ATTACHMENT 11

EXAMPLE DRILLING FLUID (MUD) PLAN FOR REGION 10 OIL AND GAS NPDES PERMITS

I. INTRODUCTION TO REGION 10 EXAMPLE Drilling Fluid PLAN

A. Background

Since 1984 and issuance of the first general NPDES permits based on BPJ/BAT, Region 10 has performed a separate evaluation for every individual drilling fluid/additive system that required discharge authorization under its oil & gas permits. During this period of time (roughly mid-1984 to 1992) the Region gathered bioassay data, chemical and product inventories of discharged drilling fluids and developed a considerable library of bioassay data on various drilling fluids, additives and systems. As bioassay data accumulated and as the technology of formulating drilling fluid/additive systems advanced, the task of evaluating each request for authorization got increasingly resource-intensive and time-consuming.

In 1992 the Region realized that the established process for drilling fluid/additive evaluation and authorization was no longer realistic in terms of time and resources. So, in July 1992 Region 10 held a technical meeting with oil & gas operators and drilling fluid companies working in Alaska to address the situation. Most agreed that the Region's conservative worst-case approach to toxicity evaluation had, in fact, motivated Alaskan operators to plan ahead for drilling fluid/additive systems that would most likely not exceed the Agency's toxicity criterion. This planning ahead resulted in proposals for (a) lower concentrations of products, (b) fewer components and additives, and (c) fewer last-minute changes to systems once drilling began. The tasks left to the Region were evaluation of bioassay data pertinent to the proposed system(s), documentation of qualifications and assumptions about the data or estimated toxicities, and compilation of the estimates as a basis for its best professional judgment (BPJ) regarding the discharge.

Region 10 believes that drilling fluid plans will be manageable for most operators if viewed in terms of steps or phases. The "planning ahead" phase is general standard procedure for Alaskan permittees. Procedures for estimating discharge toxicity are fairly straight-forward and can be easily managed by computer software. The final phase of documenting drilling fluid/additive decisions and their bases consumes the most time and will only get easier with experience.

With the advent of computerized record-keeping and the ability to locate information or bioassay data quickly, Region 10 believes the industry in Alaska is well equipped to proceed with developing Drilling Fluid Plans on a well-by-well basis.

B. Why have a Drilling Fluid Plan?

In 1993 the Region issued an individual NPDES permit for oil & gas exploration which was significantly different from previous permits in that it contained a requirement for a "mud plan." The concept is that planning ahead will not only aid permittees and their mud contractors in meeting the effluent toxicity limit, but that writing the plan down (i.e., decision criteria for "what-if" and "what-to-do-when") will ensure consistency with other permit requirements (for drilling fluids/cuttings) as well. In situations where permit limits are not met, the Drilling Fluid Plan will be a useful tool in helping both the permittee and the Agency ascertain some of the reason(s) for noncompliance.

II. EXAMPLE DRILLING FLUID PLAN BASIS

In late 1994 Region 10 proposed the Arctic general NPDES permit with a "mud plan" requirement. In response to the many comments made about the plan, the Region 10 Oil & Gas NPDES Permitting Team developed the following example of a drilling fluid plan for operators to use when they begin developing separate drilling fluid plans for actual use.

The Example Drilling Fluid Plan is based on actual evaluations of proposed drilling fluid/additive systems from past permits (all of which are a matter of public record). The key component to each drilling fluid/additive authorization is its accompanying BPJ/BAT evaluation, usually in the form of a memo to the NPDES permit file. The Example Mud Plan is based on the Region's own style of evaluation and is compiled of information from several NPDES permit files, real and fictitious bioassay data. Region 10 also used end-of-well reports as a basis for organizing the information in this example. This is only a sample of how information required in a Drilling Fluid Plan may be organized. Region 10 expects permittees will develop a variety of styles and formats developed as they gain experience in preparing Drilling Fluid Plans.

DRILLING FLUID (MUD) PLAN

GOB Oil Company
123 Northwest A St., Suite #10
Anchorage, AK 99510

Contacts:	There will be two alternating shifts for the duration of this well	
Shift Spvsr.:	B.J. Fleur	(123) 555-1212
	B.J. Green	
Drilling Engr.:	T.M. Brown	(123) 555-1213
	N. Vermiel	
MY Drilling:	P.C. Handy	(123) 555-1214

Operation Identification

Well:	Thorglid #3	Latitude:	X° XX' XX.X"
NPDES #:	AKG28000X	Longitude:	Y° YY' YY.Y"
Receiving Water:	Beaufort Sea	Lease & Block:	OCS-&-1583, #3
		Water Depth:	75 ft (MLLW)

Summary of Drilling Fluids to be Used on this Well

1st Interval from Spud – 12" casing
Salt water spud mud – details at ...
Tab #1 – inventory & toxicity
Tab #4 – criteria for contingency additives

2nd Interval from 12" – 9 5/8" casing
Cook Inlet/Generic Mud 2 type – details at ...
Tab #2 – inventory & toxicity
Tab #4 – criteria for contingency additives

3rd Interval from 9 5/8" casing to target depth
Custom potassium-chloride (KCl) fluid – details at ...
Tab #3 – inventory & toxicity
Tab #4 – criteria for contingency additives

*** **To the GOB Oil Co. and in the context of this mud plan "contingency additives" means components of the mud/additive system that will be used only as needed (e.g., for stuck pipe, filtration control, general lubricity)**

*** **See Tab #4 for GOB Oil Co. policy regarding use of mud components or additives that are not included on separate inventories for each system (Tabs 1, 2 & 3). Further, it is GOB policy that, BEFORE putting any such additive into the mud, approval of the Drilling Engineer must be noted on/in this document (including date & time of decision to add "unlisted" product). These GOB policies likewise apply to any concentration of product that is greater than the amount listed on**

proposed mud inventories.

TAB #1
Proposed Inventory: Saltwater Spud Mud

*** GOB requires that maximum concentration shall not be exceeded at any given time in this mud. Maximum concentration shall be calculated based on the amount of mud circulating, concentration of product already in the mud and the amount of product added each day.**

Basic Product	Product Name(s)	Maximum Concentration
Base Mud		
Bentonite	stock product	50 lb/bbl
Barite	MY Bar	180 lb/bbl
Soda ash/sodium bicarbonate	stock product	2 lb/bbl
Caustic (KOH or NaOH)	stock product	2 lb/bbl
Additives		

Per GOB standard drilling operation policy, the additives are relatively inert and are unlikely to cause toxicity of discharged mud to exceed the permitted toxicity limit (i.e., exhibit 96-hr LC50 of less than 300,000 ppm SPP). Thus, the following may be added to saltwater/spud mud at concentrations shown without review/approval by the GOB Drilling Engineer:

Glass, plastic, teflon spheres		10 lb/bbl
Mica or crushed nut hulls		as needed
---	Torq-Trim II	6 lb/bbl

Toxicity Estimate(s): Saltwater Spud Mud

Used-Mud Bioassay Bases: the same mud formulation as above was used (& bioassayed) on previous GOB wells – bioassay citations are as follows:

Thorglid #2, 96-hr LC50 = >1,000,000 ppm SPP (EPA Drilling Fluids Toxicity Test)

- Bioassay Citation: Marine Bioassay Labs for GOB Oil. MBL Report No. 93-1587, dated 12/5-9/93.
- Sample # GOB/TK1-001A, taken 12/2/93.

Thorglid #1, 96-hr LC50 = >1,000,000 ppm SPP (EPA Drilling Fluids Toxicity Test)

- Bioassay Citation: Espey, Huston & Assoc. for GOB Oil. EHA document # 825467, dated 12/15-19/92.

Black Gulch #78, 96-hr LC50 = >895,000 ppm SPP (EPA Drilling Fluids Toxicity Test)

- Sample taken 7/3/89.
- Bioassay Citation: E.A. Anon & Assoc. for GOB Oil, EAAAA #578928-GOB/BG, dated 7/4-9/89.

Note: Per GOB review, the muds cited above contained all of the mud components planned for use on Thorglid #3 (see Tab 1A). GOB will allow discharge of any/all of the proposed mud components/additives (as described) at maximum concentrations shown.

TAB #2
Proposed Inventory: Cook Inlet/Generic Mud 2 Type

*** GOB requires that maximum concentrations shall not be exceeded at any given time in this mud. Maximum concentration shall be calculated based on the amount of mud circulating, concentration of product already in the mud and the amount of product added each day.**

Basic Product	Product Name(s)	Maximum Concentration
Base Mud		
Bentonite, attapulgite		50 lb/bbl
Barite	MY Bar	575 lb/bbl
Lignosulfonate	Spersene	15 lb/bbl
Lignite	Tannathin	10 lb/bbl
Caustic	Potash	5 lb/bbl
Bicarb	MY Bicarb	2 lb/bbl
PACs	Drispac UL	2 lb/bbl
	Drispac HL	1 lb/bbl
Additives		
Xanthan gum or welan gum	XC Polymer, Kelzan XCD Biozan	4.0 lb/bbl
Acrylic poly	EZ Mud DP	3.0 lb/bbl
---	Soltex, Baratrol	5.0 lb/bbl
---	Resinex, Poly RX, Durenex	4.0 lb/bbl
---	Defoam X	0.3 lb/bbl
Mica	stock product	as needed
Crushed nut hulls	stock product	as needed
Inert spheres	stock product	as needed
Mineral Oil Pill	Kwikspot w/Conoco LVT	>>>SEE PERMIT<<< residual mineral oil after removal NTE 2% v/v

Toxicity Estimate(s): Cook Inlet/Generic Mud 2 type

Used Mud Bioassays: GOB has used this mud on several occasions in Alaska. Note that each time the mud contained slightly different combinations and concentrations of base mud components and additives. So, the used-mud 96-hr LC50 values below create a range in which the discharge toxicity of this mud type on Thorgild #3 may reasonably be expected to fall.

Thorglid #1, 96-hr LC50 = 560,000 ppm SPP (EPA Drilling Fluids Toxicity Test)

- Sample #GOB/TG1-001B, taken 1/1/94 (<u>before</u> pill added)
- Bioassay citation: Marine Bioassay Labs for GOB Oil, MBL Report No. 94-0002, dated 1/6-11/94.

- Mud Contained following at time of sampling for bioassay:

45 lb/bbl	attapulgite
178 lb/bbl	barite
10 lb/bbl	chrome-free lignosulfonate
1.01 lb/bbl	caustic
3.8 lb/bbl	Soltex
3.3 lb/bbl	EX Mud DP

Thorglid #1, 96-hr LC50 = 75,348 ppm SPP (EPA Drilling Fluids Toxicity Test)

- Sample #GOB/TG1-001C, taken 1/2/94 (<u>after</u> removal of ~90% v/v of pill plus 50 bbl buffer before and after pill return – per permit requirements)
- Bioassay citation: MBL for GOB Oil, MBL Report No. 94-0002A, dated 1/6-11/94.
- Mud contained the following at time of sampling for bioassay:

45 lb/bbl	attapulgite
178 lb/bbl	barite
10 lb/bbl	chrome-gree lignosulfonate
1.01 lb/bbl	caustic
3.8 lb/bbl	Soltex
3.3 lb/bbl	EZ Mud DP
~10% v/v	Halliburton Pill (based estimated recovery of 90%)
1.2% v/v oil	Conoco LVT (by API Retort 13B)
5 lb/bbl	Halliburton MO-55
10 lb/bbl	Hyflow IV
10 lb/bbl	solids

Salmonid Well S-28 Redrill, 96-hr LC50 = 975,000 ppm SPP (EPA Drilling Fluids Toxicity Test)

- Sample #GOB/SS28RD-001, taken 6/23/93
- Bioassay citation: Baker/Hughes/Intech for GOB Oil, BHI Doc. 93012, dated 7/1/93
- Bioassayed mud contained the following:

45 lb/bbl	attapulgite
178 lb/bbl	barite
10 lb/bbl	chrome-free lignosulfonate
1.01 lb/bbl	caustic
1.2 lb/bbl	Drispac UL
0.08 lb/bbl	MaxPac

Estimates for Thorgild #3: Based on <u>all</u> proposed products being present at <u>maximum</u> proposed concentrations. Three cases (shown on attached spreadsheet) establish a range into which toxicity of discharged mud may be expected to fall. (<u>See attached for re-estimation</u>

procedure, use spreadsheet "TG3_Cl2.xls")

Given: Toxicity = 1/LC50 so, as toxicity increases the 96-hr LC50 value decreases. Permit limit is 30,000 ppm SPP (a 96-hr LC50 value)

in terms of toxicity:	1/30,000 > 1/75,000 > 1/1,000,000
in terms of 96-hr LC50s:	30,000 ppm < 75,000 ppm < 1,000,000 ppm SPP

Assumptions for estimates: Toxicity is additive & can be calculated as follows:

$1/LC50_{total} = 1/LC50_{base\ mud} + 1/LC50_{additive\ 1} + ... + 1/LC50_{additive\ n}$

See attached spreadsheet "TG3_Cl2.xls" dated 1/95. Three case estimates establish a range of estimated toxicity from 102,722 ppm SPP to 141,704 ppm SPP *without* a mineral oil pill. Each case represents a slightly different concentration of additives, depending on what was in the used mud as a basis for the case. For example, the before pill bioassay from Thorgild #1 contained Soltex while the Salmonid mud did not. So, the total concentration of Soltex represented in Case 2 (by Thorgild #1 before pill) is 9.8 lb/bbl while the total concentration represented in Case 3 (by Salmonid's used mud) is only 6 lb/bbl. (See attached table "Total Additive Concentration in Toxicity Estimates: CL2 for Thorgild #3.")

Mineral oil pills: Kwikspot is the pill in-stock for the Thorgild #3 well. So, in Cases 1-3, bioassay data for the Kwikspot formula is added and shows an estimated toxicity range between 38,472 and 42,643 ppm SPP. A fourth case, Case 4, is also shown on the spreadsheet because a pill was used on Thorgild #1, although not Kwikspot. In case a mineral oil pill is needed on Throgild #3, the after pill bioassay results from Thorgild #1 may be a reasonable basis for estimating toxicity because of pill/buffer removal and substantially similar base mud formulation.

Cook Inlet MudType 2+ Additives

Spreadsheet: "TG3_Cl2.xls"

Date(s) of Estimate(s): 1/1/95

Cumulative Toxicity Estimate for Muds Additives

Bioassay Reference	Additive	Tested Conc.	Proposed Conc.	LC50 (ppm SPP)	1/LC50
Base Mud 1: EPA Cl2					
Duke & Parrish, 6/84 (US EPA)	Generic mud 2			270,000	3.70E-06
	NOTE: This mud type is a compilation of generic muds 2, 7 & 8, originally tested in 1984 to determine baseline toxicities for generic muds. Since generic mud 2 of the later NPDES permits is comprised of 3 muds, the lowest toxicity of component muds from the 1984 report is used as a basis for toxicity estimation.				
Base Mud 2: Thorgild #1					
MBL #94-0002	Soltex	3.800	5.000	560,000	1.7857E-06
1/6-11/94	EZ Mud DP	3.300	3.000		
sampled 1/1/94 #GOB/TG-001B	**Note:** Also contained attapulgit. barite, Cr free lignosulfonate, caustic. This is a "before" pill mud sample.				
Base Mud 3: Salmonid S-28 RD					
BHI #93012	Drispac UL	1.200	3.000	975,000	1.0256E-06
7/1/1993	MaxPac	0.080			
sampled 6/26/93 #GOB/SS28RD-001	**Note:** Also contained attapulgit. barite, Cr free lignosulfonate, caustic.				
Additives					
ALASKAN MUD	Con Det	0.400		662,000	1.5106E-06
EHA #84399	Desco CF	0.500			
May-84	Benex (X-Tend II, Gelex)	0.100			
	Resinex (Poly RX, Dure	4.000	4.000		
	XC Polymer	0.500	4.000		
	Bara Brine Defoam	0.100			
	Soltex	6.000	5.000		
	Pac-L	1.000			
EHA #879907, 87-183, 7/85	Defoam X	0.300	0.300	833,527	1.1997E-06
MBL, #90746, 10/89	EZ Mud DP	3.000	3.000	125,000	8.000E-06
	******** ADD NEW BIOASSAY DATA & INFO HERE!!! ********				
EHA #85764/6850, 7/85	Biozan	2.000	4.000	757,000	1.321E-06
Milpark #5337, 6/90	XC/SCD Polymer	1.000	4.000	1,000,000	1.00E-06
Core, #911252, 9/91	Xanvis	3.000	4.000	1,000,000	1.00E-06
	Note: Total concentration of xanthan & welan gum is 4.0 lb/bbl. Using all LC50s makes the total concentration represented by estimated LC50 for discharge 6.5 lb/bbl.				
Mineral Oil Pills					
EHA #85454/6504, 5/85	Kwikspot (% v/v)	3.000	residual	61,000	1.6393E-05
	Note: Kwikspot bioassayed in this mud at full 3% v/v concentration.				

Toxicity Estimates (1/LC50a + 1/LC50b+...=1/LC50total)

Case Studies	Toxicity	Total Estimated	Est. Discharge LC50 (ppm SPP)
Case 1: EPA Cl2 Generic Mud			
Base Mud 1:	3.70370E-06		
Alaskan Mud Additives:	1.51057E-06		
Other Additives:	1.25207E-05		
Subtotal	1.77350E-05		**56,386**
Kwikspot m/o pill:	1.63934E-05		
Total	3.41284E-05		**29,301**
Case 2: Thorgild #1 Used Cl2 mud			
Base Mud 2:	1.78571E-06		
Alaskan Mud Additives:	1.51057E-06		
Other Additives:	1.25207E-05		
Subtotal	1.5817E-05		**63,223**
Kwikspot m/o pill:	1.63934E-05		
Total	3.22105E-05		**31,046**
Case 3: Salmonid Used Cl2 mud			
Base Mud 3:	1.02564E-06		
Alaska Mud Additives:	1.51057E-06		
Other Additives:	1.25207E-05		
Subtotal	1.50569E-05		**66,415**
Kwikspot m/o pill:	1.63934E-05		
Total	3.14504E-05		**31,796**
Case 4: Mineral Oil Pill Removed with buffers			
Thorgild #1 after pill Cl2 mud sample		Used	Proposed
attapulgite clay		45	50
barite		178	575
lignosulfonate		10	15
caustic (KOH)		1.01	5
Soltex		3.8	5
EZ Mud DP		3.3	3
residual Halliburton pill		~10% v/v	removal
residual m/o did not exceed 2%			NTE 2% v/v
MBL #94-0002A, 1/6-11/94 sampled 1/2/94, #GOB/TG-001C		75,348 ppm SPP	

Total Additive Concentrations in Toxicity Estimates Cl2 for Thorgild #3

This table does not include nut hulls, mica, cellophane flakes, and inert spheres. Concentrations shown are based on inventories attached to the bioassay reports.

		Case 1	Case 2	Case 3	Case 4
	Thorgild #3 MACs	**EPA Mud Cl2**	**Thorgild #1 (before pill)**	**Salmonid S-28RD**	**Thorgild #1 (after pill)**
Bentonite, attapulgite	b	50	45	45	45
Barite	575	450	178	178	178
Lignosulfonate	15	15	10	10	10
Lignite	10	10			
Caustic	5	5	1.01	1.01	1.01
Sodium Bicarbonate	2	2			
Polyanionic cellulose polymers (PACs)	3 total	5.1 total	1 total	3.28 total	1 total
Xanthan gum Welan gum	4 total	6.5 total	6.5 total	6.5 total	6.5 total
EZ Mud DP	3	3	6.3	3	9.3
Soltex, Baratrol	5	6	9.8	6	6
Resinex, Durenex, Poly RX	4	4	4	4	4
Defoam X	0.3	0.3	0.3	0.3	0.3
Con Det		0.4	0.4	0.4	0.4
Desco CF		0.5	0.5	0.5	0.5
Benex (X-Tend II, Gelex)		0.1	0.1	0.1	0.1
Bara Brine Defoam		0.1	0.1	0.1	0.1
					~10% v/v Haliburton m/o pill

Note (Case 4): This case represents a single mud sample, no other bioassay data were added as they were for Cases 1-3.

TAB #3
Proposed Inventory: Custom KCl Mud (Flo-Pro)

*** GOB requires that maximum concentrations shall not be exceeded at any given time in this mud. Maximum concentration shall be calculated based on the amount of mud circulating, concentration of product already in the mud and the amount of product added each day.**

Basic Product	Product Name(s)	Maximum Concentration
Base Mud		
Xanthan gum	Xanvis	4.0 lb/bbl
KOH	stock product	1.0 lb/bbl
Potassium chloride	stock product	NTE 5% by volume or 22 lb/bbl
Sodium chloride		NTE 50,000 mg/L Cl in discharge or ### lb/bbl
Calcium carbonate	Lowate	75 lb/bbl
Starch	Morrex, FL7 Plus	3.0 lb/bbl
Additives		
Welan gum	Biozan	2.0 lb/bbl
Xanthan gums	XC, XC Polymer, Xanvis	3.0 lb/bbl

Toxicity Estimate(s): Custom KCl Mud (Flo-Pro)

Base Mud: GOB's drilling fluid contractor (MY Muds) had the complete formulation of the proposed mud bioassayed with full concentrations of each base mud component (MY Labs., MY-0292, 9/92): the 96-hr LC50 for the custom mud formula was 73,000 ppm SPP. (See attached spreadsheet for re-estimation procedure, use spreadsheet "TG3_KCL.xls")

Additives: In the event that welan or xanthan gums are needed to treat the circulating mud, they may be used (& discharged) based on the following:

Given: Toxicity = 1/LC50 so, as toxicity increases the 96-hr LC50 value decreases. Permit limit is 30,000 ppm SPP (a 96-hr LC50 value)

in terms of toxicity: $1/30{,}000 > 1/75{,}000 > 1/1{,}000{,}000$

in terms of 96-hr LC50s: $30{,}000 \text{ ppm} < 75{,}000 \text{ ppm} < 1{,}000{,}000 \text{ ppm SPP}$

Assumption: Toxicity is additive & can be calculated as follows:

$$1/LC50_{total} = 1/LC50_{base\ mud} + 1/LC50_{additive\ 1} + \ldots + 1/LC50_{additive\ n}$$

See attached spreadsheet "TG3_KCL.xls" (Flo-Pro Custom). Estimated discharge toxicity is 62,418 ppm SPP based on addition of xanthan and welan gum polymers that were not bioassayed in the base mud.

Spreadsheet: "TG3_KCL.xls"

Date(s) of Estimate(s): 1/1/95

Cummulative Toxicity Estimate for Muds Additives

Flo-Pro Custom

Bioassay Reference	Additive	Tested Conc.	Proposed Conc.	LC50 (ppm SPP)	1/LC50
Base Mud 1: Custom KCl					
My Labs	Custom Mud			72,993	1.370E-05
MY-0292, 9/92	**NOTE:** This mud bioassayed with all components & additives at maximum conc.				
	xanthan gum	4.000	4.000		
	KOH caustic	1.000	1.000		
	potassium chloride	22.00	22.00		
	sodium chloride (mg/L Cl)	50,000	50,000		
	calcium carbonate	75.00	75.00		
	starch	3.000	3.000		
Additives					
EHA #85764/6850, 7/85	Biozan	2.000	4.000	757,000	1.321E-06
Core, #911252, 9/91	Xanvis	3.000	4.000	1,000,000	1.00E-06
	Note: Data for Biozan & Xanvis represent standard lignosulfonate mud WITHOUT KCl; however, no bioassay references could be found for these products in the Flo-Pro mud.				
	******** ADD NEW BIOASSAY DATA & INFO HERE!!! ********				
Mineral Oil Pills	none anticipated				

Toxicity Estimates
(1/LC50a + 1/LC50b+...=1/LC50total)

Case Studies		Total Estimated Toxicity	Est. Discharge LC50 (ppm SPP)
Case 1: Custom KCl Mud			
	Base Mud 1:	1.36999E-05	
	Other Additives:	2.32100E-06	
	Subtotal	1.60209E-05	62,418
	Mineral Oil Pill:	0.00000E+00	
	Total	1.60209E-05	62,418

TAB #4
GOB Oil – CRITERIA FOR CONTINGENCY ADDITIVES

IF any additive needed for any of the muds described in this plan <u>are not</u> listed on the proposed inventory for that mud (Tabs #1 – 3), it may not be used without first considering the following criteria:

1. Is there an alternative product already on the proposed inventory and in stock that will have the same affect in the mud? Double check this. GOB's operating policy is that products already in stock will be used before special shipments are arranged without approval by GOB Drilling Supervisor.

2. What is the nature of the additive? Is it relatively inert with respect to toxicity?

   - <u>*For drilling operations & mud formulation in general*</u>. GOB's policy is based on past evaluations of mud/additive systems to consider the following as "relatively inert": mica (as needed), cellophane flakes (as needed), nut hulls (as needed), inert spheres (as needed), SAPP (0.5 lb/bbl), calcium carbide (as needed), "vegetable plus polymer fibers, flakes, granules" (50 lb/bbl), zinc carbonate & lime (as needed), and zinc oxide (as needed). These additives may be applied to mud as required to achieve specific mud characteristics and/or performance.

   - <u>*For potassium-based muds*</u>. GOB's policy is that <u>*only*</u> the following may be added to the mud without a toxicity estimation: aluminum stearate (0.2 lb/bbl), ammonium nitrate (200 mg/L nitrate or 0.05 lb/bbl), calsium carbide (as needed), cellophane flakes (as needed), mica (as needed), inert spheres (as needed), crushed nut hulls (as needed), SAPP (0.5 lb/bbl), "vegetable plus polymer fibers, flakes, and granules" (50 lb/bbl), zinc carbonate & lime (as needed), and zinc carbonate (as needed).

3. GOB will not allow discharge of <u>any</u> drilling product containing diesel oil or non-aqueous drilling fluids as required by the general NPDES permit.

4. Some estimate of toxicity of the discharged whole mud/additive system is required as part of this mud plan. GOB has set-up the following process for Thorgild #3 operations:

   <u>*Calculate estimate of cumulative discharge toxicity*</u>. A laptop PC in mud room is loaded with a mud spreadsheet prepared by GOB for the proposed lignosulfonate mud (Cook Inlet type 2) and the custom KCl mud (Flo-Pro). Simply record bioassay data for the new additive as indicated on the spreadsheet, estimated discharge toxicity is automatically recalculated. Spreadsheets are titled with mudtype and well numbers – in this case, "TG3_KCL.xls" (for custom KCl Flo-Pro mud) and "TG3_Cl2.xls" (for saltwater

lignosulfonate mud). **DO NOT FORGET to save, print, and attach an initialed & dated copy of the re-estimation to this mud plan!**

Obtain bioassay information for the additive(s) under consideration from GOB's mud contractor's environmental office. Ask Y. Sun or P.C. Handy on shift or call MY Drilling Services at (123) 555-2727.

Try to locate bioassay data that represents the same concentration of product that you propose to use bioassay data for. If data is not available for the exact concentration, GOB requires that data on a greater concentration be used. For instance: need to use 0.5 lb/bbl and bioassay data is only available for 0.1 lb/bbl and 1.0 lb/bbl concentrations, then use the bioassay based on 1.0 lb/bbl concentration. This requirement is based on the assumption that drilling mud toxicity is additive.

GOB's policy is to find bioassay data that represents mud similar to the mud that you are treating. That is, if a lubricity additive needs to be added to a KCl-based mud, ask first for any bioassays for KCl-based muds that contained the additive; if none are available, then use bioassays for the additive in an unlike mud (e.g., "lignosulfonate reference mud", or "standard bioassay reference mud").

GOB and MY have agreed that it is acceptable to use bioassay data that represents mixtures of additives that may contain the additive needed. List the 'extra' additives and their concentrations as indicated on the spreadsheet. This documents the worst-case nature of your estimate – in that more additives are represented than will be used.

5. It is GOB policy that no mud additive shall be applied if the estimated discharge toxicity is less than the permitted 30,000 ppm SPP *unless* adequate written documentation is attached that shows the estimation is worst-case (i.e., more additives that will be used and/or higher concentrations of additive than will be used). Final decision to apply an additive that causes estimated discharge toxicity to exceed the permitted limit will be made by the Drilling Supervisor in concurrence with GOB environmental permitting department.

6. An additive which does not cause estimated discharge toxicity to exceed the permit limit of 30,000 ppm SPP may be discharged with approval by the Drilling Supervisor or Drilling Engineer.

TEST/REPORT	SAMPLE	WHEN TO...	WHERE TO...
Reports			
Mud inventories (from PC in mud room)	Muds only	• Whenever a sample is taken for bioassay • Whenever muds are changed over • At end-of-well for all muds	
Metals (from lab)	Muds	• For any mineral oil pill application • For end-of-well	• Attach to mineral oil pill report • See end-of-well report below
Sheen Reports (from PC in mud room)	All muds &/or cuttings discharges	Monthly as attachment to DMR	See table for Static Sheen, attached
Barite Mercury/Cadmium (from Lab or MY)	On stock barite only	At end-of-well	Attach to DMRs
End-of-well	Compilation of • metals • stock barite analyses • sheen spreadsheets for whole well • last bioassay report(s) • inventories for whole well & end-of-well sample	GOB Environmental Permitting Division will compile final report after individual pieces (bioassays, lab results, etc.) arrive from MY Drilling Services and the Drilling Supervisors & Engineers.	
Mineral Oil Pill Info	Muds "before" AND "after" pill	Whenever a pill is used – see NPDES permit requirements	Attach to bioassay report for these mud samples

STATIC SHEEN for the month of _____

Well: Thorgild #3
NPDES #: AKG28000X

Sheen Observed >>IF sheen is observed & discharge HAS occurred in the last 24 hours:
Notify Drilling Supervisor immediately of noncompliance (GOB must notify EPA within 24 hours)
Sample mud AND diesel oil on-board & prepare to ship for GC/MS analysis & comparison

Reason for discharge: "Batch" or "bulk" refer to discharges as result of changing over mud, reaching end-of-well.

When in doubt, make a note at the bottom of this Table, initial it & date it!

Type of Discharge M = mud C = cuttings M/C = both	**Reason for discharge** B = batch S = standard	**Date** (mm/dd/yy)	**Time** (hr:min am/pm)	**Observer's Initials**	**Sheen** NSO = no sheen observed SO = sheen observed	**Volume discharged** (est. bbls)	**Rate** (est. bbl/hr)	**Mud Type** (Spud, Cl2, KCl)