

**St. Croix Sensory, Inc.**

**Odor Evaluation Report**

Client: Arcadis US, Inc.

Report No.: 1507802

Project: Sierrita Mine

Evaluation Date: 03/19/15

#	Field No.	Sample Description	ASTM E679 & EN13725		ASTM E544	PERSISTENCY	CHARACTERIZATION		Comments
			Detection Threshold	Recognition Threshold	Intensity	Dose-Response Slope	Hedonic Tone	Principal Odor Descriptors	
1	1A	Moly Roasta Stack - Sample Port	580	310	46	-0.55	-1.2	Medicinal, Chemical, Earthy, Offensive	
2	2A	Flotation	330	180	117	-0.76	-4.0	Chemical, Offensive, Earthy, Fruity, Medicinal	
3	3A	"C" Copper/Moly Thickener Surface	150	85	58	-0.65	-2.8	Chemical, Offensive, Earthy, Medicinal	
4	4B	SX-1 "E" Stripper Tank - Diluted 10:1	290	150	95	-0.82	-3.6	Chemical, Offensive, Earthy, Medicinal	
5	5A	Decant Feed - Bottle Agitation	2,900	1,500	155	-0.61	-5.2	Offensive, Chemical, Earthy	
6	6B	Xanthate Mixed 10:1 Diluted	3,100	1,600	195	-0.63	-5.8	Offensive, Fishy, Earthy	
7									
8									
9									
10									

**St. Croix Sensory, Inc.**

**Odor Evaluation Report**

Client: Arcadis US, Inc.

Report No.: 1507802

Project: Sierrita Mine

Evaluation Date: 03/19/15

#	Field No.	Sample Description	ASTM E679 & EN13725		ASTM E544	PERSISTENCY	CHARACTERIZATION		Comments
			Detection Threshold	Recognition Threshold	Intensity	Dose-Response Slope	Hedonic Tone	Principal Odor Descriptors	
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

Client: Arcadis US, Inc.

Field No.: 1A

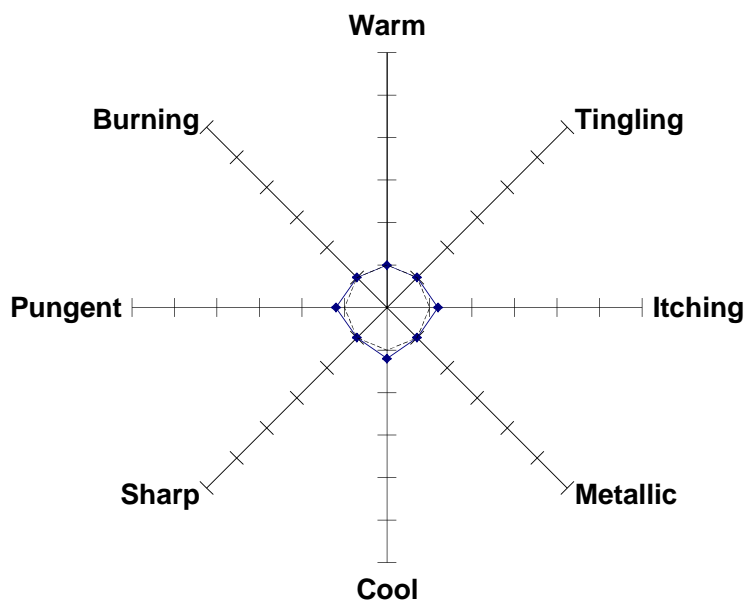
Report No.: 1507802

Project: Sierrita Mine

Description: Moly Roasta Stack - Sample Port

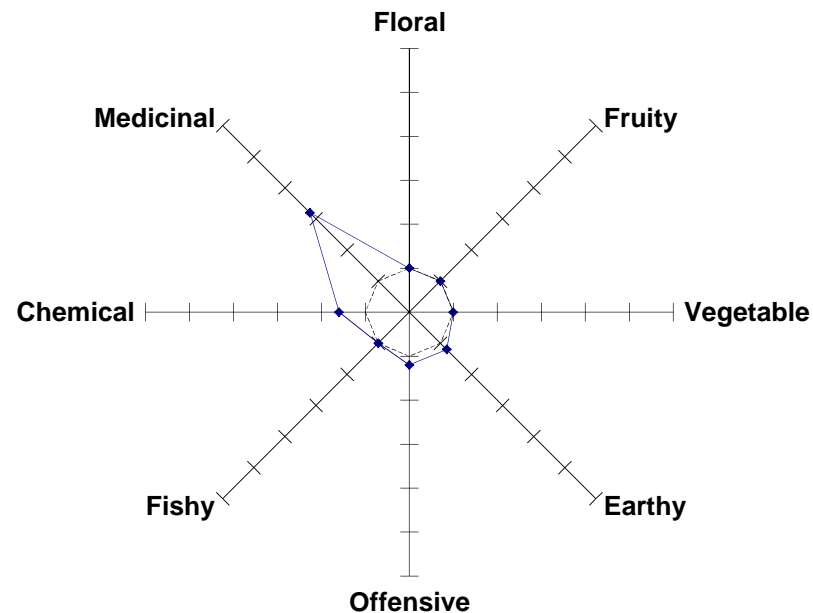
Evaluation Date: 03/19/15

### Sensation Descriptor Graph

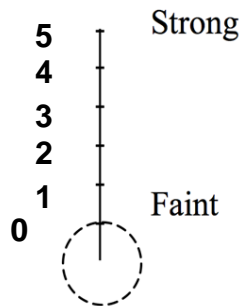


	Average Relative Strength
Warm	0.0
Tingling	0.0
Itching	0.2
Metallic	0.0
Cool	0.2
Sharp	0.0
Pungent	0.2
Burning	0.0

### Odor Descriptor Graph



#### KEY



Relative Strength

	Average Relative Strength
Floral	0.0
Fruity	0.0
Vegetable	0.0
Earthy	0.2
Offensive	0.2
Fishy	0.0
Chemical	0.6
Medicinal	2.2

**St. Croix Sensory, Inc.**

**Odor Evaluation Report**

Client: Arcadis US, Inc.

Field No.: 1A

Report No.: **1507802**

Project: Sierrita Mine

Description: Moly Roasta Stack - Sample Port

Evaluation Date: 03/19/15

% of Assessors |\*\*\*\*\*|\*\*\*\*\*|\*\*\*\*\*|\*\*\*\*\*| 100%

- Medicinal \*\*\*\*\*
- Disinfectant \*\*\*\*\*
- Ammonia \*\*\*\*\*
- Chlorinous \*\*\*\*\*
- Chemical \*\*\*\*\*
- Solvent \*\*\*\*\*
- Offensive \*\*\*\*\*
- Decay \*\*\*\*\*
- Earthy \*\*\*\*\*
- Stale \*\*\*\*\*

Client: Arcadis US, Inc.

Field No.: 1A

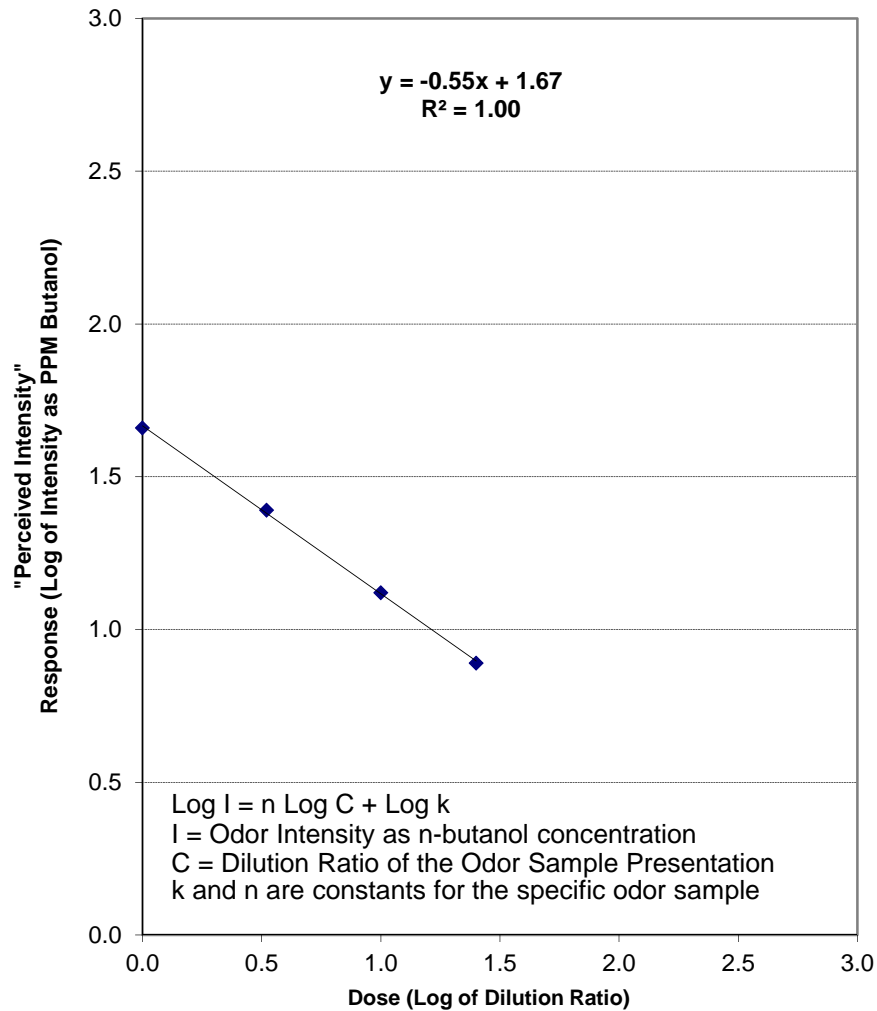
Report No.: 1507802

Project: Sierrita Mine

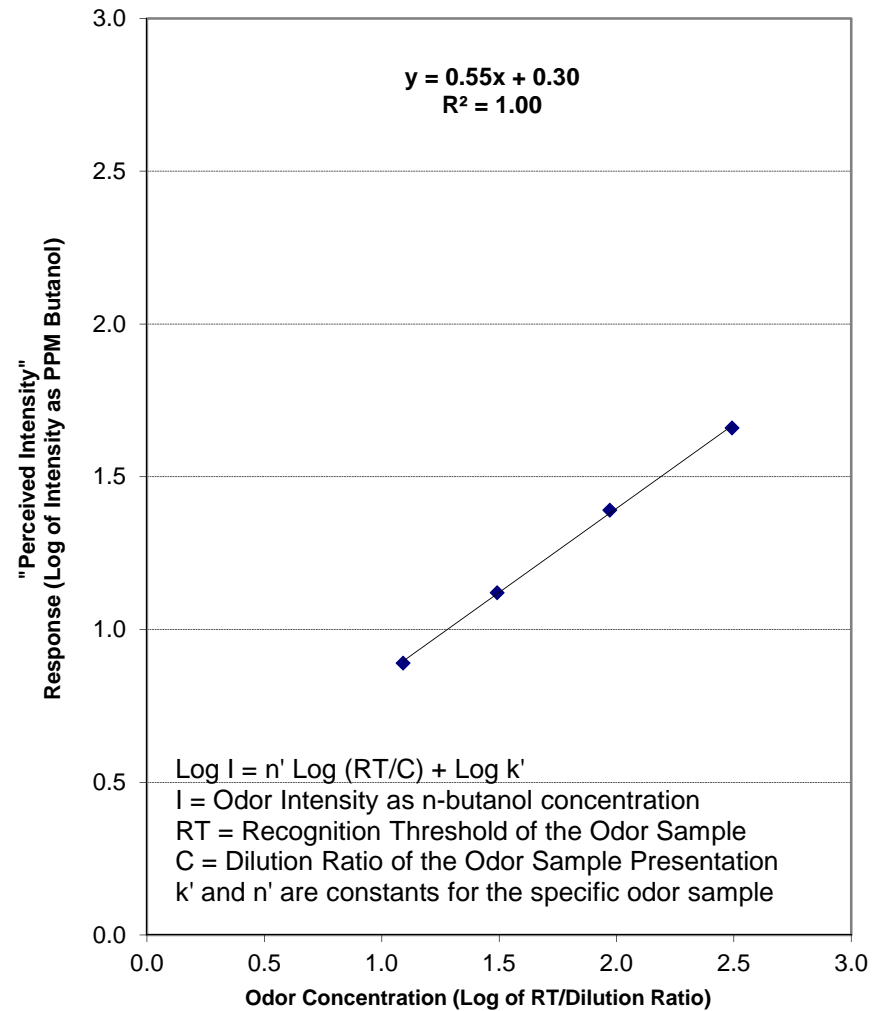
Description: Moly Roasta Stack - Sample Port

Evaluation Date: 03/19/15

### Dose-Response



### Dose-Response as Power Law



Client: Arcadis US, Inc.

Field No.: 2A

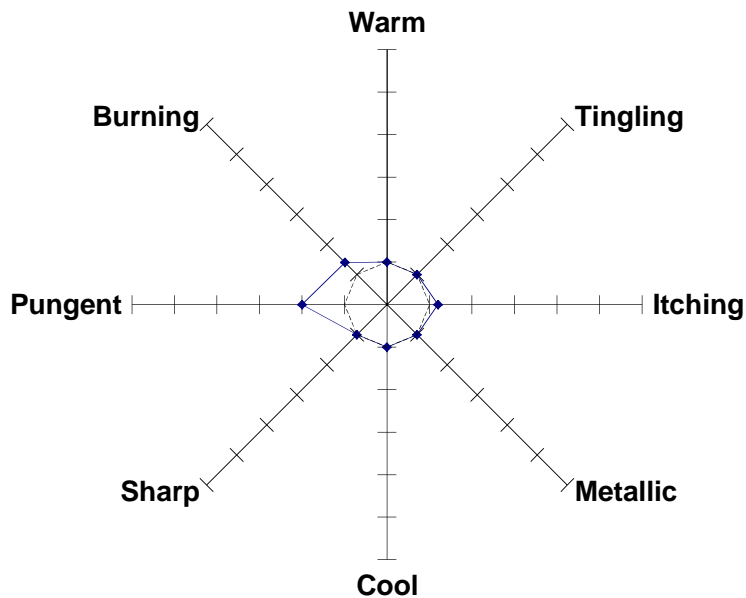
Report No.: **1507802**

Project: Sierrita Mine

Description: Flotation

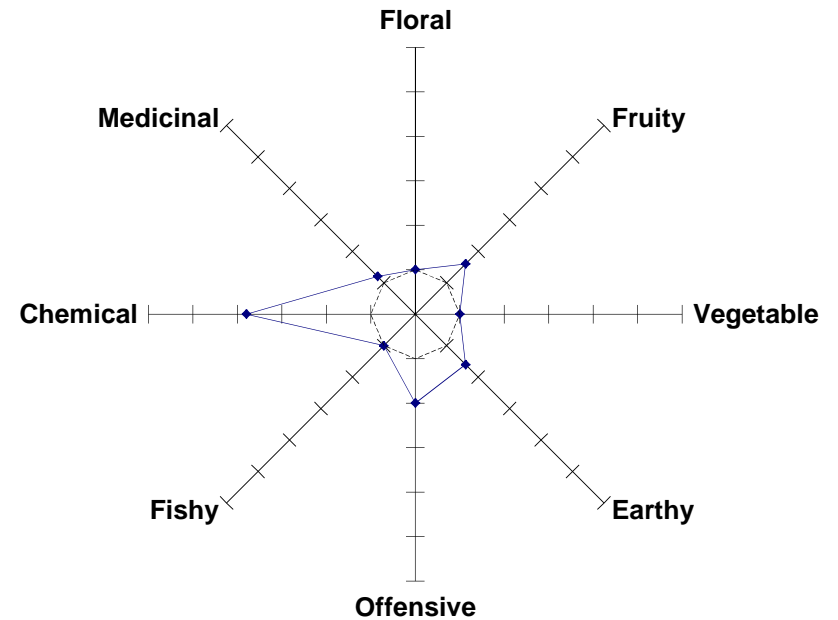
Evaluation Date: 03/19/15

**Sensation Descriptor Graph**

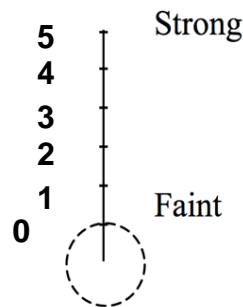


	Average Relative Strength
Warm	0.0
Tingling	0.0
Itching	0.2
Metallic	0.0
Cool	0.0
Sharp	0.0
Pungent	1.0
Burning	0.4

**Odor Descriptor Graph**



**KEY**



Relative Strength

	Average Relative Strength
Floral	0.0
Fruity	0.6
Vegetable	0.0
Earthy	0.6
Offensive	1.0
Fishy	0.0
Chemical	2.8
Medicinal	0.2

St. Croix Sensory, Inc.

Odor Evaluation Report

Client: Arcadis US, Inc.

Field No.: 2A

Report No.: 1507802

Project: Sierrita Mine

Description: Flotation

Evaluation Date: 03/19/15

% of Assessors |\*\*\*\*\*|\*\*\*\*\*|\*\*\*\*\*|\*\*\*\*\*| 100%

- Fruity \*\*\*\*\*
- Citrus \*\*\*\*\*
- Lemon \*\*\*\*\*
- Medicinal \*\*\*\*\*
- Disinfectant \*\*\*\*\*
- Chemical \*\*\*\*\*
- Car exhaust \*\*\*\*\*
- Kerosine \*\*\*\*\*
- Petroleum \*\*\*\*\*
- Turpentine \*\*\*\*\*
- Plastic \*\*\*\*\*
- Solvent \*\*\*\*\*
- Offensive \*\*\*\*\*
- Earthy \*\*\*\*\*
- Musty \*\*\*\*\*
- Stale \*\*\*\*\*
- Smoky \*\*\*\*\*

Client: Arcadis US, Inc.

Field No.: 2A

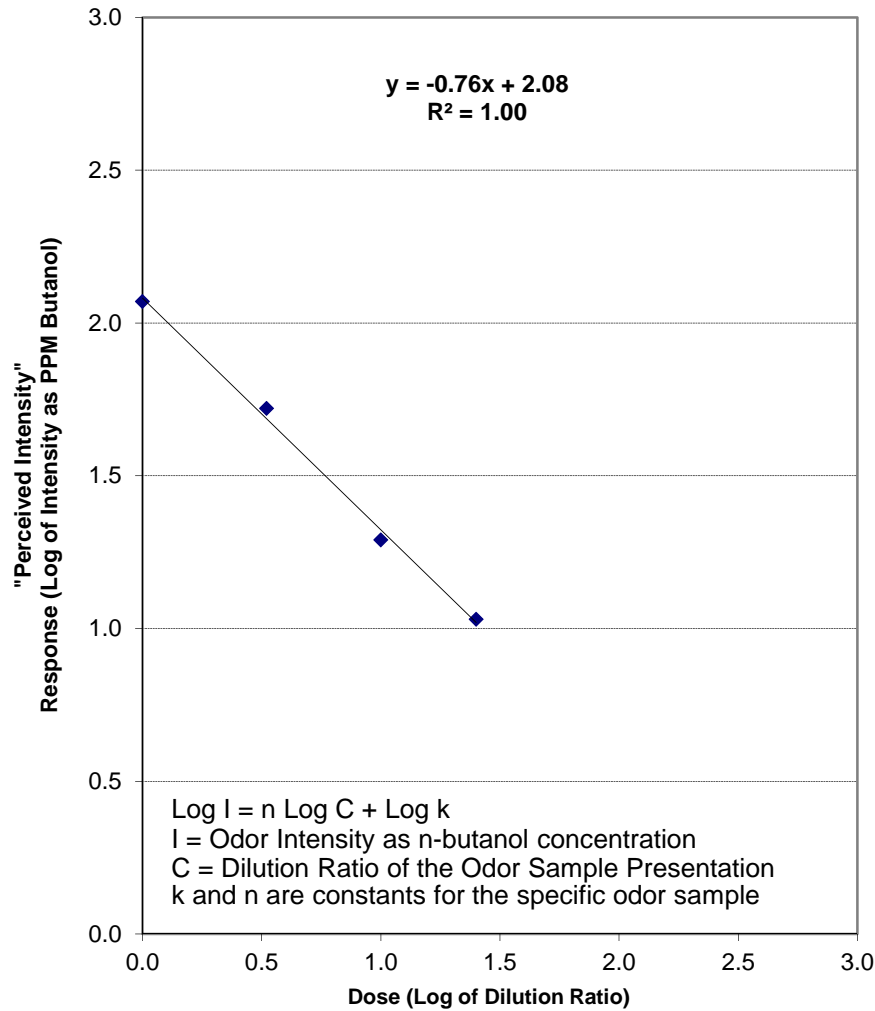
Report No.: 1507802

Project: Sierrita Mine

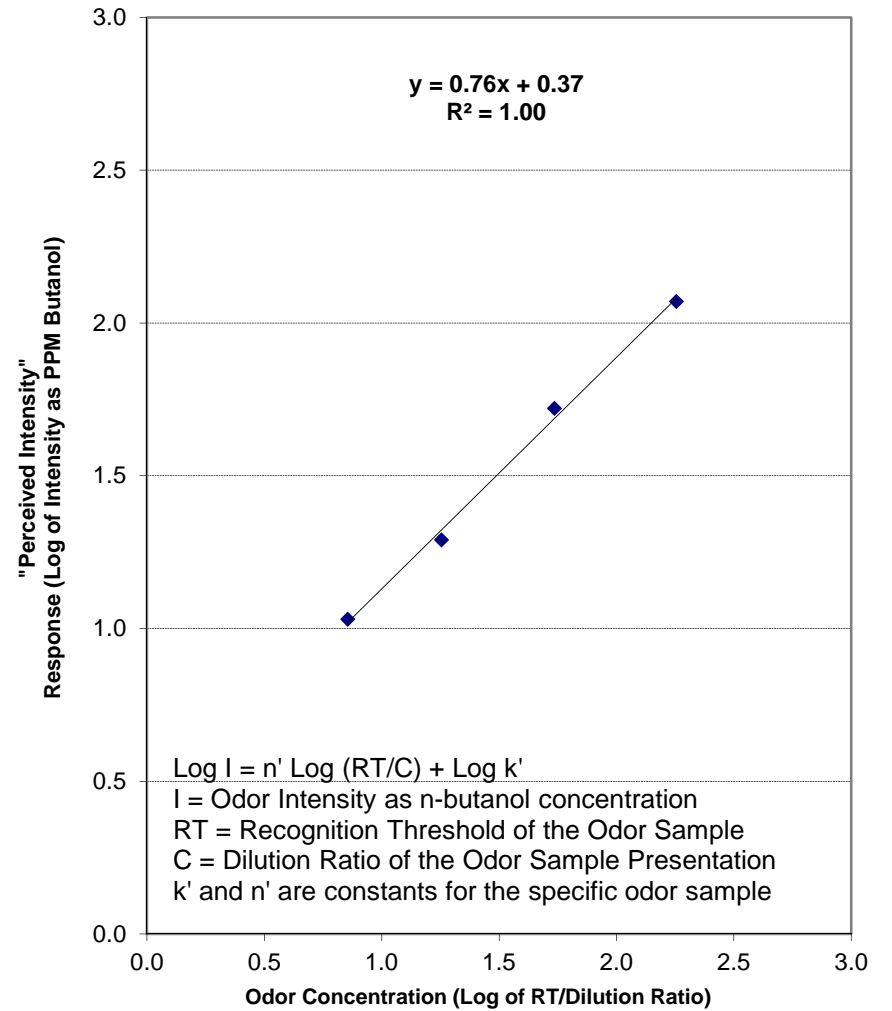
Description: Flotation

Evaluation Date: 03/19/15

**Dose-Response**



**Dose-Response as Power Law**





Client: Arcadis US, Inc.

Field No.: 3A

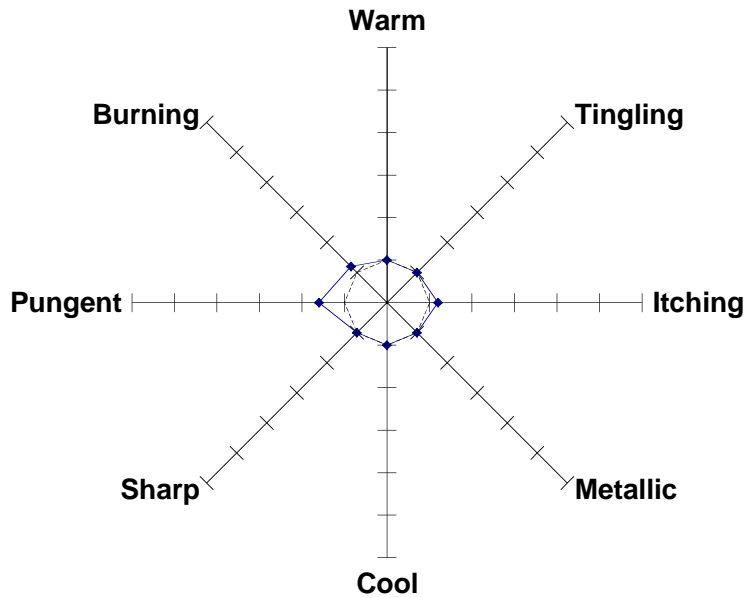
Report No.: 1507802

Project: Sierrita Mine

Description: "C" Copper/Moly Thickener Surface

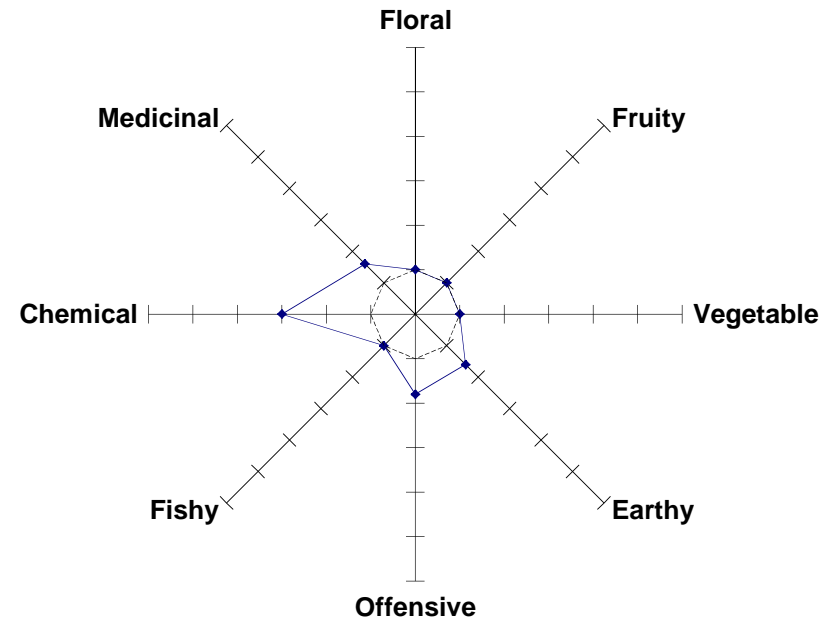
Evaluation Date: 03/19/15

**Sensation Descriptor Graph**

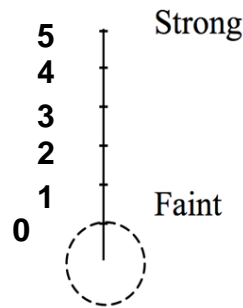


	Average Relative Strength
Warm	0.0
Tingling	0.0
Itching	0.2
Metallic	0.0
Cool	0.0
Sharp	0.0
Pungent	0.6
Burning	0.2

**Odor Descriptor Graph**



**KEY**



Relative Strength

	Average Relative Strength
Floral	0.0
Fruity	0.0
Vegetable	0.0
Earthy	0.6
Offensive	0.8
Fishy	0.0
Chemical	2.0
Medicinal	0.6

St. Croix Sensory, Inc.

Odor Evaluation Report

Client: Arcadis US, Inc.

Field No.: 3A

Report No.: 1507802

Project: Sierrita Mine

Description: "C" Copper/Moly Thickener Surface

Evaluation Date: 03/19/15

% of Assessors |\*\*\*\*\*|\*\*\*\*\*|\*\*\*\*\*|\*\*\*\*\*| 100%

- Medicinal \*\*\*\*\*
- Disinfectant \*\*\*\*\*
- Chemical \*\*\*\*\*
- Paint \*\*\*\*\*
- Car exhaust \*\*\*\*\*
- Kerosine \*\*\*\*\*
- Petroleum \*\*\*\*\*
- Turpentine \*\*\*\*\*:
- Solvent \*\*\*\*\*
- Offensive \*\*\*\*\*:
- Decay \*\*\*\*\*
- Earthy \*\*\*\*\*:
- Musty \*\*\*\*\*
- Stale \*\*\*\*\*

Client: Arcadis US, Inc.

Field No.: 3A

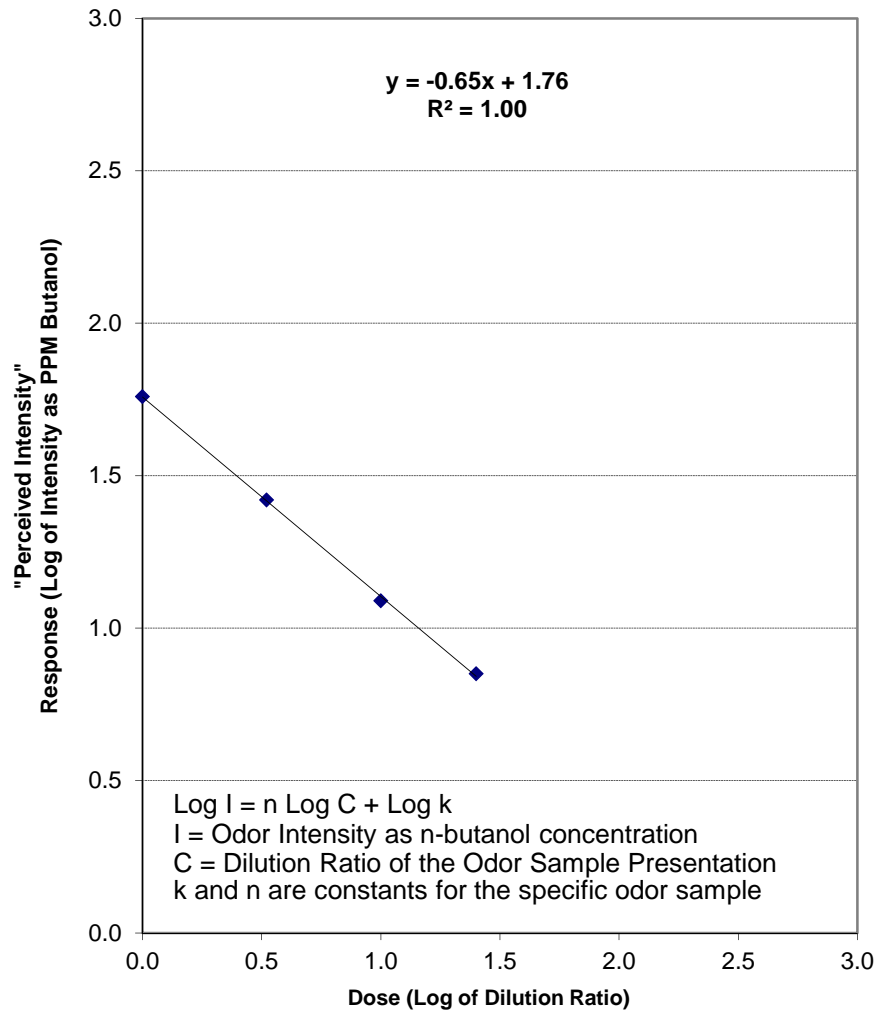
Report No.: 1507802

Project: Sierrita Mine

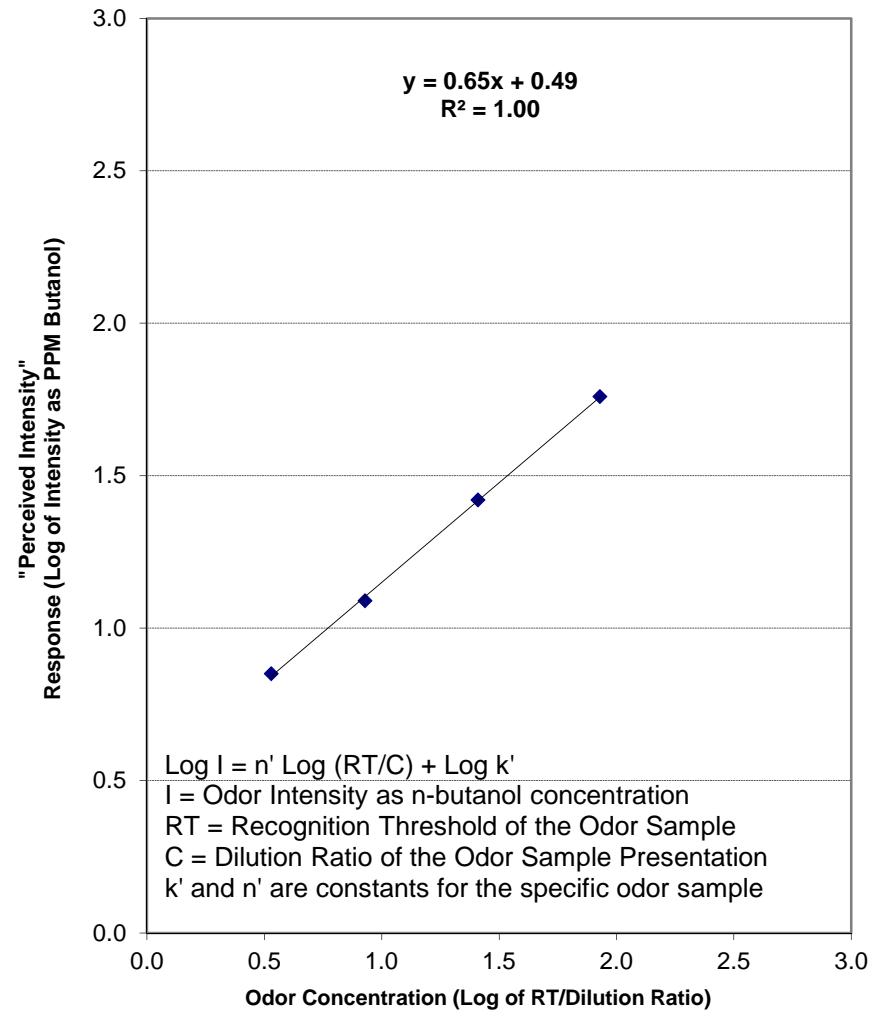
Description: "C" Copper/Moly Thickener Surface

Evaluation Date: 03/19/15

**Dose-Response**



**Dose-Response as Power Law**



Client: Arcadis US, Inc.

Field No.: 4B

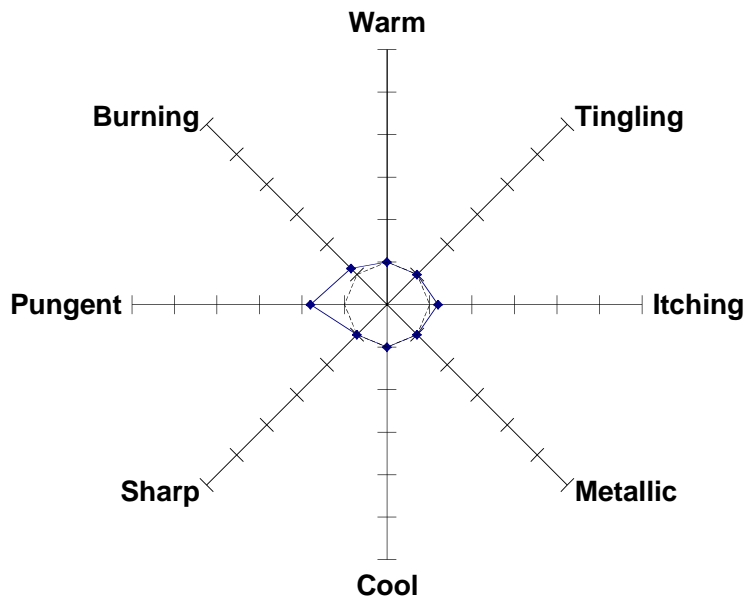
Report No.: 1507802

Project: Sierrita Mine

Description: SX-1 "E" Stripper Tank - Diluted 10:1

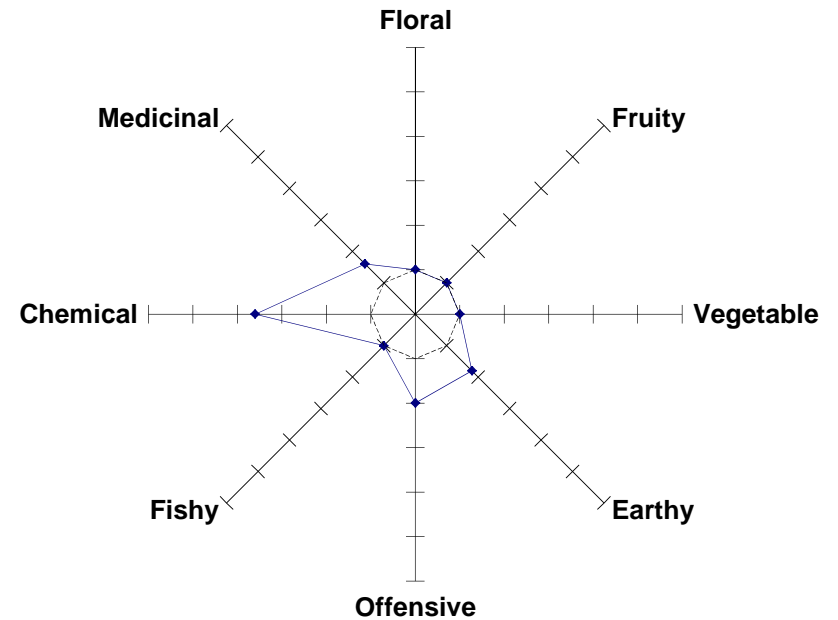
Evaluation Date: 03/19/15

**Sensation Descriptor Graph**

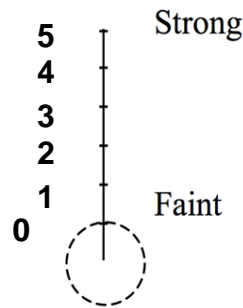


	Average Relative Strength
Warm	0.0
Tingling	0.0
Itching	0.2
Metallic	0.0
Cool	0.0
Sharp	0.0
Pungent	0.8
Burning	0.2

**Odor Descriptor Graph**



**KEY**



Relative Strength

	Average Relative Strength
Floral	0.0
Fruity	0.0
Vegetable	0.0
Earthy	0.8
Offensive	1.0
Fishy	0.0
Chemical	2.6
Medicinal	0.6

St. Croix Sensory, Inc.

Odor Evaluation Report

Client: Arcadis US, Inc.

Field No.: 4B

Report No.: 1507802

Project: Sierrita Mine

Description: SX-1 "E" Stripper Tank - Diluted 10:1

Evaluation Date: 03/19/15

% of Assessors |\*\*\*\*\*|\*\*\*\*\*|\*\*\*\*\*|\*\*\*\*\*| 100%

- Medicinal \*\*\*\*\*:
- Anesthetic \*\*\*\*\*
- Disinfectant \*\*\*\*\*
- Chemical \*\*\*\*\*
- Car exhaust \*\*\*\*\*
- Kerosine \*\*\*\*\*
- Petroleum \*\*\*\*\*
- Turpentine \*\*\*\*\*:
- Plastic \*\*\*\*\*
- Solvent \*\*\*\*\*:
- Offensive \*\*\*\*\*:
- Earthy \*\*\*\*\*
- Stale \*\*\*\*\*
- Smoky \*\*\*\*\*:

Client: Arcadis US, Inc.

Field No.: 4B

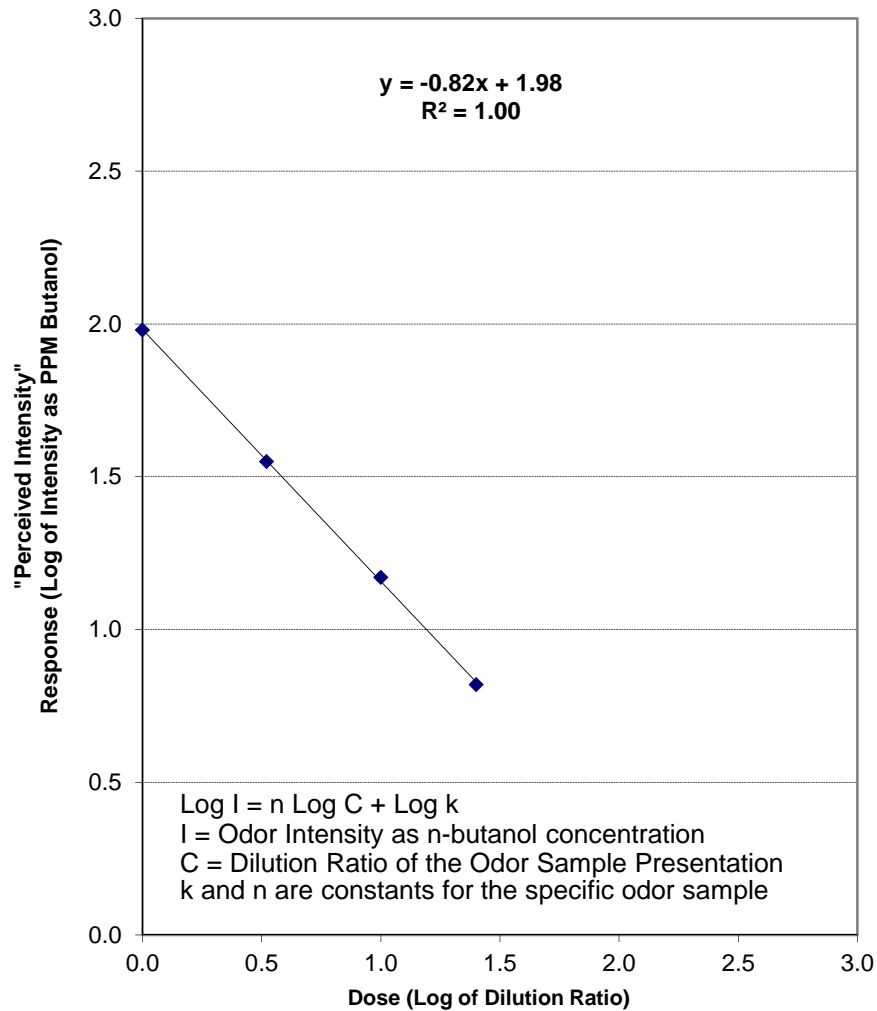
Report No.: 1507802

Project: Sierrita Mine

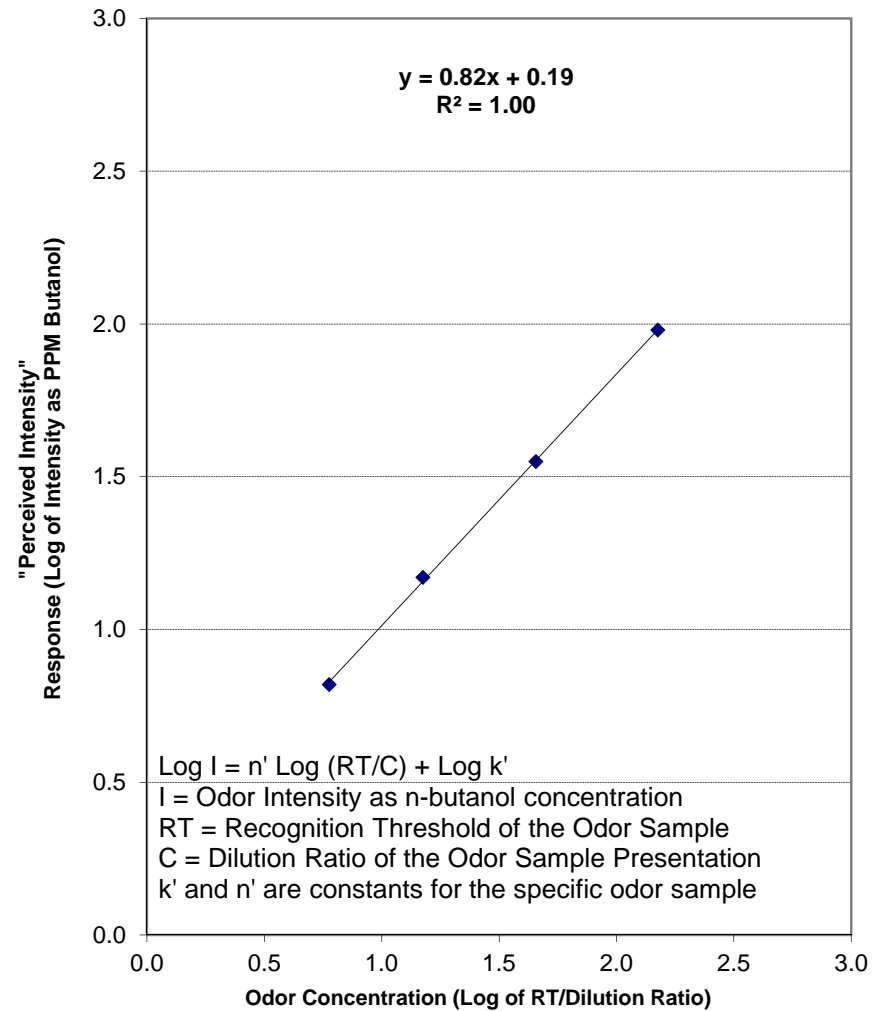
Description: SX-1 "E" Stripper Tank - Diluted 10:1

Evaluation Date: 03/19/15

### Dose-Response



### Dose-Response as Power Law



Client: Arcadis US, Inc.

Field No.: 5A

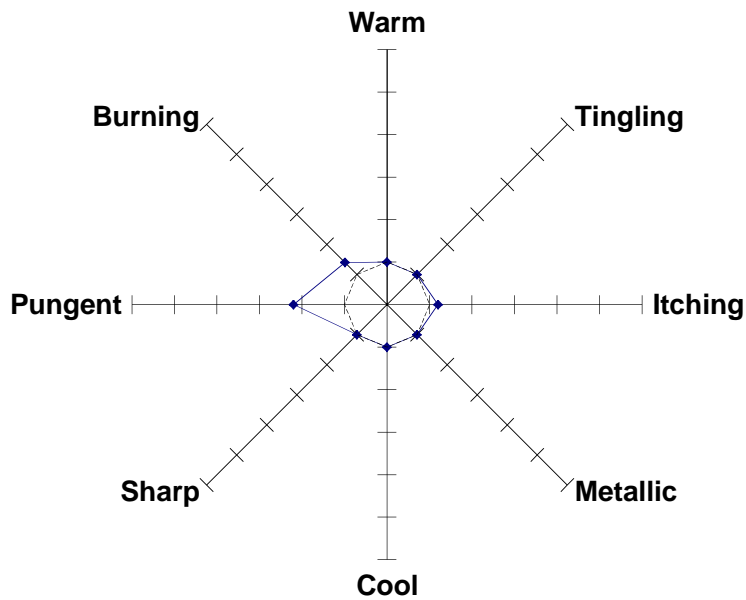
Report No.: 1507802

Project: Sierrita Mine

Description: Decant Feed - Bottle Agitation

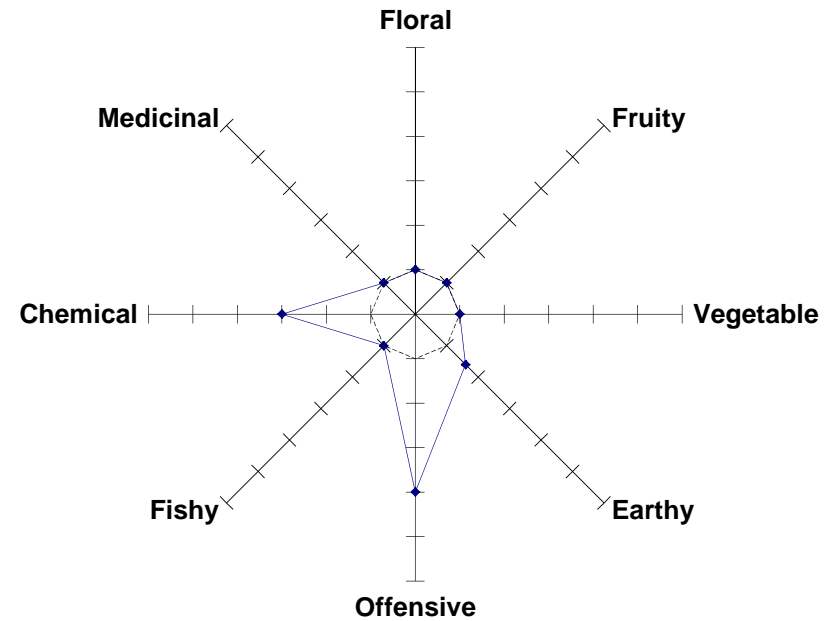
Evaluation Date: 03/19/15

**Sensation Descriptor Graph**

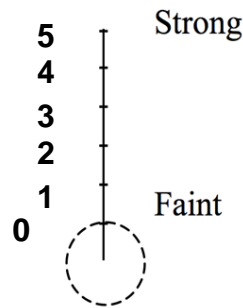


	Average Relative Strength
Warm	0.0
Tingling	0.0
Itching	0.2
Metallic	0.0
Cool	0.0
Sharp	0.0
Pungent	1.2
Burning	0.4

**Odor Descriptor Graph**



**KEY**



Relative Strength

	Average Relative Strength
Floral	0.0
Fruity	0.0
Vegetable	0.0
Earthy	0.6
Offensive	3.0
Fishy	0.0
Chemical	2.0
Medicinal	0.0

St. Croix Sensory, Inc.

Odor Evaluation Report

Client: Arcadis US, Inc.

Field No.: 5A

Report No.: 1507802

Project: Sierrita Mine

Description: Decant Feed - Bottle Agitation

Evaluation Date: 03/19/15

% of Assessors |\*\*\*\*\*|\*\*\*\*\*|\*\*\*\*\*|\*\*\*\*\*| 100%

- Chemical \*\*\*\*\*
- Petroleum \*\*\*\*\*
- Plastic \*\*\*\*\*
- Creosote \*\*\*\*\*
- Solvent \*\*\*\*\*
- Sulfur \*\*\*\*\*
- Offensive \*\*\*\*\*
- Sewer \*\*\*\*\*
- Sour \*\*\*\*\*
- Rotten eggs \*\*\*\*\*
- Putrid \*\*\*\*\*
- Septic \*\*\*\*\*
- Earthy \*\*\*\*\*
- Musty \*\*\*\*\*
- Stale \*\*\*\*\*



Client: Arcadis US, Inc.

Field No.: 5A

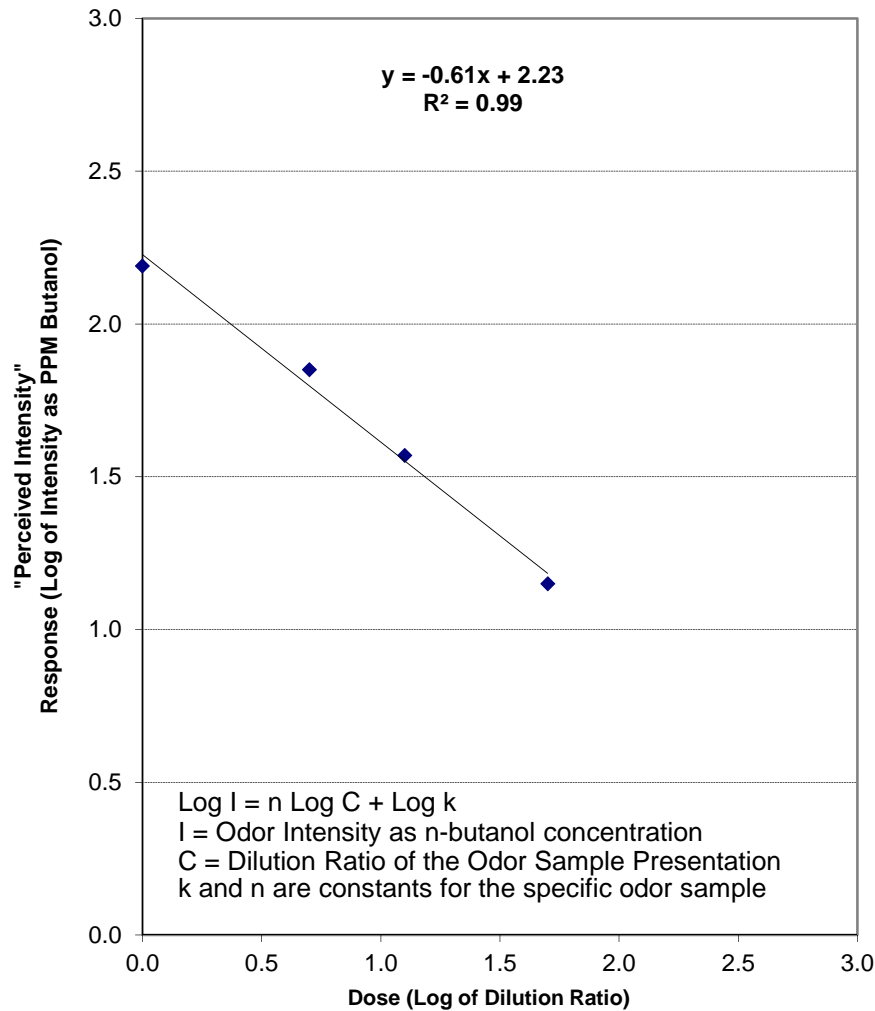
Report No.: 1507802

Project: Sierrita Mine

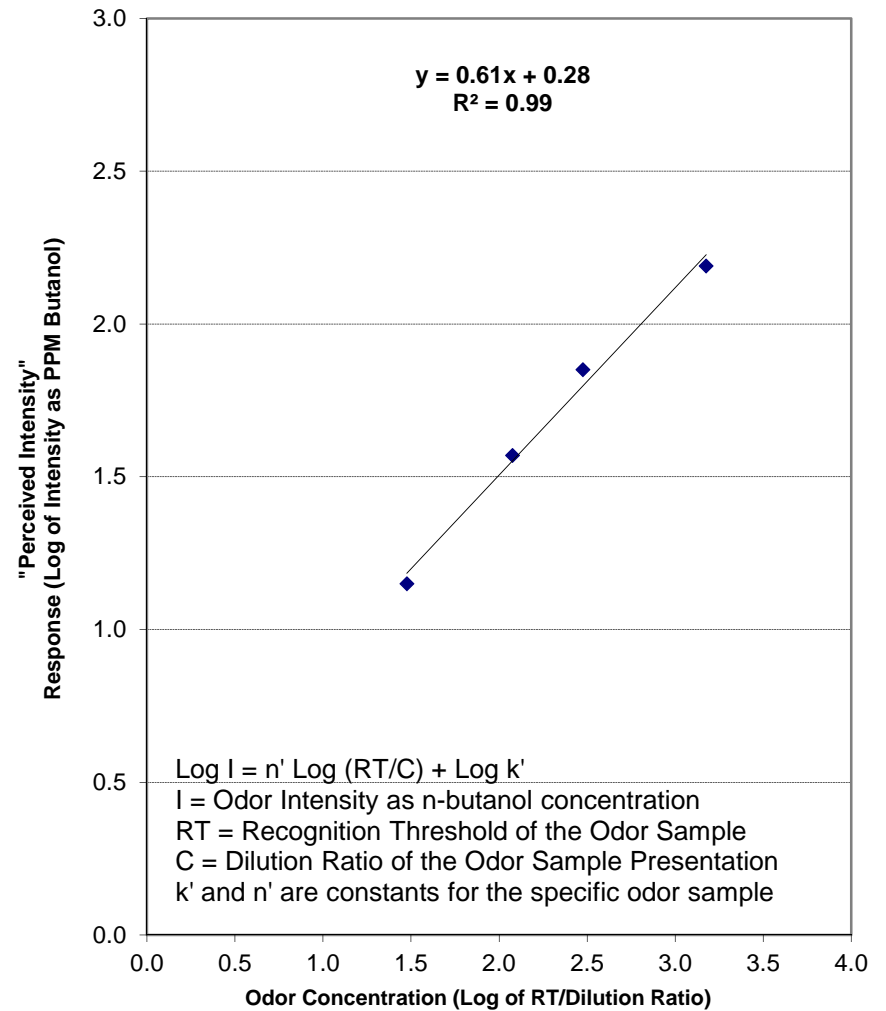
Description: Decant Feed - Bottle Agitation

Evaluation Date: 03/19/15

### Dose-Response



### Dose-Response as Power Law



Client: Arcadis US, Inc.

Field No.: 6B

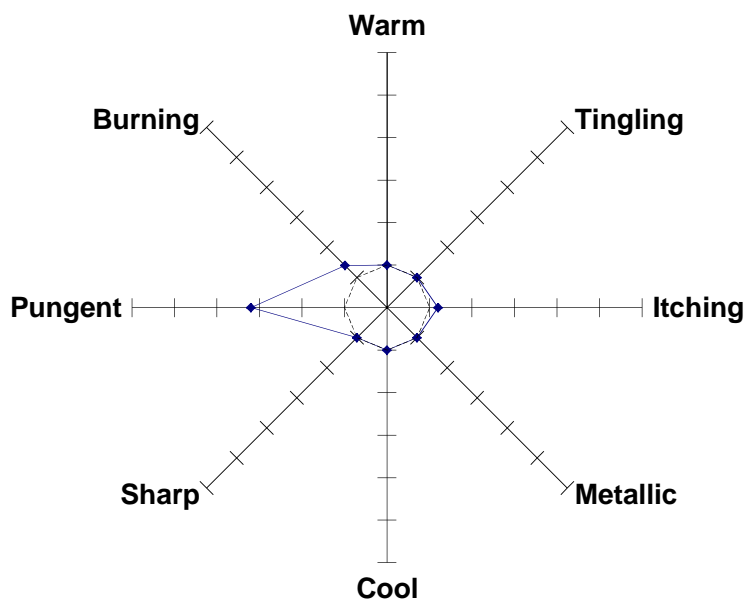
Report No.: 1507802

Project: Sierrita Mine

Description: Xanthate Mixed 10:1 Diluted

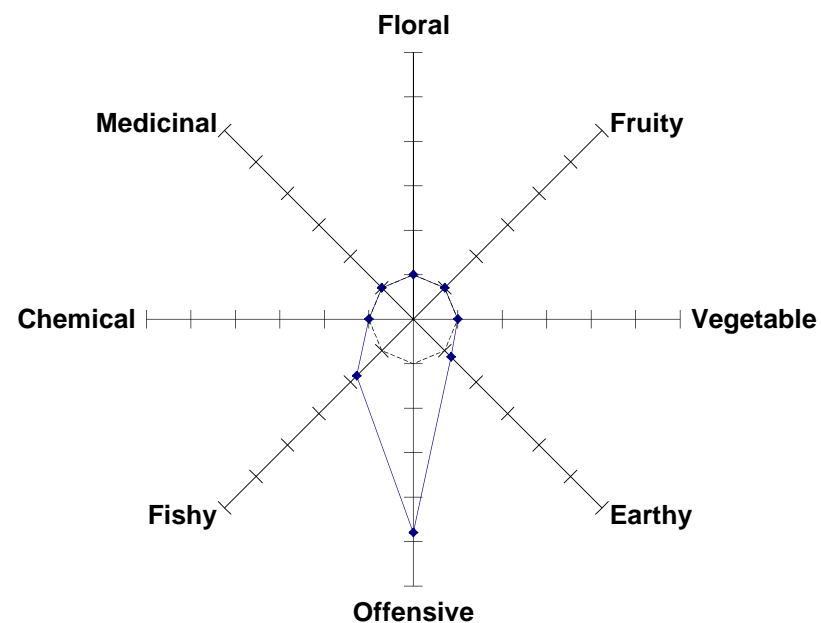
Evaluation Date: 03/19/15

### Sensation Descriptor Graph

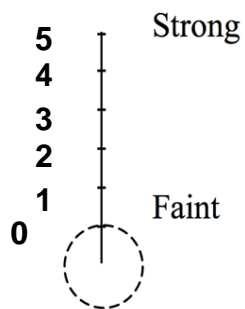


	Average Relative Strength
Warm	0.0
Tingling	0.0
Itching	0.2
Metallic	0.0
Cool	0.0
Sharp	0.0
Pungent	2.2
Burning	0.4

### Odor Descriptor Graph



#### KEY



Relative Strength

	Average Relative Strength
Floral	0.0
Fruity	0.0
Vegetable	0.0
Earthy	0.2
Offensive	3.8
Fishy	0.8
Chemical	0.0
Medicinal	0.0

**St. Croix Sensory, Inc.**

**Odor Evaluation Report**

Client: Arcadis US, Inc.

Field No.: 6B

Report No.: **1507802**

Project: Sierrita Mine

Description: Xanthate Mixed 10:1 Diluted

Evaluation Date: 03/19/15

% of Assessors |\*\*\*\*\*|\*\*\*\*\*|\*\*\*\*\*|\*\*\*\*\*| 100%

- Chemical \*\*\*\*\*
- Fishy \*\*\*\*\*
- Perm solution \*\*\*\*\*
- Offensive \*\*\*\*\*
- Rancid \*\*\*\*\*
- Sewer \*\*\*\*\*
- Sour \*\*\*\*\*
- Putrid \*\*\*\*\*
- Septic \*\*\*\*\*
- Earthy \*\*\*\*\*
- Stale \*\*\*\*\*

Client: Arcadis US, Inc.

Field No.: 6B

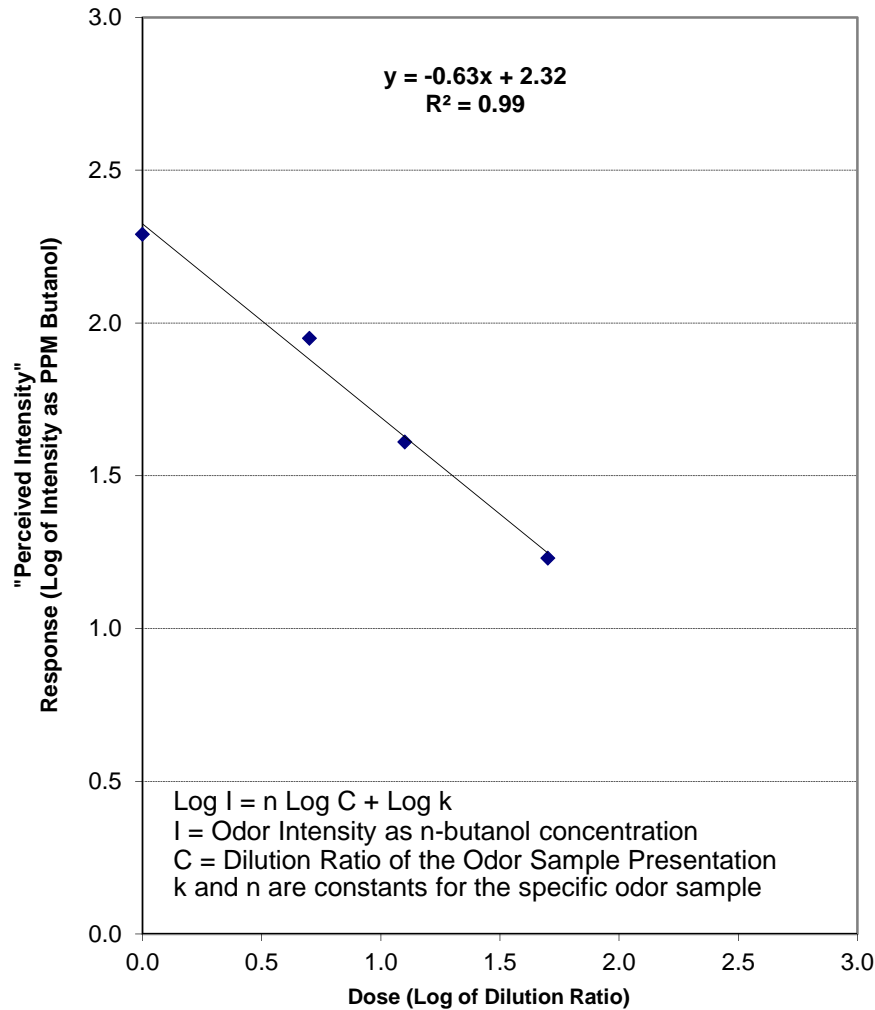
Report No.: 1507802

Project: Sierrita Mine

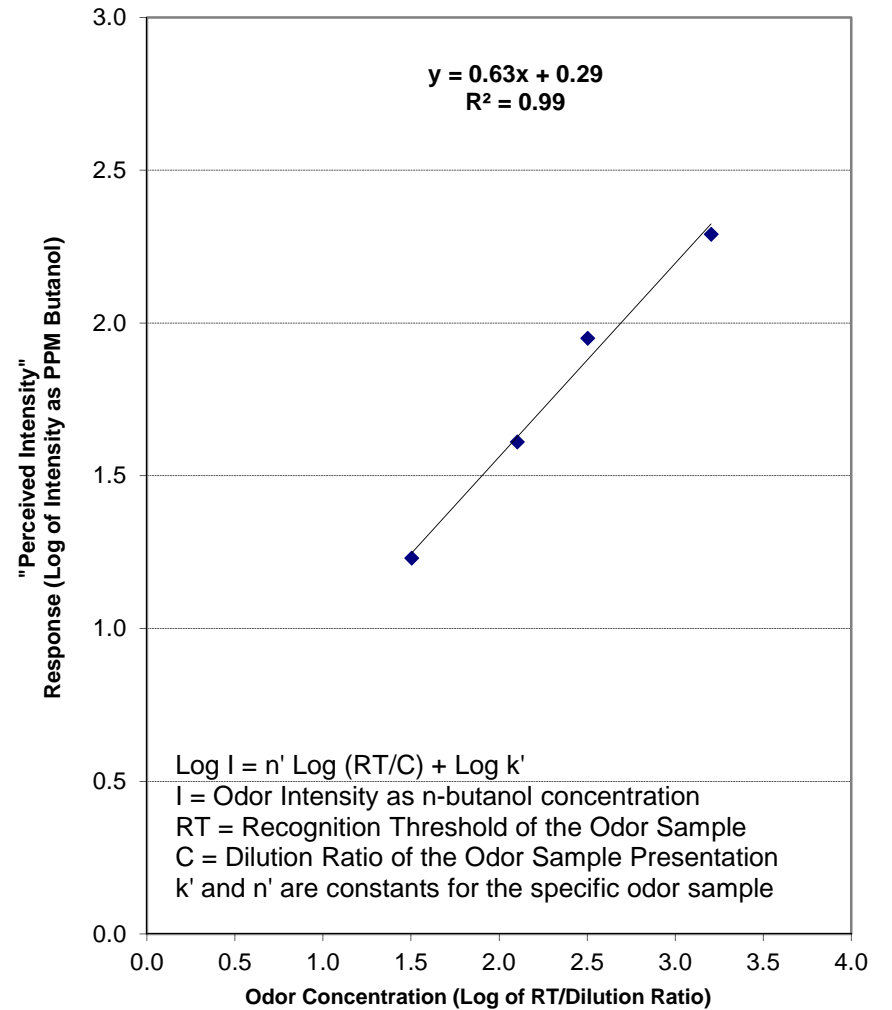
Description: Xanthate Mixed 10:1 Diluted

Evaluation Date: 03/19/15

**Dose-Response**



**Dose-Response as Power Law**



St. Croix Sensory, Inc.

# CHAIN OF CUSTODY RECORD FOR ODOR SAMPLES



Client: ARECADIS      Sampled By: Dwight Pope, Rogan Felty

Page     of    

Project Name: Sierrita Mine      Sampling Date: 3.18.15

For Laboratory use Only

Comments: 4A - bag defective 0 valve - leaked scale.  
6A - FOR YOUR REVIEW ONLY - NOT FOR TESTING

Odor Evaluation Report No. 1507802

Line No.	Field No.	Sample Description	Sample Time	Field H <sub>2</sub> S (ppm)	Odor Evaluations Requested: (X)				Laboratory Sample No. LN FN
					Odor Concentration* (Detection & Recognition Threshold)	Odor Intensity* (PPM 1-Butanol)	Odor Characterization (Hedonic Tone & Descriptors)	Odor Persistency ("Dose-Response")	
1	1A	Moly Reactor Stack - sample port	9:45 AM	N/A	X	X	X	X	
2	1D	Duplicate - Moly Reactor Stack - port	9:57 AM	N/A	X	X	X	X	
3	2A	Flotation	10:37 AM	N/A	X	X	X	X	
4	2D	Duplicate - Flotation	10:49 AM	N/A	X	X	X	X	
5	3A	2" Copper/Moly Tubing Surface	11:31 AM	N/A	X	X	X	X	
6	3B	Duplicate - 2" Copper/Moly Tubing Surf.	11:42 AM	N/A	X	X	X	X	
7	4A	SX-1 1/2" Stripper Tank - 59m <sup>2</sup> bag	N/A	N/A					
8	4B	SX-1 1/2" Stripper Tank diluted 10:1	12:23 PM	N/A	X	X	X	X	
9	5A	Decant Feed - bottle agitation	2:05 PM	N/A	X	X	X	X	
10	5B	Duplicate - Decant Feed - bottle agitation	2:15 PM	N/A	X	X	X	X	
11	6A	Xanthate fixed - undiluted	2:59 PM	N/A	X	X	X	X	
12	6B	XANTHATE fixed 10:1 diluted	2:51 PM	N/A	X	X	X	X	
		<del>XANTHATE fixed 10:1 diluted</del>	<del>2:43 PM</del>	<del>N/A</del>	<del>X</del>	<del>X</del>	<del>X</del>	<del>X</del>	

**Transmittal**

Relinquished By	Date	Time	Accepted By	Date	Time	Comments & Exceptions Noted
<u>Rogan Felty</u>	<u>3.18.15</u>	<u>4:03 AM</u>	<u>[Signature]</u>	<u>3/18</u>	<u>9:30 AM</u>	

Number of Shipping Boxes 2

Received at St. Croix Sensory Laboratory