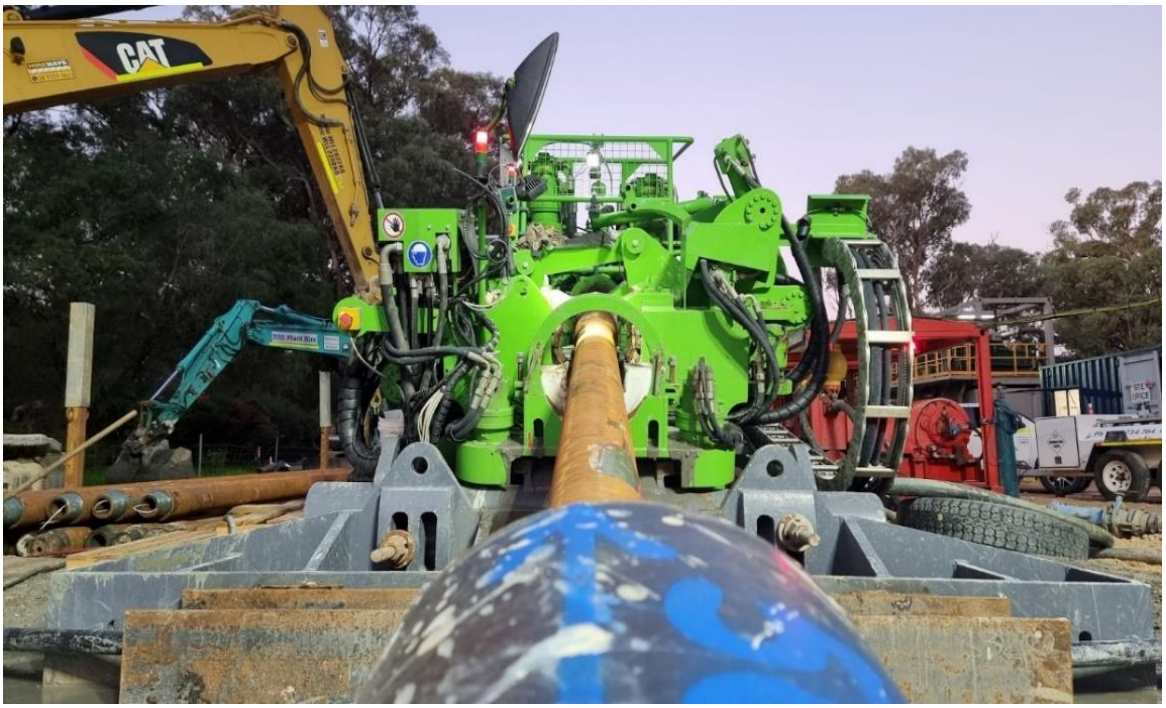
HDD & PIPELINE SOLUTIONS AUSTRALIA

Drilling Fluid Management

OPENSHORE DRILLING



Revision	Issued for	Date	Author	Check By
A	Issued for Review	18/03/2024	M Jacobi	Paul
B				
C				
D				
E				

DRILLING FLUID MANAGEMENT PLAN

HPSAUS-FLUID-001 18/03/2024

1. Design Parameters

1.1 Drilling Fluid Design and Calculation Assumptions

- An allowance of 40mm for drill pipe width compared to tool joint width for 5", 5 1/2, 6 5/8 & 7 5/8 drill pipe for more accurate calculations. All other drill pipe calculations are based on tool joint width.
- All drill pipe width assumptions are based on a new condition pipe.
- Drilling fluid program is based off industry standard calculations.
- Volumes are based off project methodology.
- Pump rates are based on several factors and will be at the discreation of the driller and superintendent.
- This calculations are based on a closed loop processing system.
- Analysis does not allow for hydrofracture event or unknown geotechnical anomalies including fluid loss.
- Specific chemical technical compositions and first aid relating to this product contact the MSDS or supplier.
- All calculataions are based on "perfect world" scenarios and can vary depending on several factors including geology, hole size, formation, mud cleaning systems effiency etc.
- Target rheoology readings take precident over mixing fluid ratios.
- Drilling volume based on a allowance outlined in required volume.
- Calculations do not allow for elevation differences.
- Permeation allowance of . 25% of total volume.

HDD & PIPELINE SOLUTIONS AUSTRALIA

DRILLING FLUID MANAGEMENT PLAN

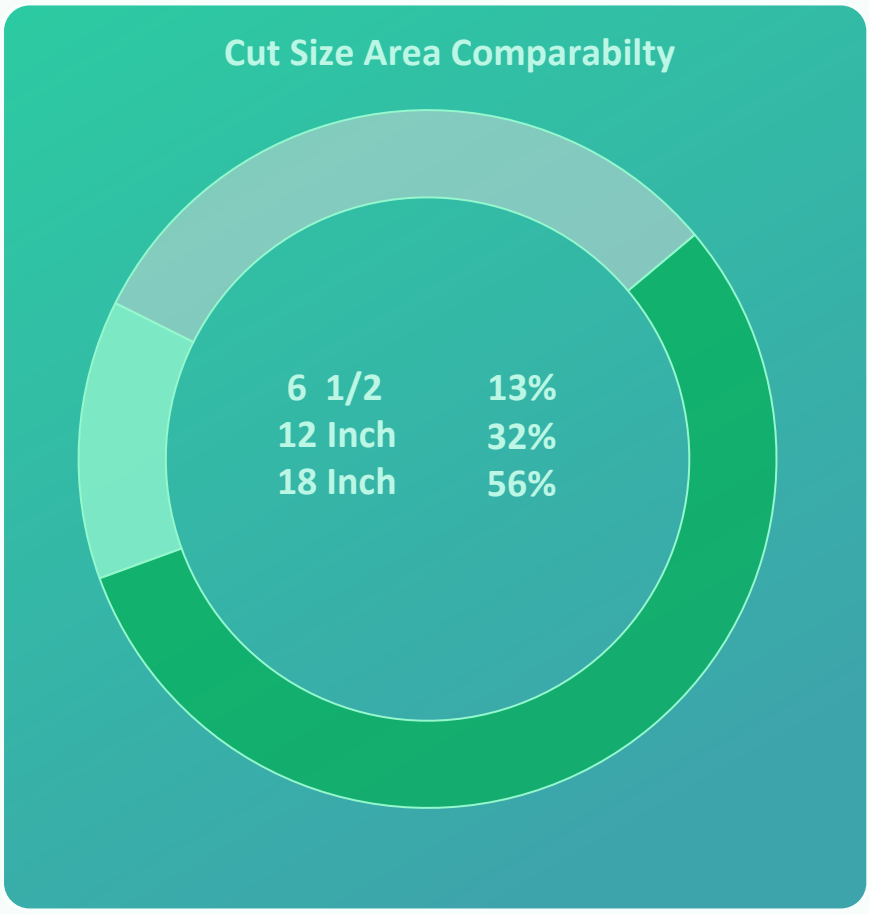
HPSAUS-FLUID-001 18/03/2024

1.2 Project Information

Product Pipe Information	Material	Size	Imperial
Electrical	**HDPE**	**315 mm**	**12 Inch**

Geotechnical Assessment	
Formation	Rock
Geology Structure	Consistant
Mpa	50-150

Factor	Metric	Imperial	Area m³
Length	420.00 m	1377.95 ft	-
Pilot Size	164.4 mm	6 1/2	0.02
Ream Size 1	304.8 mm	12 Inch	0.07
Ream Size 2	457.2 mm	18 Inch	0.16



1.3 Construction Methodology Outline

Drill Pipe Information	Specification	Imperial	Metric
Pipe Size	D100	D100	
Pipe Weight lb/ft	17.50		
Grade	Firestick		
Tool Joint Overall Diamention		4 3/8 Inch	111.1 mm
Pipe Overall Diamention		4 3/8 Inch	111.1 mm
Pipe Internal Diamention		2 1/4 Inch	57.2 mm

Proposed Pump Rates	Imperial	Metric
Pilot	100 Gallons	379 Litres
12 Inch Ream	100 Gallons	379 Litres
18 Inch Ream	100 Gallons	379 Litres

Surface Storage	Imperial		Metric		Cubic Volume
Mud System Capacity	4227	Gallons	16000	Litres	16 M³
Pit Volume	1585	Gallons	6000	Lites	6 M³

Pilot Geometry Charateristics	Imperial	Metric	Cubic Volume
Drill Rod Volume	2.56 Gal Per Foot	9.69 Ltrs Per Meter	
Open Hole Volume	5.61 Gal Per Foot	21.23 Ltrs Per Meter	
Annular Volume	0.68 Gal Per Foot	2.57 Ltrs Per Meter	
Open Hole Volume at Total Depth	2355 Gallons	8915 Litres	9 M³
Surface Volume	4227 Gallons	16000 Litres	16 M³
Total Circ. Volume	2355 Gallons	8915 Litres	9 M³

2. Pilot Hole

2.1 Pilot Fluid Design

Pilot Fluid Design	Mixture Per M³	Total Required
SODA ASH	1 Kgs Per M³	4 Kgs
QUIK-GEL GOLD	40 Kgs Per M³	357 Kgs
QUIK-TROL GOLD LV	2 Kgs Per M³	18 Kgs
SODIUM BICARBONATE	2 Kgs Per M³	18 Kgs
CON DET	2 Kgs Per M³	18 Kgs

Pilot Fluid Properties	Value	Determined Value
Mud Weight	1.1 - 1.25	**Kg / M³**
Sand Content	<0.25	**%**
Viscosity	42	**Seconds**
pH	8.5-9.5	**Value**
PV/YP	5 - 20 / 10 - 20	**Value**
Water Hardness	<100	**Mg/LO**
Fluid Filtrate	8-13	**cc**
10 Second Gel Strength	10-20	**Factor**
10 Minute Gel Strength	18-35	**Factor**

2.2 Pilot Hole Hydraulics

Annular Velocity of 6 1/2 Pilot

Ft / Min	Mtrs / Min	Gal / Mins	Ltrs / Min
73	22	68	256
97	30	90	341
108	33	100	379
119	36	110	417
135	41	125	474

Bottoms Up Time

Based on Predicted Flow Rate of 100 Gallons

Bottoms Up (Mins)	Percent of Hole Complete
5	**25%**
10	**50%**
16	**75%**
21	**100%**

Total Circulation Time

Based on Predicted Flow Rate of 100 Gallons

Total Circulation (Mins)	Percent of Hole Complete
6	**25%**
12	**50%**
18	**75%**
24	**100%**

3. Reaming Stage One

3.1 Stage One Reaming

Ream Hole Diameter :	12	Inch	304.8	mm	
Ream Length:	1378.0	Feet	420.0	Mtrs	

Hole Volume

	Factor	Imperial	Factor	Metric	
Prev. Hole Diameter	6 1/2	**Inches**	164	**mm**	
Prev. Hole Volume	6	**Gal / Mtre**	21	**Ltrs / Mtre**	
Total Prev. Hole	2355	**Gal / Mtre**	8915	**Ltrs**	9 **M³**
New Ream Volume	5741	**Gallon**	21730	**Ltrs**	
New Ream Volume	19	**Gal / Mtre**	73	**Ltrs / Mtre**	
Total Ream Volume	8096	**Gallon**	30646	**Ltrs**	
Total Hole Volume			31	**M³**	

	Factor	Imperial	Factor	Metric	Factor	
New Volume Required	2355	**Gallons**	8915	**Ltrs**	8.92	**M³**
Total Mixed - 1.1 X's New Ream Volume	2591	**Gallons**	9807	**Ltrs**	9.81	**M³**
Pits Volume	1585	**Gallons**	6000	**Ltrs**	6.00	**M³**
Volume Mixed	2591	**Gallons**	9807	**Ltrs**	9.81	**M³**
New Hole Volume	8096	**Gallons**	30646	**Ltrs**	30.65	**M³**
Total Circ. Volume	8096	**Gallons**	30646	**Ltrs**	30.65	**M³**
Losses	0	**Gallons**	0	**Ltrs**	0.00	**M³**

3.2 Stage One Reaming Fluid Design

Reaming Fluid Design	Amount	Factor	Total Required	Factor	Req Units
SODA ASH	0.5	**Kgs / M³**	5	**Kgs**	0
QUIK-GEL GOLD	45	**Kgs / M³**	441	**Kgs**	19
QUIK-TROL GOLD LV	1.5	**Kgs / M³**	15	**Kgs**	1
SODIUM BICARBONATE	0	**Kgs / M³**	0	**Kgs**	0
CON DET	0	**Kgs / M³**	0	**Kgs**	0

Reaming Fluid Properties	Value	Determined Value
Weight	1.15-1.25	**Kg / M³**
Sand	<0.25	**%**
Viscosity	70 - 120	**Seconds**
pH	8-9.5	**Value**
PV/YP	5 - 15 / 10 - 20	**Value**
Water Hardness	<100	**Mg/LO**
Filtrate	8-13	**cc**
Gel Strength 10 Second	25-40	**Factor**
Gel Strength 10 Minute	40-80	**Factor**
Mud Weight Sp Gr	1.15-1.25	**Kg / Litre**
Mud Weight @ Exit	11.25	**Lbs / US Gal**
Exit Mud Sp Gr	1.35	**Kg / Litre**

(If 100 % Solids Exited)

3.3 Stage One Reaming Fluid Hydraulics

	Factor	Imperial	Factor	Metric
Output # 1 Pump	100	**Gal / Min**	379	**Ltrs / Mtre**
Output # 2 Pump	0	**Gal / Min**	0	**Ltrs / Mtre**
Total Pump Output	100	**Gal / Min**	379	**Ltrs / Mtre**
Velocity To Exit	20	**Ft / Min**	6.0	**Mtrs / Min**
Pump Mins / Joint	3	**Minutes**		
Drill Rod Length	20.01	**Feet**	6.1	**Mtrs**
No of Rods in String	69	**Estimated**		

DRILLING FLUID MANAGEMENT PLAN

HPSAUS-FLUID-001 18/03/2024

Annular Velocity of 12 Inch Ream

Ft / Min	Mtrs / Min	Gal / Mins	Ltrs / Min
13	4	68	256
18	5	90	341
20	6	100	379
22	7	110	417
25	7	125	474

Bottoms Up Time

Based on Predicted Flow Rate of 100 Gallons

Bottoms Up (Mins)	Percent of Hole Complete
20	**25%**
39	**50%**
59	**75%**
78	**100%**

Total Circulation Time

Based on Predicted Flow Rate of 100 Gallons

Total Circulation (Mins)	Percent of Hole Complete
20	**25%**
40	**50%**
61	**75%**
81	**100%**

4. Reaming Stage Two

4.1 Stage Two Reaming

Ream Hole Diameter :	18	Inch	457.2	mm
Ream Length:	1378.0	Feet	420	Mtrs

Hole Volume

	Factor	Imperial	Factor	Metric		
Prev. Hole Diam :	12	**Inches**	305	**mm**		
Prev. Hole Volume :	19	**Gal / Mtre**	73	**Ltrs / Meter**		
Total Prev. Hole :	8096	**Gallons**	30646	**Ltrs**	31	**M³**
New Ream Volume :	10120	**Gallons**	38307	**Ltrs**		
New Ream Volume	43	**Gal / Mtre**	164	**Ltrs / Mtre**		
Total Ream Volume :	18215	**Gallons**	68953	**Ltrs**		
Total Hole Volume :			68.95	**M³**		

	Factor	Imperial	Factor	Metric		
New Volume Req'd :	10120	**Gallons**	38307	**Ltrs**	38.31	**M³**
Total Mixed - 1.1 New Ream Volume	11132	**Gallons**	42138	**Ltrs**	42.14	**M³**
Pit Volume :	1585	**Gallons**	6000	**Ltrs**	6.00	**M³**
Volume Mixed :	11132	**Gallons**	42138	**Ltrs**	42.14	**M³**
New Hole Volume :	10120	**Gallons**	38307	**Ltrs**	68.95	**M³**
Total Circ. Volume :	10120	**Gallons**	38307	**Ltrs**	68.95	**M³**
Losses :	0	**Gallons**	0	**Ltrs**	0.00	**M³**

DRILLING FLUID MANAGEMENT PLAN

HPSAUS-FLUID-001 18/03/2024

4.2 Stage Two Reaming Fluid Design

Reaming Fluid Design	Amount	Factor	Total Required	Factor	Req Units
SODA ASH	0.5	**Kgs / M³**	21	**Kgs**	1
QUIK-GEL GOLD	45	**Kgs / M³**	1896	**Kgs**	84
QUIK-TROL GOLD LV	1.5	**Kgs / M³**	63	**Kgs**	4
SODIUM BICARBONATE	0	**Kgs / M³**	0	**Kgs**	0
CON DET	0	**Kgs / M³**	0	**Kgs**	0

Reaming Fluid Properties	Value	Determined Value
Weight	1.15-1.25	**Kg / M³**
Sand	<0.25	**%**
Viscosity	70 - 120	**Seconds**
pH	8-9.5	**Value**
PV/YP	5 - 15 / 10 - 20	**Value**
Water Hardness	<100	**Mg/LO**
Filtrate	8-13	**cc**
Gel Strength 10 Second	25-40	**Factor**
Gel Strength 10 Minute	40-80	**Factor**
Mud Weight Sp Gr	1.15	**Kg / Litre**
Mud Weight @ Exit :	11.25	**Lbs / US Gal**
Exit Mud S.G :	1.35	**Kg / Litre**

(If 100 % Solids Exited)

4.3 Stage Two Reaming Fluid Hydraulics

	Factor	Imperial	Factor	Metric
Output # 1 Pump :	100.1	**Gal / Min**	379.0	**Ltrs / Mtre**
Output # 2 Pump :	0.0	**Gal / Min**	0.0	**Ltrs / Mtre**
Total Pump Output :	100.1	**Gal / Min**	379.0	**Ltrs / Mtre**
Velocity To Exit :	8.0	**Ft / Min**	2.5	**Mtrs / Min**
Pump Mins / Joint :	3			
Drill Rod Length	20.0	**Feet**	6.1	**Mtrs**
No of Rods in String	69	**Estimated**		

Annular Velocity of 18 Inch Ream

Ft / Min	Mtrs / Min	Gal / Mins	Ltrs / Min
5.4	1.7	68	256
7.2	2.2	90	341
8.0	2.5	100	379
8.9	2.7	110	417
10.1	3.1	125	474

Bottoms Up Time

Based on Predicted Flow Rate of 100 Gallons

Bottoms Up (Mins)	Percent of Hole Complete
45	**25%**
90	**50%**
134	**75%**
179	**100%**

Total Circulation Time

Based on Predicted Flow Rate of 100 Gallons

Total Circulation (Mins)	Percent of Hole Complete
45	**25%**
91	**50%**
136	**75%**
182	**100%**

5 Pipe Pull Displacement

5.1 Displacement Values

Material	Length	Size of Pipe	
HDPE	420.0 m	315 mm	12 Inch

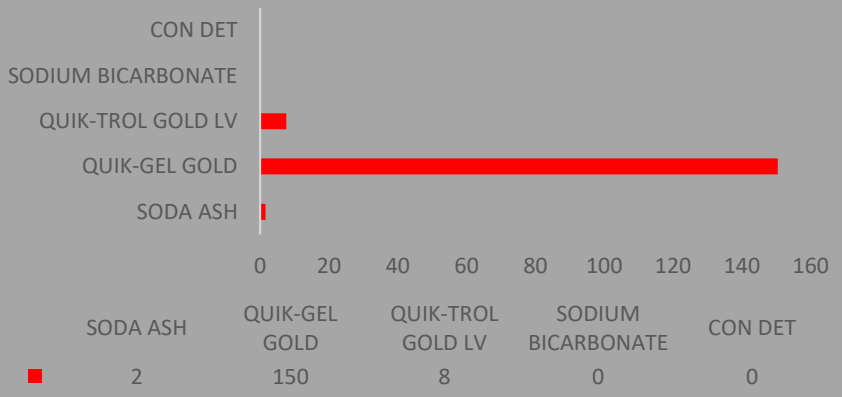
Displacement	Imperial		Metric			
Factors	8647	**Gallons**	32731	**Litres**	33	**M³**

DRILLING FLUID MANAGEMENT PLAN

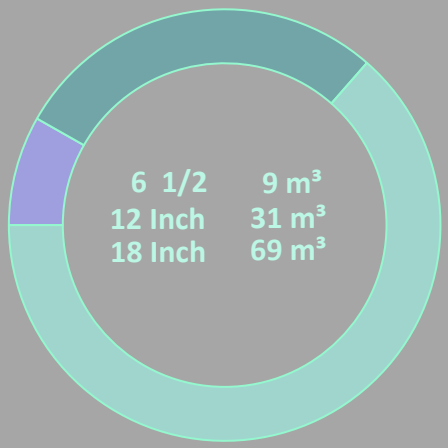
HPSAUS-FLUID-001 18/03/2024

6 Reaming Overview

Drilling Products Required

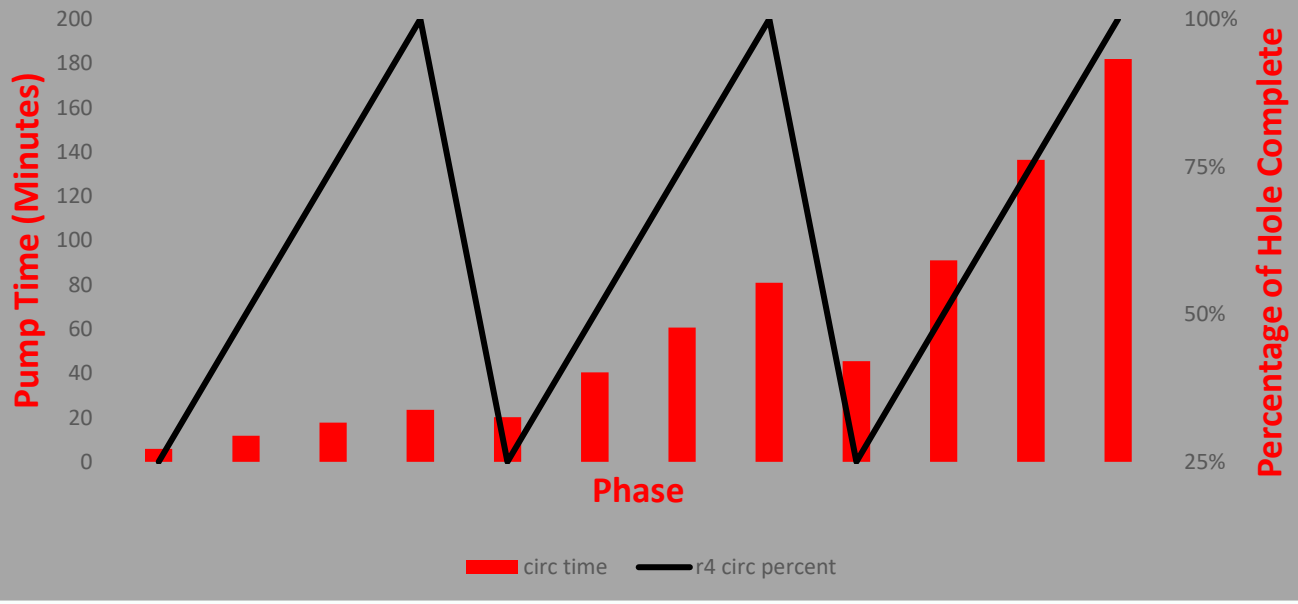


Ream Size Volumes Comparabilty



Above usage is based on the Factor of Safety amount of 1.1

Total Circulation Time



		25%	50%	75%	100%
	6 1/2	6 Mins	12 Mins	18 Mins	24 Mins
12	**Inch Ream**	20 Mins	40 Mins	61 Mins	81 Mins
18	**Inch Ream**	45 Mins	91 Mins	136 Mins	182 Mins

7 References

- Bennett and Wallin, 2008. Step-By-Step Evaluation of Hydrofracture Risks for HDD Projects, Proceedings of 2008 No-Dig Conference, Dallas, Texas, April 27-May 2, 2008
- Luger, H.J., and Hergarden, A.M., 1988. Directional Drilling in Soft Soil: Influence of Mud Pressures, International Society of Trenchless Technology, No-Dig Conference 1988.
- Gilles Gabolde, and Jean-Paul Nguyen 2006 Drilling Data Handbook Eighth Edition
- David Bennett, Ph.D. P.E., Samuel T. Ariaratnam, Ph.D., P.E., P.Eng. NASTT's Horizontal Directional Drilling (HDD) Good Practices Guidelines – 4th Edition, 2017
- Australasian Society for Trenchless Technology Standard for Horizontal Directional Drilling 2015

DRILLING FLUID MANAGEMENT PLAN

Drilling Terminology Definitions

Annular Velocity - A measure of the rate at which the drilling fluid, often referred to as mud, circulates through the annulus - the space between the drill pipe and bore hole. It ensures the efficient transport of cuttings from the drill bit to the surface, aids in cooling and lubricating the drill bit, helps manage hydrostatic pressure in the borehole to prevent hydrofracture events, and contributes to the stability of the borehole. The annular velocity is calculated by dividing the flow rate of the drilling fluid by the cross-sectional area of the annulus and is usually expressed in feet per minute (ft/min) or meters per minute (m/min).

Bottoms Up Time - Refers to the duration it takes for drilling fluid to travel from the bottom of the Bottom Hole Assembly to the surface. This time is crucial for several reasons: it indicates how long it takes for cuttings and debris to be carried out of the hole, helps in evaluating the efficiency of the drilling fluid circulation system, and is essential for real-time monitoring of the holes condition. Calculating bottoms-up time is a critical aspect of ensuring the safety and efficiency of drilling operations.

Bottom Hole Assembly (BHA) - Refers to the collection of tools and devices attached at the drill string that are essential for various cutting, drilling, and penetration operations.

Total Circulating Time - Is the time it takes for the drilling fluid, to travel from the surface through the drill pipe and back to surface.

Drilling Fluid Definitions

Viscosity - refers to the resistance of a drilling fluid to flow. It's a measure of the fluid's internal friction or thickness. In HDD operations, the viscosity of the drilling fluid is crucial because it influences the fluid's ability to suspend and transport drilled cuttings out of the borehole, cool and lubricate the drill bit, and stabilize the borehole wall. A proper balance is needed: too high viscosity can cause excessive pump pressure and inefficient cutting removal, while too low viscosity may lead to inadequate hole cleaning and poor borehole stability.

Mud Weight - is the measure of the drilling fluid's density, usually quantified in pounds per gallon (ppg) or kilograms per cubic meter (SP/GR - g per cm^3). This parameter is crucial in HDD as it governs the balance of underground pressures encountered during the drilling process.

Sand content - signifies the proportion of sand-sized particles (smaller than 74 microns) in the drilling fluid, impacting equipment wear, fluid properties, and borehole stability. High sand content can lead to increased abrasiveness, affecting drilling efficiency and the condition of the borehole. The sand content is typically managed using mechanical solids control equipment and is measured by passing the drilling fluid through a 200+mesh screen, with results expressed as a percentage of the fluid’s total volume.

Drilling Fluid Definitions - Continued

pH - The pH level in drilling fluid is a crucial indicator of its acidity or alkalinity, measured on a scale from 0 (acidic) to 14 (alkaline), with 7 being neutral. This level influences the drilling fluid's ability to prevent equipment corrosion, effectiveness of additives, borehole stability, and reactions with the geological formation. In drilling operations, maintaining the optimal pH is essential for operational efficiency and adjusted using specific chemicals.

Plastic Viscosity (PV) -a key parameter in drilling fluid mechanics, measures the flow resistance due to mechanical friction. Its variation is influenced by several factors:

The concentration of solids in the fluid
The size and shape of these solids
The viscosity of the fluid's base component

A rise in plastic viscosity is often linked to increased solids concentration, smaller solid particles, changes in the shape of these solids, or a combination of these elements. You can verify an increase in solids concentration through methods like density measurement or retort analysis.
To modify drilling fluid properties, certain solids like bentonite (for viscosity) are intentionally added. Conversely, drilled solids or cuttings, which are unintentional, can disrupt the fluid's designed properties. These are typically removed using methods such as mechanical solids control, settling, or dilution/displacement.
The viscosity of the fluid phase itself also plays a role in plastic viscosity. For instance, water's viscosity decreases as temperature increases, which in turn reduces the plastic viscosity. Maintaining a low plastic viscosity is crucial as it leads to more efficient energy transfer to the drilling bit, improved hole cleaning, and reduced equipment wear.

Yield Point (YP) lb/100ft^2- The fluid's resistance to initial flow, or essentially, the stress required to start moving the fluid. It is a critical parameter in the rheology of drilling muds. The yield point indicates the fluid's ability to carry and suspend cuttings and other solids out of the borehole. A higher yield point suggests better suspension capabilities, crucial for maintaining borehole cleanliness and preventing sedimentation. However, too high a yield point can lead to issues such as increased pump pressure and inefficient flow. This parameter is typically measured in force per unit area, such as pounds per 100 square feet (lb/100 ft^2), and is determined using specialized rheological tests. Adjusting the yield point to the right level is vital for the effective and efficient performance of drilling operations.

On-site, plastic viscosity and yeild point is computed using the formula:

PV (centipose) = Reading at 600 RPM - 300rpm
YV (lb/100ft^2) = Reading at 300 RPM minus PV

Drilling Fluid Definitions - Continued

Water Hardness - Water hardness in drilling fluid refers to the concentration of dissolved minerals, primarily calcium and magnesium, in the water used to make the drilling mud. Measured in parts per million (ppm) or grains per gallon (gpg), water hardness is a significant factor in drilling operations because these minerals can react with certain mud additives, affecting the fluid's properties and performance. For instance, high water hardness can lead to issues such as reduced effectiveness of shale stabilizers, increased risk of formation damage, and challenges in maintaining the desired viscosity and pH levels. In some drilling scenarios, particularly those involving sensitive formations or specific mud compositions, controlling water hardness is crucial for optimal drilling efficiency and to prevent equipment corrosion or scale buildup. This is often managed by treating the water with softening agents or using water with known low hardness levels

Fluid Filtrate - Filtrate in drilling fluid refers to the liquid portion that separates and passes through the formation during the drilling process. When drilling fluid is exposed to the permeable layers of the earth, the solid components of the fluid are designed to form a filter cake on the borehole walls, while the liquid part (filtrate) can penetrate the formation. The properties of the filtrate, such as its chemical composition and the amount that invades the formation, are critical in drilling operations. Excessive filtrate invasion can lead to formation damage, alteration of the formation's properties, and complications in subsequent operations like well logging and completion. Therefore, controlling the filtrate characteristics, such as its volume and composition, is essential to minimize impact on the formation and ensure the efficiency and safety of the drilling process. This is typically achieved through careful selection and management of drilling fluid components and properties.

Gel Strength - The 10-second gel strength test measures the initial gel strength of a drilling fluid, which is determined by assessing the shear stress required to initiate fluid flow after resting for 10 seconds. This test evaluates the fluid's ability to suspend cuttings and prevent sag when circulation is momentarily stopped. In contrast, the 10 Minute Gel Strength Test evaluates the same parameters but after a 10-minute static period, providing insight into the fluid's long-term suspension characteristics.

DRILLING FLUID MANAGEMENT PLAN

HPSAUS-FLUID-001 18/03/2024

The Product Estimator

Disclaimer

This product utilisation estimator operates based on the parameters outlined in the supplied information, incorporating an additional contingency factor as detailed subsequently. The estimator is designed to account for various operational aspects, including fluid permeation, fluid loss across screening interfaces, and other general losses typically encountered in drilling operations. This tool serves merely as a guideline and provides indicative estimates. Comprehensive due diligence and verification of these estimates are the contractor's responsibility and should be undertaken to ensure accuracy and applicability to specific project requirements.

Hole Volume and Above Ground Storage	**90.95**	**m³**	
Drilling Fluid Allowance Factor vs Fluid Requirement	**1.1**		**X's More Than Volume**
Allowable Fluid Total	**100**	**m³**	

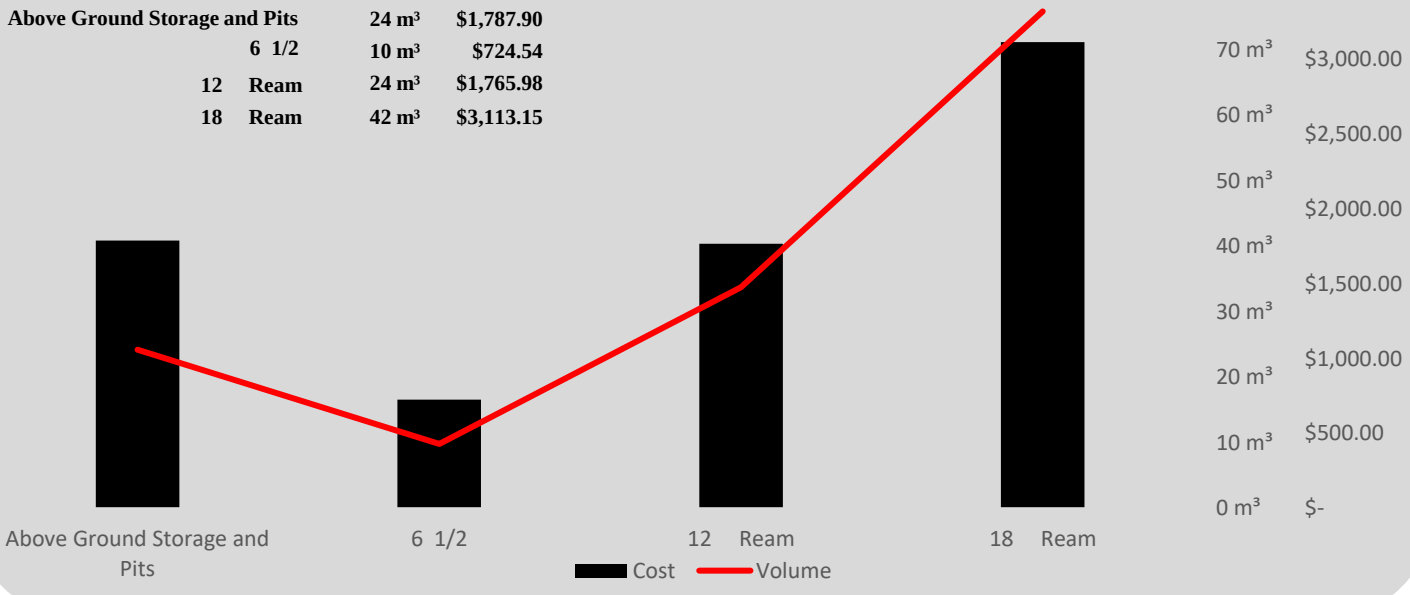
Product	Supplier	Size KG	Cost Per KG	Cost Per Bag	KG Per m³	Total Amount	Cost
SODA ASH	Baroid	25	$ 0.80	$ 20.00	0.5	2	**$30.34**
QUIK-GEL GOLD	Baroid	22.7	$ 1.30	$ 29.50	45	150	**$4,435.61**
QUIK-TROL GOLD LV	Baroid	15	$ 10.00	$ 150.00	1.5	8	**$1,137.72**
SODIUM BICARBONATE	Baroid	20	$ -	$ -	0	0	**$0.00**
CON DET	Baroid	20	$ -	$ -	0	0	**$0.00**
						Ex Gst	**$5,603.67**
						Inc GST	**$6,164.03**

Benonite Pallet Calculator

Bags per pallet	**48**	**Bags**
Total	**3**	**Pallets**

Cost Estimate Per Phase

Above Ground Storage and Pits		**24 m³**	**$1,787.90**
	6 1/2	**10 m³**	**$724.54**
12	**Ream**	**24 m³**	**$1,765.98**
18	**Ream**	**42 m³**	**$3,113.15**



Sullage Estimator

Disclaimer

This Sullage estimator operates based on the parameters outlined in the supplied information, incorporating an additional contingency factor as detailed subsequently. The estimator is designed to account for various operational aspects, including fluid permeation, fluid loss across screening interfaces, and other general losses typically encountered in drilling operations. This tool serves merely as a guideline and provides indicative estimates. Comprehensive due diligence and verification of these estimates are the contractor's responsibility and should be undertaken to ensure accuracy and applicability to specific project requirements. Estimation is based on 100% cuttings removal during drilling operations and exact truck volumes filled per load. No safety factor has been applied for the calculation below.

Above Ground Storage	**16**	**M³**
Displacement Of Pullback	**33**	**M³**
Total Hole Volume	**69**	**M³**
Total Fluid	**118**	**M³**

	Factor	Imperial	Factor	Metric
Truck Storage Size	2642	**Gallons**	10000	**Litres**

Hole Displacement Factors	Factor	Imperial	Factor	Metric		Truck Loads Req
Pilot	2355	**Gallons**	8915	**Ltrs**	9 M³	0.9
Stage One Reaming	5741	**Gallons**	21730	**Ltrs**	22 M³	2.2
Stage Two Reaming	10120	**Gallons**	38307	**Ltrs**	38 M³	3.8
Pipe Pull Displacement	8647	**Gallons**	32731	**Ltrs**	33 M³	3
Above Ground Storage Systems	4227	**Gallons**	16000	**Ltrs**	16 M³	1.6
Total Amount	**31089**	**Gallons**	**117684**	**Ltrs**	**118 M³**	**12**

	Cost Per Truck Load	Number Of Loads	Total Sullage Disposal Cost
Sullage Costing	$ 1,100.00	12	$ 12,945.22

	Houring Running Cost	Hours per Load	Total Operating Cost
Truck Operating Cost	$ 180.00	1.5	$ 3,177.46
	Overall Toal		**$ 16,122.68**

Tooling Hours Calculator

Disclaimer

The Tooling Hours Calculator operates based on the parameters outlined in the supplied information. This tool serves merely as a guideline and provides indicative estimates. Comprehensive due diligence and verification of these estimates are the contractor's responsibility and should be undertaken to ensure accuracy and applicability to specific project requirements.

Project Parameters	Factor	Imperial	Factor	Metric
Length	1378	**Feet**	420.00	**Meters**
Drill Pipe Length	20.013	**Feet**	6.1	**Meters**

Geology	
Formation	Rock
Geology Structure	Consistant
Mpa	50-150

Planned Stages	Factor	Imperial	Factor	Metric
Pilot	6 1/2	**Inch**	164.4	**Millimeters**
Cut Size 1	12	**Inch**	305	**Millimeters**
Cut Size 2	18	**Inch**	457	**Millimeters**

Expected Rate of Penetration	Hours/Minutes	Time Per Drill Pipe
Pilot	63:38	0:55
Cut Size 1	87:30	1:16
Cut Size 2	87:30	1:16

	Hours
Total	238:38

Shift Production Calculator

Disclaimer

The Shift Production Calculator operates based on the parameters outlined in the supplied information, incorporating an additional contingency factor as detailed subsequently. This tool serves merely as a guideline and provides indicative estimates. Comprehensive due diligence and verification of these estimates are the contractor's responsibility and should be undertaken to ensure accuracy and applicability to specific project requirements. This calculation is based on production cutting only and does not allow for tripping of pipe, tool changes and breakdowns etc.

Project Parameters	Factor	Imperial	Factor	Metric
Length	1378	**Feet**	420.00	**Meters**
Drill Pipe Length	20.0	**Feet**	6.1	**Meters**

Geology	
Formation	Rock
Geology Structure	Consistant
Mpa	50-150

Planned Stages	Factor	Imperial	Factor	Metric	ROP Per/Min	ROP Total Hours
Pilot	6 1/2	**Inch**	164.4	**Millimeters**	**0.11**	63:38 Hr/Min
Cut Size 1	12	**Inch**	305	**Millimeters**	**0.08**	87:30 Hr/Min
Cut Size 2	18	**Inch**	457	**Millimeters**	**0.08**	87:30 Hr/Min

Project TimeFrame Outline	Factor
Allowable Working Hours	10 Hours
Shift Production Drilling Allocation	7 Hours
Percentage of Production Drilling Per Shift	70%

Planned Stages	Shifts Required
Pilot	9.1 Shifts
Cut Size 1	12.5 Shifts
Cut Size 2	12.5 Shifts

Total Shifts Required	34.1 Shifts