	21/05/2019
Material Source	EXISTING

Sample Location

Test Pit		JTP3
Test Depth	m	2.3-2.4m
Material Type		EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**99**	
1.18		**98**	
0.600		**96**	
0.425		**95**	
0.300		**94**	
0.150		**88**	
0.075		**77**	



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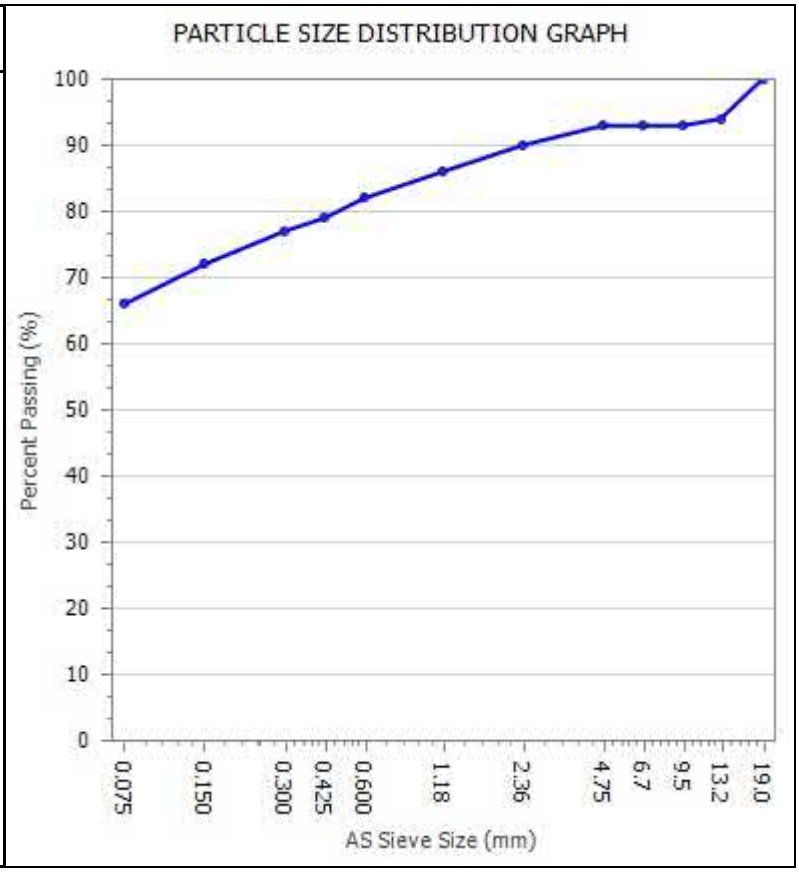
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP4
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 17 of 39

Test Procedures:	AS1289.3.6.1		
Sample Number	10599/S/206030	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP4
Date Sampled	3/05/2019	Test Depth m	2.8-2.9m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**94**	
9.5		**93**	
6.7		**93**	
4.75		**93**	
2.36		**90**	
1.18		**86**	
0.600		**82**	
0.425		**79**	
0.300		**77**	
0.150		**72**	
0.075		**66**	



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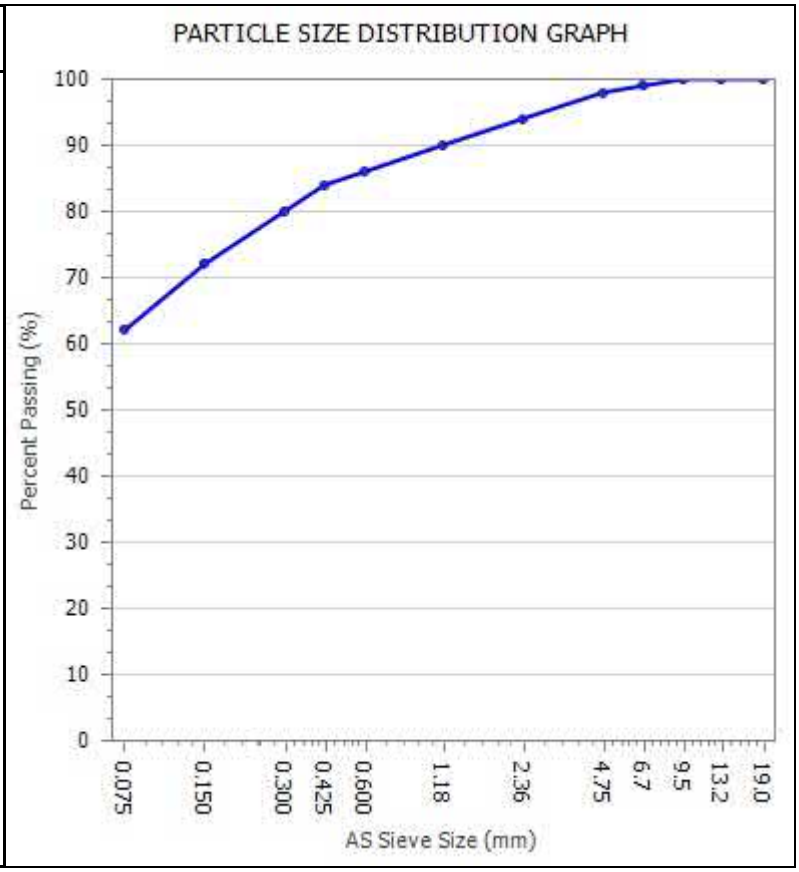
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP6
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 18 of 39

Test Procedures:	AS1289.3.6.1		
Sample Number	10599/S/206032	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP6
Date Sampled	3/05/2019	Test Depth m	0.5-0.6m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**99**	
4.75		**98**	
2.36		**94**	
1.18		**90**	
0.600		**86**	
0.425		**84**	
0.300		**80**	
0.150		**72**	
0.075		**62**	



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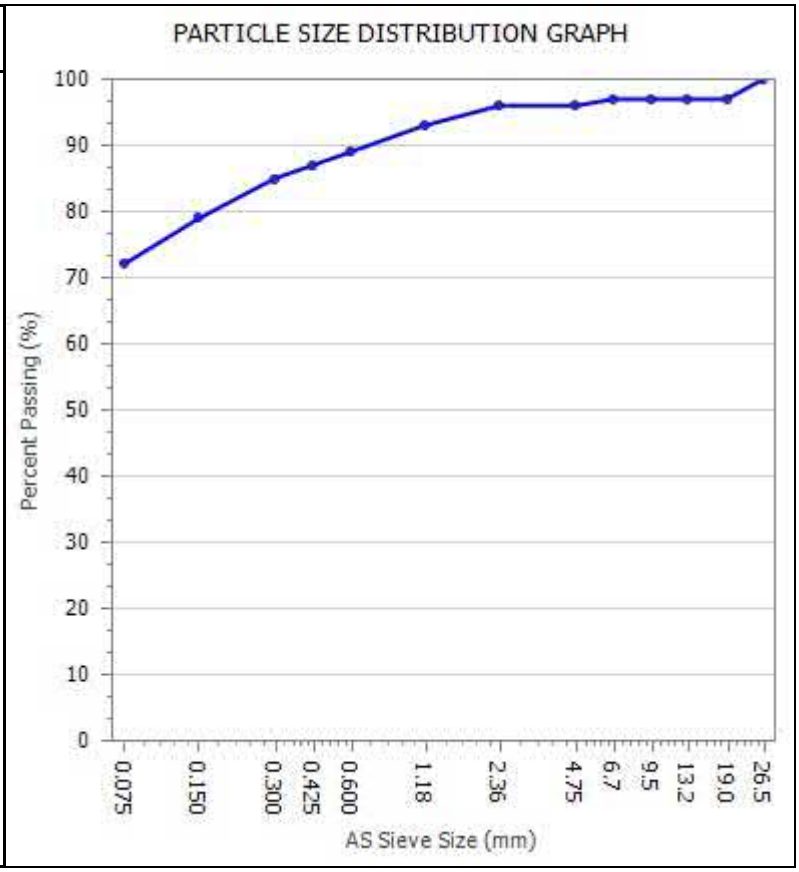
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP7
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 19 of 39

Test Procedures:	AS1289.3.6.1			
Sample Number	10599/S/206033	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP7
Date Sampled	3/05/2019	Test Depth	m	1.9-2.0m
Sampled By	Client Sampled			
Date Tested	21/05/2019			
Material Source	EXISTING	Material Type		EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
26.5		**100**	
19.0		**97**	
13.2		**97**	
9.5		**97**	
6.7		**97**	
4.75		**96**	
2.36		**96**	
1.18		**93**	
0.600		**89**	
0.425		**87**	
0.300		**85**	
0.150		**79**	
0.075		**72**	



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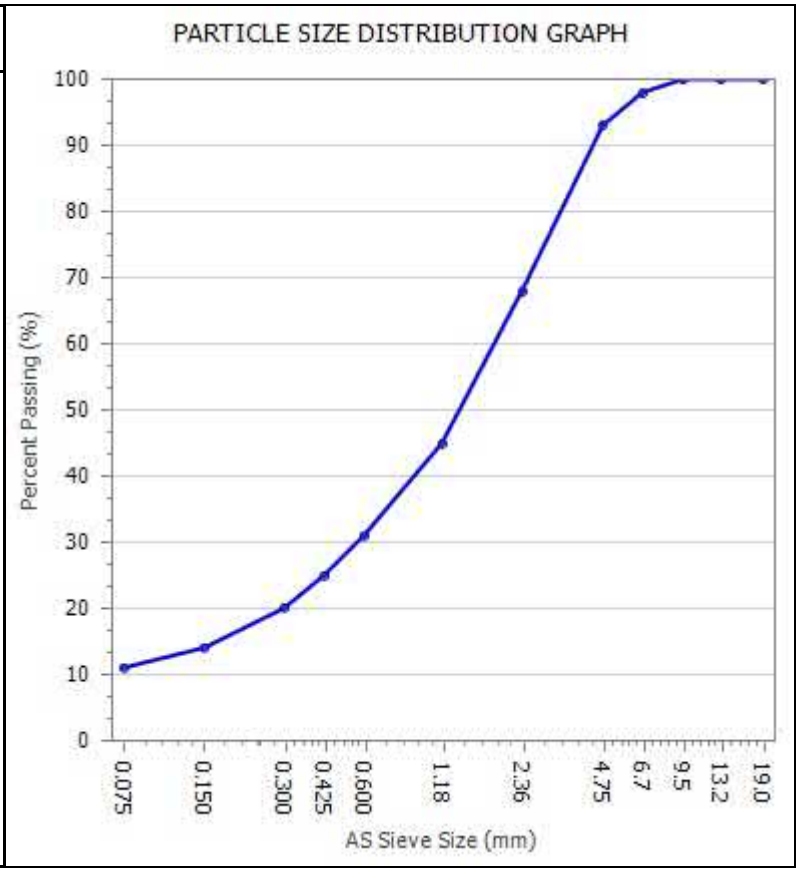
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP8
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 20 of 39

Test Procedures:	AS1289.3.6.1			
Sample Number	10599/S/206034	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP8
Date Sampled	3/05/2019	Test Depth	m	2.5-2.6m
Sampled By	Client Sampled			
Date Tested	20/05/2019			
Material Source	EXISTING	Material Type		EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**98**	
4.75		**93**	
2.36		**68**	
1.18		**45**	
0.600		**31**	
0.425		**25**	
0.300		**20**	
0.150		**14**	
0.075		**11**	



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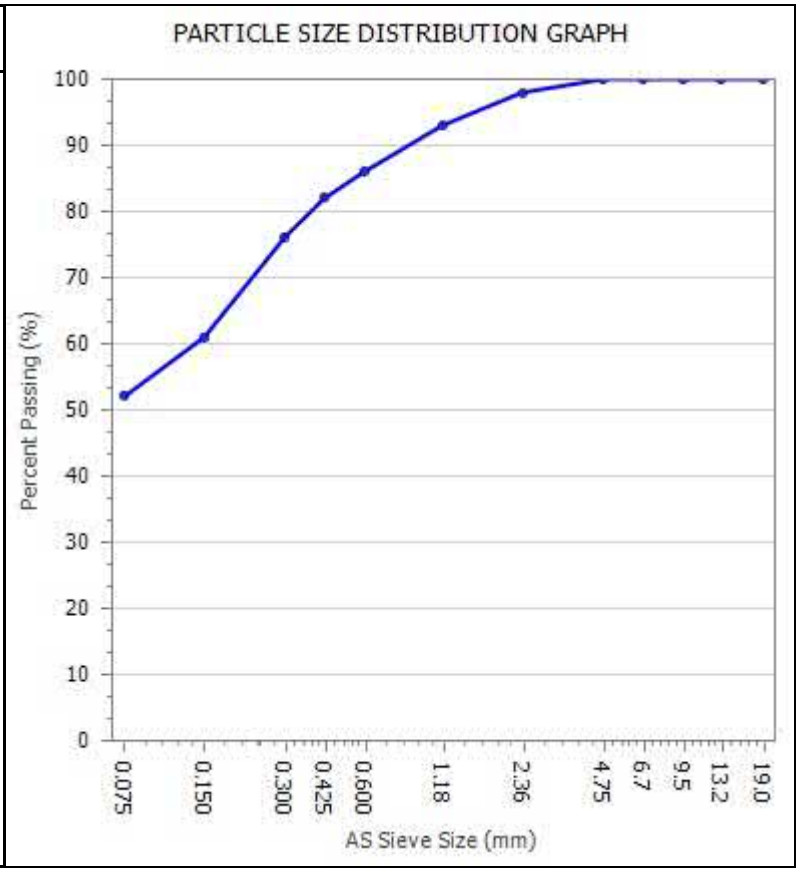
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP11
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 21 of 39

Test Procedures:	AS1289.3.6.1		
Sample Number	10599/S/206036	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP11
Date Sampled	2/05/2019	Test Depth m	0.6-0.8m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**98**	
1.18		**93**	
0.600		**86**	
0.425		**82**	
0.300		**76**	
0.150		**61**	
0.075		**52**	



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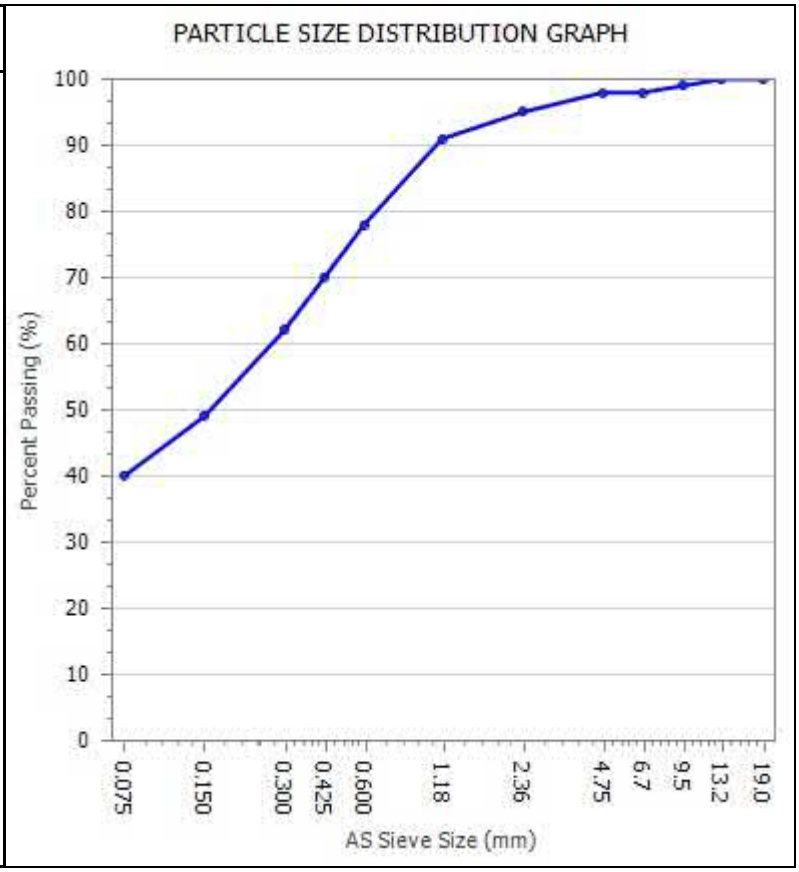
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP14
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 22 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206037	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP14
Date Sampled	8/05/2019	Test Depth m	0.9-1.0m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**99**	
6.7		**98**	
4.75		**98**	
2.36		**95**	
1.18		**91**	
0.600		**78**	
0.425		**70**	
0.300		**62**	
0.150		**49**	
0.075		**40**	



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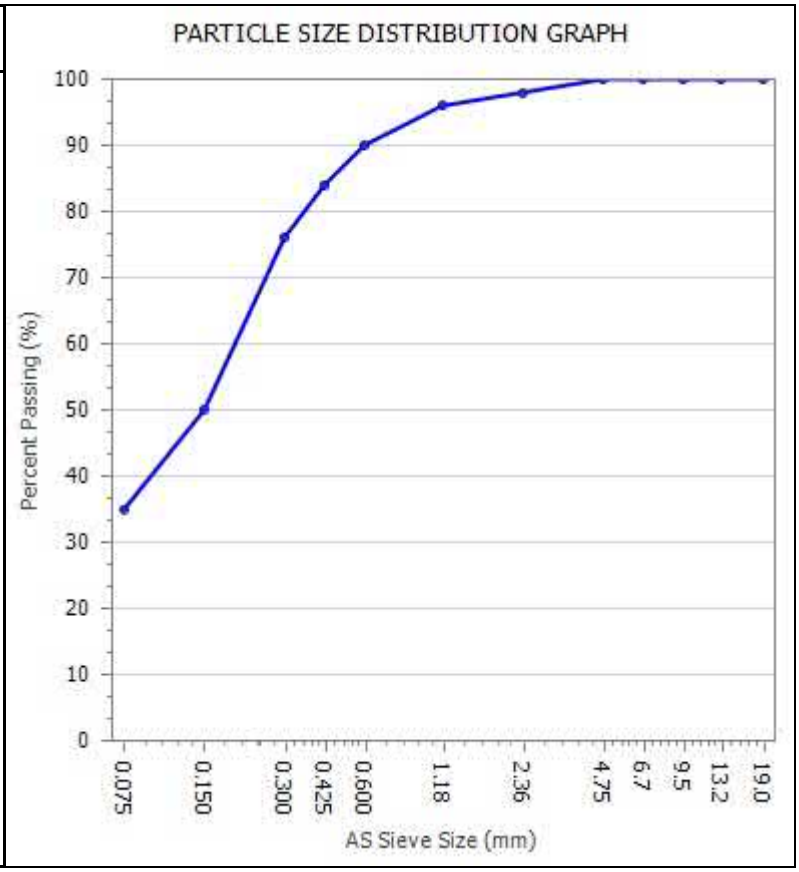
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP16
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 23 of 39

Test Procedures:	AS1289.3.6.1		
Sample Number	10599/S/206038	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP16
Date Sampled	8/05/2019	Test Depth m	0.4-0.5m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**98**	
1.18		**96**	
0.600		**90**	
0.425		**84**	
0.300		**76**	
0.150		**50**	
0.075		**35**	



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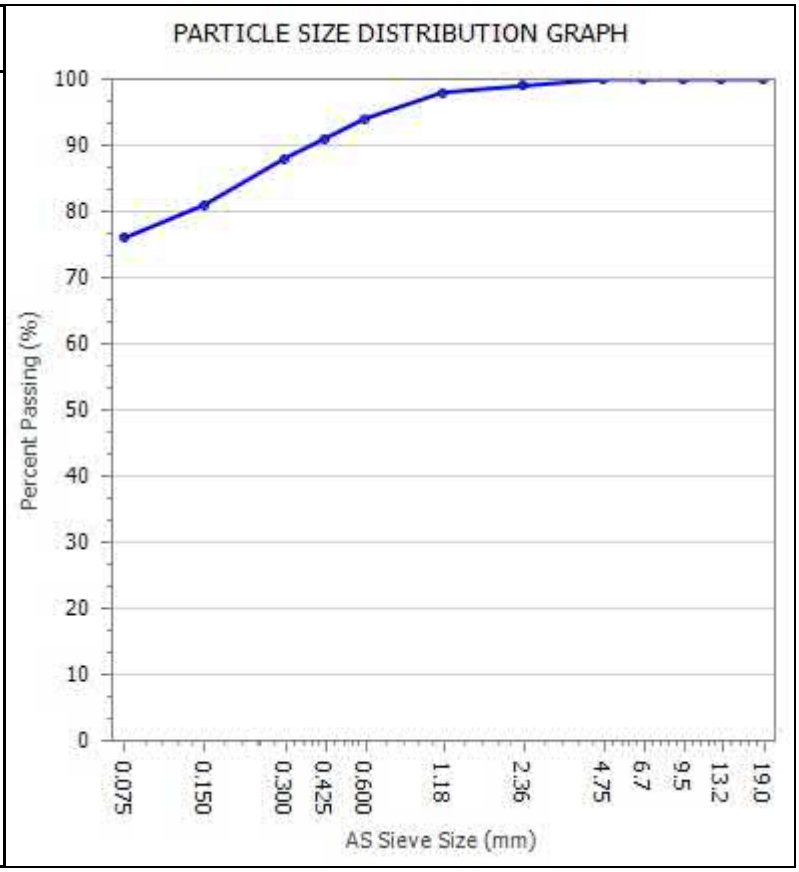
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP17
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 24 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206039	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP17
Date Sampled	8/05/2019	Test Depth m	0.6-0.7m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**99**	
1.18		**98**	
0.600		**94**	
0.425		**91**	
0.300		**88**	
0.150		**81**	
0.075		**76**	



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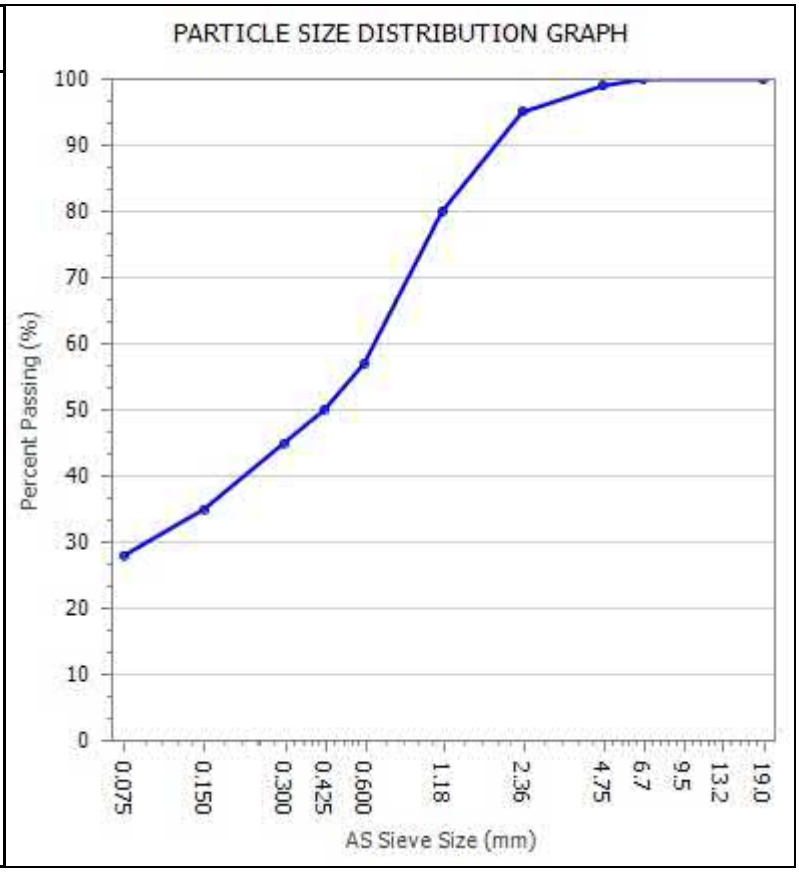
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP17
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 25 of 39

Test Procedures:	AS1289.3.6.1		
Sample Number	10599/S/206040	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP17
Date Sampled	8/05/2019	Test Depth m	2.6-2.7m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
6.7		**100**	
4.75		**99**	
2.36		**95**	
1.18		**80**	
0.600		**57**	
0.425		**50**	
0.300		**45**	
0.150		**35**	
0.075		**28**	



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Form ID: W9Rep Rev 2

Construction Sciences

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Laboratory: **Townsville Laboratory**
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Fax: 0747288024
Email: Townsville@constructionsciences.net

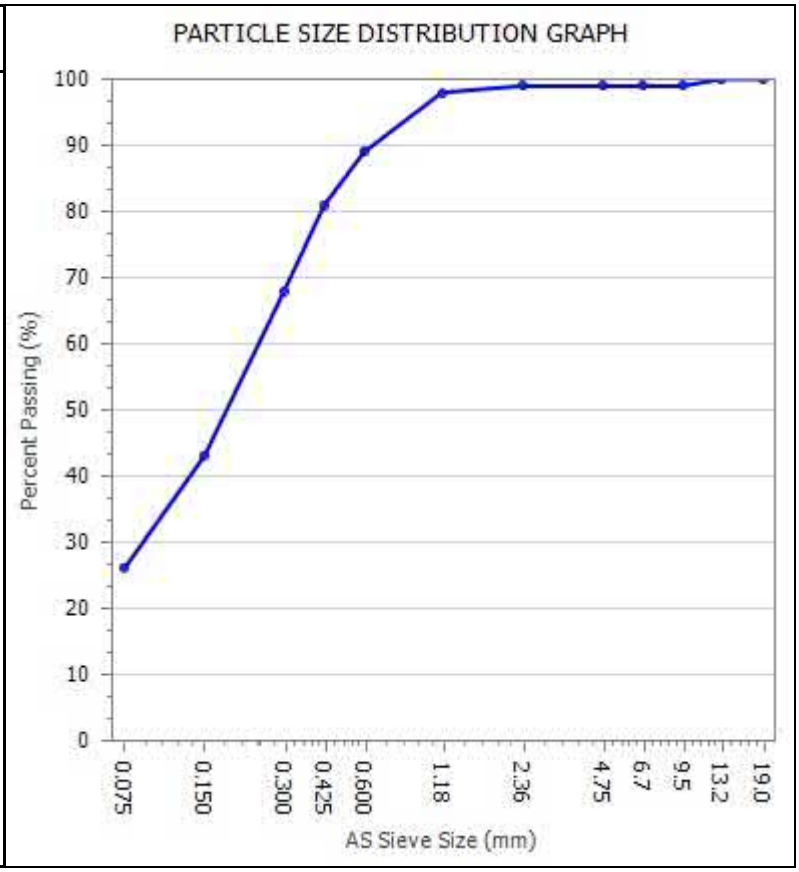
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP18
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 26 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206041	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP18
Date Sampled	8/05/2019	Test Depth m	0.4-0.5m
Sampled By	Client Sampled		
Date Tested	20/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**99**	
6.7		**99**	
4.75		**99**	
2.36		**99**	
1.18		**98**	
0.600		**89**	
0.425		**81**	
0.300		**68**	
0.150		**43**	
0.075		**26**	



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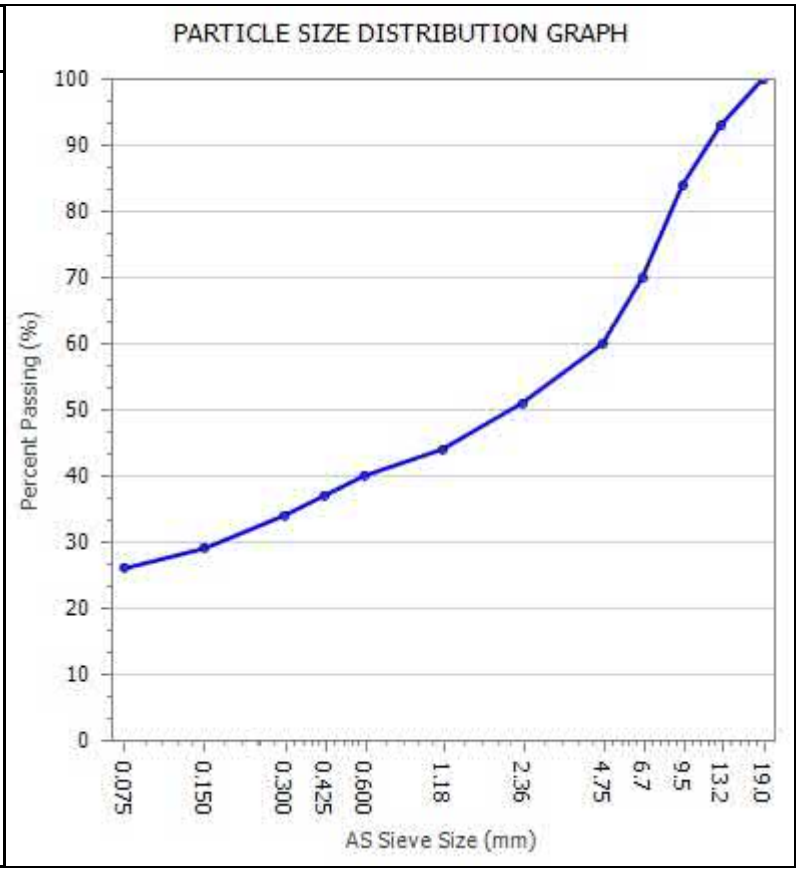
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP18
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 27 of 39

Test Procedures:	AS1289.3.6.1		
Sample Number	10599/S/206042	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP18
Date Sampled	8/05/2019	Test Depth m	0.8-0.9m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**93**	
9.5		**84**	
6.7		**70**	
4.75		**60**	
2.36		**51**	
1.18		**44**	
0.600		**40**	
0.425		**37**	
0.300		**34**	
0.150		**29**	
0.075		**26**	



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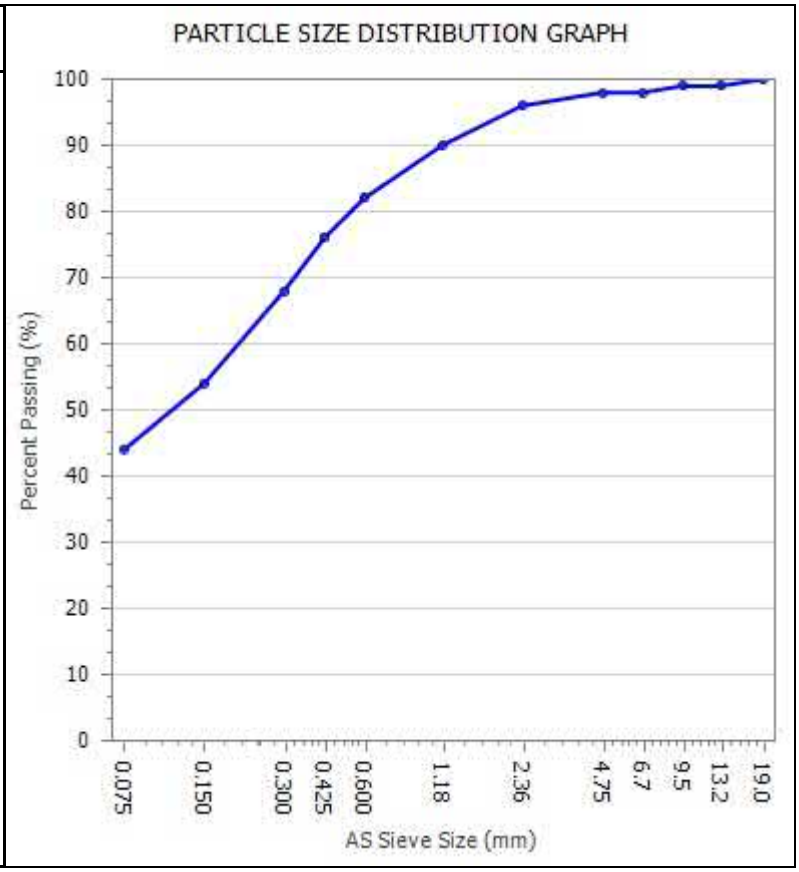
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP19
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 28 of 39

Test Procedures:	AS1289.3.6.1			
Sample Number	10599/S/206043	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP19
Date Sampled	9/05/2019	Test Depth	m	0.8-0.9m
Sampled By	Client Sampled			
Date Tested	20/05/2019			
Material Source	EXISTING	Material Type		EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**99**	
9.5		**99**	
6.7		**98**	
4.75		**98**	
2.36		**96**	
1.18		**90**	
0.600		**82**	
0.425		**76**	
0.300		**68**	
0.150		**54**	
0.075		**44**	



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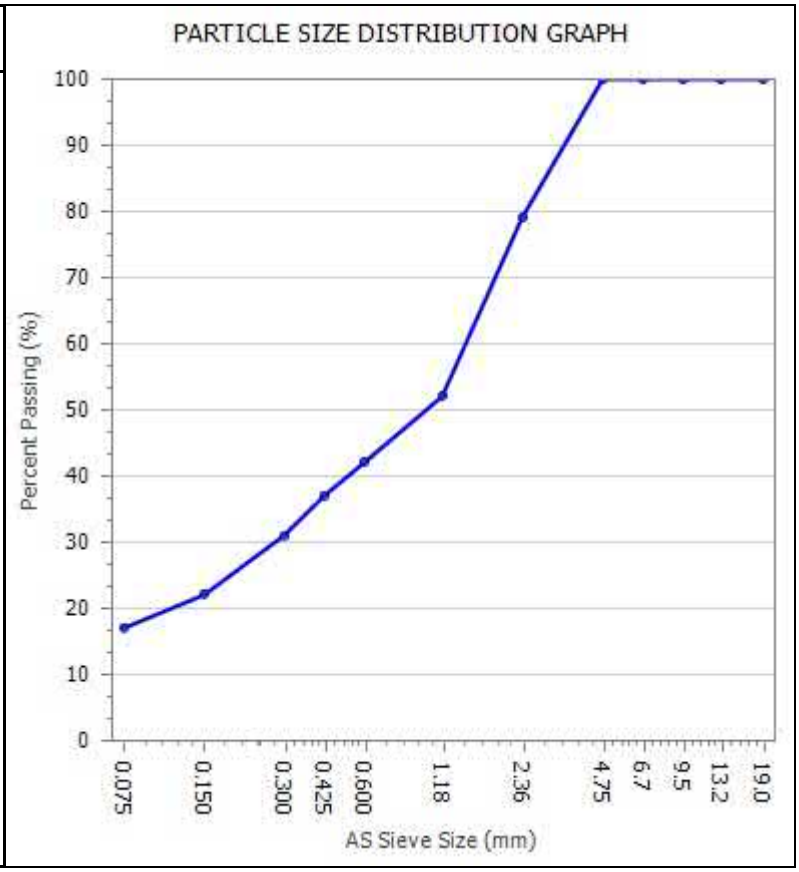
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP20
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 29 of 39

Test Procedures:	AS1289.3.6.1			
Sample Number	10599/S/206044	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP20
Date Sampled	9/05/2019	Test Depth	m	1.3-1.4m
Sampled By	Client Sampled			
Date Tested	20/05/2019			
Material Source	EXISTING	Material Type		EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**79**	
1.18		**52**	
0.600		**42**	
0.425		**37**	
0.300		**31**	
0.150		**22**	
0.075		**17**	



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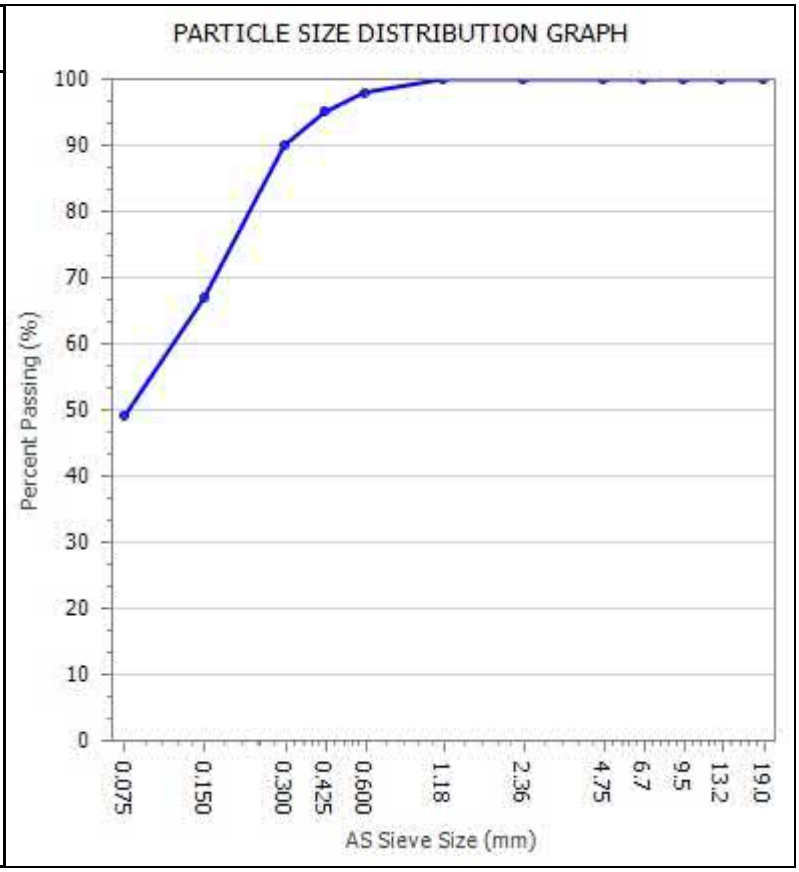
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP21
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 30 of 39

Test Procedures:	AS1289.3.6.1			
Sample Number	10599/S/206045	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP21
Date Sampled	9/05/2019	Test Depth	m	0.3-0.4m
Sampled By	Client Sampled			
Date Tested	21/05/2019			
Material Source	EXISTING	Material Type		EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**100**	
1.18		**100**	
0.600		**98**	
0.425		**95**	
0.300		**90**	
0.150		**67**	
0.075		**49**	



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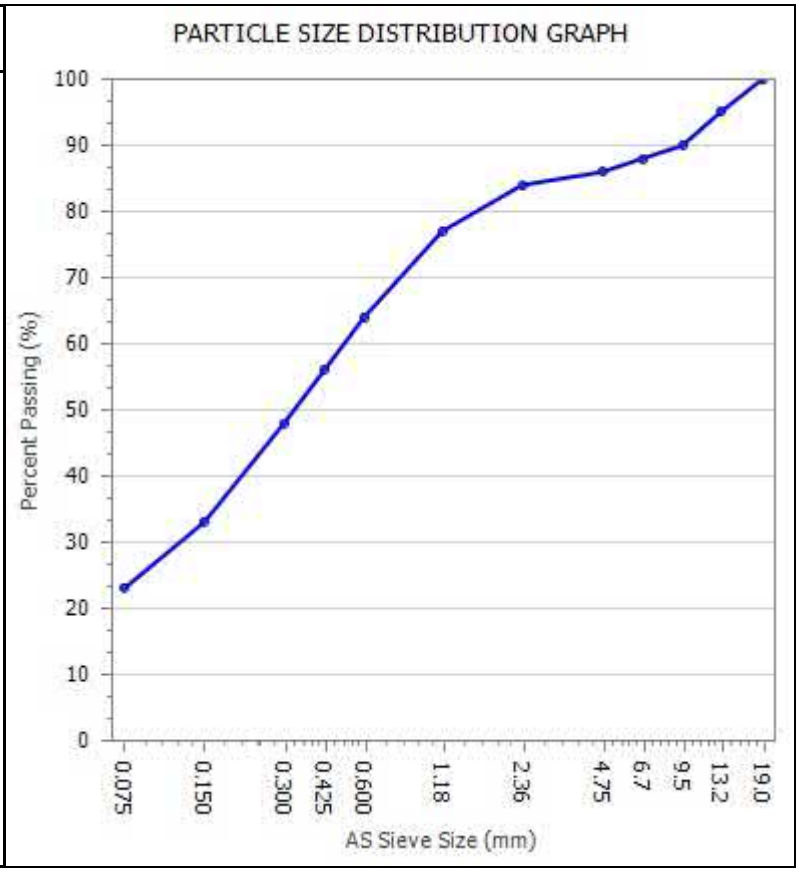
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP21
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 31 of 39

Test Procedures:	AS1289.3.6.1		
Sample Number	10599/S/206046	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP21
Date Sampled	9/05/2019	Test Depth m	2.1-2.2m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**95**	
9.5		**90**	
6.7		**88**	
4.75		**86**	
2.36		**84**	
1.18		**77**	
0.600		**64**	
0.425		**56**	
0.300		**48**	
0.150		**33**	
0.075		**23**	



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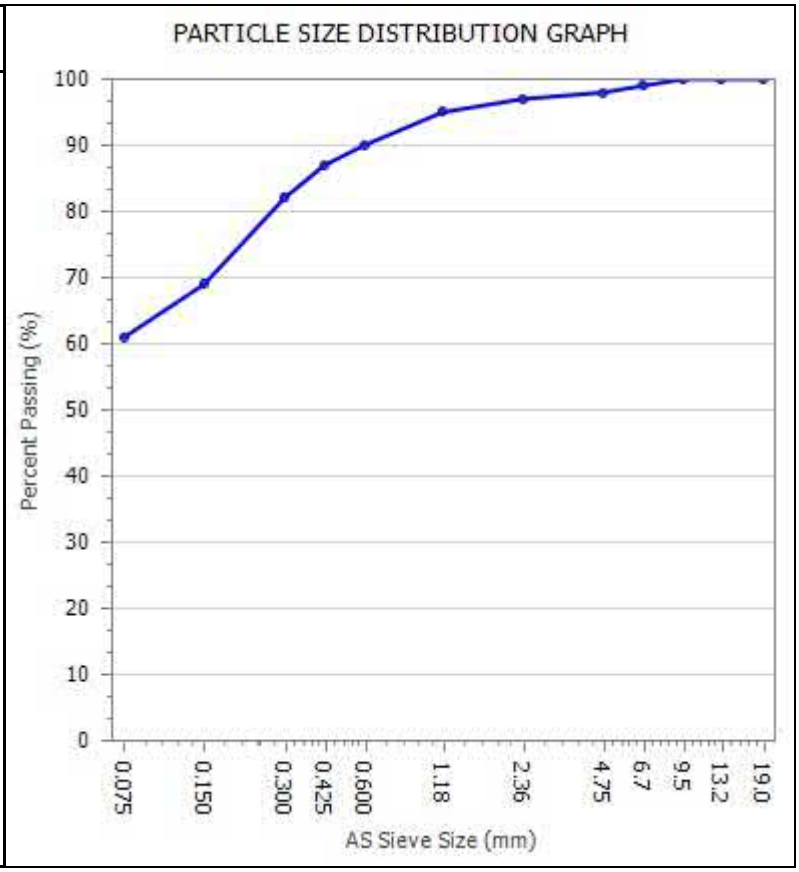
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP23
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 32 of 39

Test Procedures:	AS1289.3.6.1			
Sample Number	10599/S/206047	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP23
Date Sampled	10/05/2019	Test Depth	m	0.5-0.6m
Sampled By	Client Sampled			
Date Tested	20/05/2019			
Material Source	EXISTING	Material Type		EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**99**	
4.75		**98**	
2.36		**97**	
1.18		**95**	
0.600		**90**	
0.425		**87**	
0.300		**82**	
0.150		**69**	
0.075		**61**	



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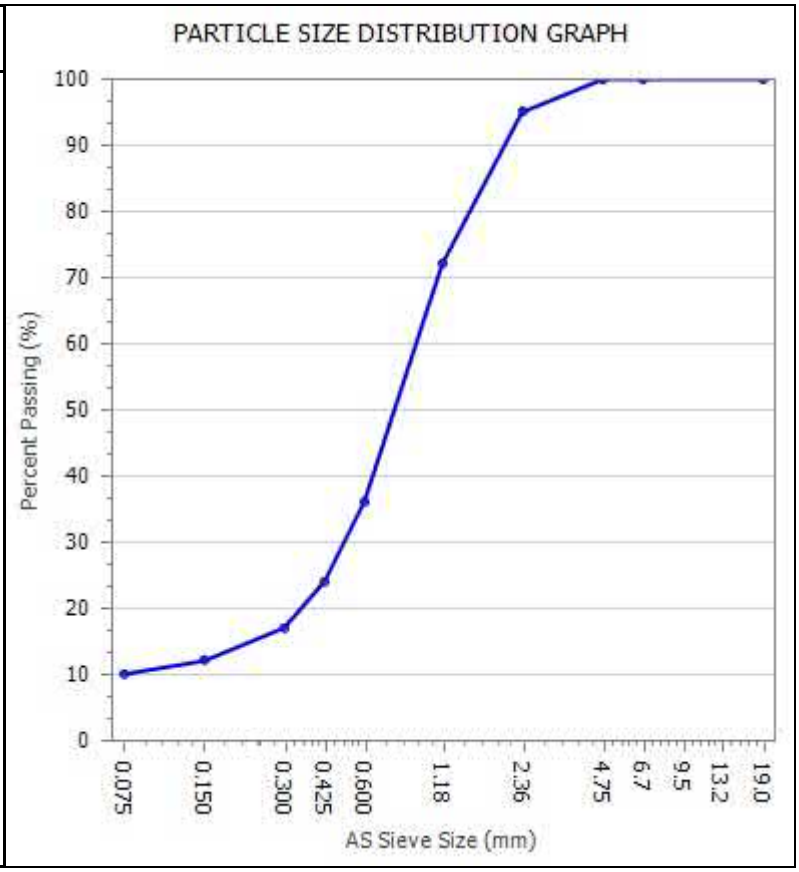
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP23
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 33 of 39

Test Procedures:	AS1289.3.6.1		
Sample Number	10599/S/206048	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP23
Date Sampled	10/05/2019	Test Depth m	2.8-2.9m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
6.7		**100**	
4.75		**100**	
2.36		**95**	
1.18		**72**	
0.600		**36**	
0.425		**24**	
0.300		**17**	
0.150		**12**	
0.075		**10**	



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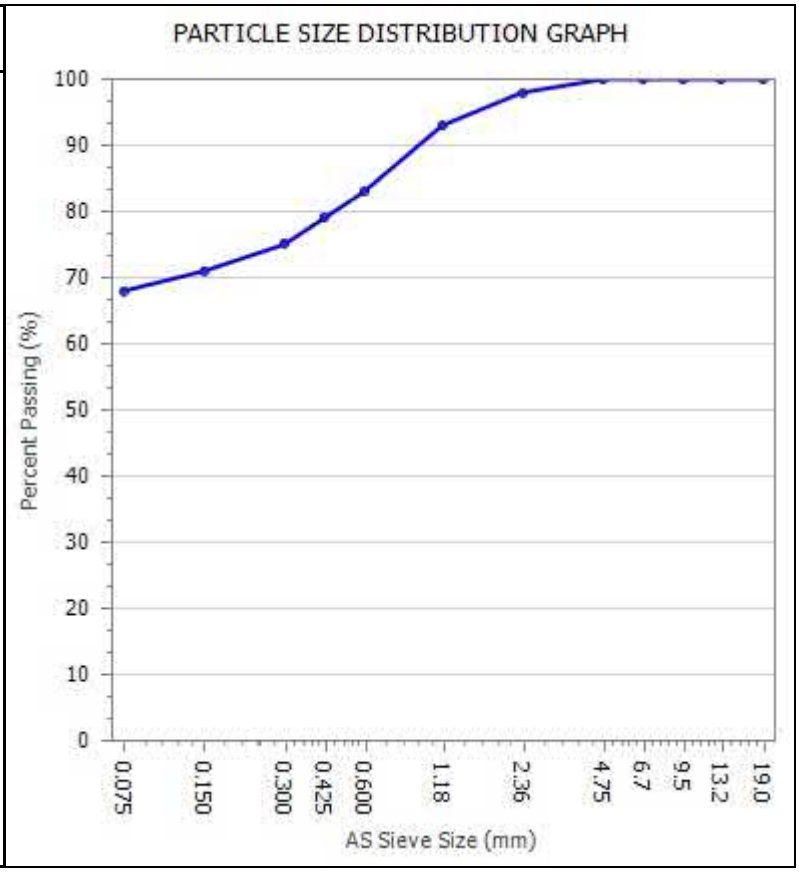
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP24
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 34 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206049	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP24
Date Sampled	10/05/2019	Test Depth m	2.6-2.7m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**98**	
1.18		**93**	
0.600		**83**	
0.425		**79**	
0.300		**75**	
0.150		**71**	
0.075		**68**	



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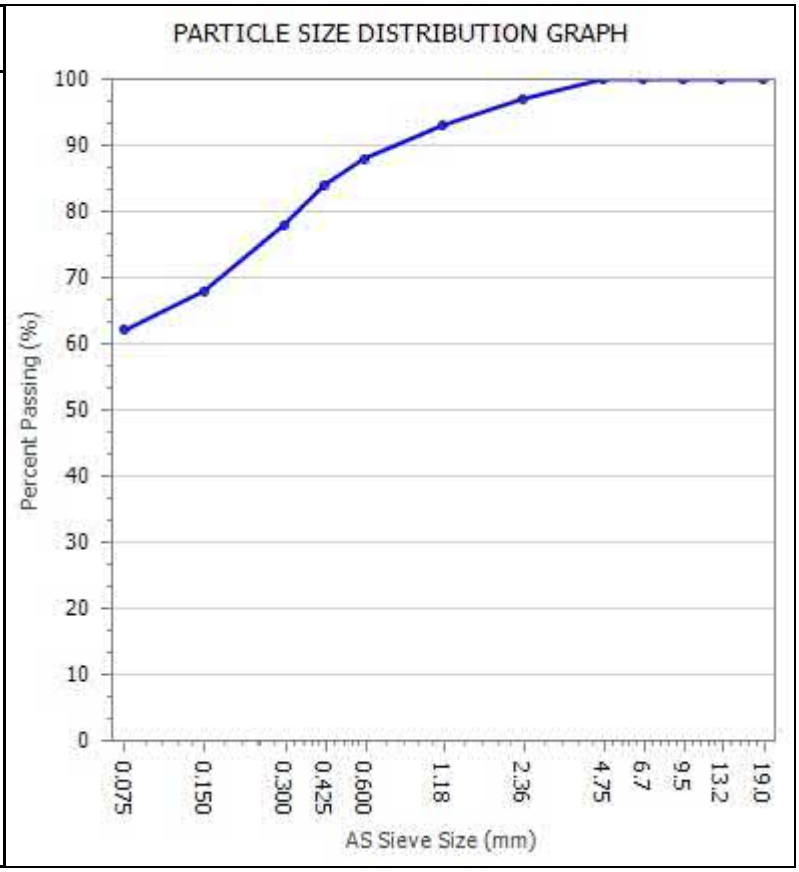
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP25
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 35 of 39

Test Procedures:	AS1289.3.6.1		
Sample Number	10599/S/206050	Sample Location	
Sampling Method	Tested As Received	Test Pit	JTP25
Date Sampled	10/05/2019	Test Depth m	1.2-1.3m
Sampled By	Client Sampled		
Date Tested	21/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**97**	
1.18		**93**	
0.600		**88**	
0.425		**84**	
0.300		**78**	
0.150		**68**	
0.075		**62**	



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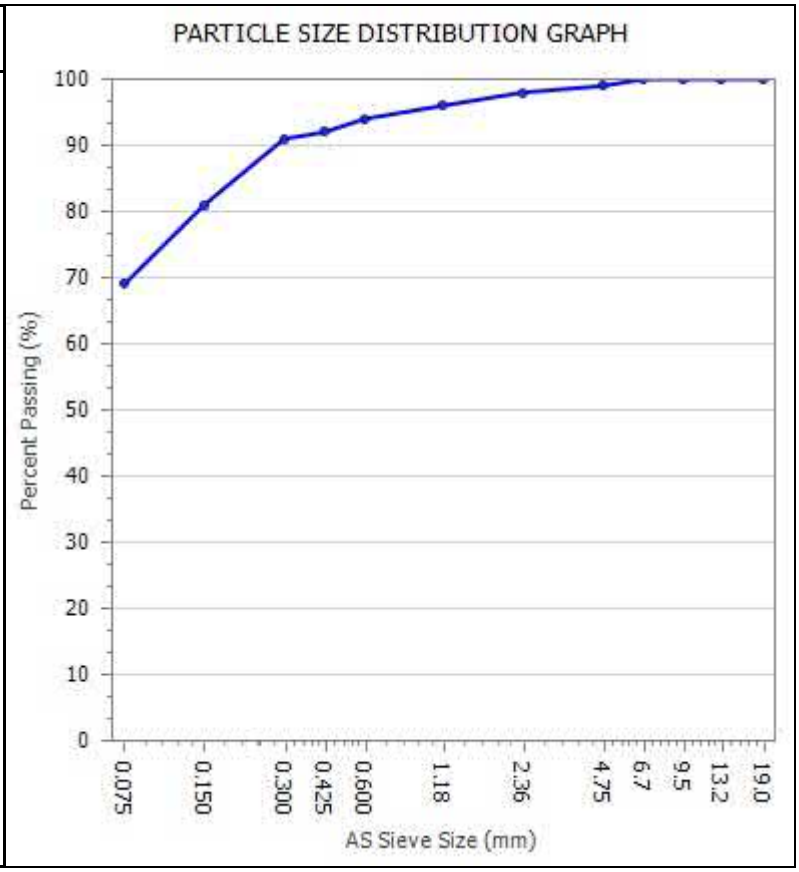
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP25
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 36 of 39

Test Procedures:	AS1289.3.6.1			
Sample Number	10599/S/206051	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP25
Date Sampled	10/05/2019	Test Depth	m	2.7-2.8m
Sampled By	Client Sampled			
Date Tested	20/05/2019			
Material Source	EXISTING	Material Type		EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**99**	
2.36		**98**	
1.18		**96**	
0.600		**94**	
0.425		**92**	
0.300		**91**	
0.150		**81**	
0.075		**69**	



Remarks	Results apply to sample(s) tested as received.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation Number: 1986
Corporate Site Number: 10599

Approved Signatory: Kimberly Rutherford
Form ID: W9Rep Rev 2

Construction Sciences

Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
37 Carmel Street,
Garbutt QLD 4814

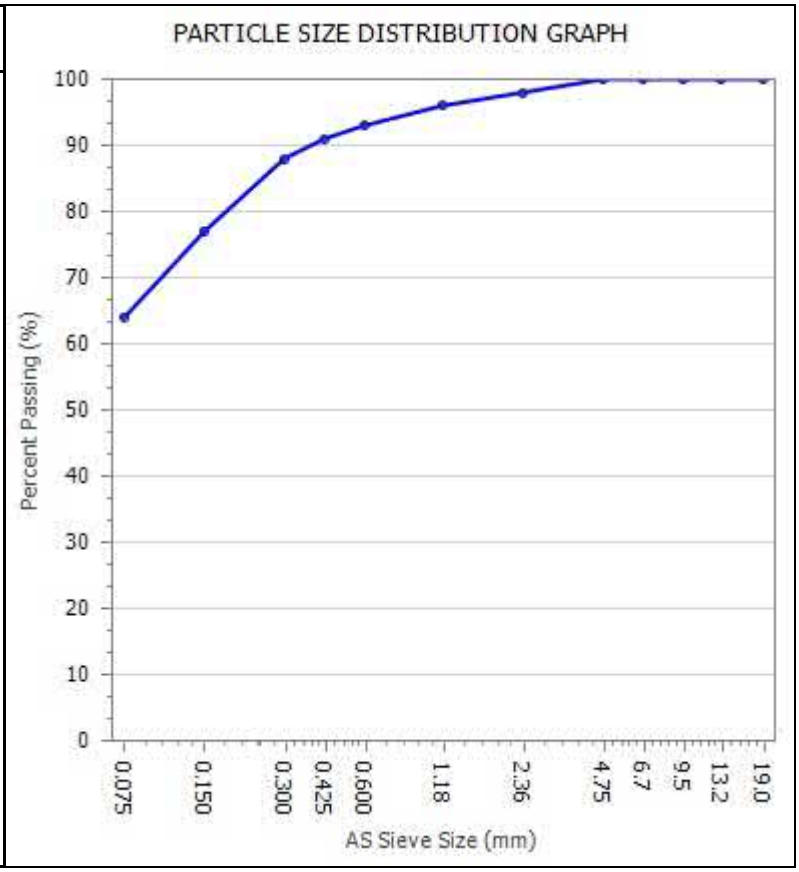
Laboratory: **Townsville Laboratory**
Phone: 0747288023
Fax: 0747288024
Email: Townsville@constructionsciences.net

PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JTP26
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 37 of 39

Test Procedures:	AS1289.3.6.1			
Sample Number	10599/S/206052	Sample Location		
Sampling Method	Tested As Received	Test Pit		JTP26
Date Sampled	10/05/2019	Test Depth	m	0.3-0.4m
Sampled By	Client Sampled			
Date Tested	20/05/2019			
Material Source	EXISTING	Material Type		EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**98**	
1.18		**96**	
0.600		**93**	
0.425		**91**	
0.300		**88**	
0.150		**77**	
0.075		**64**	



Remarks	Results apply to sample(s) tested as received.

NATA

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Accreditation Number: 1986
Corporate Site Number: 10599

K. Rutherford

Approved Signatory: Kimberly Rutherford
Form ID: W9Rep Rev 2

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Garbutt QLD 4814

Laboratory: **Townsville Laboratory**
Phone: 0747288023
Fax: 0747288024
Email: Townsville@constructionsciences.net

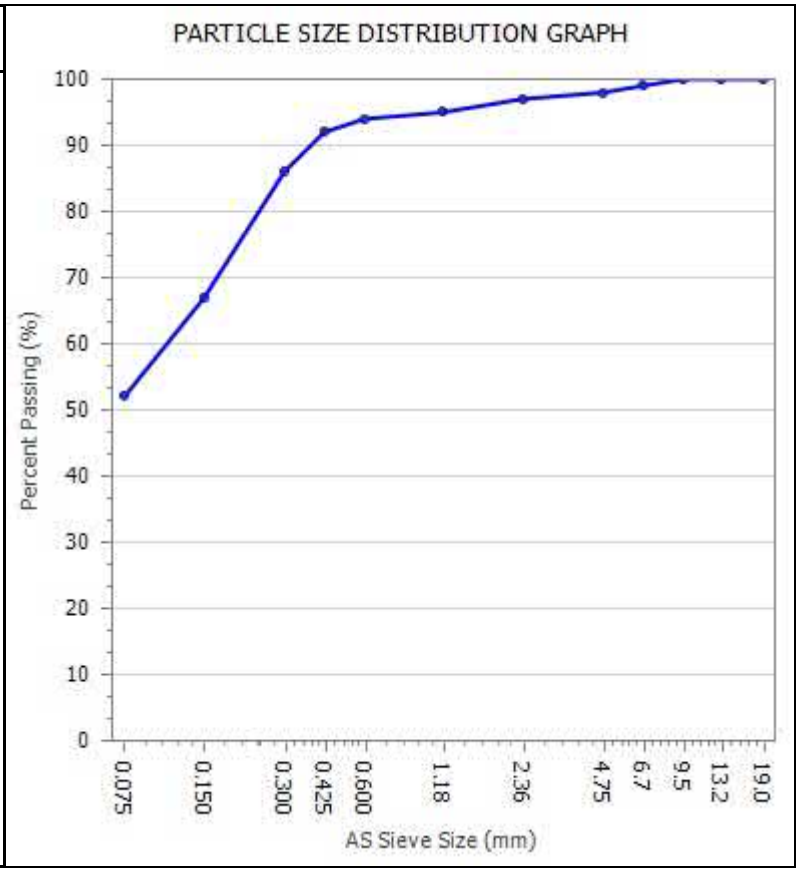
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH9
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 38 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206287	Sample Location	
Sampling Method	Tested As Received	Location	(Borehole) JBH9
Date Sampled	15/05/2019	Depth	(m) 0.5-0.95m
Sampled By	Client Sampled		
Date Tested	27/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**99**	
4.75		**98**	
2.36		**97**	
1.18		**95**	
0.600		**94**	
0.425		**92**	
0.300		**86**	
0.150		**67**	
0.075		**52**	



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Construction Sciences Pty Ltd
ABN: 74 128 806 735

Address:
37 Carmel Street,
Garbutt QLD 4814

Laboratory: **Townsville Laboratory**
Phone: 0747288023
Fax: 0747288024
Email: Townsville@constructionsciences.net

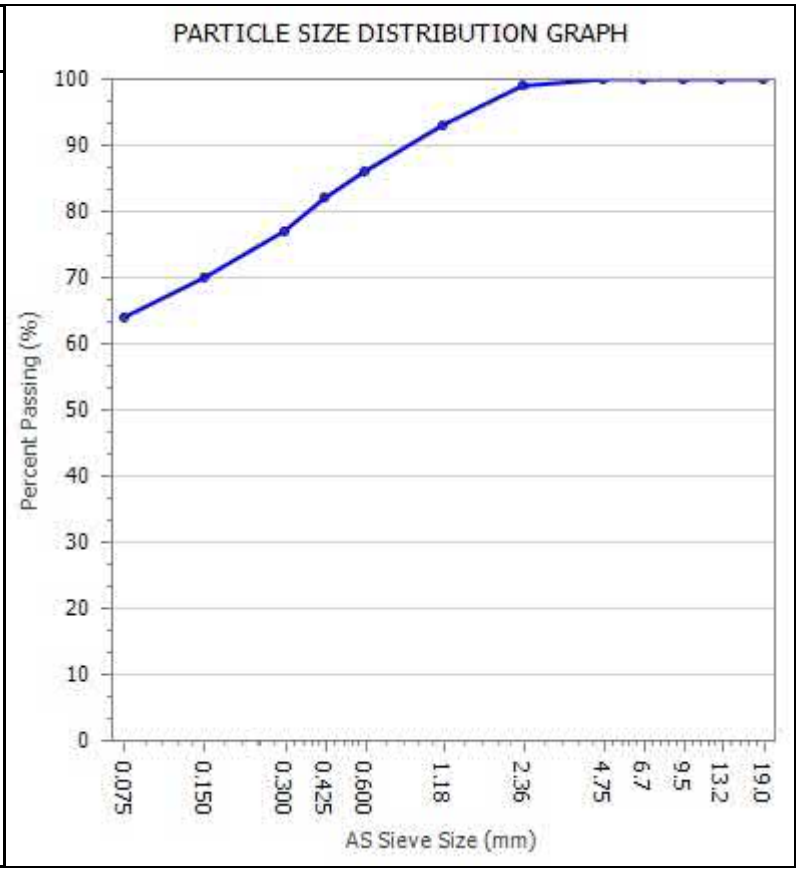
PARTICLE SIZE DISTRIBUTION REPORT

Client:	Jacobs	Report Number:	10599/R/86242-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH9
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	28/05/2019 Page 39 of 39

Test Procedures: AS1289.3.6.1

Sample Number	10599/S/206288	Sample Location	
Sampling Method	Tested As Received	Location (Borehole)	JBH9
Date Sampled	15/05/2019	Depth (m)	3.5-3.95m
Sampled By	Client Sampled		
Date Tested	27/05/2019		
Material Source	EXISTING	Material Type	EXISTING

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**99**	
1.18		**93**	
0.600		**86**	
0.425		**82**	
0.300		**77**	
0.150		**70**	
0.075		**64**	



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NATA

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Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation Number: 1986
Corporate Site Number: 10599

Approved Signatory: Kimberly Rutherford
Form ID: W9Rep Rev 2

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37 Carmel Street,
Garbutt QLD 4814

Laboratory: **Townsville Laboratory**
Phone: 0747288023
Fax: 0747288024
Email: Townsville@constructionsciences.net

PARTICLE SIZE DISTRIBUTION REPORT

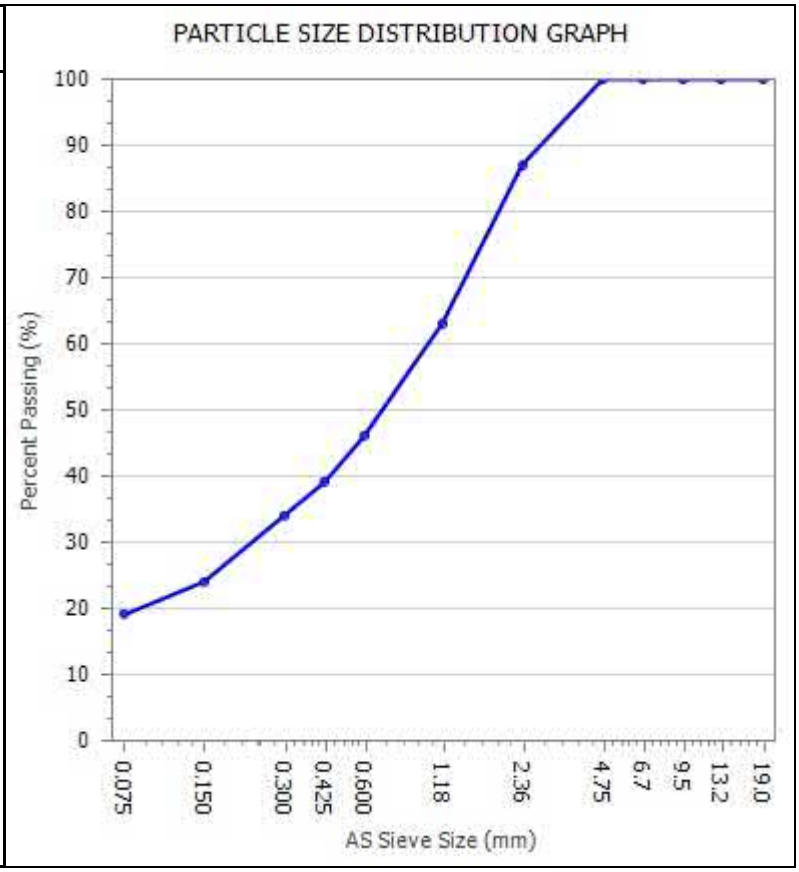
Client:	Jacobs	Report Number:	10599/R/86350-1
Client Address:	444 Flinders Street, PO Box 856, Townsville	Project Number:	10599/P/866
Project:	Jacobs- General Testing	Lot Number:	JBH5
Location:	Townsville	Internal Test Request:	10599/T/36157
Component:	Haughton Pipeline Stage 2 - Business Case	Client Reference/s:	IH175200
Area Description:		Report Date / Page:	30/05/2019 Page 1 of 1

Test Procedures:	AS1289.3.6.1
Sample Number	10599/S/206019
Sampling Method	Tested As Received
Date Sampled	9/05/2019
Sampled By	Client Sampled
Date Tested	30/05/2019
Material Source	EXISTING

Sample Location

Location	(Borehole)	JBH5
Depth	(m)	7.5-7.95m
Material Type	EXISTING	

AS Sieve (mm)	Specification Minimum	**Percent Passing (%)**	Specification Maximum
19.0		**100**	
13.2		**100**	
9.5		**100**	
6.7		**100**	
4.75		**100**	
2.36		**87**	
1.18		**63**	
0.600		**46**	
0.425		**39**	
0.300		**34**	
0.150		**24**	
0.075		**19**	



Remarks	Results apply to sample(s) tested as received.

NATA

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Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation Number: 1986
Corporate Site Number: 10599

K. Rutherford

Approved Signatory: Kimberly Rutherford
Form ID: W9Rep Rev 2

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1912157**	Page	: 1 of 12
Client	: **JACOBS GROUP (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: RYAN DAVIS	Contact	: Brenda Hong
Address	: 444 FLINDERS STREET PO BOX 856 TOWNSVILLE QLD, AUSTRALIA 4810	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 2 8784 8555
Project	: IH1752000	Date Samples Received	: 14-May-2019 09:00
Order number	: IH1752000	Date Analysis Commenced	: 16-May-2019
C-O-C number	: ----	Issue Date	: 16-May-2019 15:05
Sampler	: DANIEL MOULE		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 76		
No. of samples analysed	: 50		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
~ = Indicates an estimated value.

- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH3 0	JBH3 0.25	JBH3 0.5	JBH3 1	JBH3 1.5
			Client sampling date / time	08-May-2019 00:00	08-May-2019 00:00	08-May-2019 00:00	08-May-2019 00:00	08-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912157-017	EB1912157-018	EB1912157-019	EB1912157-020	EB1912157-021
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.2**	**6.8**	**7.0**	**7.6**	**7.3**
pH (Fox)	----	0.1	pH Unit	**3.9**	**5.0**	**5.1**	**5.5**	**6.3**
Reaction Rate	----	1	-	**2**	**2**	**2**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH3 2.5	JBH3 3.5	JBH3 4.5	JBH3 5.5	JBH3 6.5
			Client sampling date / time	08-May-2019 00:00	08-May-2019 00:00	08-May-2019 00:00	08-May-2019 00:00	08-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912157-022	EB1912157-023	EB1912157-024	EB1912157-025	EB1912157-026
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**7.2**	**7.8**	**8.0**	**8.1**	**8.0**
pH (Fox)	----	0.1	pH Unit	**6.1**	**7.2**	**7.3**	**7.4**	**7.3**
Reaction Rate	----	1	-	**2**	**4**	**4**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH4 0	JBH4 0.25	JBH4 0.5	JBH4 1	JBH4 1.5
			Client sampling date / time	09-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912157-027	EB1912157-028	EB1912157-029	EB1912157-030	EB1912157-031
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**5.5**	**6.7**	**7.7**	**9.2**	**9.0**
pH (Fox)	----	0.1	pH Unit	**2.6**	**3.7**	**5.6**	**8.5**	**8.3**
Reaction Rate	----	1	-	**3**	**4**	**4**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH4 2.5	JBH4 5.5	JBH4 6.5	JBH5 0	JBH5 0.25
			Client sampling date / time	09-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912157-032	EB1912157-035	EB1912157-036	EB1912157-037	EB1912157-038
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**9.0**	**8.8**	**9.2**	**6.8**	**6.6**
pH (Fox)	----	0.1	pH Unit	**8.5**	**5.9**	**6.7**	**3.3**	**4.4**
Reaction Rate	----	1	-	**4**	**2**	**3**	**3**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	JBH5 0.5	JBH5 1	JBH5 1.5	JBH5 2.5	JBH6 0
				Client sampling date / time	09-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00	10-May-2019 00:00
Compound	CAS Number	LOR	Unit		EB1912157-039	EB1912157-040	EB1912157-041	EB1912157-042	EB1912157-047
					Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**6.5**	**7.0**	**6.5**	**7.4**	**7.0**
pH (Fox)	----	0.1	pH Unit		**4.3**	**5.0**	**5.0**	**5.8**	**4.1**
Reaction Rate	----	1	-		**4**	**2**	**2**	**2**	**3**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH6 0.25	JBH6 0.5	JBH6 1	JBH6 1.5	JBH6 2.5
			Client sampling date / time	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912157-048	EB1912157-049	EB1912157-050	EB1912157-051	EB1912157-052
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.5**	**6.4**	**7.9**	**8.1**	**7.9**
pH (Fox)	----	0.1	pH Unit	**4.0**	**4.4**	**5.2**	**5.5**	**5.6**
Reaction Rate	----	1	-	**2**	**2**	**2**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH7 0	JBH7 0.25	JBH7 0.5	JBH7 1	JBH7 1.5
			Client sampling date / time	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912157-057	EB1912157-058	EB1912157-059	EB1912157-060	EB1912157-061
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.4**	**6.4**	**7.3**	**8.1**	**9.0**
pH (Fox)	----	0.1	pH Unit	**3.0**	**3.7**	**5.3**	**6.0**	**5.8**
Reaction Rate	----	1	-	**3**	**3**	**2**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH7 2.5	JBH7 3.5	JBH7 4.5	JBH7 5.5	JBH7 6.5
			Client sampling date / time	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912157-062	EB1912157-063	EB1912157-064	EB1912157-065	EB1912157-066
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**8.9**	**8.6**	**8.7**	**8.6**	**8.8**
pH (Fox)	----	0.1	pH Unit	**6.4**	**7.8**	**5.7**	**5.7**	**5.9**
Reaction Rate	----	1	-	**2**	**3**	**2**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	JBH8 0	JBH8 0.25	JBH8 0.5	JBH8 1	JBH8 1.5
				Client sampling date / time	11-May-2019 00:00	11-May-2019 00:00	11-May-2019 00:00	11-May-2019 00:00	11-May-2019 00:00
Compound	CAS Number	LOR	Unit		EB1912157-067	EB1912157-068	EB1912157-069	EB1912157-070	EB1912157-071
					Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**7.0**	**7.9**	**8.0**	**7.3**	**7.4**
pH (Fox)	----	0.1	pH Unit		**4.3**	**5.9**	**5.7**	**6.0**	**5.6**
Reaction Rate	----	1	-		**2**	**2**	**2**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	JBH8 2.5	JBH8 3.5	JBH8 4.5	JBH8 5.5	JBH8 6.5
				Client sampling date / time	11-May-2019 00:00	11-May-2019 00:00	11-May-2019 00:00	11-May-2019 00:00	11-May-2019 00:00
Compound	CAS Number	LOR	Unit		EB1912157-072	EB1912157-073	EB1912157-074	EB1912157-075	EB1912157-076
					Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis									
pH (F)	----	0.1	pH Unit		**7.7**	**7.9**	**8.6**	**8.8**	**6.9**
pH (Fox)	----	0.1	pH Unit		**5.5**	**7.4**	**5.7**	**5.9**	**5.6**
Reaction Rate	----	1	-		**2**	**4**	**2**	**2**	**2**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1912591**	Page	: 1 of 4
Client	: **JACOBS GROUP (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: RYAN DAVIS	Contact	: Brenda Hong
Address	: 444 FLINDERS STREET PO BOX 856 TOWNSVILLE QLD, AUSTRALIA 4810	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 2 8784 8555
Project	: IH1752000	Date Samples Received	: 17-May-2019 10:10
Order number	: IH1752000	Date Analysis Commenced	: 20-May-2019
C-O-C number	: ----	Issue Date	: 20-May-2019 13:38
Sampler	: MANEESHA WIJEKOON		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 10		
No. of samples analysed	: 10		

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

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Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
~ = Indicates an estimated value.

- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH9 0	JBH9 0.25	JBH9 0.5	JBH9 1	JBH9 1.5
			Client sampling date / time	[16-May-2019]	[16-May-2019]	[16-May-2019]	[16-May-2019]	[16-May-2019]
Compound	CAS Number	LOR	Unit	EB1912591-001	EB1912591-002	EB1912591-003	EB1912591-004	EB1912591-005
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**6.1**	**6.3**	**6.8**	**8.8**	**9.1**
pH (Fox)	----	0.1	pH Unit	**4.9**	**5.3**	**5.5**	**8.1**	**8.5**
Reaction Rate	----	1	-	**4**	**4**	**4**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH9 2.5	JBH9 3.5	JBH9 4.5	JBH9 5.5	JBH9 0.75
			Client sampling date / time	[16-May-2019]	[16-May-2019]	[16-May-2019]	[16-May-2019]	[16-May-2019]
Compound	CAS Number	LOR	Unit	EB1912591-006	EB1912591-007	EB1912591-008	EB1912591-009	EB1912591-010
				Result	Result	Result	Result	Result
EA037: Ass Field Screening Analysis								
pH (F)	----	0.1	pH Unit	**9.1**	**8.5**	**8.8**	**8.3**	**9.0**
pH (Fox)	----	0.1	pH Unit	**8.6**	**5.8**	**8.7**	**5.6**	**8.4**
Reaction Rate	----	1	-	**4**	**2**	**4**	**2**	**4**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1912808**	Page	: 1 of 6
Client	: **JACOBS GROUP (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: RYAN DAVIS	Contact	: Brenda Hong
Address	: 444 FLINDERS STREET PO BOX 856 TOWNSVILLE QLD, AUSTRALIA 4810	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 2 8784 8555
Project	: IH175200	Date Samples Received	: 20-May-2019 14:23
Order number	: IH175200	Date Analysis Commenced	: 22-May-2019
C-O-C number	: ----	Issue Date	: 23-May-2019 12:34
Sampler	: MANEESHA WIJEKOON		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 18		
No. of samples analysed	: 18		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ASS: EA033 (CRS Suite):Retained Acidity not required because pH KCl greater than or equal to 4.5
- ASS: EA033 (CRS Suite): ANC not required because pH KCl less than 6.5
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH3 0	JBH3 0.25	JBH4 0	JBH4 0.5	JBH4 5.5
			Client sampling date / time	08-May-2019 00:00	08-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912808-001	EB1912808-002	EB1912808-003	EB1912808-004	EB1912808-005
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**5.7**	**6.0**	**4.6**	**5.7**	**6.4**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	**20**	**2**	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	**0.03**	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	<0.005	<0.005	<0.005	<0.005
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	**0.03**	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	**20**	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	**2**	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	**0.03**	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	**20**	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	**2**	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH5 0.25	JBH5 1	JBH6 0	JBH6 0.25	JBH6 1
			Client sampling date / time	09-May-2019 00:00	09-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912808-006	EB1912808-007	EB1912808-008	EB1912808-009	EB1912808-010
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**6.1**	**5.2**	**5.6**	**5.8**	**6.0**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	**5**	<2	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	<0.005	<0.005	<0.005	<0.005
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH6 2.5	JBH7 0	JBH7 0.25	JBH7 1.5	JBH7 4.5
			Client sampling date / time	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912808-011	EB1912808-012	EB1912808-013	EB1912808-014	EB1912808-015
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**5.4**	**5.5**	**5.6**	**6.4**	**6.1**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	**3**	**3**	**2**	<2	<2
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	<0.02	<0.02
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	<0.005	<0.005	<0.005	<0.005
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	<10	<10
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**1.5**	**1.5**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	<1	<1
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	<0.02	<0.02
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	<10	<10
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH8 0	JBH8 2.5	JBH8 4.5	----	----
			Client sampling date / time	11-May-2019 00:00	11-May-2019 00:00	11-May-2019 00:00	----	----
Compound	CAS Number	LOR	Unit	EB1912808-016	EB1912808-017	EB1912808-018	--------	--------
				Result	Result	Result	----	----
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**5.4**	**5.5**	**6.2**	**----**	**----**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	<2	**----**	**----**
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	**----**	**----**
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	<0.005	<0.005	**----**	**----**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	**----**	**----**
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**----**	**----**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	**----**	**----**
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	**----**	**----**
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	**----**	**----**
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	**----**	**----**
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	**----**	**----**
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	**----**	**----**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1913016**	Page	: 1 of 2
Client	: **JACOBS GROUP (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: RYAN DAVIS	Contact	: Brenda Hong
Address	: 444 FLINDERS STREET PO BOX 856 TOWNSVILLE QLD, AUSTRALIA 4810	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 2 8784 8555
Project	: IH175200	Date Samples Received	: 21-May-2019 16:52
Order number	:	Date Analysis Commenced	: 24-May-2019
C-O-C number	: ----	Issue Date	: 24-May-2019 16:46
Sampler	: MANEESHA WIJEKOON		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 3		
No. of samples analysed	: 3		

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Signatories

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Signatories	*Position*	*Accreditation Category*
Satishkumar Trivedi	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

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LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

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- ASS: EA033 (CRS Suite): ANC not required because pH KCl less than 6.5
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	BH9 0	BH9 0.25	BH9 5.5	----	----
			Client sampling date / time	16-May-2019 00:00	16-May-2019 00:00	16-May-2019 00:00	----	----
Compound	CAS Number	LOR	Unit	EB1913016-001	EB1913016-002	EB1913016-003	--------	--------
				Result	Result	Result	----	----
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**5.8**	**5.3**	**6.1**	**----**	**----**
Titratable Actual Acidity (23F)	----	2	mole H+ / t	**2**	<2	<2	**----**	**----**
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	<0.02	**----**	**----**
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	<0.005	<0.005	**----**	**----**
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	<10	<10	**----**	**----**
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	**1.5**	**1.5**	**----**	**----**
Net Acidity (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	**----**	**----**
Net Acidity (acidity units)	----	10	mole H+ / t	<10	<10	<10	**----**	**----**
Liming Rate	----	1	kg CaCO3/t	<1	<1	<1	**----**	**----**
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	<0.02	<0.02	<0.02	**----**	**----**
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	<10	<10	<10	**----**	**----**
Liming Rate excluding ANC	----	1	kg CaCO3/t	<1	<1	<1	**----**	**----**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1912584**	Page	: 1 of 5
Client	: **JACOBS GROUP (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: RYAN DAVIS	Contact	: Brenda Hong
Address	: 444 FLINDERS STREET PO BOX 856 TOWNSVILLE QLD, AUSTRALIA 4810	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 2 8784 8555
Project	: IH1752000	Date Samples Received	: 16-May-2019 09:25
Order number	: IH1752000	Date Analysis Commenced	: 20-May-2019
C-O-C number	: ----	Issue Date	: 29-May-2019 13:04
Sampler	: MANEESHA WIJEKOON		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 16		
No. of samples analysed	: 15		

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- Analytical Results

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Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

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Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED006 Exchangeable Cations (Magnesium/Potassium Ratio): Results could not be calculated for some samples as the required Magnesium or Potassium analytes were less than reportable limits.
- ALS is not NATA accredited for the analysis of Exchangeable Aluminium and Exchange Acidity in soils when performed under ALS Method ED005.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH1 0.5-0.95m	JBH1 1.5-1.95m	JBH2 1.5-1.95m	JBH3 1.5-1.95m	JBH3 3.5-3.95m
			Client sampling date / time	03-May-2019 00:00	03-May-2019 00:00	07-May-2019 00:00	08-May-2019 00:00	08-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912584-001	EB1912584-002	EB1912584-020	EB1912584-030	EB1912584-032
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.6	7.4	7.1	7.2	7.8
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	21	17	40	23	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	----	----	----	11.4	10.5
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	7.4	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	----	3.4	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	----	0.4	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	----	0.2	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	----	11.3	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	----	2.2	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	----	2.2	----	----	----
ø Magnesium/Potassium Ratio	----	0.2	-	----	9.4	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	6.4	----	6.0	6.7	----
Exchangeable Magnesium	----	0.1	meq/100g	3.5	----	3.6	4.1	----
Exchangeable Potassium	----	0.1	meq/100g	0.3	----	0.3	0.3	----
Exchangeable Sodium	----	0.1	meq/100g	0.2	----	0.5	0.2	----
Cation Exchange Capacity	----	0.1	meq/100g	10.4	----	10.5	11.3	----
Exchangeable Sodium Percent	----	0.1	%	1.6	----	5.0	1.8	----
Calcium/Magnesium Ratio	----	0.1	-	1.8	----	1.7	1.6	----
Magnesium/Potassium Ratio	----	0.1	-	12.0	----	10.7	15.4	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	----	----	<10	<10
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	----	----	40	<10

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH3 6.5-6.95m	JBH4 1.5-1.95m	JBH4 5.5-5.95m	JBH5 1.5-1.92m	JBH6 1.5-1.95m
			Client sampling date / time	08-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00	10-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912584-035	EB1912584-049	EB1912584-053	EB1912584-059	EB1912584-069
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**8.6**	**9.1**	**9.1**	**7.1**	**8.6**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**9.6**	**11.4**	**11.1**	**7.6**	**11.1**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	**20**	**50**	<10	**10**
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	**410**	**380**	**200**	**210**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH7 1.5-1.92m	JBH7 3.5-3.59m	JBH7 4.5-4.95m	JBH8 0.65-0.95m	JBH8 3.5-3.56m
			Client sampling date / time	09-May-2019 00:00	09-May-2019 00:00	09-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912584-079	EB1912584-081	EB1912584-082	EB1912584-088	EB1912584-091
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.1**	**8.6**	**8.9**	**6.4**	**7.6**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**31**	**----**	**----**	**----**	**----**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**10.3**	**15.9**	**11.0**	**5.1**	**11.3**
ED006: Exchangeable Cations on Alkaline Soils								
ø **Exchangeable Calcium**	----	0.2	meq/100g	**4.2**	**----**	**----**	**----**	**----**
ø **Exchangeable Magnesium**	----	0.2	meq/100g	**1.6**	**----**	**----**	**----**	**----**
ø **Exchangeable Potassium**	----	0.2	meq/100g	<0.2	**----**	**----**	**----**	**----**
ø **Exchangeable Sodium**	----	0.2	meq/100g	**1.6**	**----**	**----**	**----**	**----**
ø **Cation Exchange Capacity**	----	0.2	meq/100g	**7.5**	**----**	**----**	**----**	**----**
ø **Exchangeable Sodium Percent**	----	0.2	%	**21.8**	**----**	**----**	**----**	**----**
ø **Calcium/Magnesium Ratio**	----	0.2	-	**2.6**	**----**	**----**	**----**	**----**
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	<10	<10	<10
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	**20**	**20**	**310**	**10**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1912708**	Page	: 1 of 3
Client	: **JACOBS GROUP (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: RYAN DAVIS	Contact	: Brenda Hong
Address	: 444 FLINDERS STREET PO BOX 856 TOWNSVILLE QLD, AUSTRALIA 4810	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 2 8784 8555
Project	: IH175200	Date Samples Received	: 17-May-2019 10:10
Order number	: IH175200	Date Analysis Commenced	: 20-May-2019
C-O-C number	: ----	Issue Date	: 24-May-2019 17:16
Sampler	: MANEESHA WIJEKOON		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 3		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED006 (Exchangeable Cations on Alkaline Soils): Unable to calculate Magnesium/Potassium Ratio for some samples as the required results for Magnesium/Potassium are below LOR.
- ALS is not NATA accredited for the analysis of Exchangeable Aluminium and Exchange Acidity in soils when performed under ALS Method ED005.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JBH9 0.5-0.95m	JBH9 3.5-3.95m	----	----	----
			Client sampling date / time	15-May-2019 00:00	15-May-2019 00:00	----	----	----
Compound	CAS Number	LOR	Unit	EB1912708-001	EB1912708-003	--------	--------	--------
				Result	Result	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**8.4**	**9.0**	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**79**	**224**	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**19.3**	**10.1**	----	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø **Exchangeable Calcium**	----	0.2	meq/100g	**3.0**	**1.7**	----	----	----
ø **Exchangeable Magnesium**	----	0.2	meq/100g	**3.1**	**2.6**	----	----	----
ø **Exchangeable Potassium**	----	0.2	meq/100g	<0.2	<0.2	----	----	----
ø **Exchangeable Sodium**	----	0.2	meq/100g	**2.5**	**3.8**	----	----	----
ø **Cation Exchange Capacity**	----	0.2	meq/100g	**8.7**	**8.1**	----	----	----
ø **Exchangeable Sodium Percent**	----	0.2	%	**29.1**	**46.6**	----	----	----
ø **Calcium/Magnesium Ratio**	----	0.2	-	**1.0**	**0.6**	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**50**	**300**	----	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1912586**	Page	: 1 of 8
Client	: **JACOBS GROUP (AUSTRALIA) PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: RYAN DAVIS	Contact	: Brenda Hong
Address	: 444 FLINDERS STREET PO BOX 856 TOWNSVILLE QLD, AUSTRALIA 4810	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61 2 8784 8555
Project	: IH175200	Date Samples Received	: 16-May-2019 09:25
Order number	: IH175200	Date Analysis Commenced	: 20-May-2019
C-O-C number	: ----	Issue Date	: 29-May-2019 13:13
Sampler	: MANEESHA WIJEKOON		
Site	: ----		
Quote number	: EN/222		
No. of samples received	: 29		
No. of samples analysed	: 28		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Satishkumar Trivedi	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED006 Exchangeable Cations (Magnesium/Potassium Ratio): Results could not be calculated for some samples as the required Magnesium or Potassium analytes were less than reportable limits.
- ED007 (Exchangeable Cations): Unable to calculate Magnesium/Potassium Ratio for some samples as the required results for Magnesium/Potassium are below LOR.
- ALS is not NATA accredited for the analysis of Exchangeable Aluminium and Exchange Acidity in soils when performed under ALS Method ED005.
- ALS is not NATA accredited for the analysis of Exchangeable Cations on Alkaline Soils when performed under ALS Method ED006.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JTP1 0.8-1.00m	JTP1 3.10-3.20m	JTP2 0.60-0.70m	JTP2 1.70-1.80m	JTP3 0.5-0.7m
			Client sampling date / time	02-May-2019 00:00	02-May-2019 00:00	02-May-2019 00:00	02-May-2019 00:00	07-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912586-001	EB1912586-004	EB1912586-005	EB1912586-007	EB1912586-008
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.4	7.4	6.9	9.0	8.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	8	9	14	----	141
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	----	7.3	15.2	7.8	9.5
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	6.1	6.9	----	----	2.2
ø Exchangeable Magnesium	----	0.2	meq/100g	2.0	2.8	----	----	0.7
ø Exchangeable Potassium	----	0.2	meq/100g	0.2	0.5	----	----	<0.2
ø Exchangeable Sodium	----	0.2	meq/100g	<0.2	<0.2	----	----	3.0
ø Cation Exchange Capacity	----	0.2	meq/100g	8.3	10.2	----	----	5.8
ø Exchangeable Sodium Percent	----	0.2	%	<0.2	<0.2	----	----	51.1
ø Calcium/Magnesium Ratio	----	0.2	-	3.1	2.5	----	----	3.2
ø Magnesium/Potassium Ratio	----	0.2	-	7.8	5.3	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	5.4	----	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	4.6	----	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	<0.1	----	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	1.8	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	12.0	----	----
Exchangeable Sodium Percent	----	0.1	%	----	----	15.4	----	----
Calcium/Magnesium Ratio	----	0.1	-	----	----	1.2	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	----	<10	<10	<10	40
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	----	<10	20	40	150

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JTP3 2.3-2.4m	JTP4 2.8-2.9m	JTP5 0.5-0.6m	JTP6 0.5-0.6m	JTP6 1.7-1.8m
			Client sampling date / time	07-May-2019 00:00	03-May-2019 00:00	07-May-2019 00:00	03-May-2019 00:00	03-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912586-010	EB1912586-013	EB1912586-014	EB1912586-018	EB1912586-020
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.9	9.6	7.6	9.4	9.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	364	415	8	438	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	9.4	12.3	11.4	7.3	6.5
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	5.4	4.0	6.4	1.9	----
ø Exchangeable Magnesium	----	0.2	meq/100g	2.4	2.7	1.0	4.2	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	<0.2	<0.2	<0.2	----
ø Exchangeable Sodium	----	0.2	meq/100g	10.2	12.0	<0.2	4.3	----
ø Cation Exchange Capacity	----	0.2	meq/100g	18.0	18.6	7.6	10.5	----
ø Exchangeable Sodium Percent	----	0.2	%	56.7	64.2	<0.2	41.3	----
ø Calcium/Magnesium Ratio	----	0.2	-	2.3	1.5	6.2	0.4	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	10	60	<10	100	30
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	180	260	<10	530	400

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JTP7 1.9-2.0m	JTP8 2.5-2.6m	JTP9 0.4-0.5m	JTP11 0.6-0.8m	JTP14 0.9-1.0m
			Client sampling date / time	03-May-2019 00:00	03-May-2019 00:00	03-May-2019 00:00	02-May-2019 00:00	08-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912586-022	EB1912586-025	EB1912586-026	EB1912586-030	EB1912586-039
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	9.3	8.9	7.4	8.0	7.8
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	670	440	415	40	110
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	21.2	8.0	4.9	12.9	11.8
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	2.0	4.6	1.3	5.9	0.6
ø Exchangeable Magnesium	----	0.2	meq/100g	3.5	5.0	1.2	3.4	2.2
ø Exchangeable Potassium	----	0.2	meq/100g	0.3	<0.2	<0.2	<0.2	<0.2
ø Exchangeable Sodium	----	0.2	meq/100g	19.2	21.6	2.5	0.7	2.6
ø Cation Exchange Capacity	----	0.2	meq/100g	25.1	31.2	5.0	10.0	5.4
ø Exchangeable Sodium Percent	----	0.2	%	76.7	69.2	49.7	6.9	47.7
ø Calcium/Magnesium Ratio	----	0.2	-	0.6	0.9	1.1	1.7	0.3
ø Magnesium/Potassium Ratio	----	0.2	-	11.3	----	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	200	30	110	20	50
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	1170	740	560	<10	130

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JTP16 0.4-0.5m	JTP17 0.6-0.7m	JTP17 2.6-2.7m	JTP18 0.4-0.5m	JTP19 0.8-0.9m
			Client sampling date / time	08-May-2019 00:00	08-May-2019 00:00	08-May-2019 00:00	08-May-2019 00:00	09-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912586-043	EB1912586-045	EB1912586-048	EB1912586-049	EB1912586-053
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.7	6.5	8.7	5.8	5.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	14	271	94	15	169
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	21.6	25.2	8.7	----	6.7
ED005: Exchange Acidity								
ø Exchange Acidity	----	0.1	meq/100g	0.9	----	----	0.2	0.3
ø Exchangeable Aluminium	----	0.1	meq/100g	0.7	----	----	<0.1	0.2
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	----	3.8	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	----	----	3.0	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	----	----	<0.2	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	----	----	1.0	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	----	----	7.9	----	----
ø Exchangeable Sodium Percent	----	0.2	%	----	----	13.4	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	----	----	1.3	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	2.1	12.7	----	0.8	1.1
Exchangeable Magnesium	----	0.1	meq/100g	3.3	8.7	----	0.4	1.9
Exchangeable Potassium	----	0.1	meq/100g	<0.1	0.2	----	0.3	<0.1
Exchangeable Sodium	----	0.1	meq/100g	0.4	2.4	----	<0.1	1.9
Cation Exchange Capacity	----	0.1	meq/100g	6.7	24.2	----	1.7	5.2
Exchangeable Sodium Percent	----	0.1	%	6.4	10.1	----	1.3	37.8
Calcium/Magnesium Ratio	----	0.1	-	0.6	1.4	----	2.0	0.6
Magnesium/Potassium Ratio	----	0.1	-	----	41.8	----	1.4	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	20	310	<10	----	40
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	300	120	----	220

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JTP21 0.3-0.4m	JTP21 2.1-2.2m	JTP23 0.5-0.6m	JTP23 2.8-2.9m	JTP24 2.6-2.7m
			Client sampling date / time	09-May-2019 00:00	09-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00
Compound	CAS Number	LOR	Unit	EB1912586-056	EB1912586-058	EB1912586-061	EB1912586-063	EB1912586-065
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.9	8.7	9.1	8.8	8.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	8	27	580	92	223
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	14.0	10.3	10.6	----	13.9
ED005: Exchange Acidity								
ø Exchange Acidity	----	0.1	meq/100g	0.2	----	----	----	----
ø Exchangeable Aluminium	----	0.1	meq/100g	0.2	----	----	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	----	2.5	3.6	0.7	11.2
ø Exchangeable Magnesium	----	0.2	meq/100g	----	2.1	5.0	0.6	6.8
ø Exchangeable Potassium	----	0.2	meq/100g	----	<0.2	<0.2	<0.2	0.3
ø Exchangeable Sodium	----	0.2	meq/100g	----	1.7	5.7	1.2	4.4
ø Cation Exchange Capacity	----	0.2	meq/100g	----	6.2	14.3	2.4	22.8
ø Exchangeable Sodium Percent	----	0.2	%	----	27.0	40.0	48.0	19.6
ø Calcium/Magnesium Ratio	----	0.2	-	----	1.2	0.7	1.3	1.6
ø Magnesium/Potassium Ratio	----	0.2	-	----	----	----	----	23.8
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	3.5	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	2.9	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	0.1	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	0.1	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	6.8	----	----	----	----
Exchangeable Sodium Percent	----	0.1	%	1.6	----	----	----	----
Calcium/Magnesium Ratio	----	0.1	-	1.2	----	----	----	----
Magnesium/Potassium Ratio	----	0.1	-	21.3	----	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	10	<10	50	----	<10
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	20	710	----	320

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	JTP25 1.2-1.3m	JTP25 2.7-2.8m	JTP26 0.3-0.4m	----	----
			Client sampling date / time	10-May-2019 00:00	10-May-2019 00:00	10-May-2019 00:00	----	----
Compound	CAS Number	LOR	Unit	EB1912586-067	EB1912586-069	EB1912586-070	--------	--------
				Result	Result	Result	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**9.7**	**9.0**	**6.4**	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**640**	**520**	**14**	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**10.0**	**12.2**	**14.9**	----	----
ED006: Exchangeable Cations on Alkaline Soils								
ø Exchangeable Calcium	----	0.2	meq/100g	**4.1**	**3.5**	----	----	----
ø Exchangeable Magnesium	----	0.2	meq/100g	**7.3**	**6.2**	----	----	----
ø Exchangeable Potassium	----	0.2	meq/100g	<0.2	<0.2	----	----	----
ø Exchangeable Sodium	----	0.2	meq/100g	**9.4**	**7.4**	----	----	----
ø Cation Exchange Capacity	----	0.2	meq/100g	**20.9**	**17.2**	----	----	----
ø Exchangeable Sodium Percent	----	0.2	%	**44.8**	**43.0**	----	----	----
ø Calcium/Magnesium Ratio	----	0.2	-	**0.6**	**0.6**	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	**3.4**	----	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	**2.6**	----	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	<0.1	----	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	**0.7**	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	**6.8**	----	----
Exchangeable Sodium Percent	----	0.1	%	----	----	**9.9**	----	----
Calcium/Magnesium Ratio	----	0.1	-	----	----	**1.3**	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**110**	**60**	**10**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**780**	**770**	<10	----	----

Table 1: Summary of the soil strength parameters

Case No.	Layer Depth (m)	Soil type	Strength Parameters Used			Density Values (kN/m^3)	
			Drained		Undrained	Dry	Saturated
			Cohesion (kPa)	Friction angle °	Cohesion (kPa)		
1	0-1	Soft-Firm Clay	10	15	18	15	17
	1-2	Loose Silty Sand	0	30	-	15	18
	2-3	Stiff Clay	20	20	50	16	18
	3-8	XW Rock	0	35	-	20	20
2	0-1	Loose Silty Sand	0	30	-	15	18
	1-2	Medi. Dense Sand	0	32	-	17	20
	2-3	Stiff Clay	20	20	50	16	18
	3-8	XW Rock	0	35	-	20	20
3	0-1	Soft Clay	10	15	12	12	16
	1-2	Firm Clay	15	17	25	15	17
	2-3	Very Stiff Clay	50	20	100	16	18
	3-8	XW Rock	0	35	-	20	20
4	0-1	Loose Silty Sand	0	30	-	15	18
	1-2	Medi. Dense Sand	0	32	-	17	20
	2-3	Dense Sand	0	36	-	19	21
	3-8	XW Rock	0	35	-	20	20
5	0-1	Loose Silty Sand	0	30	-	15	18
	1-2	Dense Sand	0	36	-	19	21
	2-3	XW Rock	0	35	-	20	20
	3-8	XW Rock	0	35	-	20	20
6	0-1	Soft Clay	10	15	12	12	16
	1-2	Firm-Stiff Clay	17	17	37	14	17
	2-3	XW Rock	0	35	-	20	20
	3-8	XW Rock	0	35	-	20	20
7	0-1	Soft-Firm Clay	10	15	18	15	17
	1-2	Loose Silty Sand	0	30	-	15	18
	2-3	Stiff Clay	5	30	50	16	18
	3-8	XW Rock	0	35	-	20	20
8	0-1	Soft Clay	10	15	12	12	16
	1-2	Firm Clay	15	17	25	15	17
	2-3	Stiff Clay	5	30	50	16	18
	3-8	XW Rock	0	35	-	20	20

Table 2: Summary of the slope stability assessment

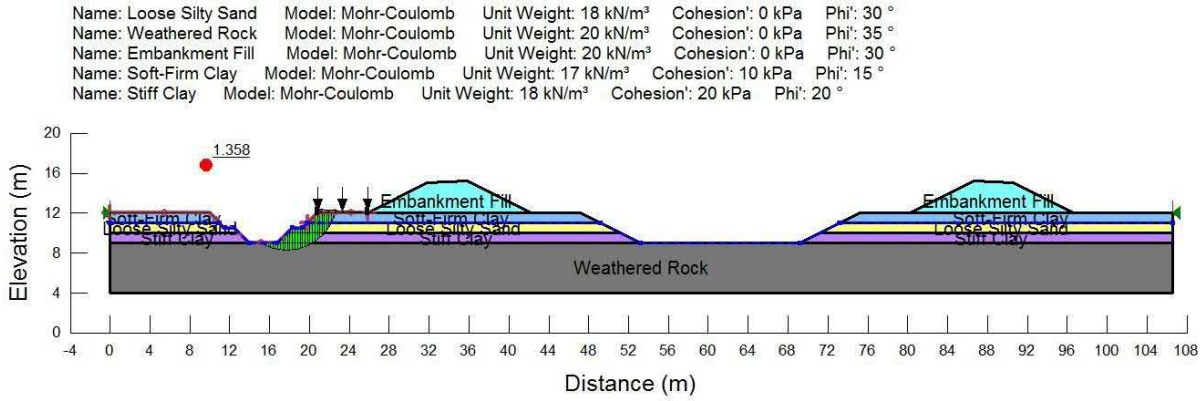
Case No.	FoS for slope stability of the proposed pipeline & existing main channel when the effect of the proposed excavation has been considered				Slope stability of the existing main channel without the proposed pipeline excavation	
	Drained Condition		Undrained Condition			
	Proposed pipe line excavation	Main Channel	Proposed pipe line excavation	Main Channel	Drained	Undrained
1	1.36	1.65	2.05	2.25	1.65	2.25
2	0.60	1.22	0.60	1.22	1.22	1.22
3	2.15	2.43	3.20	3.35	2.43	3.35
4	0.49	0.57	0.49	0.57	0.57	0.57
5	0.47	0.58	0.47	0.58	0.58	0.58
6	1.28	1.58	1.87	2.07	1.58	2.07
7	1.28	1.66	2.05	2.25	1.66	2.25
8	1.58	1.95	3.20	2.60	1.95	2.60

Appendix E. HMC Slope Stability Analysis

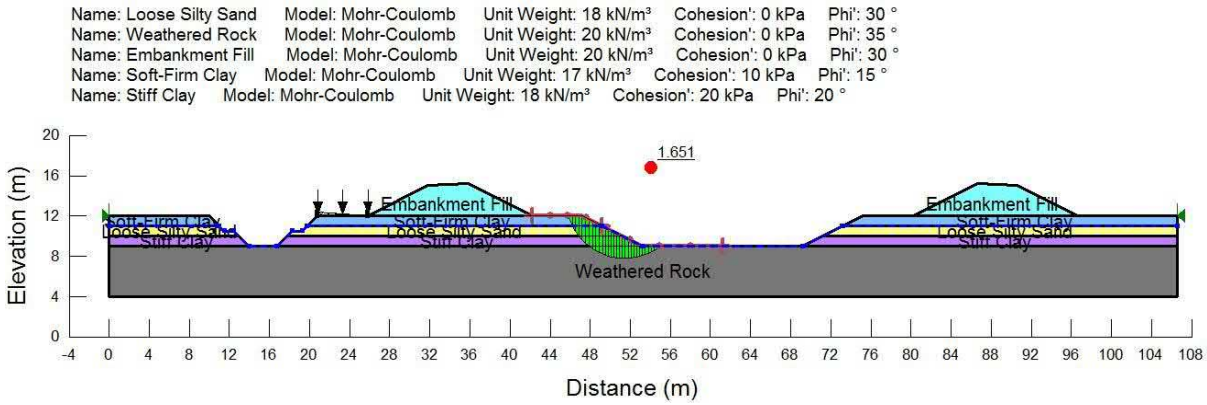
Soil condition anlysed : Drained Condition

Case 1 Summary

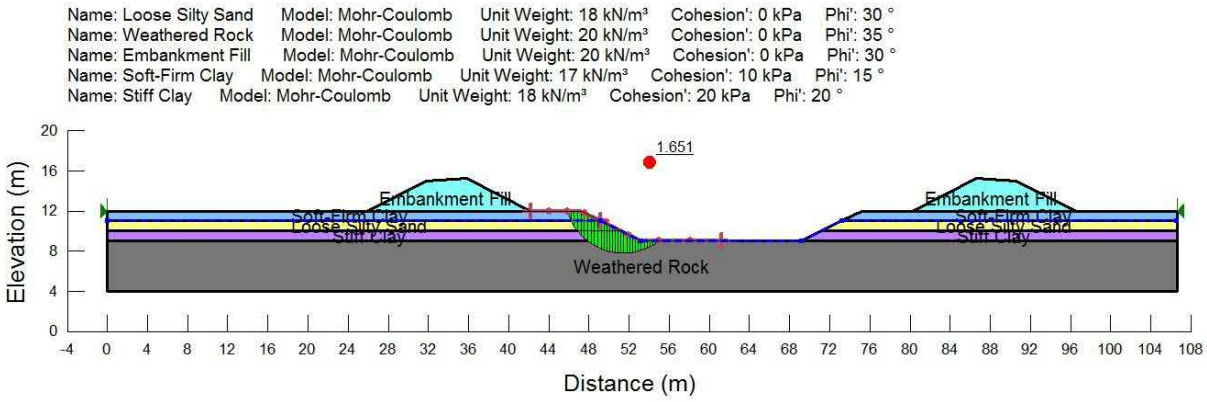
a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered

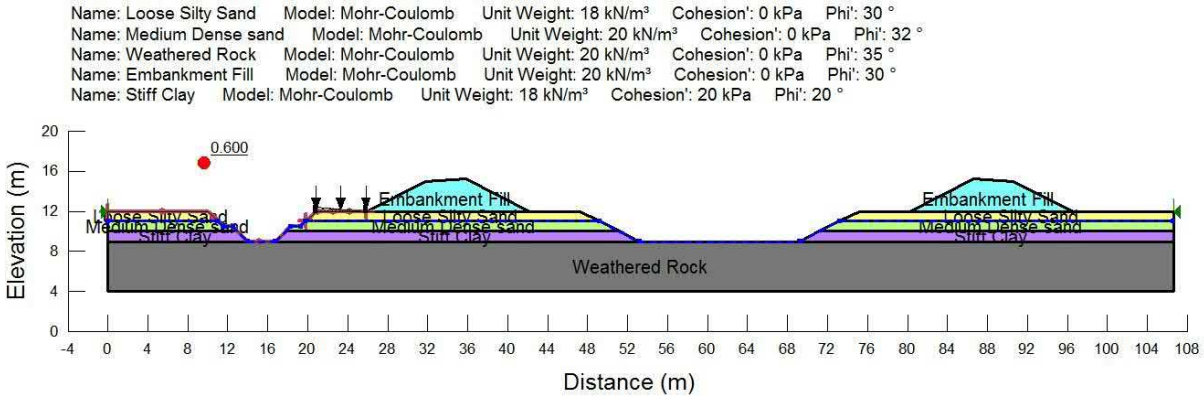


c) Slope stability of the existing main channel without the proposed pipeline excavation

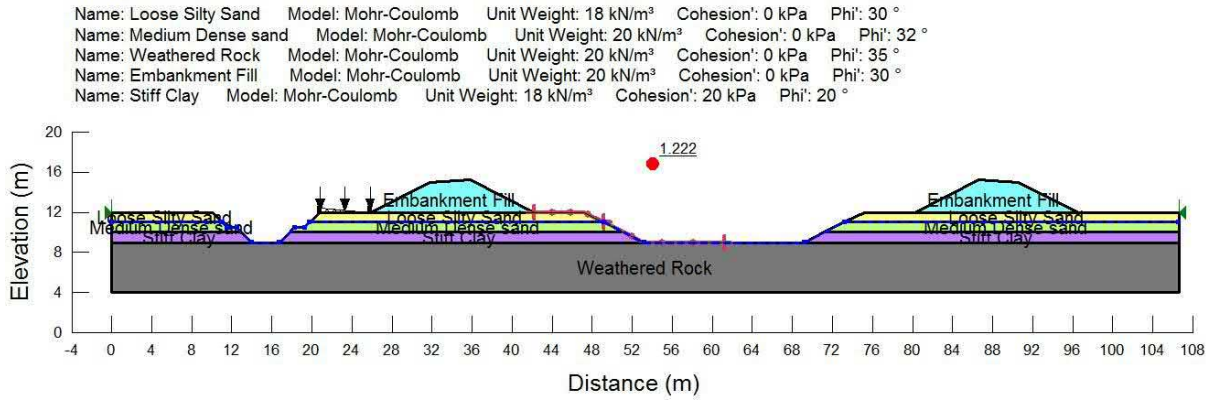


Case 2 Summary

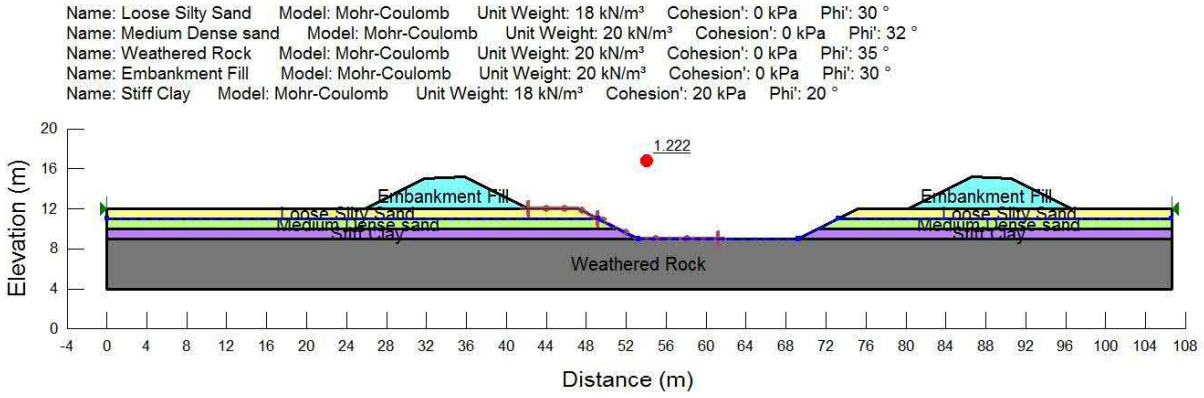
a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered

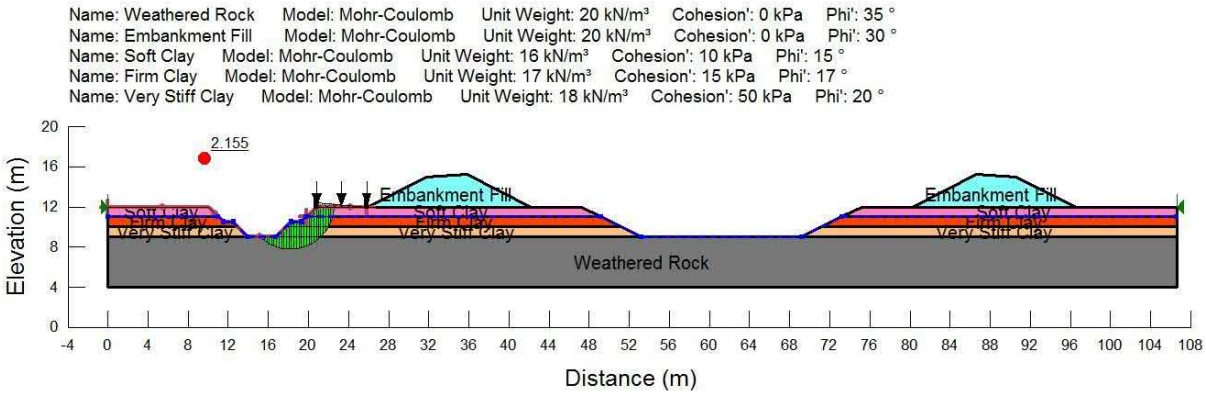


c) Slope stability of the existing main channel without the proposed pipeline excavation

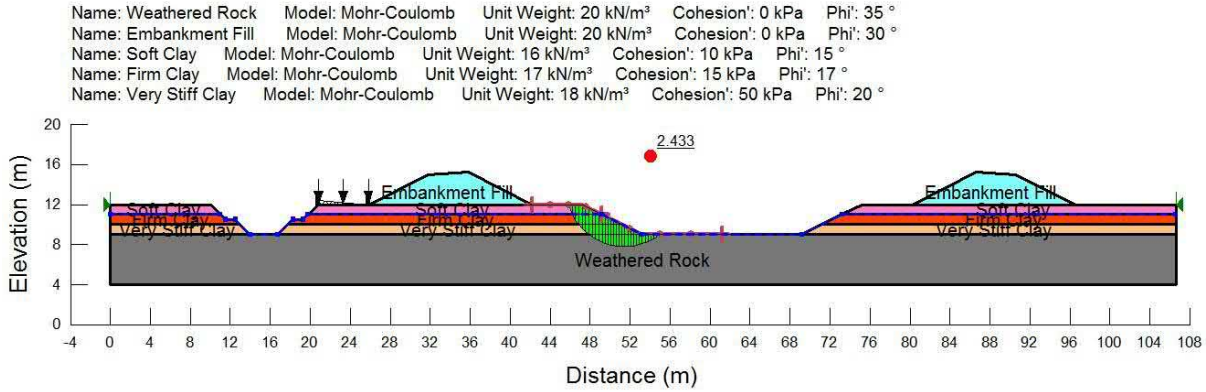


Case 3 Summary

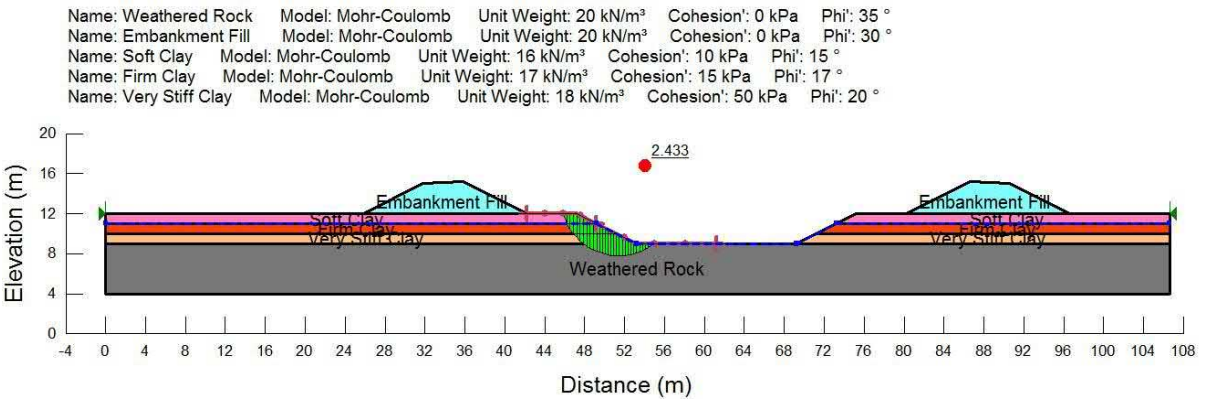
a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered

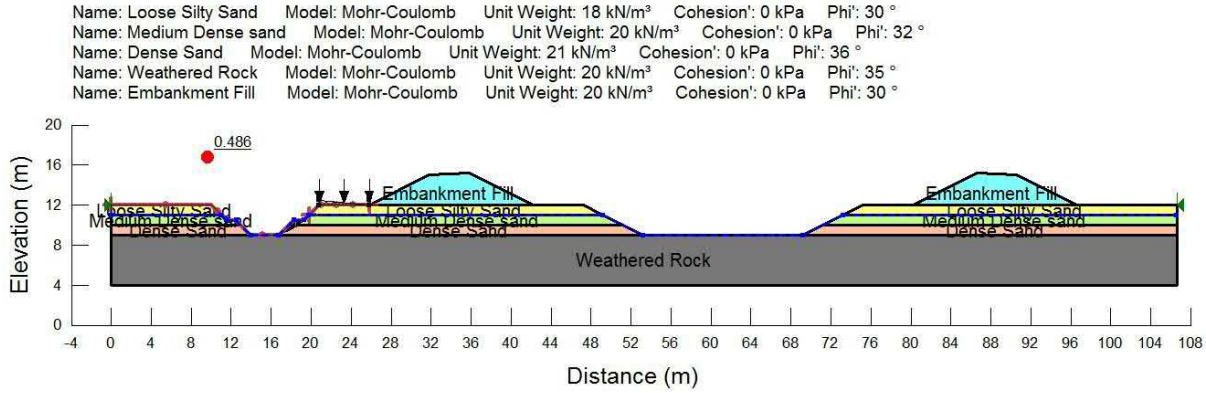


c) Slope stability of the existing main channel without the proposed pipeline excavation

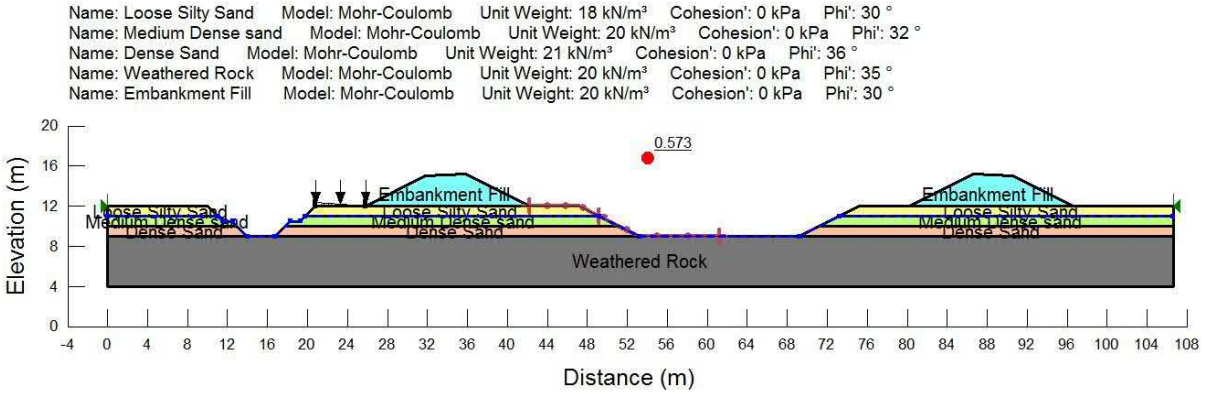


Case 4 Summary

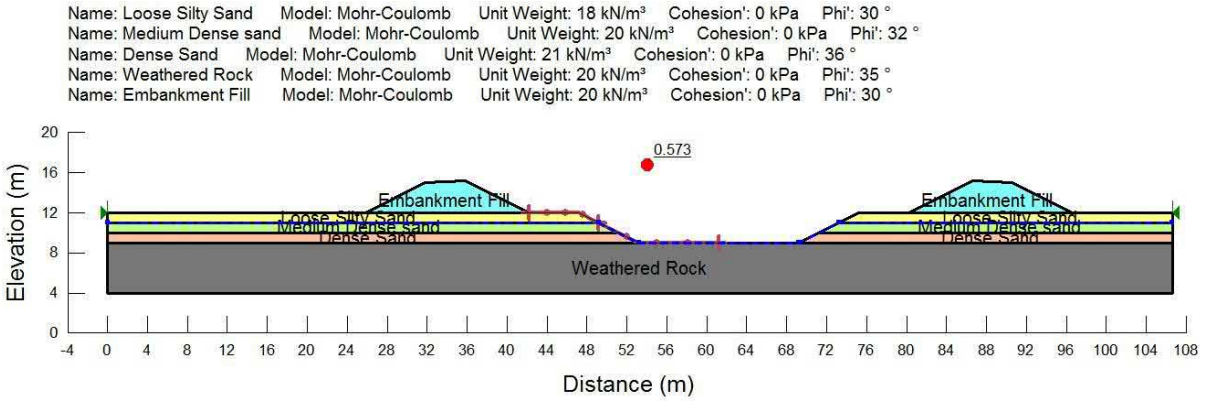
a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered

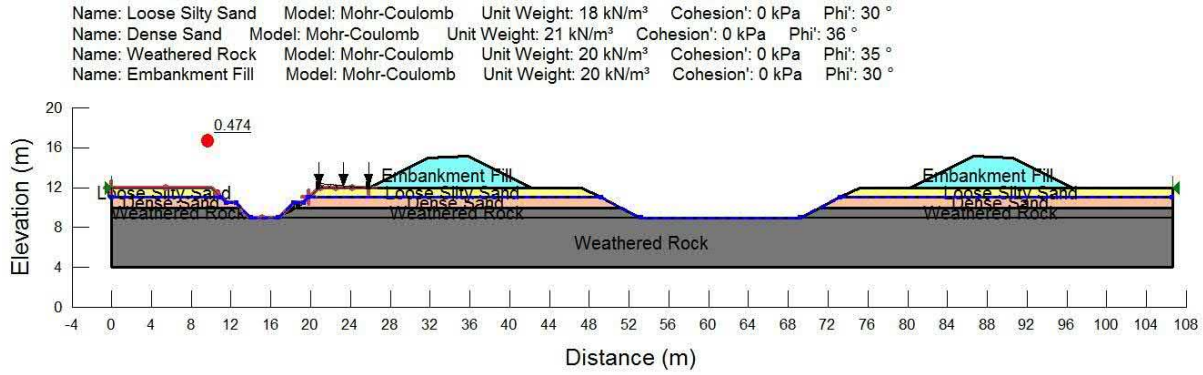


c) Slope stability of the existing main channel without the proposed pipeline excavation

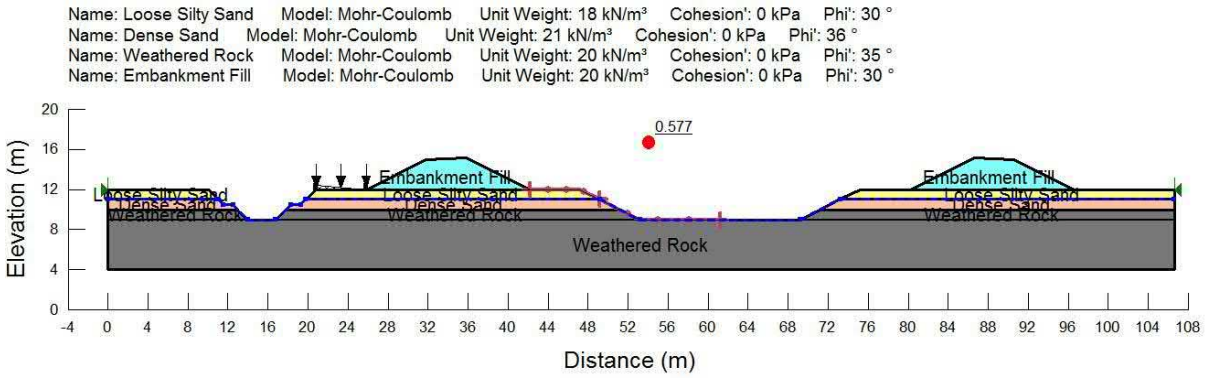


Case 5 Summary

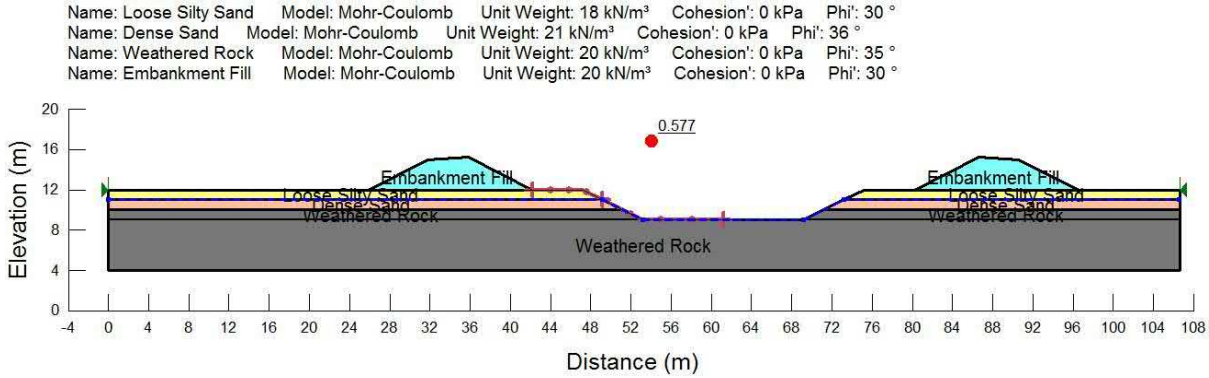
a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered

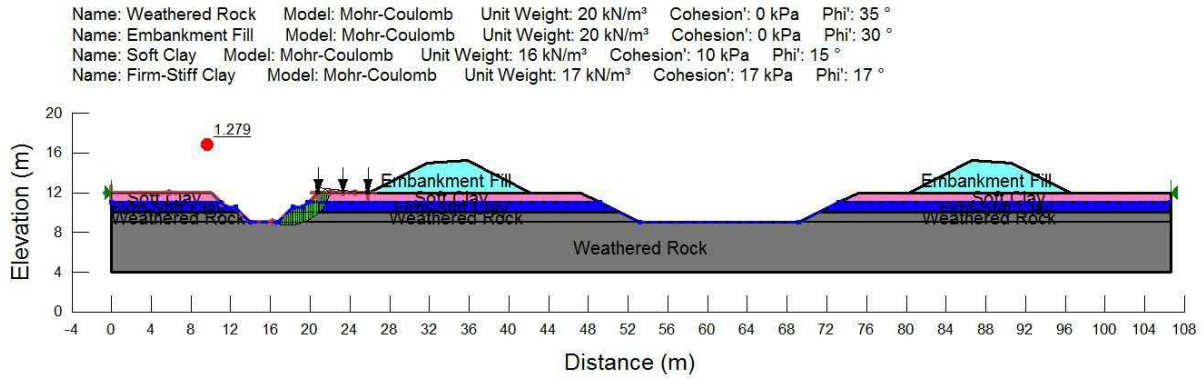


c) Slope stability of the existing main channel without the proposed pipeline excavation

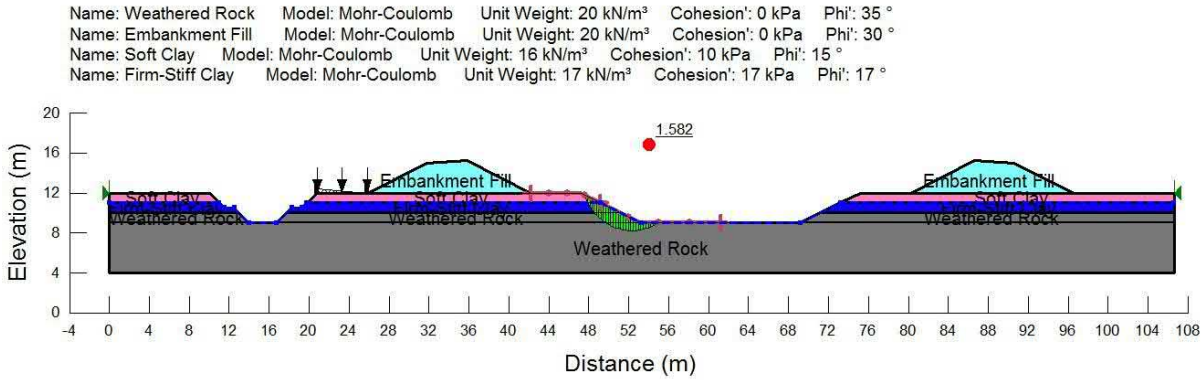


Case 6 Summary

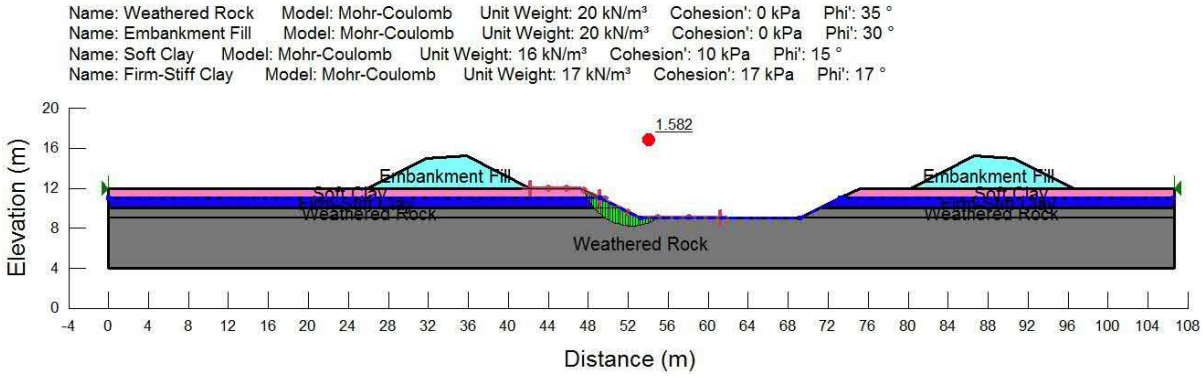
a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered

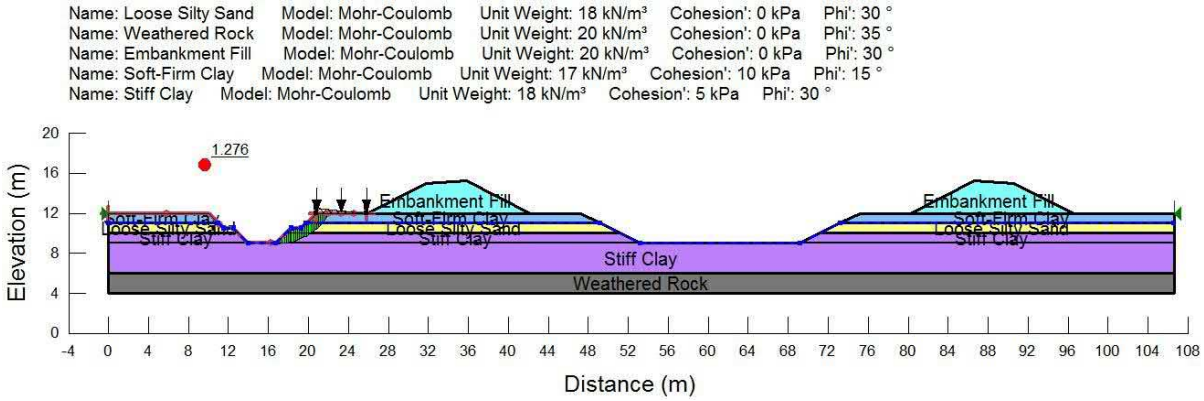


c) Slope stability of the existing main channel without the proposed pipeline excavation

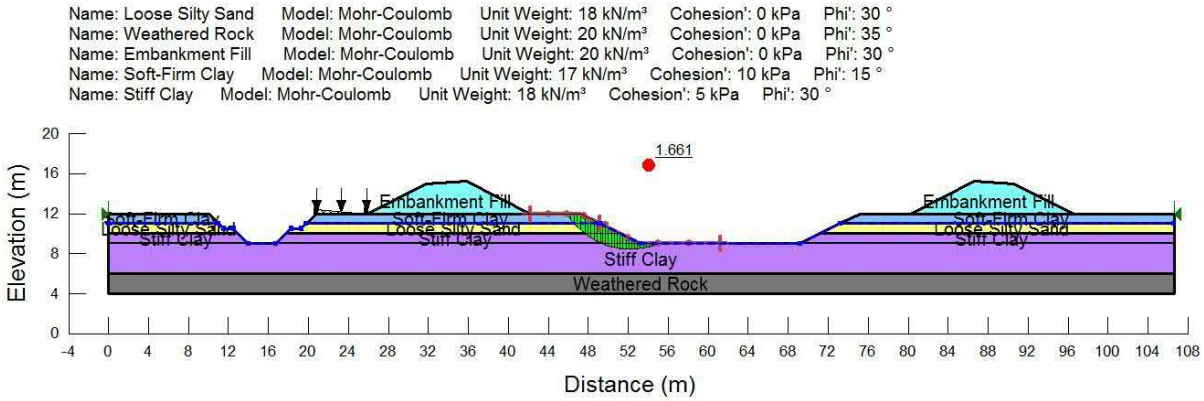


Case 7 Summary

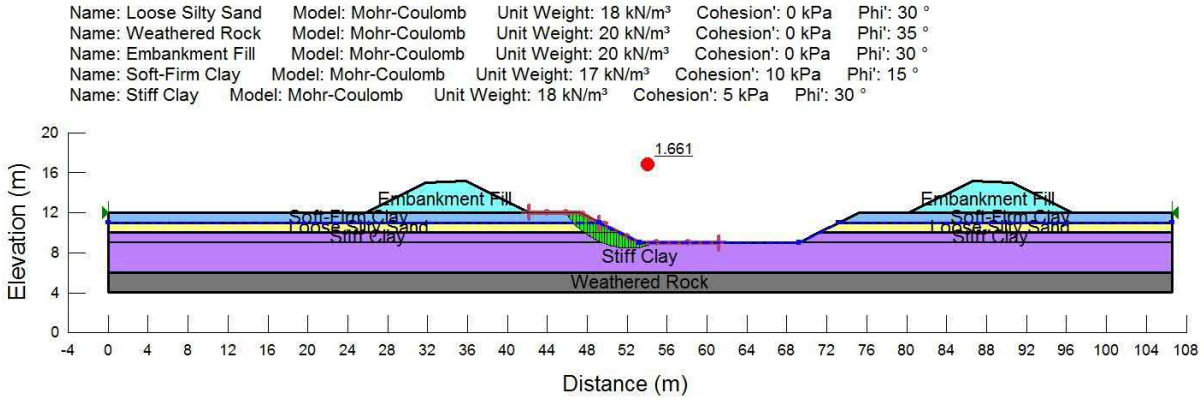
a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered

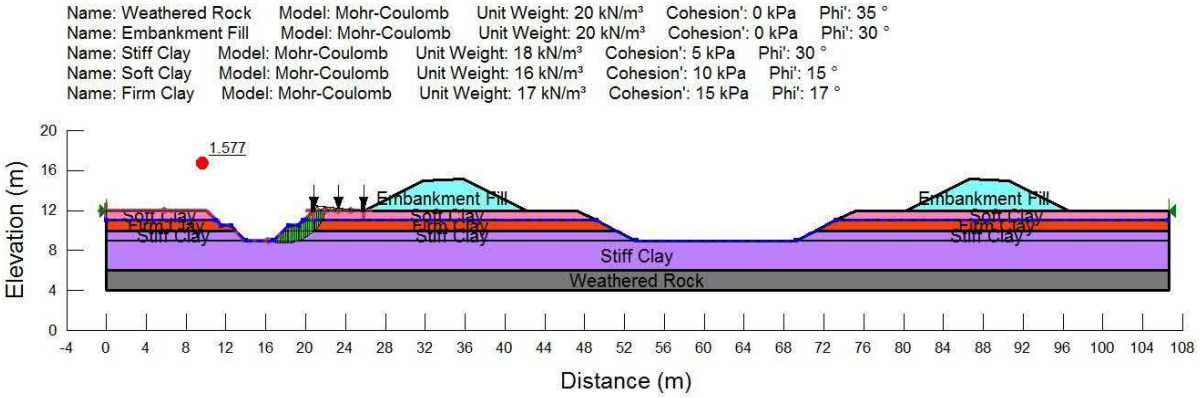


c) Slope stability of the existing main channel without the proposed pipeline excavation

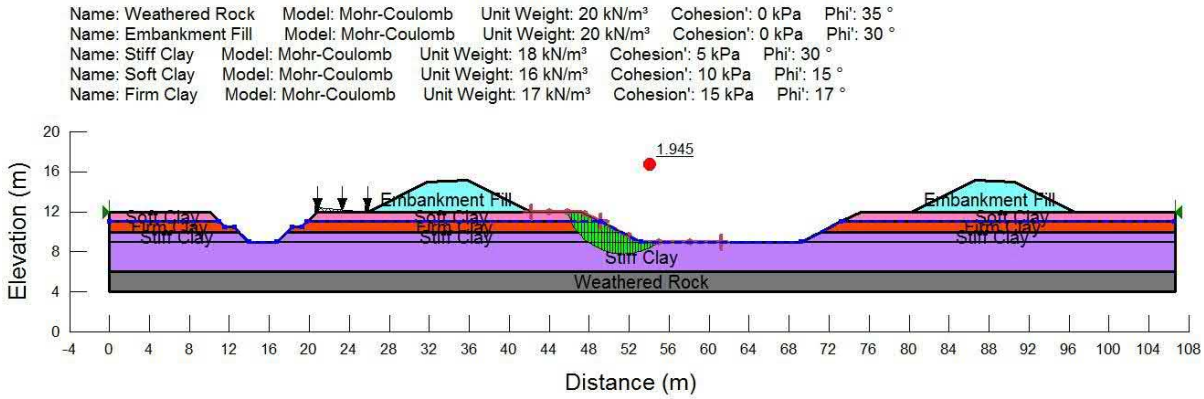


Case 8 Summary

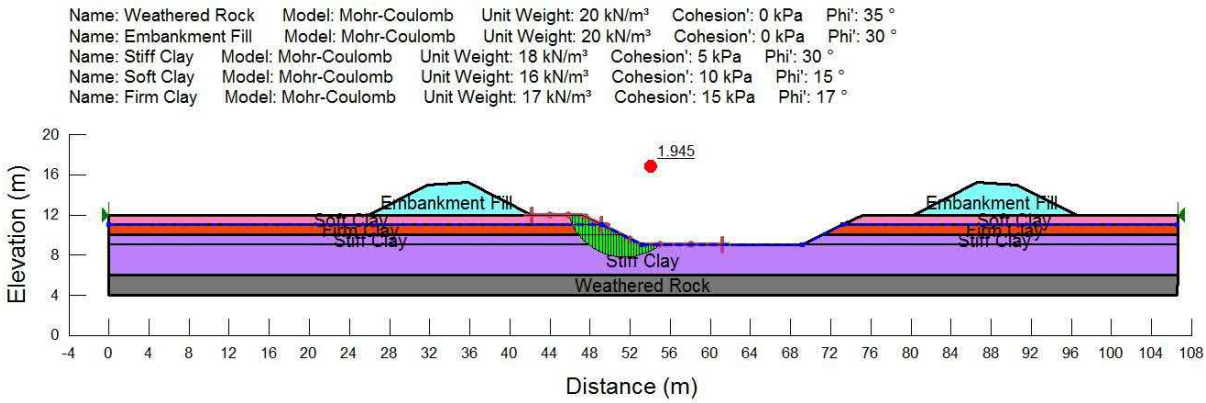
a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered



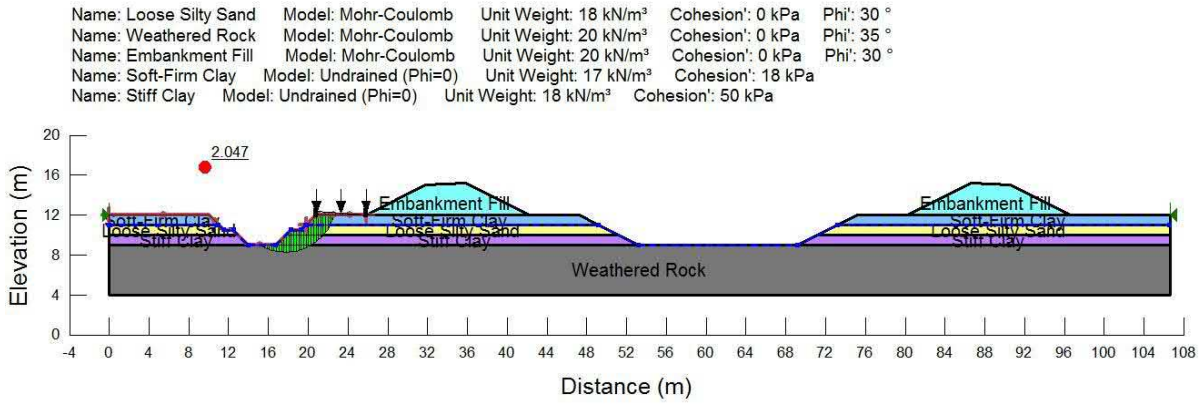
c) Slope stability of the existing main channel without the proposed pipeline excavation



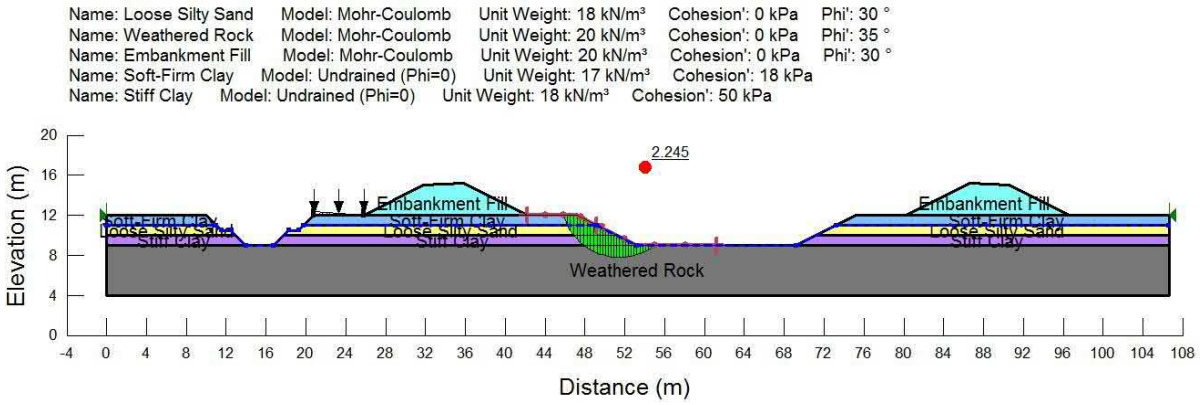
Soil condition anlysed : Undrained Condition

Case 1 Summary

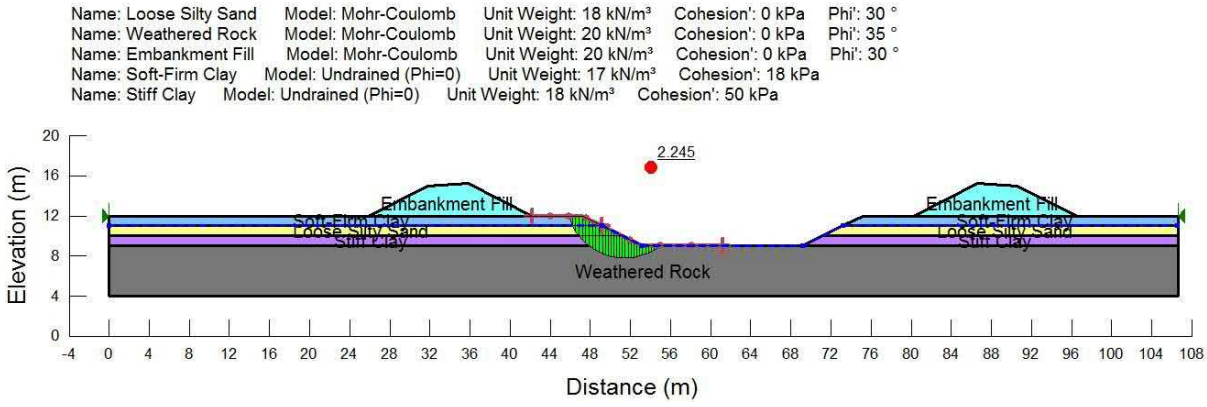
a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered

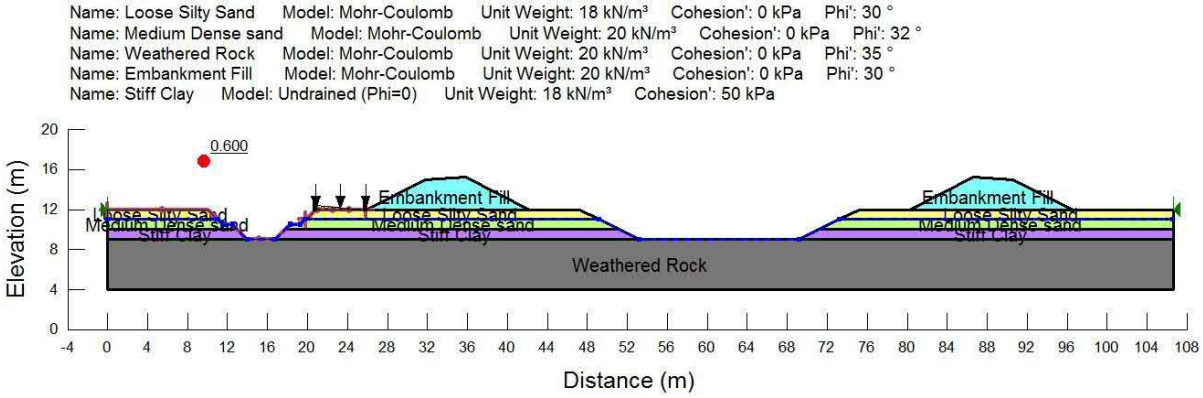


c) Slope stability of the existing main channel without the proposed pipeline excavation

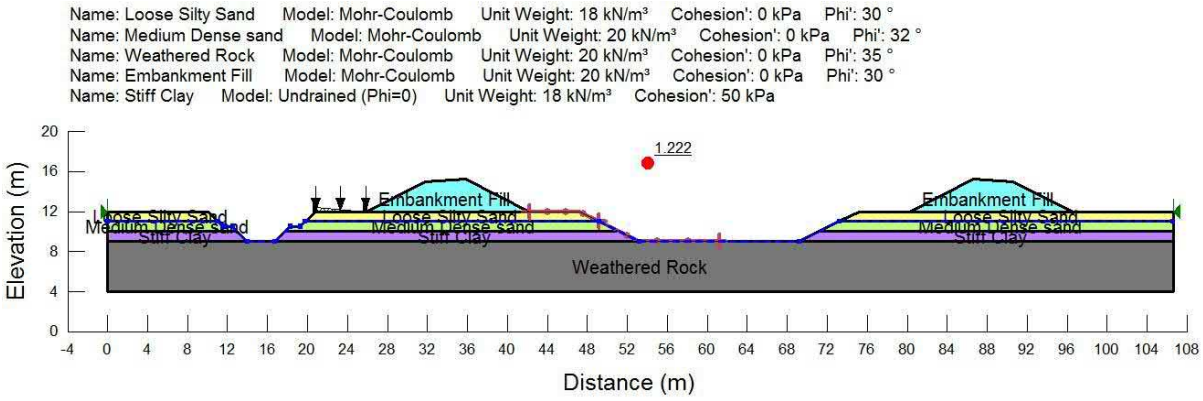


Case 2 Summary

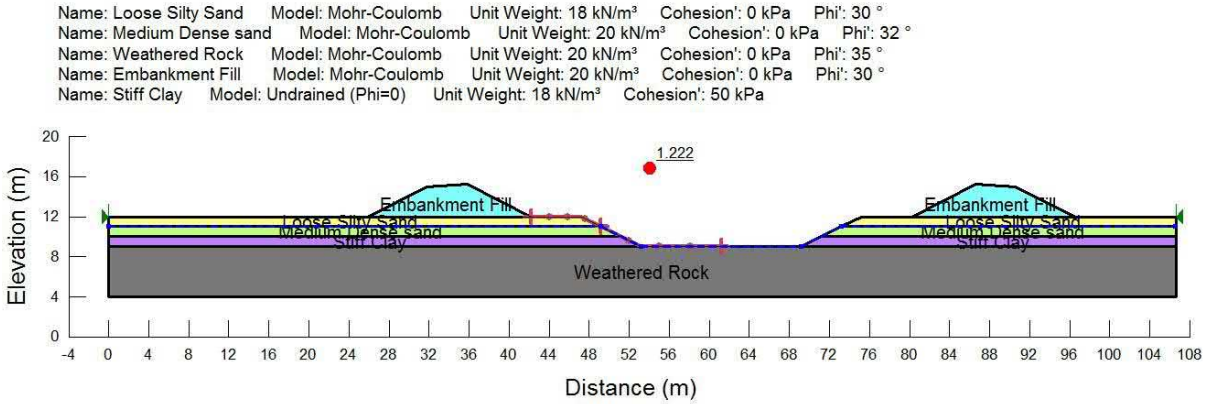
a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered

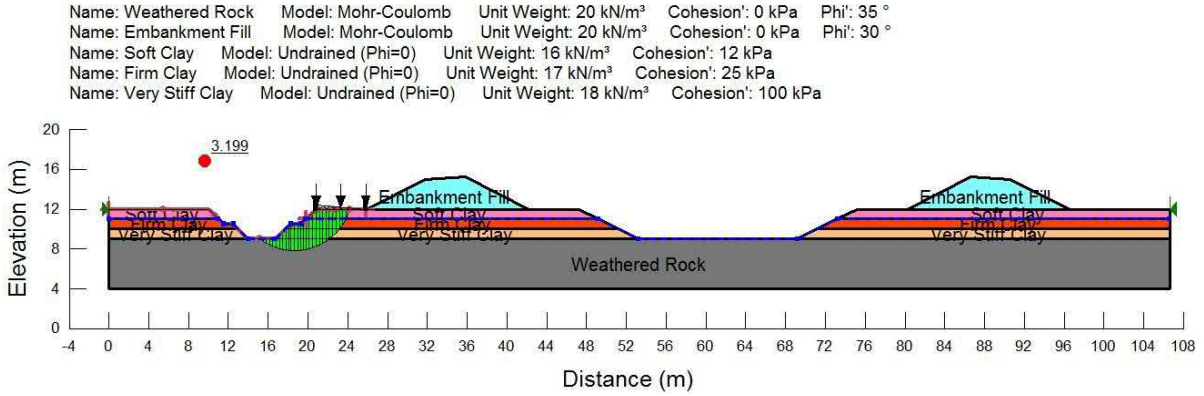


c) Slope stability of the existing main channel without the proposed pipeline excavation

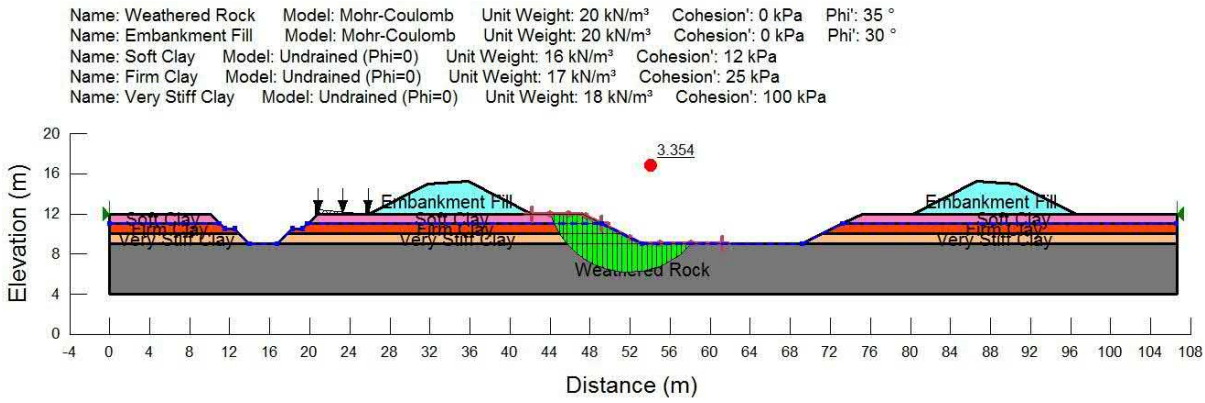


Case 3 Summary

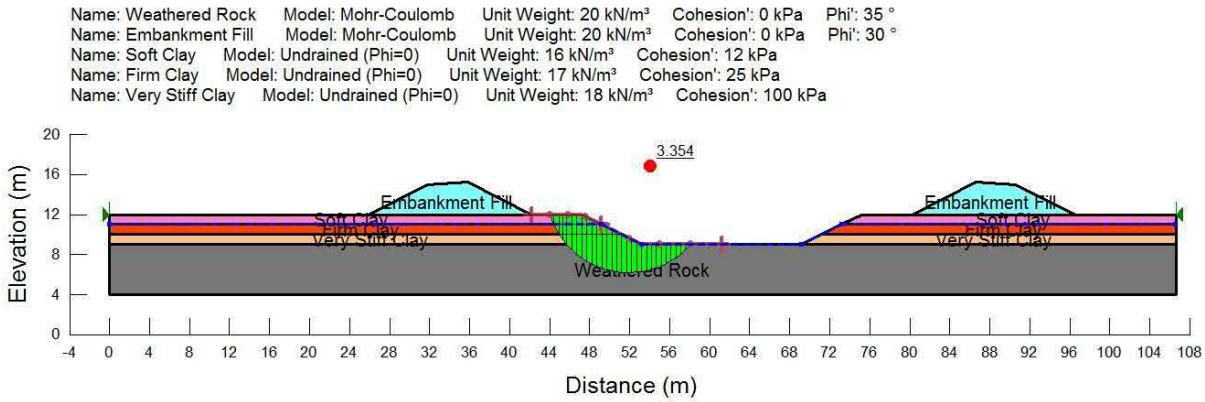
a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered

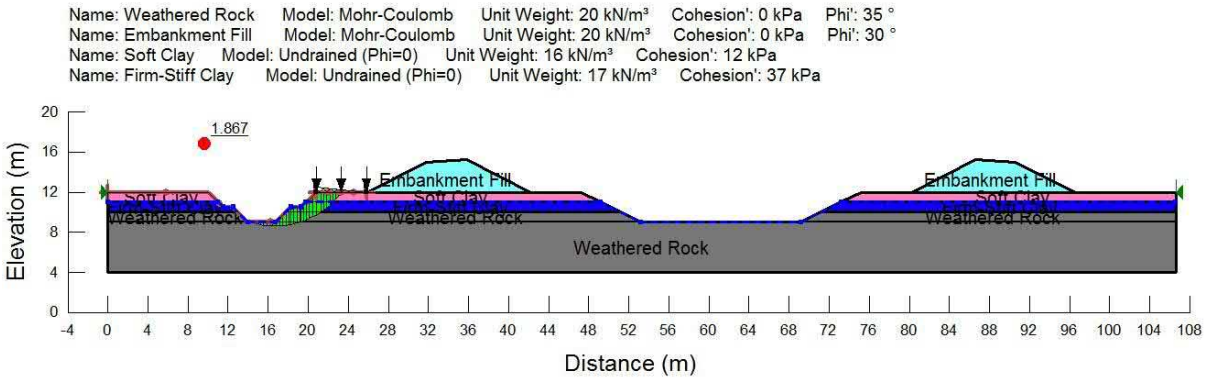


c) Slope stability of the existing main channel without the proposed pipeline excavation

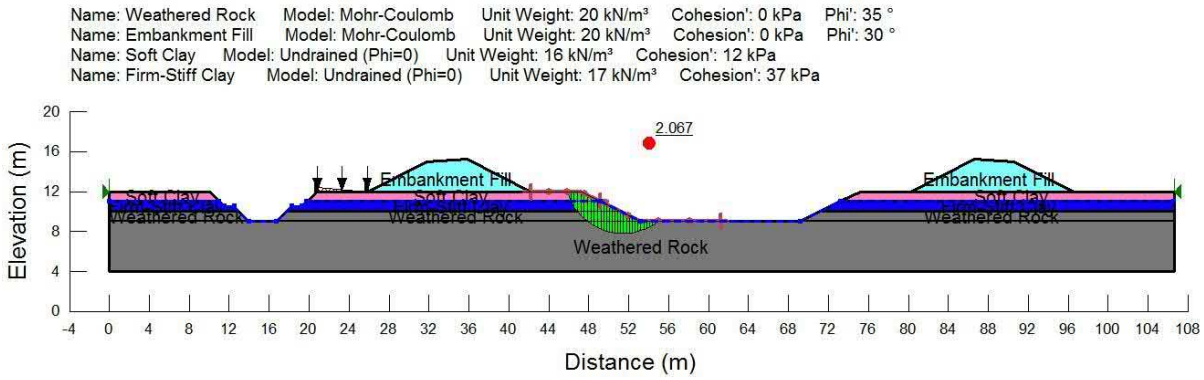


Case 6 Summary

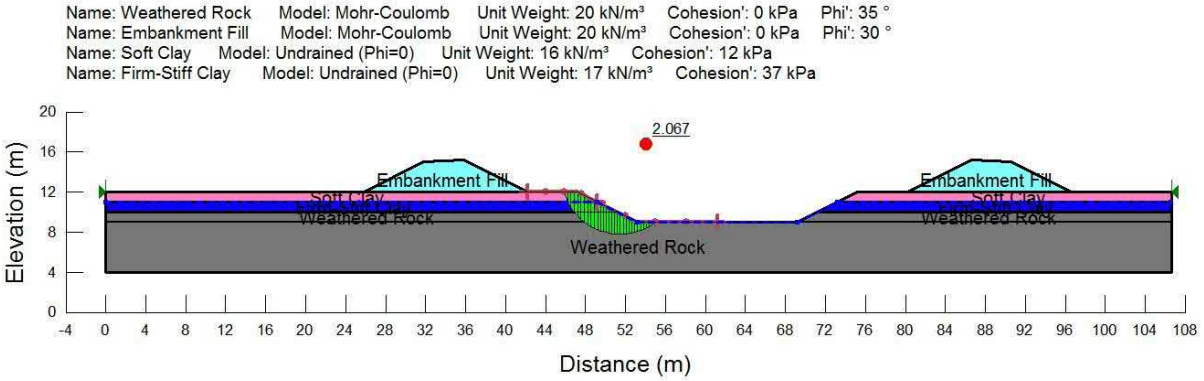
a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered

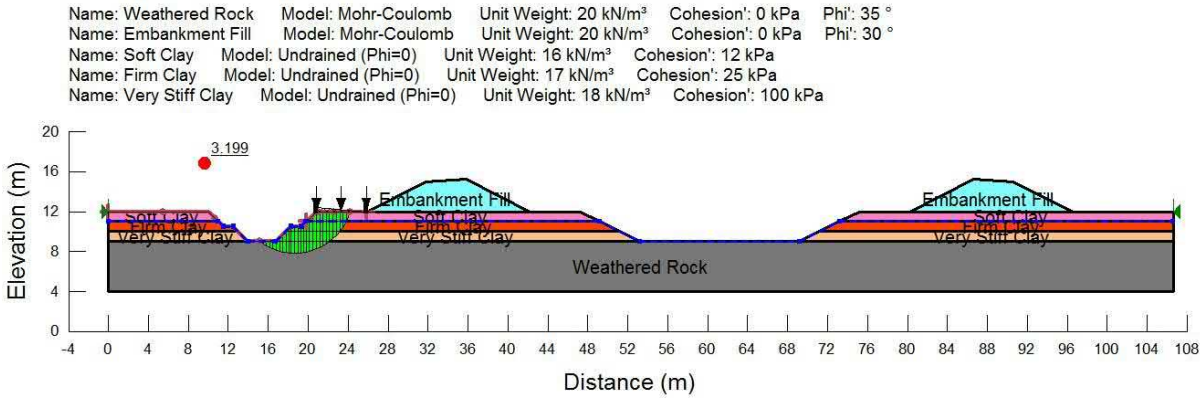


c) Slope stability of the existing main channel without the proposed pipeline excavation

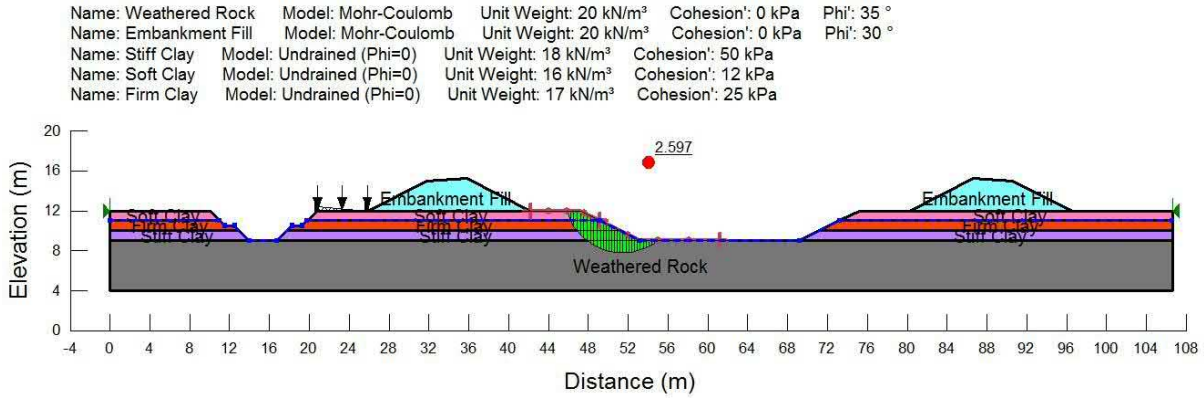


Case 8 Summary

a) Slope stability of the proposed pipe line excavation



b) Slope stability of the existing main channel when the effect of the proposed excavation has been considered



c) Slope stability of the existing main channel without the proposed pipeline excavation