



APPENDIX F

ROCK QUALITY DETERMINATIONS, ROCK MULCH AND RIPRAP



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

ROCK QUALITY DETERMINATION

United Nuclear Corporation
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, New Mexico 87305-3077

Job No. 3145JB031
Inv. No. 31450084
Date of Report 12/05/95
Reviewed By [Signature]

Project: 1995 Church Rock Uranium Mill Tailings Reclamation Project
Location: Church Rock, New Mexico Sampled by: H. Kuebler/WT Date 04/06/95
Material Source: Hamilton Brothers Construction Authorized by: E. Morales/Client Date 04/06/95
Material Type: Basaltic 1.5 Aggregate Intended Use _____

Property	Value	Score	Weighting Factor	Score x Weight
Specific Gravity (SSD)	2.735	9.4	9	84.6
Absorption, %	1.21	9.8	2	11.7
L.A. Abrasion, 100 rev, %	6	7.6	1	7.6
Sodium Soundness Loss, %	2.74	9.7	11	106.7

Total = 210.6, Rock Quality Score = 210.6/230 x 100 = 92

Dist: Client (3) Field File (1)

/cb:RQD.UNC12



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450084
Report Date: 04/24/95

Project: 1996 Reclamation

Location: Church Rock, NM

Material: 1.5 Aggregate Sampled By: H. Kuebler Date 04/06/95

Source: Hamilton Brothers Submitted By: H. Kuebler Date 04/06/95

Authorized By: Client Date 04/06/95

Coarse Aggregate, ASTM C127

Weight of Oven-Dry Specimen in Air, gms. - 4369.6

Bulk Specific Gravity	2.703
Bulk Specific Gravity (SSD)	2.735
Apparent Specific Gravity	2.794
Absorption, Percent	1.21

Copies to: Addressee (3), Billing (1)
46.4/dn:unc031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY: *Thomas Kuebler*



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client:	UNC Mining & Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	<u>3145JB031</u>
		Lab/Inv. No.	<u>31450084</u>
		Report Date:	<u>04/24/95</u>
Project:	<u>1995 Reclamation</u>		
Location:	<u>Church Rock, NM</u>		
Material:	<u>1.5 Aggregate</u>	Sampled By:	<u>H. Kuebler</u> Date <u>04/06/95</u>
Source:	<u>Hamilton Brothers</u>	Submitted By:	<u>H. Kuebler</u> Date <u>04/06/95</u>
Supplier:	<u>Hamilton Brothers</u>	Authorized By:	<u>Client</u> Date <u>04/06/95</u>

L.A. Abrasion, ASTM C131, Grading A

% Loss at 100 Revs. 6

Copies to: Addressee (3), Billing (1)
46.2/unc031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY Thomas Brake

SOUNDNESS OF AGGREGATES

Client: UNC Mining & Milling
Attn: Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031
 Lab/Inv. No. 31450084
 Report Date: 04/24/95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: 1.5 Aggregate Sampled By: H. Kuebler Date 04/06/95

Source: Hamilton Brothers Submitted By: H. Kuebler Date 04/06/95

Procedure: ASTM C88 Authorized By: Client Date 04/06/95

Solution: Sodium Sulfate (Used)

FINE AGGREGATE

<u>Fine Fraction Size</u>	<u>Grading of Original Sample Percent</u>	<u>Wt. of Test Fractions Before Test, grams</u>	<u>Percentage Passing Designated Sieve</u>	<u>Weight Percentage Loss, %</u>
Minus No. 100				
No. 50 to No. 100				
No. 30 to No. 50				
No. 16 to No. 30				
No. 8 to No. 16				
No. 4 to No. 8				
3/8 to No. 4				
Totals				

COARSE AGGREGATE

<u>Coarse Fraction Size</u>	<u>Grading of Original Sample Percent</u>	<u>Wt. of Test Fractions Before Test, grams</u>	<u>Percentage Passing Designated Sieve</u>	<u>Weighted Percentage Loss, %</u>
2-1/2" to 2"				
2" to 1-1/2"				
1-1/2" to 1"	76		2.48	1.88
1" to 3/4"				
3/4" to 1/2"	24			.86
1/2" to 3/8"				
3/8" to No. 4				
Minus No. 4				
Totals				2.74

*The size fraction indicated contains less than 5% of one or more components therefore, the percent loss is assumed to be that of the next smaller size.

Percentage of fraction in original grading: % Plus #4, % Minus #4.

Copies to: Addressee (3), Billing (1)
 46.3/dn:unc031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY Thomas Blake



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

ROCK QUALITY DETERMINATION

United Nuclear Corporation
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, New Mexico 87305-3077

Job No. 3145JB031
Inv. No. 31450145
Date of Report 11/14/95
Reviewed By JR

Project: 1995 Church Rock Uranium Mill Tailings Reclamation Project
Location: Church Rock, New Mexico Sampled by: H. Kuebler/WT Date 06/07/95
Material Source: Hamilton Brothers Construction Authorized by: E. Morales/Client Date 06/07/95
Material Type: D50 1.5" Intended Use Swale Aggregate

Property	Value	Score	Weighting Factor	Score x Weight
Specific Gravity (SSD)	2.753	10	9	90
Absorption, %	2.66	1.5	2	3
L.A. Abrasion, 100 rev, %	3.0	9.0	1	9
Sodium Soundness Loss, %	3.77	8.5	11	93.5

Total = 195.5, Rock Quality Score = $195.5/230 \times 100 = 85$

Dist: Client (3) Field File (1)

/cb:RQD.UNC2



**Western
Technologies
Inc.**
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client:	UNC Mining and Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	3145JB031
		Lab/Inv. No.	31450145
		Report Date:	11-14-95
Project: 1995 Reclamation			
Location: Church Rock, NM			
Material:	Crushed Basalt D ⁵⁰ 1.5 Aggre.	Sampled By:	H.K./WT
		Date	6-7-95
Source:	Hamilton Brothers	Submitted By:	H.K./WT
		Date	6-7-95
Supplier:		Authorized By:	Client
		Date	6-7-95

L.A. Abrasion, ASTM C535, Grading 2

% Loss at 100 Revs. 3.0
% Loss at 500 Revs.

Copies to: Addressee (3), Billing (1), Field File (1).
67.2\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied, is included or intended.

REVIEWED BY _____



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining and Milling
Attn: Mr. Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450145
Report Date: 11-14-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: Crushed Basalt D⁵⁰ 1.5 Aggre. Sampled By: H.K./WT Date 6-7-95

Source: Hamilton Brothers Submitted By: H.K./WT Date 6-7-95

Authorized By: Client Date 6-7-95

Coarse Aggregate, ASTM C127

Bulk Specific Gravity	2.682
Bulk Specific Gravity (SSD)	2.753
Apparent Specific Gravity	2.888
Absorption, Percent	2.66

Copies to: Client (3), Billing (1), Field File (1).
67.1\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

SOUNDNESS OF AGGREGATES

Client:	UNC Mining and Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	3145JB031
		Lab/Inv. No.	31450145
		Report Date:	11-14-95
Project:	1995 Reclamation		
Location:	Church Rock, NM		
Material:	Crushed Basalt D ⁵⁰ 1.5 Aggre.	Sampled By:	H.K./WT
		Date	6-7-95
Source:	Hamilton Brothers	Submitted By:	H.K./WT
		Date	6-7-95
Procedure:	ASTM C88	Authorized By:	Client
		Date	6-7-95
		Solution:	Sodium Sulfate (Used) 5 Cycles

COARSE AGGREGATE

Coarse Fraction Size	Grading of Original Sample Percent	Wt. of Test Fractions Before Test, grams	Percentage Passing Designated Sieve	Weighted Percentage Loss, %
2-1/2" to 2" 2" to 1-1/2"	38	2015.4	1.1	.41
1-1/2" to 1" 1" to 3/4"	46 9	1022.5 508.5	4.6 10.9	2.116 .981
3/4" to 1/2" 1/2" to 3/8"	4 0	671.8 330.6	6.6 8.8	.264 0
3/8" to No. 4 Minus No. 4	0	300.6	10.0	0
Totals				3.77

*The size fraction indicated contains less than 5% of one or more components therefore, the percent loss is assumed to be that of the next smaller size.

Percentage of fraction in original grading: % Plus #4, % Minus #4.

Copies to: Addressee (3), Billing (1), Field File (1).
67.3\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

ROCK QUALITY DETERMINATION

United Nuclear Corporation
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, New Mexico 87305-3077

Job No. 3145JB031
Inv. No. 31450243
Date of Report 08/29/95
Reviewed By am

Project: 1995 Church Rock Uranium Mill Tailings Reclamation Project
Location: Church Rock, New Mexico Sampled by: H. Kuebler/WT Date 07/05/95
Material Source: Hamilton Brothers Construction Authorized by: E. Morales/Client Date 07/05/95
Material Type: Crushed Basalt Intended Use D50 - 1.5"

Property	Value	Score	Weighting Factor	Score x Weight
Specific Gravity (SSD)	2.747	10	9	90
Absorption, %	.61	7.2	2	14.4
L.A. Abrasion, 100 rev, %	5.6	7.63	1	7.63
Sodium Soundness Loss, %	2.30	9.375	11	103.1

Total = 214.5, Rock Quality Score = $214.5/230 \times 100 = 93$

/cb:RQD.UNC2



**Western
Technologies
Inc.**
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450185
Report Date: 11-28-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: D⁵⁰ 1.5 Aggregate Sampled By: H.K./WT Date 7-5-95

Source: Hamilton Brothers Submitted By: H.K./WT Date 7-5-95

Authorized By: Client Date 7-5-95

Coarse Aggregate, ASTM C127

Bulk Specific Gravity	2.730
Bulk Specific Gravity (SSD)	2.747
Apparent Specific Gravity	2.776
Absorption, Percent	0.61

Copies to: Client (3), Billing (1), Field File (1).
75\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client:	UNC Mining & Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	<u>3145JB031</u>
		Lab/Inv. No.	<u>31450243</u>
		Report Date:	<u>8-28-95</u>
Project:	<u>1995 Reclamation</u>		
Location:	<u>Church Rock, NM</u>		
Material:	<u>1.5 Aggregate</u>	Sampled By:	<u>HK</u> Date <u>7-5-95</u>
Source:	<u></u>	Submitted By:	<u>HK</u> Date <u>7-5-95</u>
Supplier:	<u></u>	Authorized By:	<u>Client</u> Date <u>7-5-95</u>

L.A. Abrasion, ASTM C131, Grading A

% Loss at 100 Revs. 5.6
% Loss at 500 Revs.

Copies to: Addressee (3), Billing (1), Field File (1).
75\ha:UNC031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied, is included or intended.

REVIEWED BY *Christine M. [Signature]*

SOUNDNESS OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031
 Lab/Inv. No. 31450243
 Report Date: 8-29-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: 1.5 Aggregate Sampled By: HK Date: 7-5-95

Source: Hamilton Brothers Submitted By: HK Date: 7-5-95

Procedure: ASTM C88 Authorized By: Client Date: 7-5-95

Solution: Sodium Sulfate (Fresh) 5 cycles

COARSE AGGREGATE

Coarse Fraction Size	Grading of Original Sample Percent	Wt. of Test Fractions Before Test, grams	Percentage Passing Designated Sieve	Weighted Percentage Loss, %
2-1/2" to 2" 2" to 1-1/2"	39	2109.7	2.803	1.093
1-1/2" to 1" 1" to 3/4"	61	1015.3	1.983	1.210
3/4" to 1/2" 1/2" to 3/8"				
3/8" to No. 4 Minus No. 4				
Totals	100			2.30

*The size fraction indicated contains less than 5% of one or more components therefore, the percent loss is assumed to be that of the next smaller size.

Percentage of fraction in original grading: % Plus #4, % Minus #4.

Copies to: Addressee (3), Billing (1), Field File (1).
 75\ha:unc031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY _____

Ant McPherson



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

ROCK QUALITY DETERMINATION

United Nuclear Corporation
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, New Mexico 87305-3077

Job No. 3145JB031
Inv. No. 31450122
Date of Report 11/14/95
Reviewed By _____

Project: 1995 Church Rock Uranium Mill Tailings Reclamation Project
Location: Church Rock, New Mexico Sampled by: H. Kuebler/WT Date 05/23/95
Material Source: Hamilton Brothers Construction Authorized by: E. Morales/Client Date 05/23/95
Material Type: D50 .35 Aggregate Intended Use Swale Aggregate

Property	Value	Score	Weighting Factor	Score x Weight
Specific Gravity (SSD)	2.756	10	9	90
Absorption, %	2.1	3	2	6
L.A. Abrasion, 100 rev, %	2.7	9	1	9
Sodium Soundness Loss, %	4.93	8	11	88

Total = 193.0, Rock Quality Score = 193.0/230 x 100 = 84

Dist: Client (3) Field File (1)

/cb:RQD.UNC2



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining and Milling
Attn: Mr. Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031

Lab/Inv. No. 31450122

Report Date: 11-14-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: Crushed Basalt D⁵⁰ .35 Aggre.

Sampled By: H.K./WT

Date 5-23-95

Source: Hamilton Brothers

Submitted By: H.K./WT

Date 5-23-95

Authorized By: Client

Date 5-23-95

Coarse Aggregate, ASTM C127

Bulk Specific Gravity 2.699

Bulk Specific Gravity (SSD) 2.756

Apparent Specific Gravity 2.863

Absorption, Percent 2.1

Copies to: Client (3), Billing (1), Field File (1).
523.1\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining and Milling
Attn: Mr. Ed Morales
PO Box 3077
Gallup, NM 87305

Job No.	3145JB031
Lab/Inv. No.	31450122
Report Date:	11-14-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: Crushed Basalt D ⁵⁰ .35 Aggre.	Sampled By: H.K./WT	Date	5-23-95
Source: Hamilton Brothers	Submitted By: H.K./WT	Date	5-23-95
Supplier:	Authorized By: Client	Date	5-23-95

L.A. Abrasion, ASTM C131, Grading

% Loss at 100 Revs. 2.7

% Loss at 500 Revs. —

Copies to: Addressee (3), Billing (1), Field File (1).
523.2\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

SOUNDNESS OF AGGREGATES

Client:	UNC Mining and Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	<u>3145JB031</u>
		Lab/Inv. No.	<u>31450122</u>
		Report Date:	<u>11-14-95</u>
Project:	<u>1995 Reclamation</u>		
Location:	<u>Church Rock, NM</u>		
Material:	<u>Crushed Basalt</u>	Sampled By:	<u>H.K./WT</u> Date <u>5-23-95</u>
Source:	<u>Hamilton Brothers</u>	Submitted By:	<u>H.K./WT</u> Date <u>5-23-95</u>
Procedure:	<u>ASTM C88</u>	Authorized By:	<u>Client</u> Date <u>5-23-95</u>
		Solution:	<u>Sodium Sulfate (Used) 5 Cycles</u>

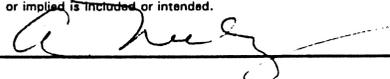
COARSE AGGREGATE

<u>Coarse Fraction Size</u>	<u>Grading of Original Sample Percent</u>	<u>Wt. of Test Fractions Before Test, grams</u>	<u>Percentage Passing Designated Sieve</u>	<u>Weighted Percentage Loss, %</u>
2-1/2" to 2" 2" to 1-1/2"				
1-1/2" to 1" 1" to 3/4"	28 11	1004.3 503.0	4.0 5.1	1.12 .56
3/4" to 1/2" 1/2" to 3/8"	14 7	670.1 330.6	9.6 12.9	1.34 .90
3/8" to No. 4 Minus No. 4	11	300.9	9.2	1.01
Totals				4.93

*The size fraction indicated contains less than 5% of one or more components therefore, the percent loss is assumed to be that of the next smaller size.

Copies to: Addressee (3), Billing (1), Field File (1).
523\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY 



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

ROCK QUALITY DETERMINATION

United Nuclear Corporation
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, New Mexico 87305-3077

Job No. 3145JB031
Inv. No. 31450145
Date of Report 11/14/95
Reviewed By [Signature]

Project: 1995 Church Rock Uranium Mill Tailings Reclamation Project
Location: Church Rock, New Mexico Sampled by: H. Kuebler/WT Date 06/12/95
Material Source: Hamilton Brothers Construction Authorized by: E. Morales/Client Date 06/12/95
Material Type: D50 .35 Aggregate Intended Use Swale Aggregate

Property	Value	Score	Weighting Factor	Score x Weight
Specific Gravity (SSD)	2.75	10	9	90
Absorption, %	1.5	4	2	8
L.A. Abrasion, 100 rev, %	2.6	9.0	1	9
Sodium Soundness Loss, %	6.38	7.0	11	77.0

Total = 184.0, Rock Quality Score = $184.0/230 \times 100 = 80$

Dist: Client (3) Field File (1)

/cb:RQD.UNC2



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining and Milling
Attn: Mr. Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450145
Report Date: 11-14-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: Crushed Basalt D⁵⁰ .35 Aggre. Sampled By: H.K./WT Date 6-12-95

Source: Hamilton Brothers Submitted By: H.K./WT Date 6-12-95

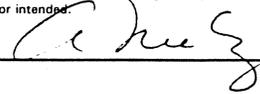
Authorized By: Client Date 6-12-95

Coarse Aggregate, ASTM C127

Bulk Specific Gravity	<u>2.709</u>
Bulk Specific Gravity (SSD)	<u>2.750</u>
Apparent Specific Gravity	<u>2.824</u>
Absorption, Percent	<u>1.50</u>

Copies to: Client (3), Billing (1), Field File (1).
612\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY 



**Western
Technologies
Inc.**
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining and Milling
Attn: Mr. Ed Morales
PO Box 3077
Gallup, NM 87305

Job No.	3145JB031
Lab/Inv. No.	31450145
Report Date:	11-14-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: <u>Crushed Basalt D⁵⁰ .35 aggre.</u>	Sampled By: <u>H.K./WT</u>	Date	6-12-95
Source: <u>Hamilton Brothers</u>	Submitted By: <u>H.K./WT</u>	Date	6-12-95
Supplier: _____	Authorized By: <u>Client</u>	Date	6-12-95

L.A. Abrasion, ASTM C131, Grading A

% Loss at 100 Revs. 2.6

% Loss at 500 Revs.

Copies to: Addressee (3), Billing (1). Field File (1).
612.3\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY _____



**Western
Technologies
Inc.**
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

SOUNDNESS OF AGGREGATES

Client:	UNC Mining & Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	3145JB031
		Lab/Inv. No.	31450145
		Report Date:	11-15-95
Project:	1995 Reclamation		
Location:	Church Rock, NM		
Material:	Crushed Basalt	Sampled By:	H.K./WT Date 6-12-95
Source:	D ⁵⁰ .35 Aggre.	Submitted By:	H.K./WT Date 6-12-95
Procedure:	ASTM C88	Authorized By:	Client Date 6-12-95
		Solution:	Sodium Sulfate (Used) Cycles 5

COARSE AGGREGATE

Coarse Fraction Size	Grading of Original Sample Percent	Wt. of Test Fractions Before Test, grams	Percentage Passing Designated Sieve	Weighted Percentage Loss, %
2-1/2" to 2" 2" to 1-1/2"				
1-1/2" to 1" 1" to 3/4"	28 11	1007.2 500.8	9.1 6.0	2.55 .66
3/4" to 1/2" 1/2" to 3/8"	14 7	670.2 331.3	6.9 15.9	.97 1.11
3/8" to No. 4 Minus No. 4	11	300.5	9.9	1.09
Totals				6.38

*The size fraction indicated contains less than 5% of one or more components therefore, the percent loss is assumed to be that of the next smaller size.

Percentage of fraction in original grading: % Plus #4, % Minus #4.

Copies to: Addressee (3), Billing (1), Field File (1).
628\h:unc031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied, is included or intended.

REVIEWED BY



**Western
Technologies
Inc.**
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

ROCK QUALITY DETERMINATION

United Nuclear Corporation
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, New Mexico 87305-3077

Job No. 3145JB031
Inv. No. 31450185
Date of Report 12/05/95
Reviewed By [Signature]

Project: 1995 Church Rock Uranium Mill Tailings Reclamation Project
Location: Church Rock, New Mexico Sampled by: H. Kuebler/WT Date 07/10/95
Material Source: Hamilton Brothers Construction Authorized by: E. Morales/Client Date 07/10/95
Material Type: D50 .35 Aggregate Intended Use Swales

Property	Value	Score	Weighting Factor	Score x Weight
Specific Gravity (SSD)	2.718	9.3	9	83.7
Absorption, %	2.07	2.9	2	5.8
L.A. Abrasion, 100 rev, %	5.4	7.6	1	7.6
Sodium Soundness Loss, %	.99	10	11	110

Total = 207.1, Rock Quality Score = 207.1/230 x 100 = 90

Dist: Client (3) Field File (1)

/cb:RQD.UNC2



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining and Milling
Attn: Mr. Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450185
Report Date: 11-27-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material:	<u>Crushed Basalt D⁵⁰ .35 Aggre.</u>	Sampled By:	<u>H.K./WT</u>	Date	<u>7-10-95</u>
Source:	<u>Hamilton Brothers</u>	Submitted By:	<u>H.K./WT</u>	Date	<u>7-10-95</u>
		Authorized By:	<u>Client</u>	Date	<u>7-10-95</u>

Coarse Aggregate, ASTM C127

Bulk Specific Gravity	<u>2.663</u>
Bulk Specific Gravity (SSD)	<u>2.718</u>
Apparent Specific Gravity	<u>2.818</u>
Absorption, Percent	<u>2.07</u>

Copies to: Client (3), Billing (1), Field File (1).
710.1\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY 



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

SOUNDNESS OF AGGREGATES

Client:	UNC Mining and Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	3145JB031
		Lab/Inv. No.	31450185
		Report Date:	11-27-95
Project:	1995 Reclamation		
Location:	Church Rock, NM		
Material:	Basalt D ⁵⁰ .35 Aggre.	Sampled By:	H.K./WT Date 7-10-95
Source:		Submitted By:	H.K./WT Date 7-10-95
Procedure:	ASTM C88	Authorized By:	Client Date 7-10-95
		Solution:	Sodium Sulfate (Used) 5 Cycles

COARSE AGGREGATE

Coarse Fraction Size	Grading of Original Sample Percent	Wt. of Test Fractions Before Test, grams	Percentage Passing Designated Sieve	Weighted Percentage Loss, %
2-1/2" to 2" 2" to 1-1/2"				
1-1/2" to 1" 1" to 3/4"	17 7	1009.7 500.7	.05 .04	.01 .00
3/4" to 1/2" 1/2" to 3/8"	14 10	670.3 330.7	.03 .36	.4 .04
3/8" to No. 4 Minus No. 4	17	300.0	3.2	.54
Totals				.99

*The size fraction indicated contains less than 5% of one or more components therefore, the percent loss is assumed to be that of the next smaller size.

Percentage of fraction in original grading: % Plus #4, % Minus #4.

Copies to: Addressee (3), Billing (1), Field File (1).
710/va:UN031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY



**Western
Technologies
Inc.**
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

ROCK QUALITY DETERMINATION

United Nuclear Corporation
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, New Mexico 87305-3077

Job No. 3145JB031
Inv. No. 31450243
Date of Report 08/29/95
Reviewed By *[Signature]*

Project: 1995 Church Rock Uranium Mill Tailings Reclamation Project
Location: Church Rock, New Mexico Sampled by: H. Kuebler/WT Date 06/20/95
Material Source: Hamilton Brothers Construction Authorized by: E. Morales/Client Date 06/20/95
Material Type: Crushed Basalt Intended Use D50 - 3

Property	Value	Score	Weighting Factor	Score x Weight
Specific Gravity (SSD)	2.728	9.5	9	85.5
Absorption, %	1.45	4	2	8.0
L.A. Abrasion, 100 rev, %	6.1	7.6	1	7.6
Sodium Soundness Loss, %	1.85	9.6	11	105.6

Total = 206.7, Rock Quality Score = 206.7/230 x 100 = 90

/cb:RQD.UNC1



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450243
Report Date: 8-29-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: Basalt Rock Sampled By: HK Date 6-20-95

Source: D50-3 Submitted By: HK Date 6-20-95

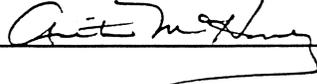
Authorized By: Client Date 6-20-95

Coarse Aggregate, ASTM C127

Bulk Specific Gravity	2.689
Bulk Specific Gravity (SSD)	2.728
Apparent Specific Gravity	2.798
Absorption, Percent	1.45

Copies: Client (3), Billing & Field File (2).
620\ha:UNC031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY 



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client:	UNC Mining & Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	3145JB031
		Lab/Inv. No.	31450243
		Report Date:	8-28-95
Project: 1995 Reclamation			
Location: Church Rock, NM			
Material:	Basalt Rock	Sampled By:	HK
		Date	6-20-95
Source:	D50-3	Submitted By:	HK
		Date	6-20-95
Supplier:		Authorized By:	Client
		Date	6-20-95

L.A. Abrasion, ASTM C131, Grading A

% Loss at 100 Revs. 6.1

% Loss at 500 Revs.

Copies to: Addressee (3), Billing (1), Field File (1).
620\ha:UNC031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY *Arnie McHenry*

LABORATORY REPORT

SOUNDNESS OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031
 Lab/Inv. No. 31450243
 Report Date: 8-29-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: <u>Basalt Rock</u>	Sampled By: <u>HK</u>	Date: <u>6-20-95</u>
Source: <u>D50-3</u>	Submitted By: <u>HK</u>	Date: <u>6-20-95</u>
Procedure: <u>ASTM C88</u>	Authorized By: <u>Client</u>	Date: <u>6-20-95</u>
	Solution: <u>Sodium Sulfate</u>	

COARSE AGGREGATE

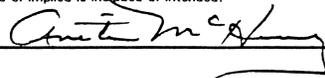
<u>Coarse Fraction Size</u>	<u>Grading of Original Sample Percent</u>	<u>Wt. of Test Fractions Before Test, grams</u>	<u>Percentage Passing Designated Sieve</u>	<u>Weighted Percentage Loss, %</u>
2-1/2" to 2" 2" to 1-1/2"	64	3053.3 2018.4	1.97	1.26
1-1/2" to 1" 1" to 3/4"	19	1015.0 509.5	.60	.11
3/4" to 1/2" 1/2" to 3/8"	13	674.9 332.9	2.28	.30
3/8" to No. 4 Minus No. 4	4	302.2	.46	.18
Totals				1.85

*The size fraction indicated contains less than 5% of one or more components therefore, the percent loss is assumed to be that of the next smaller size.

Percentage of fraction in original grading: % Plus #4, % Minus #4.

Copies to: Addressee (3), Billing (1), Field File (1).
 620/h:unc031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY 



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

ROCK QUALITY DETERMINATION

United Nuclear Corporation
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, New Mexico 87305-3077

Job No. 3145JB031
Inv. No. 31450243
Date of Report 11/14/95
Reviewed By _____

Project: 1995 Church Rock Uranium Mill Tailings Reclamation Project
Location: Church Rock, New Mexico Sampled by: H. Kuebler/WT Date 07/19/95
Material Source: Hamilton Brothers Construction Authorized by: E. Morales/Client Date 07/19/95
Material Type: D50 -3" Intended Use Swale Aggregate

Property	Value	Score	Weighting Factor	Score x Weight
Specific Gravity (SSD)	2.710	9	9	81
Absorption, %	1.76	3.5	2	7.0
L.A. Abrasion, 100 rev, %	2.6	8.5	1	8.5
Sodium Soundness Loss, %	3.78	8.5	11	93.5

Total = 190.0, Rock Quality Score = 190.0/230 x 100 = 83

Dist: Client (3) Field File (1)

/cb:RQD.UNC2



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

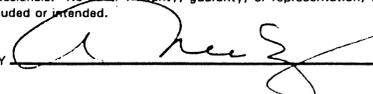
Client:	UNC Mining and Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	<u>3145JB031</u>
		Lab/Inv. No.	<u>31450185</u>
		Report Date:	<u>11-14-95</u>
Project:	<u>1995 Reclamation</u>		
Location:	<u>Church Rock, NM</u>		
Material:	<u>Crushed Basalt D⁵⁰ 3 inch</u>	Sampled By:	<u>H.K./WT</u> Date <u>7-19-95</u>
Source:	<u>Hamilton Brothers</u>	Submitted By:	<u>H.K./WT</u> Date <u>7-19-95</u>
		Authorized By:	<u>Client</u> Date <u>7-19-95</u>

Coarse Aggregate, ASTM C127

Bulk Specific Gravity	<u>2.663</u>
Bulk Specific Gravity (SSD)	<u>2.71</u>
Apparent Specific Gravity	<u>2.794</u>
Absorption, Percent	<u>1.76</u>

Copies to: Client (3), Billing (1), Field File (1).
719\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY 



**Western
Technologies
Inc.**
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client:	UNC Mining and Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	3145JB031
		Lab/Inv. No.	31450185
		Report Date:	11-14-95
Project: 1995 Reclamation			
Location: Church Rock, NM			
Material:	Crushed Basalt D ⁵⁰ 3 inch	Sampled By:	H.K./WT
		Date	7-19-95
Source:	Hamilton Brothers	Submitted By:	H.K./WT
		Date	7-19-95
Supplier:		Authorized By:	Client
		Date	7-9-95

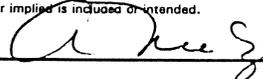
L.A. Abrasion, ASTM C131, Grading A

% Loss at 100 Revs. 2.6

% Loss at 500 Revs. —

Copies to: Addressee (3), Billing (1), Field File (1).
719.1\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY 



Western Technologies Inc.
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

SOUNDNESS OF AGGREGATES

Client:	UNC Mining & Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	<u>3145JB031</u>
		Lab/Inv. No.	<u>31450185</u>
		Report Date:	<u>11-15-95</u>
Project:	<u>1995 Reclamation</u>		
Location:	<u>Church Rock, NM</u>		
Material:	<u>Crushed Basalt D⁵⁰ 3 inch</u>	Sampled By:	<u>H.K./WT</u> Date <u>7-19-95</u>
Source:	<u>Hamilton Brothers</u>	Submitted By:	<u>H.K./WT</u> Date <u>7-19-95</u>
Procedure:	<u>ASTM C88</u>	Authorized By:	<u>Client</u> Date <u>7-19-95</u>
		Solution:	<u>Sodium Sulfate (Used) Cycles 5</u>

COARSE AGGREGATE

Coarse Fraction Size	Grading of Original Sample Percent	Wt. of Test Fractions Before Test, grams	Percentage Passing Designated Sieve	Weighted Percentage Loss, %
2-1/2" to 2"	20	3007.3	3.56	.71
2" to 1-1/2"	26	2010.2	1.9	.49
1-1/2" to 1"	20	1003.2	11.9	2.38
1" to 3/4"	2	501.2	10.0	.2
3/4" to 1/2"	0	670.7	6.0	0
1/2" to 3/8"	0	330.8	14.5	0
3/8" to No. 4 Minus No. 4	0	300.8	8.9	0
Totals				3.78

*The size fraction indicated contains less than 5% of one or more components therefore, the percent loss is assumed to be that of the next smaller size.

Percentage of fraction in original grading: % Plus #4, % Minus #4.

Copies to: Addressee (3), Billing (1), Field File (1).
719.2\h:unc031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied, is included or intended.

REVIEWED BY _____

[Handwritten Signature]



**Western
Technologies
Inc.**
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

ROCK QUALITY DETERMINATION

United Nuclear Corporation
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, New Mexico 87305-3077

Job No. 3145JB031
Inv. No. 31450243
Date of Report 11/14/95
Reviewed By _____

Project: 1995 Church Rock Uranium Mill Tailings Reclamation Project
Location: Church Rock, New Mexico Sampled by: H. Kuebler/WT Date 07/26/95
Material Source: Hamilton Brothers Construction Authorized by: E. Morales/Client Date 07/26/95
Material Type: D50 -3" Intended Use Swale Aggregate

Property	Value	Score	Weighting Factor	Score x Weight
Specific Gravity (SSD)	2.781	10	9	90
Absorption, %	1.93	3	2	6
L.A. Abrasion, 100 rev, %	3.1	9	1	9
Sodium Soundness Loss, %	2.20	9	11	99

Total = 204.0, Rock Quality Score = 204.0/230 x 100 = 89

Dist: Client (3) Field File (1)

/cb:RQD.UNC2



**Western
Technologies
Inc.**
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining and Milling
Attn: Mr. Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450185
Report Date: 11-14-95

Project: 1995 Reclamation

Location: Church Rock, NM

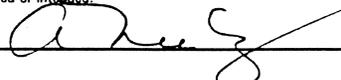
Material: <u>Crushed Basalt D⁵⁰ 3 inch</u>	Sampled By: <u>H.K./WT</u>	Date: <u>7-26-95</u>
Source: <u>Hamilton Brothers</u>	Submitted By: <u>H.K./WT</u>	Date: <u>7-26-95</u>
	Authorized By: <u>Client</u>	Date: <u>7-26-95</u>

Coarse Aggregate, ASTM C127

Bulk Specific Gravity	<u>2.728</u>
Bulk Specific Gravity (SSD)	<u>2.781</u>
Apparent Specific Gravity	<u>2.880</u>
Absorption, Percent	<u>1.93</u>

Copies to: Client (3), Billing (1), Field File (1).
726.1\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY 



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client:	UNC Mining and Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	3145JB031
		Lab/Inv. No.	31450185
		Report Date:	11-14-95
Project:	1995 Reclamation		
Location:	Church Rock, NM		
Material:	Crushed Basalt D ⁵⁰ 3 inch	Sampled By:	H.K./WT
		Date	7-26-95
Source:	Hamilton Brothers	Submitted By:	H.K./WT
		Date	7-26-95
Supplier:		Authorized By:	Client
		Date	7-26-95

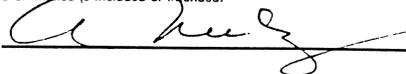
L.A. Abrasion, ASTM C535, Grading 1

% Loss at 100 Revs. 3.1

% Loss at 500 Revs.

Copies to: Addressee (3), Billing (1), Field File (1).
726\ha:UN031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied, is included or intended.

REVIEWED BY 



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

SOUNDNESS OF AGGREGATES

Client:	UNC Mining & Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	<u>3145JB031</u>
		Lab/Inv. No.	<u>31450185</u>
		Report Date:	<u>11-15-95</u>
Project:	<u>1995 Reclamation</u>		
Location:	<u>Church Rock, NM</u>		
Material:	<u>Crushed Basalt D⁵⁰ 3 inch</u>	Sampled By:	<u>H.K./WT</u> Date <u>7-26-95</u>
Source:	<u>Hamilton Brothers</u>	Submitted By:	<u>H.K./WT</u> Date <u>7-26-95</u>
Procedure:	<u>ASTM C88</u>	Authorized By:	<u>Client</u> Date <u>7-26-95</u>
		Solution:	<u>Sodium Sulfate (Used) Cycles 5</u>

COARSE AGGREGATE

Coarse Fraction Size	Grading of Original Sample Percent	Wt. of Test Fractions Before Test, grams	Percentage Passing Designated Sieve	Weighted Percentage Loss, %
2-1/2" to 2"	25	3064.4	4.10	1.03
2" to 1-1/2"	21	2025.6	3.17	.67
1-1/2" to 1"	7	1022.8	7.18	.50
1" to 3/4"	0	505.3	8.41	0
3/4" to 1/2"	0	671.4	11.3	0
1/2" to 3/8"	0	330.3	23.3	0
3/8" to No. 4 Minus No. 4	0	300.4	18.0	0
Totals				2.20

*The size fraction indicated contains less than 5% of one or more components therefore, the percent loss is assumed to be that of the next smaller size.

Percentage of fraction in original grading: % Plus #4, % Minus #4.

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY *A. Neely*



APPENDIX G

ROCK GRADATION TESTS, ROCK MULCH AND RIPRAP

UNITED NUCLEAR CORPORATION 1995 RECLAMATION

WT JOB NO. 3145JB0.

TEST SUMMARY FOR D50 1.5 MATERIAL

DATE OF REPORT 12/07/9

DATE	SAMPLE LOCATION	% PASS 3" SPEC. 100%	% PASS 1" SPEC. 8-37%	% PASS #4 SPEC. 0-8%	WITHIN SPECS. ?
03/09/95	Hamilton Brothers	100	14	1	Yes
03/14/95	Hamilton Brothers	100	16	1	Yes
03/21/95	Hamilton Brothers	100	27	1	Yes
03/31/95	UNC Stockpile	100	19	.6	
04/06/95	Rock Score				
04/06/95	Hamilton Brothers	100	40	3	No*
05/23/95	UNC Windrow	100	15	.1	Yes
06/07/95	Rock Score				Yes
07/05/95	Rock Score				
07/05/95	UNC	100	22	1	Yes
09/07/95	Hamilton Brothers	100	35	.8	Yes

*Material was wasted.

cb/1995.UNC/3

Dist: Client (3) Field File (1) Billing (1)



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450051
Report Date: 04/04/95

Project: 1995 Reclamation

Location: Chruch Rock, New Mexico

Material: 1.5 Aggregate Sampled By: H. Kuebler /WT Date: 03/09/95

Source: Hamilton Brothers Submitted By: H. Kuebler /WT Date: 03/09/95

Authorized By: Client Date: 03/09/95

SIEVE ANALYSIS, ASTM C136 & C117

<u>Sieve Size</u>	<u>% Passing Accumulative</u>	<u>Specification (As Required)</u>
<u>2"</u>	<u>100</u>	<u>100</u>
<u>1"</u>	<u>14</u>	<u>8 - 37</u>
<u>No. 4</u>	<u>1</u>	<u>0 - 8</u>

Copies: Client (3), Billing (1), Field File (1)
3-9/dn:unc031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY _____



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client:	UNC Mining & Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	3145JB031
		Lab/Inv. No.	31450051
		Report Date:	04/04/95
Project:	1995 Reclamation		
Location:	Chruch Rock, New Mexico		
Material:	1.5 Aggregate	Sampled By:	P. Christensen/WT Date 03/14/95
Source:	Hamilton Brothers Crusher	Submitted By:	P. Christensen/WT Date 03/14/95
		Authorized By:	Client Date 03/14/95

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
2"	100	100
1"	16	8 - 37
No. 4	1	0 - 8

Copies: Client (3), Billing (1), Field File (1)
3-14.2/dn:unc031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY _____



**Western
Technologies
Inc.**
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
PO Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450051
Report Date: 04/04/95

Project: 1995 Reclamation

Location: Chruch Rock, New Mexico

Material: 1.5 Aggregate, Sample #83 Sampled By: H. Kuebler /WT Date 03/21/95

Source: Hamilton Brothers Belt Sample Submitted By: H. Kuebler /WT Date 03/21/95

Authorized By: H. Kuebler /WT Date 03/21/95

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
2"	100	100
1"	27	8 - 37
No. 4	1	0 - 8

Copies: Client (3), Billing (1), Field File (1)
3-21.1/dn:unc031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY _____



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client:	UNC Mining & Milling Attn: Mr. Ed Morales PO Box 3077 Gallup, NM 87305	Job No.	<u>3145JB031</u>
		Lab/Inv. No.	<u>31450051</u>
		Report Date:	<u>04/04/95</u>
Project:	<u>1995 Reclamation</u>		
Location:	<u>Chruch Rock, New Mexico</u>		
Material:	<u>1.5 Aggregate, Sample #83</u>	Sampled By:	<u>H. Kuebler /WT</u> Date <u>03/31/95</u>
Source:	<u>UNC Stockpile</u>	Submitted By:	<u>H. Kuebler /WT</u> Date <u>03/31/95</u>
		Authorized By:	<u>H. Kuebler /WT</u> Date <u>03/31/95</u>

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
2"	100	100
1"	19	8 - 37
No. 4	.6	0 - 8

Copies: Client (3), Billing (1), Field File (1)
3-31.1/dn:unc031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY _____



**Western
Technologies
Inc.**
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450084
Report Date: 11/16/95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: 1.5 Aggregate Sampled By: H. Kuebler/WT Date: 04/06/95

Source: Hamilton Brothers Submitted By: H. Kuebler/WT Date: 04/06/95

Authorized By: Client Date: 04/06/95

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
2"	100	100
1-1/2"		
1-1/8"		
1"	40	8-37
3/4"		
1/2"		
3/8"		
1/4"		
No. 4	3	0-8
8		
10		
16		
30		
40		
50		
100		
200		

Moisture Density Relations, pcf (ASTM D698 Method A)

Maximum Dry Density, pcf N/A

Optimum Moisture, % N/A

Plasticity Index, ASTM D4318

Liquid Limit N/A

Plasticity Index N/A

Copies: Client (3), Billing (1) Field File (1)
406/cb:UNC.031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY *[Signature]*



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450122
Report Date: 11/16/95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: D⁵⁰ 1.5 Aggregate

Sampled By: H. Kuebler/WT Date 05/23/95

Source: UNC Wind Row

Submitted By: H. Kuebler/WT Date 05/23/95

Authorized By: Client Date 05/23/95

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
2"	100	100
1-1/2"		
1-1/8"		
1"	15	8-37
3/4"		
1/2"		
3/8"		
1/4"		
No. 4	0.1	0-8
8		
10		
16		
30		
40		
50		
100		
200		

Moisture Density Relations, pcf (ASTM D698 Method A)

Maximum Dry Density, pcf N/A

Optimum Moisture, % N/A

Plasticity Index, ASTM D4318

Liquid Limit N/A

Plasticity Index N/A

Copies: Client (3), Billing (1) Field File (1)
523.2/cb:UNC.031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450145
Report Date: 11/16/95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: D⁵⁰ 1.5 Aggregate

Sampled By: H. Kuebler/WT Date 07/05/95

Source: Hamilton Brothers

Submitted By: H. Kuebler/WT Date 07/05/95

Authorized By: Client Date 07/05/95

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
2"	100	100
1-1/2"		
1-1/8"		
1"	22	8-37
3/4"		
1/2"		
3/8"		
1/4"		
No. 4	1	0-8
8		
10		
16		
30		
40		
50		
100		
200		

Moisture Density Relations, pcf (ASTM D698 Method A)

Maximum Dry Density, pcf N/A
Optimum Moisture, % N/A

Plasticity Index, ASTM D4318

Liquid Limit N/A
Plasticity Index N/A

Copies: Client (3), Billing (1) Field File (1)
705/cb:UNC.031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY *[Signature]*



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
Post Office Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450185
Report Date: 11/16/95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: <u>D⁵⁰ 1.5</u>	Sampled By: <u>Hamilton Brothers</u>	Date: <u>09/07/95</u>	
Source: <u>Hamilton Brothers</u>	Submitted By: <u>H. Kuebler/WT</u>	Date: <u>09/07/95</u>	
	Authorized By: <u>Client</u>	Date: <u>09/07/95</u>	

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
4"		
3"		
2"	100	100
1"	35	20-37
3/4"		
1/2"		
3/8"		
1/4"		
No. 4	0.8	0-8
8		
10		
16		
30		
40		
50		
100		
200		

Moisture Density Relations, pcf (ASTM D698 Method A)

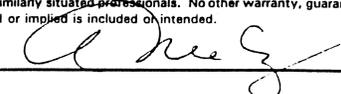
Maximum Dry Density, pcf	<u>N/A</u>
Optimum Moisture, %	<u>N/A</u>

Plasticity Index, ASTM D4318

Liquid Limit	<u>N/A</u>
Plasticity Index	<u>N/A</u>

Copies: Client (3), Billing (1) Field File (1)
907/cb:UNC.031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY: 

UNITED NUCLEAR CORPORATION 1995 RECLAMATION

WT JOB NO. 3145JB031

TEST SUMMARY FOR D50 3" MATERIAL

DATE OF REPORT 12/07/95

JK

DATE	SAMPLE LOCATION	% PASS 6" SPEC. 100%	% PASS 3" SPEC. 40-50%	% PASS 1" SPEC. 0-22%	WITHIN SPECS. ?
06/14/95	Stockpile	100	45	.1	Yes
06/21/95	Hamilton Brothers	100	18*	0	No
06/20/95	Rock Score				
07/06/95	Hamilton Brothers	100	21*	.1	No
07/07/95	Hamilton Brothers	100	60*	9	No
07/10/95	Hamilton Brothers	100	32*	2.6	No
07/11/95	Hamilton Brothers	100	54	2.0	Yes
07/19/95	Belt Sample	100	46	1.0	Yes
07/19/95	Rock Score				
07/26/95	Belt Sample	100	49	1.1	Yes
07/26/95	Rock Score				

*MATERIAL WAS DISCARDED

cb/1995.UNC/1

Dist: Client (3) Field File (1) Billing (1)





**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
P.O. Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450145
Report Date: 06/16/95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: D50 - 3" Sampled By: H. Kuebler Date: 06/14/95

Source: Stock Pile Submitted By: H. Kuebler Date: 06/14/95

Authorized By: Client Date: 06/14/95

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
6"	100	100
4"		
3"	45	40-50
1"	.1	0-22
3/4"		
1/2"		
3/8"		
1/4"		
No. 4		
8		
10		
16		
30		
40		
50		
100		
200		

Copies: Client (3), Billing (1), Field File (1)
6-14/rgo:UNC031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY *Thomas Kuebler*



Western Technologies Inc.
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
P.O. Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450145
Report Date: 8-29-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: <u>D50-3" Aggregate</u>	Sampled By: <u>Jim Golding</u>	Date: <u>6-21-95</u>	
Source: <u>Hamilton Brothers Crusher</u>	Submitted By: <u>Jim Golding</u>	Date: <u>6-21-95</u>	
	Authorized By: <u>Client</u>	Date: <u>6-21-95</u>	

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
6		100
4	100	
3	18	40-50
2	18	
1 1/2	18	
1 1/8	18	
1	0	0-22
3/4		
1/2		
3/8		
1/4,3		
#4		
8		
10		
16		

Moisture Density Relations, pcf (ASTM D698 Method A)

Maximum Dry Density, pcf N/A
Optimum Moisture, % A

Plasticity Index, ASTM D4318

Liquid Limit N/A
Plasticity Index N/A

Copies: Client (3), Billing (1), Field File (1)
621\ha:UNC031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY *Chris M. [Signature]*



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: **UNC Mining & Milling**
Attn: Mr. Ed Morales
P.O. Box 3077
Gallup, NM 87305

Job No. 3145JB031

Lab/Inv. No. 31450185

Report Date: 07/06/95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: D50 - 3" Aggregate

Sampled By: J. Golding Date 07/05/95

Source: Hamilton Crusher

Submitted By: J. Golding Date 07/05/95

Authorized By: Client Date 07/05/95

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
6"	100	100
4"	100	
3"	21	40-50
2"		
1 1/2"		
1 1/8"		
1"	0.1	0-22
3/4"		
No. 4		
8		
10		
16		
30		
40		
50		
100		
200		

Copies: Client (3), Billing (1), Field File (1)
7-5/rgo:UNC031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY Thomas Morales



Western Technologies Inc.
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
P.O. Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450185
Report Date: 8-29-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: D50-3" Aggregate **Sampled By:** HP **Date:** 7-7-95

Source: Hamilton Brothers Crusher **Submitted By:** HP **Date:** 7-7-95

Authorized By: Client **Date:** 7-7-95

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
6	100	
4		
3	60	40-50
2		
1 1/2		
1 1/8		
1	9	0-22
3/4	0	
1/2		
3/8		
1/4,3		
#4		
8		
10		
16		

Moisture Density Relations, pcf (ASTM D698 Method A)

Maximum Dry Density, pcf N/A
Optimum Moisture, % N/A

Plasticity Index, ASTM D4318

Liquid Limit N/A
Plasticity Index N/A

Copies: Client (3), Billing (1), Field File (1)
77ha:UNC031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY *Christine McHenry*



Western Technologies Inc.

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: **UNC Mining & Milling**
Attn: Mr. Ed Morales
P.O. Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450185
Report Date: 8-29-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: D50-3" Aggregate Sampled By: HD Date: 7-10-95

Source: Hamilton Brothers Crusher Submitted By: HD Date: 7-10-95

Authorized By: Client Date: 7-10-95

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
6	100	100
4		
3	32	40-50
2		
1 1/2		
1 1/8		
1	2.6	0-22
3/4		
1/2		
3/8		
1/4,3		
#4		
8		
10		
16		

Moisture Density Relations, pcf (ASTM D698 Method A)

Maximum Dry Density, pcf N/A
Optimum Moisture, % N/A

Plasticity Index, ASTM D4318

Liquid Limit N/A
Plasticity Index N/A

Copies: Client (3), Billing (1), Field File (1)
710\ha:UNC031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY *Amit M. [Signature]*



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: UNC Mining & Milling
Attn: Mr. Ed Morales
P.O. Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450185
Report Date: 8-29-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: D50-3" Sampled By: WTI Crew Date: 7-11-95

Source: Hamilton Brothers Stockpile Submitted By: WTI Crew Date: 7-11-95

Authorized By: Client Date: 7-11-95

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
6	100	
4		
3	54	40-50
2		
1 1/2		
1 1/8		
1	2	0-22
3/4		
1/2		
3/8		
1/4,3		
#4		
8		
10		
16		

Moisture Density Relations, pcf (ASTM D698 Method A)

Maximum Dry Density, pcf N/A
Optimum Moisture, % N/A

Plasticity Index, ASTM D4318

Liquid Limit N/A
Plasticity Index N/A

Copies: Client (3), Billing (1), Field File (1)
711\ha:UNC031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY *Carole McHenry*



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: **UNC Mining & Milling**
Attn: Mr. Ed Morales
P.O. Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450185
Report Date: 8-29-95

Project: 1995 Reclamation

Location: Church Rock, NM

Material: 3" Rock

Sampled By: Paul/Hamilton Bro. Date 7-19-95

Source: Belt - 121:45pm

Submitted By: CP Date 7-19-95

Authorized By: Client Date 7-19-95

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
6	100	100
4		
3	46	40-50
2		
1 1/2		
1 1/8		
1	1	0-22
3/4		
1/2		
3/8		
1/4, 3		
#4		
8		
10		
16		

Moisture Density Relations, pcf (ASTM D698 Method A)

Maximum Dry Density, pcf N/A
Optimum Moisture, % N/A

Plasticity Index, ASTM D4318

Liquid Limit N/A
Plasticity Index N/A

Copies: Client (3), Billing (1), Field File (1)
719\ha:UNC031

The above services and report were performed pursuant to the terms and conditions of the contract between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

LABORATORY REPORT

PHYSICAL PROPERTIES OF AGGREGATES

Client: **UNC Mining & Milling**
Attn: Mr. Ed Morales
P.O. Box 3077
Gallup, NM 87305

Job No. 3145JB031
Lab/Inv. No. 31450185
Report Date: 07/27/95

Project: 1995 Reclamation

Location: Church Rock, N.M.

Material: D50 - 3inch Sampled By: H. Kuebler Date: 07/26/95

Source: Hamilton Belt Sample Submitted By: H. Kuebler Date: 07/26/95

Authorized By: Client Date: 07/26/95

SIEVE ANALYSIS, ASTM C136 & C117

Sieve Size	% Passing Accumulative	Specification (As Required)
6"	100	100
4"		
3"	49	40-50
1"	1.1	0-22
3/4"		
1/2"		
3/8"		
1/4"		
No. 4		
8		
10		
16		
30		
40		
50		
100		
200		

Copies: Client (3), Billing (1), Field File (1)
7-26/rgo:UNC031

The above services and report were performed pursuant to the terms and conditions of the agreement or proposal, if any, between WT and client. WT warrants that this was performed under the appropriate standard of care, including the skill and judgement that is reasonably expected from similarly situated professionals. No other warranty, guaranty, or representation, either expressed or implied is included or intended.

REVIEWED BY Thomas Kuebler



APPENDIX H

ROCK MULCH AND SOIL/ROCK MATRIX MEASUREMENTS



**Western
Technologies
Inc.**
The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

UNITED NUCLEAR CORPORATION 1995 RECLAMATION

WT JOB NO. 3145JB031

DATE OF REPORT 08/17/95

**D50 1.5 AGGREGATE PLACEMENT THICKNESS
Pit #2**

Location	Thickness	Location	Thickness
R + 1	3 1/2"	R + 2	4"
R + 3	3"	R + 4	4"
R + 5	3"	R + 6	4"
R + 7	4"	R + 8	4"
R + 9	3"	R.5 + 1.5	4"
R.5 + 2.5	4"	R.5 + 3.5	4"
R.5 + 4.5	4"	R.5 + 5.5	3 1/2"
R.5 + 6.5	4"	R.5 + 7.5	4"
R.5 + 8.5	4"	S + 1.5	3 1/4"
S + 2	3 1/4"	S + 3	4"
S + 4	4"	S + 19	4"
B.5 + 19.5	3 1/4"	S + 5	3 1/2"
S + 6	4 1/2"	S + 7	3"
S + 8	4"	S + 8.5	4"

Dist: Client (3) Field File (1) Billing (1)
/cb:031.UNC

TESTS REPORTED HEREIN ARE INDICATIVE OF CONDITIONS FOUND AT THE EXACT LOCATION AND TIME OF TESTING ONLY. THE ABOVE SERVICES AND REPORT WERE PERFORMED PURSUANT TO THE TERMS AND CONDITIONS OF THE CONTRACT BETWEEN WT AND CLIENT. WT WARRANTS THAT THIS WAS PERFORMED UNDER THE APPROPRIATE STANDARD OF CARE, INCLUDING THE SKILL AND JUDGMENT THAT IS REASONABLY EXPECTED FROM SIMILARLY SITUATED PROFESSIONALS. NO OTHER WARRANTY, GUARANTY, OR REPRESENTATION, EXPRESS OR IMPLIED, IS INCLUDED OR INTENDED.

REVIEWED BY



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

UNITED NUCLEAR CORPORATION 1995 RECLAMATION

WT JOB NO. 3145JB031

DATE OF REPORT 08/17/95

**D50 1.5 AGGREGATE PLACEMENT THICKNESS
Pit #2**

Location	Thickness	Location	Thickness
S.5 + 0.5	3 1/2"	S.5 + 1.5	4"
S.5 + 2.5	3 1/4"	S.5 + 3.5	4"
S.5 + 4.5	3"	S.5 + 5.5	3 1/2"
S.5 + 6.5	4"	S.5 + 7.5	4"
S.5 + 8.5	3 1/2"	T + 1.0	3"
T + 2.0	3"	T + 3.0	3 1/2"
T + 4.0	3 1/4"	T + 5.0	3 1/2"
T + 6.0	4"	T + 7.0	3 1/2"
T + 8.0	3 1/2"	T.5 + 0.5	4"
T.5 + 1.5	3"	T.5 + 2.5	3 1/4"
T.5 + 3.5	3"	T.5 + 4.5	3 1/4"
T.5 + 5.5	4"	T.5 + 6.5	4"
T.5 + 7.5	3 1/4"	W.5 + 5.5	3 1/2"
W.5 + 6.5	4"	U + 1	3"

Dist: Client (3) Field File (1) Billing (1)
/cb:031.UNC

TESTS REPORTED HEREIN ARE INDICATIVE OF CONDITIONS FOUND AT THE EXACT LOCATION AND TIME OF TESTING ONLY. THE ABOVE SERVICES AND REPORT WERE PERFORMED PURSUANT TO THE TERMS AND CONDITIONS OF THE CONTRACT BETWEEN WT AND CLIENT. WT WARRANTS THAT THIS WAS PERFORMED UNDER THE APPROPRIATE STANDARD OF CARE, INCLUDING THE SKILL AND JUDGMENT THAT IS REASONABLY EXPECTED FROM SIMILARLY SITUATED PROFESSIONALS. NO OTHER WARRANTY, GUARANTY, OR REPRESENTATION, EXPRESS OR IMPLIED, IS INCLUDED OR INTENDED.

REVIEWED BY



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

UNITED NUCLEAR CORPORATION 1995 RECLAMATION

WT JOB NO. 3145JB031

DATE OF REPORT 08/17/95

**D50 1.5 AGGREGATE PLACEMENT THICKNESS
Pit #2**

Location	Thickness	Location	Thickness
U+2	3"	U+3	3 3/4"
U+4	3"	U+5	3 1/2"
U+6	3 1/4"	U+7	3 1/2"
U.5+1.5	3 1/2"	U.5+2.5	3 1/2"
U.5+3.5	3"	U.5+4.5	3 1/2"
U.5+5.5	3 1/2"	U.5+6.5	4"
V+2	3 1/2"	V+3	4"
V+4	3 1/4"	V+5	3"
V+6	4"	V+7	4"
V.5+2.5	3 1/4"	V.5+3.5	4"
V.5+4.5	3 1/4"	V.5+5.5	3 1/4"
V.5+6.5	3 3/4"	W+4	3"
W+5	4"	W+6	3 1/2"
W+7	4"		

Dist: Client (3) Field File (1) Billing (1)
/cb:031.UNC

TESTS REPORTED HEREIN ARE INDICATIVE OF CONDITIONS FOUND AT THE EXACT LOCATION AND TIME OF TESTING ONLY. THE ABOVE SERVICES AND REPORT WERE PERFORMED PURSUANT TO THE TERMS AND CONDITIONS OF THE CONTRACT BETWEEN WT AND CLIENT. WT WARRANTS THAT THIS WAS PERFORMED UNDER THE APPROPRIATE STANDARD OF CARE, INCLUDING THE SKILL AND JUDGMENT THAT IS REASONABLY EXPECTED FROM SIMILARLY SITUATED PROFESSIONALS. NO OTHER WARRANTY, GUARANTY, OR REPRESENTATION, EXPRESS OR IMPLIED, IS INCLUDED OR INTENDED.

REVIEWED BY



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

UNITED NUCLEAR CORPORATION 1995 RECLAMATION

WT JOB NO. 3145JB031

DATE OF REPORT 12/05/95

**SOIL ON MULCH PLACEMENT THICKNESS
Borrow Pit #2**

Location	Thickness	Location	Thickness
R + 1	3"	R + 2	4"
R + 3	3"	R + 4	3"
R + 5	3"	R + 6	3 1/4"
R + 7	3 1/2"	R + 8	3 1/4"
R + 9	7"	R.5 + 1.5	3 1/4"
R.5 + 2.5	3 1/4"	R.5 + 3.5	3 1/2"
R.5 + 4.5	4 1/4"	R.5 + 5.5	3 1/4"
R.5 + 6.5	3"	R.5 + 7.5	3 1/4"
R.5 + 8.5	5"	S + 1.5	3"
S + 2	3 1/4"	S + 3	4 1/4"
S + 4	4 1/2"	S + 5	3 1/2"
S + 6	4"	S + 7	4"
S + 8	3 1/4"	S + 8.5	4 1/4"
S.5 + 0.5	7"	S.5 + 1.5	3 1/2"

Dist: Client (3) Field File (1) Billing (1)
/cb:031.UNC/22

TESTS REPORTED HEREIN ARE INDICATIVE OF CONDITIONS FOUND AT THE EXACT LOCATION AND TIME OF TESTING ONLY. THE ABOVE SERVICES AND REPORT WERE PERFORMED PURSUANT TO THE TERMS AND CONDITIONS OF THE CONTRACT BETWEEN WT AND CLIENT. WT WARRANTS THAT THIS WAS PERFORMED UNDER THE APPROPRIATE STANDARD OF CARE, INCLUDING THE SKILL AND JUDGMENT THAT IS REASONABLY EXPECTED FROM SIMILARLY SITUATED PROFESSIONALS. NO OTHER WARRANTY, GUARANTY, OR REPRESENTATION, EXPRESS OR IMPLIED, IS INCLUDED OR INTENDED.

REVIEWED BY J. Keel



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

UNITED NUCLEAR CORPORATION 1995 RECLAMATION

WT JOB NO. 3145JB031

DATE OF REPORT 12/05/95

**SOIL ON MULCH PLACEMENT THICKNESS
Borrow Pit #2**

Location	Thickness	Location	Thickness
S.5 + 2.5	4 1/4"	S.5 + 3.5	4 1/2"
S.5 + 4.5	3"	S.5 + 5.5	4 1/4"
S.5 + 6.5	3"	S.5 + 7.5	3"
S.5 + 8.5	5 1/2"	T + 1.0	4 1/2"
T + 2.0	3 1/2"	T + 3.0	3"
T + 4.0	3 3/4"	T + 5.0	5"
T + 6.0	4"	T + 7.0	3"
T + 8.0	4 1/4"	T.5 + 0.5	5"
T.5 + 1.5	3"	T.5 + 2.5	3"
T.5 + 3.5	5 1/4"	T.5 + 4.5	5"
T.5 + 5.5	4"	T.5 + 6.5	4"
T.5 + 7.5	3"	W.5 + 4.5	3 1/2"
W.5 + 5.5	3 1/2"	W.5 + 6.5	5"
U + 0	11"	U + 1	4 1/2"

Dist: Client (3) Field File (1) Billing (1)
/cb:031.UNC/23

TESTS REPORTED HEREIN ARE INDICATIVE OF CONDITIONS FOUND AT THE EXACT LOCATION AND TIME OF TESTING ONLY. THE ABOVE SERVICES AND REPORT WERE PERFORMED PURSUANT TO THE TERMS AND CONDITIONS OF THE CONTRACT BETWEEN WT AND CLIENT. WT WARRANTS THAT THIS WAS PERFORMED UNDER THE APPROPRIATE STANDARD OF CARE, INCLUDING THE SKILL AND JUDGMENT THAT IS REASONABLY EXPECTED FROM SIMILARLY SITUATED PROFESSIONALS. NO OTHER WARRANTY, GUARANTY, OR REPRESENTATION, EXPRESS OR IMPLIED, IS INCLUDED OR INTENDED.

REVIEWED BY



**Western
Technologies
Inc.**

The Quality People
Since 1955

400 South Lorena Avenue
Farmington, New Mexico 87401
(505) 327-4966 • fax 327-5293

UNITED NUCLEAR CORPORATION 1995 RECLAMATION

WT JOB NO. 3145JB031

DATE OF REPORT 12/05/95

**SOIL ON MULCH PLACEMENT THICKNESS
Borrow Pit #2**

Location	Thickness	Location	Thickness
U+2	7 1/2"	U+3	3 1/4"
U+4	6 1/2"	U+5	3"
U+6	4 1/2"	U+7	6"
U.5+1.5	3 1/4"	U.5+2.5	3 1/4"
U.5+3.5	6 1/4"	U.5+4.5	6"
U.5+5.5	5 3/4"	U.5+6.5	4"
U.5+7.5	4 1/4"	V+2	3 1/4"
V+3	7 1/2"	V+4	6"
V+5	4"	V+6	4 1/2"
V+7	4 1/2"	V.5+2.5	5"
V.5+3.5	4"	V.5+4.5	4 1/2"
V.5+5.5	3"	V.5+6.5	5"
W+4	4 1/4"	W+5	5"
W+6	5"	W+7	4"

Dist: Client (3) Field File (1) Billing (1)
/cb:031.UNC/24

TESTS REPORTED HEREIN ARE INDICATIVE OF CONDITIONS FOUND AT THE EXACT LOCATION AND TIME OF TESTING ONLY. THE ABOVE SERVICES AND REPORT WERE PERFORMED PURSUANT TO THE TERMS AND CONDITIONS OF THE CONTRACT BETWEEN WT AND CLIENT. WT WARRANTS THAT THIS WAS PERFORMED UNDER THE APPROPRIATE STANDARD OF CARE, INCLUDING THE SKILL AND JUDGMENT THAT IS REASONABLY EXPECTED FROM SIMILARLY SITUATED PROFESSIONALS. NO OTHER WARRANTY, GUARANTY, OR REPRESENTATION, EXPRESS OR IMPLIED, IS INCLUDED OR INTENDED.

REVIEWED BY



APPENDIX I

FIELD MODIFICATIONS, SWALES A, B AND C

Canonie Environmental Services Corp.
94 Inverness Terrace East
Englewood, Colorado 80112

Phone 303 790-1747
Fax 303 799-0186

May 24, 1994

86-060-20

Mr. Edward Morales
United Nuclear Corporation
New Mexico Operations
P.O. Drawer QQ
Gallup, NM 87305-3077

Minor Design Modification of Swale A

Dear Ed:

As we discussed earlier today, Swale A of the final cover design can be modified to discharge into Swale B rather than directly into the North Diversion Ditch. This modification can be made provided that the riprap in Swale B is increased to a D_{50} of three inches and a thickness of six inches in that portion which is downgradient of where Swale A discharges into Swale B. This minor modification in the configuration of Swale A eliminates the need for excavating through the embankment which surrounds Borrow Pit No. 2.

Canonie Environmental Services Corp. also evaluated the possibility of eliminating Swale A from the design. Our evaluation indicates that the D_{50} of the rock mulch cover would have to be increased from 1.5 inches to 1.8 inches in the area south of Swale B. The D_{50} of the riprap would also have to be increased in the upper portion of Swale B.

A copy of the supporting calculations for the change in configuration of Swale A is attached for your records. If you have any questions or need further information, please call Eric Helm or me at (303) 790-1747.

Very truly yours,



Frank J. Filas, P.E.
Project Engineer

FJF/ajw

Enclosure

cc: Juan Velasquez (w/o enclosure)

Canonie Environmental

By EPH Date 5/20/94 Subject Channel Design Evaluation Sheet 1 of 19
Chkd By FJF Date 5-23-94 With Swale A Rerouted Proj No 86-060-20

TABLE OF CONTENTS

Purpose	Sheet <u>1</u> of <u>19</u>
Design Criteria	Sheet <u>1</u> of <u>19</u>
Methods	Sheet <u>1</u> of <u>19</u>
Results	Sheet <u>3</u> of <u>19</u>
Spreadsheets	Sheet <u>8</u> of <u>19</u>
Figure	Sheet <u>17</u> of <u>19</u>
References	Sheet <u>19</u> of <u>19</u>

Canonie Environmental

By EPH Date 5/20/94 Subject Channel Design Evaluation Sheet 1 of 19
Chkd By JF Date 5-23-94 With Swale A Rerouted Proj No 86-060-20

PURPOSE:

Field conditions encountered during implementation of the Tailings Reclamation Plan (Canonie, August 1991) at United Nuclear Corporation's Gallup, New Mexico site indicate that the routing of one of the Branch Swales on the ~~North~~ ^{Central} Cell is impractical and should be rerouted. It has been suggested that Branch Swale A should be diverted into Swale B as indicated in Figure 1 rather than routing it down the embankment of the tailings pile to the North Diversion Ditch.

This calculation brief evaluates the effect of rerouting Swale A into Swale B on the ditch design of Swale A, Swale B, and the North Cell Drainage Channel. The modification alters the slope of Swale A and the total flow in Swale B and the North Cell Drainage Channel. The channel dimensions, depth of flow, and riprap must be reevaluated to verify that each channel remains within the original design parameters of the Tailings Reclamation Plan.

DESIGN CRITERIA:

The design criteria established in the Tailings Reclamation Plan are as follows:

- Design for the Probable Maximum Flow (PMF) which would result from the Probable Maximum Precipitation (PMP),
- Provide at least 0.5-feet of freeboard above the maximum flow condition, and
- Size channel riprap to prevent erosion under the flow conditions produced by the PMP.

METHODS:

O.K. [Signature]
Channel design for the North Cell cover was done previously for the Tailings Reclamation Plan. Modifying the route of Swale A will not change the majority of the parameters involved in the ditch design. The PMP for the site remains the same and the probable maximum flow (PMF) in each ditch will be about the same except for the fact that Swale A will empty into Swale B increasing the flow in Swale B and the

Canonie Environmental

By EPH Date 5/20/94 Subject Channel Design Evaluation Sheet 2 of 19
Chkd By FJF Date 5-23-94 With Swale A Rerouted Proj No 86-060-20

North Cell Drainage Channel by the total flow of Swale A. The physical properties of the rock used for riprap will also be unchanged.

The PMF of Swale A will be altered slightly by the new routing, but the originally calculated PMF will be used as a conservative estimate. Figure 1 shows that the overall length of Swale A will be shorter than in the original design. The discharge reach that traveled down the tailing embankment to the diversion ditch has been eliminated, and field conditions indicate that the upper reach of the Swale is located in virtually flat terrain which will actually drain toward the South Cell. The calculated PMF of the original design will, therefore, be greater than the actual flow in the Swale.

The PMP, concentration times, and PMF calculations are not revisited in this calc brief. Only the depth of flow and riprap sizing are reevaluated. The depth of flow is calculated using Mannings equation as described in NRC's NUREG/CR 4620, and the riprap size is determined using the Safety Factors Method as outlined in "Applied Hydrology and Sedimentology for Disturbed Areas." (Barfield et. al., 1981)

Depth Of Flow

Given ditch dimensions and the maximum probable flow, Manning's Equation is used to calculate the depth of flow. The steps taken to size the channels are as follows:

1. Designate a bottom width and side slope for the channel,
2. Assume a D50 value for the channel riprap,
3. Assume a depth of flow in the channel,
4. Calculate a value for Manning's n using Eqn. 4.41 of NRC's NUREG/CR 4620,

$$n = 0.0395 (D50)^{0.1667}$$

5. Calculate the flow in the ditch using Manning's equation (Eqn 4.40 of NRC's NUREG/CR 4620),

$$Q = (1.486/n)AR^{(2/3)} S^{(1/2)}$$

6. Compare Q to the PMF of the ditch,

Canonie Environmental

By EPH Date 5/20/94 Subject Channel Design Evaluation Sheet 3 of 19
Chkd By EPH Date 5-23-94 With Swale A Rerouted Proj No 86-060-20

7. Iterate until Q equals the PMF,

Size Riprap

The Safety Factors Method is used to calculate the required riprap size given the ditch dimensions and the PMF of the ditch. The method is used iteratively with the methods above, because the PMF as calculated above depends on the D50 of the riprap. A change in riprap sizing changes the PMF which in turn can change the required riprap size. The process is iterated until the calculated riprap D50 matches the assumed D50 used to calculate the PMF. The riprap is sized as follows:

8. Calculate the Safety Factor for the channel bed, as described in Barfield, et. al. (1985, Included as attachment A),
9. Calculate the Safety Factor for the channel sideslopes (Barfield, et. al, 1985),
10. Iterate until both safety factors are greater than or equal to 1.

Spreadsheets were developed to facilitate the multiple iterations required to implement the Safety Factors Method. The "Spreadsheets" section of this calc brief contains print-outs of these spreadsheets for each channel design.

RESULTS:

The methods described above are used to reevaluate the channel designs of Swale A, Swale B, and the Upper and Lower Sections of the North Cell Drainage Channel given the design modification of rerouting Swale A into Swale B as shown in the attached figure. Table 1 shows the design parameters and the resulting channel configurations for these channels as presented in the Tailings Reclamation Plan. Table 2 shows the design parameters and configurations for the channels that result from rerouting Swale A into Swale B.

Swale A

The PMF and the riprap in Swale A will not be modified by rerouting it into Swale B. The parameter to be calculated is the maximum allowable slope given the PMF and

Canonie Environmental

By EPH Date 5/20/94 Subject Channel Design Evaluation Sheet 4 of 19
Chkd By RF Date 5-23-94 With Swale A Rerouted Proj No 86-060-20

the riprap D50 of the channel. This is the slope that can not be exceeded while rerouting the Swale. The maximum allowable slope is:

$$S = 0.0110 \text{ ft/ft.}$$

Swale B

The route of Swale B will be unaltered, so the slope of Swale B is not a variable. Given the original slope the required riprap D50 is calculated for the increased flow created by adding the flow of Swale A. The results show that below the confluence of the two swales the originally designated D50 of 1.5" will not be sufficient. The safety factor for the riprap dropped below 1.0 to 0.9. When the next larger riprap grading which has a D50 of 3.0" is substituted the safety factor is increased to 1.37 indicating that it will be sufficient. Therefore, The size of riprap used in Swale B will have to be increased from D50 = 1.5" to D50 = 3.0" below the confluence of Swales A and B.

The maximum depth of flow in Swale B will be increased from 0.97 ft to 1.26 ft. This, however, still leaves more than the minimum freeboard of 0.5 ft in the original channel design of 2.0 ft.

North Cell Drainage Channel - Upper Section

The Safety Factors Method was run for the North Cell Drainage Channel (NCDC) Upper Section using the original ditch design but with an increased flow due to flow from Swale A. The depth of flow was increased from 2.54 ft to 2.67 ft, and the safety factor was decreased to 0.98. The original channel depth of 3.5 ft will still provide to minimum freeboard of 0.5 ft, but the safety factor is slightly below the required 1.0. This design is not rejected, however, because of the conservative assumptions made in this calculation. The modifications to Swale A will decrease its PMF as described in the Methods section, but the original PMF of 40 cfs is used in this calculation.

North Cell Drainage Channel - Upper Section

The Safety Factors Method was run for the North Cell Drainage Channel (NCDC) Lower Section using the original ditch design but with an increased flow due to flow

Canonie Environmental

By EPH Date 5/20/94 Subject Channel Design Evaluation Sheet 5 of 19
Chkd By EF Date 5-23-94 With Swale A Rerouted Proj No 86-060-20

from Swale A. The depth of flow was increased from 3.53 ft to 3.64 ft, and the safety factor was decreased to 1.03. The original channel depth of 3.5 ft will still provide to minimum freeboard of 0.5 ft, and the safety factor is still above the required 1.0.

TABLE 1

DITCH DESIGN PARAMETERS
AND RESULTING DITCH DESIGNS
FROM TAILINGS RECLAMATION PLAN

	Swale A	Swale B	North Cell Drainage Channel	
			Upper	Lower
Parameters				
PMF	40	97	359	562
Bottom Width	10	20	10	10
Side Slopes	3 to 1	3 to 1	3 to 1	3 to 1
Channel Slope	0.0038	0.0083	0.0200	0.0126
Riprap Specific Gravity	2.5	2.5	2.5	2.5
Coefficient t	0.75	0.75	0.75	0.75
Riprap Angle of Repose	37	37	37	37
Configurations				
Riprap D50 (Inches)	1.5	1.5	9	9
Depth of Flow (Feet)	0.98	0.97	2.54	3.53
Depth of Ditch (Feet)	2	2	3.5	4.5
Safety Factor	1.10	1.08	1.02	1.06

By: EPH 5/20/94

TABLE 2

MODIFIED DITCH DESIGN PARAMETERS
AND RESULTING DITCH DESIGNS

	Swale A	Swale B	North Cell Drainage Channel	
			Upper	Lower
Parameters				
PMF	40	137	399	602
Bottom Width	10	20	10	10
Side Slopes	3 to 1	3 to 1	3 to 1	3 to 1
Channel Slope	0.0110 (a)	0.0083	0.0200	0.0125
Riprap Specific Gravity	2.5	2.5	2.5	2.5
Coefficient t	0.75	0.75	0.75	0.75
Riprap Angle of Repose	37	37	37	37
Configurations				
Riprap D50 (Inches)	1.5	3 (b)	9	9
Depth of Flow (Feet)	0.78	1.26	2.67 (c)	3.64 (c)
Depth of Ditch (Feet)	2	2	3.5	4.5
Safety Factor	1.03	1.37	0.98	1.03

NOTES:
 (a): Maximum allowable slope calculated given the PMF and riprap D50.
 (b): D50 of 1.5" was not sufficient given the added flow of Swale A.
 (c): Calculated for the original ditch design with the additional flow from Swale A.

By: EPH 5/20/94

Canonie Environmental

By EPH Date 5/20/94 Subject Channel Design Evaluation Sheet 8 of 19
Chkd By Date With Swale A Rerouted Proj No 86-060-20

SPREADSHEETS

SAFETY FACTOR METHOD CHANNEL DESIGN

RIPRAP SIZE AND CHANNEL CONFIGURATION DESIGN BY SAFETY FACTOR METHOD

PROJECT: United Nuclear Corporation
 PROJECT #: 88-060-20
 LOCATION: North Cell Swale A
 Spreadsheet Varification

INPUT PARAMETERS

Q(input) 40 CFS
 BOTTOM WIDTH 10 FT
 Z (SIDE SLOPE) 3 (ZH:1V)
 CHANNEL SLOPE 0.0038 FT/FT
 CHANNEL LENGTH 3600 FT
 FREEBOARD 0.5 FT
 RIPRAP S.G. 2.5
 COEF FOR t 0.75 (See Reference; Figure 3.16, p. 192)
 Phi 37.00 Degrees (See Reference; Figure 3.14, p. 187)

SAFETY FACTORS METHOD

Alpha 18.43 Degrees Sideslope
 Theta 0.22 Degrees Channel Slope

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUMED)	0.06 FT	↔	D50 (ASSUMED)	0.06 FT	Avg. Riprap size
	0.720 IN			0.720 IN	
n	0.025		n	0.025	Mannings n
d (ASSUMED)	0.98 FT	↔	d (ASSUMED)	0.98 FT	Depth of flow
A	12.62 FT ²		A	12.62 FT ²	Area of flow
R	0.78 FT		R	0.78 FT	Hydraulic Radius
Q (CALC)	40.0 CFS		Q (CALC)	40.0 CFS	Check against Q(input)
v	3.17 FPS		v	3.17 FPS	Velocity
t	0.23 PSF		tMAX	0.17 PSF	Shear stress
nu b	0.865		nu s	0.65	See Reference
			Beta	37.63 Degrees	See Reference
			nu'	0.52	See Reference
SF (bottom)	1.15		SF (sideslope)	1.11	Safety Factor

DESIGN VALUES

CHANNEL DEPTH 1.476 FT Depth from top of freeboard to top of riprap
 Dmax 0.12 FT If D50 < 10", Dmax = 2*D50, If D50 > 10", Dmax = 1.5*D50
 Layer Thickness 0.12 FT If D50 < 10", Layer Thickness = 2*D50, If D50 > 10", Layer Thickness = 1.5*D50
 RIPRAP VOLUME 309 CY Riprap perimeter*thickness* channel length

REFERENCE: "Applied Hydrology and Sedimentology for Disturbed Areas", pgs. 185-194, Barfield, Warner, and Haan

← Denotes iterative parameters

By: EPH 5/20/94

SAFETY FACTOR METHOD CHANNEL DESIGN

RIPRAP SIZE AND CHANNEL CONFIGURATION DESIGN BY SAFETY FACTOR METHOD

PROJECT: United Nuclear Corporation
 PROJECT #: 86-060-20
 LOCATION: North Cell Swale A
 Maximum Allowable Slope, Given D50 = 1.5"

INPUT PARAMETERS

Q(input) 40 CFS
 BOTTOM WIDTH 10 FT
 Z (SIDE SLOPE) 3 (ZH:1V)
 CHANNEL SLOPE 0.0110 FT/FT
 CHANNEL LENGTH 1180 FT
 FREEBOARD 0.5 FT
 RIPRAP S.G. 2.5
 COEF FOR t 0.75 (See Reference; Figure 3.16, p. 192)
 Phi 37.00 Degrees (See Reference; Figure 3.14, p. 187)

SAFETY FACTORS METHOD

Alpha 18.43 Degrees Sideslope
 Theta 0.63 Degrees Channel Slope

CHANNEL BOTTOM

CHANNEL SIDE SLOPES

<p>D50 (ASSUMED) 0.13 FT 1.500 IN n 0.028 d (ASSUMED) 0.78 FT A 9.55 FT² R 0.64 FT Q (CALC) 40.0 CFS v 4.19 FPS t 0.53 PSF nu b 0.955</p>	<p>↔</p>	<p>D50 (ASSUMED) 0.13 FT 1.500 IN n 0.028 d (ASSUMED) 0.78 FT A 9.55 FT² R 0.64 FT Q (CALC) 40.0 CFS v 4.19 FPS tMAX 0.40 PSF nu s 0.72</p>	<p>↔</p>	<p>Avg. Riprap size Mannings n Depth of flow Area of flow Hydraulic Radius Check against Q(input) Velocity Shear stress See Reference Beta 40.21 Degrees See Reference nu' 0.59 See Reference SF (bottom) 1.03 SF (sideslope) 1.04 Safety Factor</p>
---	----------	---	----------	--

DESIGN VALUES

CHANNEL DEPTH	1.275 FT	Depth from top of freeboard to top of riprap
Dmax	0.25 FT	If D50 < 10", Dmax = 2*D50, If D50 > 10", Dmax = 1.5*D50
Layer Thickness	0.25 FT	If D50 < 10", Layer Thickness = 2*D50, If D50 > 10", Layer Thickness = 1.5*D50
RIPRAP VOLUME	197 CY	Riprap perimeter*thickness* channel length

REFERENCE: "Applied Hydrology and Sedimentology for Disturbed Areas", pgs. 185-194, Barfield, Warner, and Haan

← Denotes iterative parameters

BY: EPH

SAFETY FACTOR METHOD CHANNEL DESIGN

RIPRAP SIZE AND CHANNEL CONFIGURATION DESIGN BY SAFETY FACTOR METHOD

PROJECT: United Nuclear Corporation
 PROJECT #: 86-060-20
 LOCATION: North Cell Swale B with Swale A Added to Flow.

INPUT PARAMETERS

Q(input) 137 CFS
 BOTTOM WIDTH 20 FT
 Z (SIDE SLOPE) 3 (ZH:1V)
 CHANNEL SLOPE 0.0083 FT/FT
 CHANNEL LENGTH 3600 FT
 FREEBOARD 0.5 FT
 RIPRAP S.G. 2.5
 COEF FOR t 0.75 (See Reference; Figure 3.16, p. 192)
 Phi 37.00 Degrees (See Reference; Figure 3.14, p. 187)

SAFETY FACTORS METHOD

Alpha 18.43 Degrees Sideslope
 Theta 0.48 Degrees Channel Slope

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUMED)	0.13 FT	↔	D50 (ASSUMED)	0.13 FT	Avg. Riprap size
	1.500 IN			1.500 IN	
n	0.028		n	0.028	Mannings n
d (ASSUMED)	1.18 FT	↔	d (ASSUMED)	1.18 FT	Depth of flow
A	27.78 FT ²		A	27.78 FT ²	Area of flow
R	1.01 FT		R	1.01 FT	Hydraulic Radius
Q (CALC)	136.9 CFS		Q (CALC)	136.9 CFS	Check against Q(input)
v	4.93 FPS		v	4.93 FPS	Velocity
t	0.61 PSF		tMAX	0.46 PSF	Shear stress
nu b	1.097		nu s	0.82	See Reference
			Beta	44.19 Degrees	See Reference
			nu'	0.70	See Reference
SF (bottom)	0.90		SF (sideslope)	0.95	Safety Factor

DESIGN VALUES

CHANNEL DEPTH 1.68 FT Depth from top of freeboard to top of riprap
 Dmax 0.25 FT If D50 < 10", Dmax = 2*D50, If D50 > 10", Dmax = 1.5*D50
 Layer Thickness 0.25 FT If D50 < 10", Layer Thickness = 2*D50, If D50 > 10", Layer Thickness = 1.5*D50
 RIPRAP VOLUME 1021 CY Riprap perimeter*thickness* channel length

REFERENCE: "Applied Hydrology and Sedimentology for Disturbed Areas", pgs. 185-194, Barfield, Warner, and Haan

← Denotes iterative parameters

BY: EPH

SAFETY FACTOR METHOD CHANNEL DESIGN

RIPRAP SIZE AND CHANNEL CONFIGURATION DESIGN BY SAFETY FACTOR METHOD

PROJECT: United Nuclear Corporation
 PROJECT #: 86-060-20
 LOCATION: North Cell Swale B with Swale A Added to Flow.
 Using Riprap with D50 = 3"

INPUT PARAMETERS

Q(input) 137 CFS
 BOTTOM WIDTH 20 FT
 Z (SIDE SLOPE) 3 (ZH:1V)
 CHANNEL SLOPE 0.0083 FT/FT
 CHANNEL LENGTH 3600 FT
 FREEBOARD 0.5 FT
 RIPRAP S.G. 2.5
 COEF FOR t 0.75 (See Reference; Figure 3.16, p. 192)
 Phi 37.00 Degrees (See Reference; Figure 3.14, p. 187)

SAFETY FACTORS METHOD

Alpha 18.43 Degrees Sideslope
 Theta 0.48 Degrees Channel Slope

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUMED)	0.25 FT 3.000 IN	↔	D50 (ASSUMED)	0.25 FT 3.000 IN	Avg. Riprap size
n	0.031		n	0.031	Mannings n
d (ASSUMED)	1.28 FT	↔	d (ASSUMED)	1.28 FT	Depth of flow
A	29.96 FT ²		A	29.96 FT ²	Area of flow
R	1.07 FT		R	1.07 FT	Hydraulic Radius
Q (CALC)	136.7 CFS		Q (CALC)	136.7 CFS	Check against Q(input)
v	4.56 FPS		v	4.56 FPS	Velocity
t	0.65 PSF		tMAX	0.49 PSF	Shear stress
nu b	0.586		nu s	0.44	See Reference
			Beta	27.52 Degrees	See Reference
			nu'	0.32	See Reference
SF (bottom)	1.68		SF (sideslope)	1.37	Safety Factor

DESIGN VALUES

CHANNEL DEPTH 1.76 FT Depth from top of freeboard to top of riprap
 Dmax 0.50 FT If D50 < 10", Dmax = 2*D50, If D50 > 10", Dmax = 1.5*D50
 Layer Thickness 0.50 FT If D50 < 10", Layer Thickness = 2*D50, If D50 > 10", Layer Thickness = 1.5*D50
 RIPRAP VOLUME 2075 CY Riprap perimeter*thickness* channel length

REFERENCE: "Applied Hydrology and Sedimentology for Disturbed Areas", pgs. 185-194, Barfield, Warner, and Haan

← Denotes iterative parameters

By: EPH

SAFETY FACTOR METHOD CHANNEL DESIGN

RIPRAP SIZE AND CHANNEL CONFIGURATION DESIGN BY SAFETY FACTOR METHOD

PROJECT: United Nuclear Corporation
 PROJECT #: 86-060-20
 LOCATION: North Cell Swale A
 Maximum Allowable Slope, Given D50 = 3.0"

INPUT PARAMETERS

Q(input) 40 CFS
 BOTTOM WIDTH 10 FT
 Z (SIDE SLOPE) 3 (ZH:1V)
 CHANNEL SLOPE 0.0250 FT/FT
 CHANNEL LENGTH 1180 FT
 FREEBOARD 0.5 FT
 RIPRAP S.G. 2.5
 COEF FOR t 0.75 (See Reference; Figure 3.16, p. 192)
 Phi 37.00 Degrees (See Reference; Figure 3.14, p. 187)

SAFETY FACTORS METHOD

Alpha 18.43 Degrees Sideslope
 Theta 1.43 Degrees Channel Slope

CHANNEL BOTTOM

CHANNEL SIDE SLOPES

<p>D50 (ASSUMED) 0.25 FT 3.000 IN n 0.031 d (ASSUMED) 0.66 FT A 7.84 FT² R 0.55 FT Q (CALC) 40.0 CFS v 5.10 FPS t 1.02 PSF nu b 0.917</p>	<p>↔</p>	<p>D50 (ASSUMED) 0.25 FT 3.000 IN n 0.031 d (ASSUMED) 0.66 FT A 7.84 FT² R 0.55 FT Q (CALC) 40.0 CFS v 5.10 FPS tMAX 0.77 PSF nu s 0.69</p>	<p>Avg. Riprap size Mannings n Depth of flow Area of flow Hydraulic Radius Check against Q(input) Velocity Shear stress See Reference Beta 38.76 Degrees See Reference nu' 0.57 See Reference SF (bottom) 1.05 SF (sideslope) 1.06 Safety Factor</p>
---	----------	---	--

DESIGN VALUES

CHANNEL DEPTH 1.155 FT Depth from top of freeboard to top of riprap
 Dmax 0.50 FT If D50 < 10", Dmax = 2*D50, If D50 > 10", Dmax = 1.5*D50
 Layer Thickness 0.50 FT If D50 < 10", Layer Thickness = 2*D50, If D50 > 10", Layer Thickness = 1.5*D50
 RIPRAP VOLUME 378 CY Riprap perimeter*thickness* channel length

REFERENCE: "Applied Hydrology and Sedimentology for Disturbed Areas", pgs. 185-194, Barfield, Warner, and Haan

← Denotes iterative parameters

By: EPH

SAFETY FACTOR METHOD CHANNEL DESIGN

RIPRAP SIZE AND CHANNEL CONFIGURATION DESIGN BY SAFETY FACTOR METHOD

PROJECT: United Nuclear Corporation
 PROJECT #: 86-060-20
 LOCATION: North Cell Drainage Channel-Upper Section
 With Swale A added to the PMF

INPUT PARAMETERS

Q(input) 399 CFS
 BOTTOM WIDTH 10 FT
 Z (SIDE SLOPE) 3 (ZH:1V)
 CHANNEL SLOPE 0.0200 FT/FT
 CHANNEL LENGTH = FT
 FREEBOARD 0.5 FT
 RIPRAP S.G. 2.5
 COEF FOR t 0.75 (See Reference; Figure 3.16, p. 192)
 Phi 37.00 Degrees (See Reference; Figure 3.14, p. 187)

SAFETY FACTORS METHOD

Alpha 18.43 Degrees Sideslope
 Theta 1.15 Degrees Channel Slope

CHANNEL BOTTOM

D50 (ASSUMED) 0.75 FT
 9.000 IN
 n 0.038
 d (ASSUMED) 2.67 FT
 A 48.09 FT²
 R 1.79 FT
 Q (CALC) 399.2 CFS
 v 8.30 FPS
 t 3.33 PSF
 nu b 0.997

CHANNEL SIDE SLOPES

D50 (ASSUMED) 0.75 FT Avg. Riprap size
 9.000 IN
 n 0.038 Mannings n
 d (ASSUMED) 2.67 FT Depth of flow
 A 48.09 FT² Area of flow
 R 1.79 FT Hydraulic Radius
 Q (CALC) 399.2 CFS Check against Q(input)
 v 8.30 FPS Velocity
 tMAX 2.50 PSF Shear stress
 nu s 0.75 See Reference
 Beta 41.19 Degrees See Reference
 nu' 0.63 See Reference
 SF (bottom) 0.98
 SF (sideslope) 1.01 Safety Factor

DESIGN VALUES

CHANNEL DEPTH 3.17 FT Depth from top of freeboard to top of riprap
 Dmax 1.50 FT If D50 < 10", Dmax = 2*D50, If D50 > 10", Dmax = 1.5*D50
 Layer Thickness 1.50 FT If D50 < 10", Layer Thickness = 2*D50, If D50 > 10", Layer Thickness = 1.5*D50
 RIPRAP VOLUME 0 CY Riprap perimeter*thickness* channel length

REFERENCE: "Applied Hydrology and Sedimentology for Disturbed Areas", pgs. 185-194, Barfield, Warner, and Haan

← Denotes iterative parameters

By: EPH

SAFETY FACTOR METHOD CHANNEL DESIGN

RIPRAP SIZE AND CHANNEL CONFIGURATION DESIGN BY SAFETY FACTOR METHOD

PROJECT: United Nuclear Corporation
 PROJECT #: 86-060-20
 LOCATION: North Cell Drainage Channel-Upper Section
 Maximum Allowable Flow Given D50=9"

INPUT PARAMETERS

Q(input) 379 CFS
 BOTTOM WIDTH 10 FT
 Z (SIDE SLOPE) 3 (ZH:1V)
 CHANNEL SLOPE 0.0200 FT/FT
 CHANNEL LENGTH = FT
 FREEBOARD 0.5 FT
 RIPRAP S.G. 2.5
 COEF FOR t 0.75 (See Reference; Figure 3.16, p. 192)
 Phi 37.00 Degrees (See Reference; Figure 3.14, p. 187)

SAFETY FACTORS METHOD

Alpha 18.43 Degrees Sideslope
 Theta 1.15 Degrees Channel Slope

CHANNEL BOTTOM			CHANNEL SIDE SLOPES		
D50 (ASSUMED)	0.75 FT	↔	D50 (ASSUMED)	0.75 FT	Avg. Riprap size
	9.000 IN			9.000 IN	
n	0.038		n	0.038	Mannings n
d (ASSUMED)	2.60 FT	↔	d (ASSUMED)	2.60 FT	Depth of flow
A	46.28 FT ²		A	46.28 FT ²	Area of flow
R	1.75 FT		R	1.75 FT	Hydraulic Radius
Q (CALC)	378.7 CFS		Q (CALC)	378.7 CFS	Check against Q(input)
v	8.18 FPS		v	8.18 FPS	Velocity
t	3.24 PSF		tMAX	2.43 PSF	Shear stress
nu b	0.971		nu s	0.73	See Reference
			Beta	40.45 Degrees	See Reference
			nu'	0.61	See Reference
SF (bottom)	1.00		SF (sideslope)	1.03	Safety Factor

DESIGN VALUES

CHANNEL DEPTH 3.1 FT Depth from top of freeboard to top of riprap
 Dmax 1.50 FT If D50 < 10", Dmax = 2*D50, If D50 > 10", Dmax = 1.5*D50
 Layer Thickness 1.50 FT If D50 < 10", Layer Thickness = 2*D50, If D50 > 10", Layer Thickness = 1.5*D50
 RIPRAP VOLUME 0 CY Riprap perimeter*thickness* channel length

REFERENCE: "Applied Hydrology and Sedimentology for Disturbed Areas", pgs. 185-194, Barfield, Warner, and Haan

← Denotes iterative parameters

By: EPH

SAFETY FACTOR METHOD CHANNEL DESIGN

RIPRAP SIZE AND CHANNEL CONFIGURATION DESIGN BY SAFETY FACTOR METHOD

PROJECT: United Nuclear Corporation
 PROJECT #: 86-060-20
 LOCATION: North Cell Drainage Channel-Lower Section
 With Swale A Added to the Flow

INPUT PARAMETERS

Q(input) 602 CFS
 BOTTOM WIDTH 10 FT
 Z (SIDE SLOPE) 3 (ZH:1V)
 CHANNEL SLOPE 0.0125 FT/FT
 CHANNEL LENGTH = FT
 FREEBOARD 0.5 FT
 RIPRAP S.G. 2.5
 COEF FOR t 0.75 (See Reference; Figure 3.16, p. 192)
 Phi 37.00 Degrees (See Reference; Figure 3.14, p. 187)

SAFETY FACTORS METHOD

Alpha 18.43 Degrees Sideslope
 Theta 0.72 Degrees Channel Slope

CHANNEL BOTTOM		↔	CHANNEL SIDE SLOPES		
D50 (ASSUMED)	0.67 FT 8.000 IN	↔	D50 (ASSUMED)	0.67 FT 8.000 IN	Avg. Riprap size
n	0.037		n	0.037	Mannings n
d (ASSUMED)	3.64 FT	↔	d (ASSUMED)	3.64 FT	Depth of flow
A	75.99 FT ²		A	75.99 FT ²	Area of flow
R	2.30 FT		R	2.30 FT	Hydraulic Radius
Q (CALC)	602.1 CFS		Q (CALC)	602.1 CFS	Check against Q(input)
v	7.92 FPS		v	7.92 FPS	Velocity
t	2.84 PSF		tMAX	2.13 PSF	Shear stress
nu b	0.954		nu s	0.72	See Reference
			Beta	40.15 Degrees	See Reference
			nu'	0.59	See Reference
SF (bottom)	1.03		SF (sideslope)	1.04	Safety Factor

DESIGN VALUES

CHANNEL DEPTH 4.135 FT Depth from top of freeboard to top of riprap
 Dmax 1.33 FT If D50 < 10", Dmax = 2*D50, If D50 > 10", Dmax = 1.5*D50
 Layer Thickness 1.33 FT If D50 < 10", Layer Thickness = 2*D50, If D50 > 10", Layer Thickness = 1.5*D50
 RIPRAP VOLUME 0 CY Riprap perimeter*thickness* channel length

REFERENCE: "Applied Hydrology and Sedimentology for Disturbed Areas", pgs. 185-194, Barfield, Warner, and Haan

← Denotes iterative parameters

By: EPH

Canonie Environmental

By EPH Date 5/20/94 Subject Channel Design Evaluation Sheet 17 of 19
Chkd By Date With Swale A Rerouted Proj No 86-060-20

FIGURE

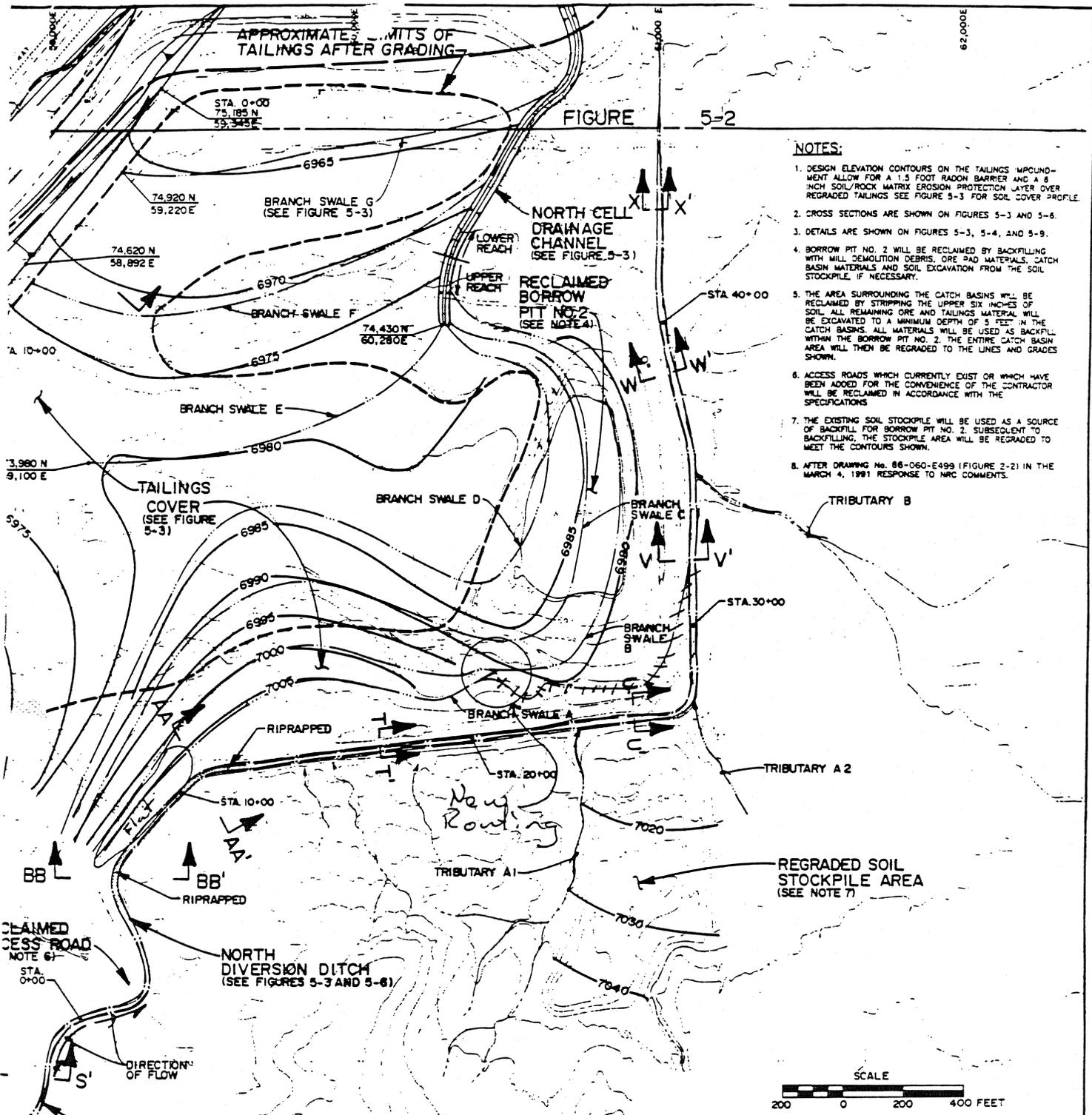


FIGURE 5-2

- NOTES:**
1. DESIGN ELEVATION CONTOURS ON THE TAILINGS MOUNDMENT ALLOW FOR A 1.5 FOOT RADON BARRIER AND A 6 INCH SOIL/ROCK MATRIX EROSION PROTECTION LAYER OVER REGRADED TAILINGS SEE FIGURE 5-3 FOR SOIL COVER PROFILE.
 2. CROSS SECTIONS ARE SHOWN ON FIGURES 5-3 AND 5-6.
 3. DETAILS ARE SHOWN ON FIGURES 5-3, 5-4, AND 5-9.
 4. BORROW PIT NO. 2 WILL BE RECLAIMED BY BACKFILLING WITH MILL DEMOLITION DEBRIS, ORE PAD MATERIALS, CATCH BASIN MATERIALS AND SOIL EXCAVATION FROM THE SOIL STOCKPILE, IF NECESSARY.
 5. THE AREA SURROUNDING THE CATCH BASINS WILL BE RECLAIMED BY STRIPPING THE UPPER SIX INCHES OF SOIL. ALL REMAINING ORE AND TAILINGS MATERIAL WILL BE EXCAVATED TO A MINIMUM DEPTH OF 5 FEET IN THE CATCH BASINS. ALL MATERIALS WILL BE USED AS BACKFILL WITHIN THE BORROW PIT NO. 2. THE ENTIRE CATCH BASIN AREA WILL THEN BE REGRADED TO THE LINES AND GRADES SHOWN.
 6. ACCESS ROADS WHICH CURRENTLY EXIST OR WHICH HAVE BEEN ADDED FOR THE CONVENIENCE OF THE CONTRACTOR WILL BE RECLAIMED IN ACCORDANCE WITH THE SPECIFICATIONS.
 7. THE EXISTING SOIL STOCKPILE WILL BE USED AS A SOURCE OF BACKFILL FOR BORROW PIT NO. 2. SUBSEQUENT TO BACKFILLING, THE STOCKPILE AREA WILL BE REGRADED TO MEET THE CONTOURS SHOWN.
 8. AFTER DRAWING No. 86-060-E499 (FIGURE 2-2) IN THE MARCH 4, 1991 RESPONSE TO HRC COMMENTS.

LEGEND:

- 6970 — ELEVATION OF FINAL GRADE, FEET (SEE NOTE 1)
- [Hatched Box] APPROXIMATE LIMITS OF CATCH BASINS I AND II AREAS REQUIRING STRIPPING, (SEE NOTE 5)
- DIRECTION OF FLOW

FINAL RECLAMATION PLAN
SOUTH END
PREPARED FOR
UNC MINING AND MILLING
GALLUP, NEW MEXICO
CanonieEnvironmental

△	8-24-91	ISSUED FOR 1991 RECLAMATION PLAN	M.T.H.	D.W.K.	D.H.G.
No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY

DATE: 5-30-91	FIGURE 5-1	DRAWING NUMBER 86-060-E544
SCALE: AS SHOWN		

86-060-E639

Canonie Environmental

By EPH Date 5/20/94 Subject Channel Design Evaluation Sheet 19 of 19
Chkd By Date With Swale A Rerouted Proj No 86-060-20

REFERENCES

Canonie Environmental Services, "Tailings Reclamation Plan As Approved by NRC March 1, 1991, License No. SUA-1475, Church Rock Site, Gallup, New Mexico," Prepared for United Nuclear Corporation, Gallup, New Mexico, August 1991.

Nelson, Abt, Volpe, Zyl, Hinkle, Staub, "Methodologies for Evaluating Long-Term Stabilization Designs of Uranium Mill Tailings Impoundments," U.S. Nuclear Regulatory Commission, NUREG/CR-4620, June 1986.

Barfield, B. J., Warner, R. C., "Applied Hydrology and Sedimentology for Disturbed Areas," Oklahoma Technical Press, 1981.

ff



June 26, 1995

86-060-20

Mr. Edward M. Morales
United Nuclear Corporation
P.O. Box 3077
Gallup, NM 87305-3077

Transmittal
Field Design Modifications
Central and South Cell Reclamation

Dear Ed:

This letter summarizes the minor field modifications made in the reclamation design of the Central and South Cells of the tailings disposal area in conjunction with 1995 reclamation activities. These field modifications were designed in accordance with NRC guidelines and serve to fit the approved reclamation design to actual site conditions encountered during reclamation.

Branch Swales B and C

Branch Swale B of the Central Cell was originally designed to pass through the area where the North Cross-Dike Pump-Back Wells are located prior to discharging into the North Cell Drainage Channel. This design was based on the assumption that ground water remediation in Zone 1 would be completed by this time and that the North Cross-Dike Pump-Back Wells would be decommissioned. This was a reasonable design assumption given the limited ground water impacts in Zone 1 and concurrence by the regulatory agencies that extensive remediation in this formation was infeasible. Unfortunately, regulatory delays have caused the remediation of Zone 1 to be extended, and the wells, although currently inactive, have not been approved for decommissioning.

To avoid unnecessary delays in the reclamation of the tailings disposal area, United Nuclear has proposed rerouting the final 367 feet of Swale B around the North Cross-Dike Pump-Back Wells by combining Swale B with Swale C at Survey Station 30+00, as

RMW:86-060\FDM.LTR (Jun. 26, 1995)

94 Inverness Terrace E. • Suite 100 • Englewood, CO 80112 • (303) 790-1747 • fax (303) 799-7398

shown on the enclosed sketch. The grade of Swales B and BC are to be 0.0102 from Stations SB 27 to SBC 31 and 0.083 from Stations SB 31 to SB 33+61.7. Canonie/Smith Environmental Technologies Corporation has reviewed this field modification to the reclamation design and has determined that it is consistent with the NRC's reclamation guidelines and the approved reclamation plan, provided that the modified design incorporates the following:

1. The combined swale is to be 20 feet wide at its base and armored with riprap having a D_{50} of 3.0 inches.
2. The combined swale is to be 2.1 feet deep or deeper to allow for adequate freeboard during the design event.

A copy of the supporting calculations for the change in configuration of Swales B and C is enclosed.

Branch Swales H, I and J

The lower portion of Branch Swale H was originally designed to pass through the bedrock outcrop area southeast of the South Cell of the tailings area. However, this design requires substantial excavation in the bedrock to construct the swale to the design grade. United Nuclear has proposed moving Swale H closer to the tailings areas as shown on the enclosed modified Figure 5-1. The invert elevation where Swale I flows into the South Cell Drainage Channel will also require modification from an elevation of 6951 feet to approximately 6947.85 feet (assuming a 3.5-foot deep swale) to match Swale I to the South Cell as-built contours.

These two field modifications result in moving the juncture between Swales J and H approximately 200 feet further to the northeast and increasing the grades of Swale I from 0.0040 to 0.0067 and Swale H from 0.0085 to 0.010. The grade of Swale J will remain the same at 0.0047. These modifications will not require any change in specified swale depths, bedding material or riprap because the calculated safety factors remain above 1.0. A copy of the supporting calculations for the changes in configuration of Swales H, I and J is enclosed.

South Cell Drainage Channel

Lowering the invert elevation where Swale I flows into the South Cell Drainage Channel will also reduce the grade in the South Cell Drainage Channel. The optimum place to make this grade change is the first 450 feet of channel because, after this point, the channel is to be constructed in bedrock. This would result in a grade reduction from



Mr. Edward M. Morales

3

June 26, 1995

0.0244 to 0.0174 over the 450-foot section. As shown in the enclosed calculations, the D_{50} of the riprap could also be reduced from 1.25 feet (i.e., 15 inches) to 0.83 foot (i.e., 10 inches). Alternately, the channel could be widened from 10 to 12 feet and the D_{50} reduced to 0.75 foot (i.e., 9 inches) if a smaller sized riprap is desired.

Bedding Layer 2

The reclamation plan calls for the placement of Bedding Layer 2 in a number of channels and swales, including Branch Swales H and I, which are to be completed this year. The bedding gradation specification listed in Table 5.7 of the reclamation plan calls for 5 to 12 percent passing the No. 40 screen size. However, the bedding material produced by the quarry is typically running about 14 percent passing the No. 40 screen.

Review of the original gradation calculations presented in United Nuclear's March 1991 response to NRC comments shows that Bedding Layer 2 (also called Filter Layer No. 2) can have up to 20 percent passing the No. 40 screen size in Swales H and I and the Lower Reach of the Runoff Control Ditch. Therefore, use of the finer gradation is acceptable for these areas, but would be unacceptable for the South and North Cell Drainage Channels and the North Diversion Ditch. Figure 1 of the original gradation calculations is enclosed for reference purposes.

If you have any questions or need further information, please call me at (303) 790-1747.

Very truly yours,

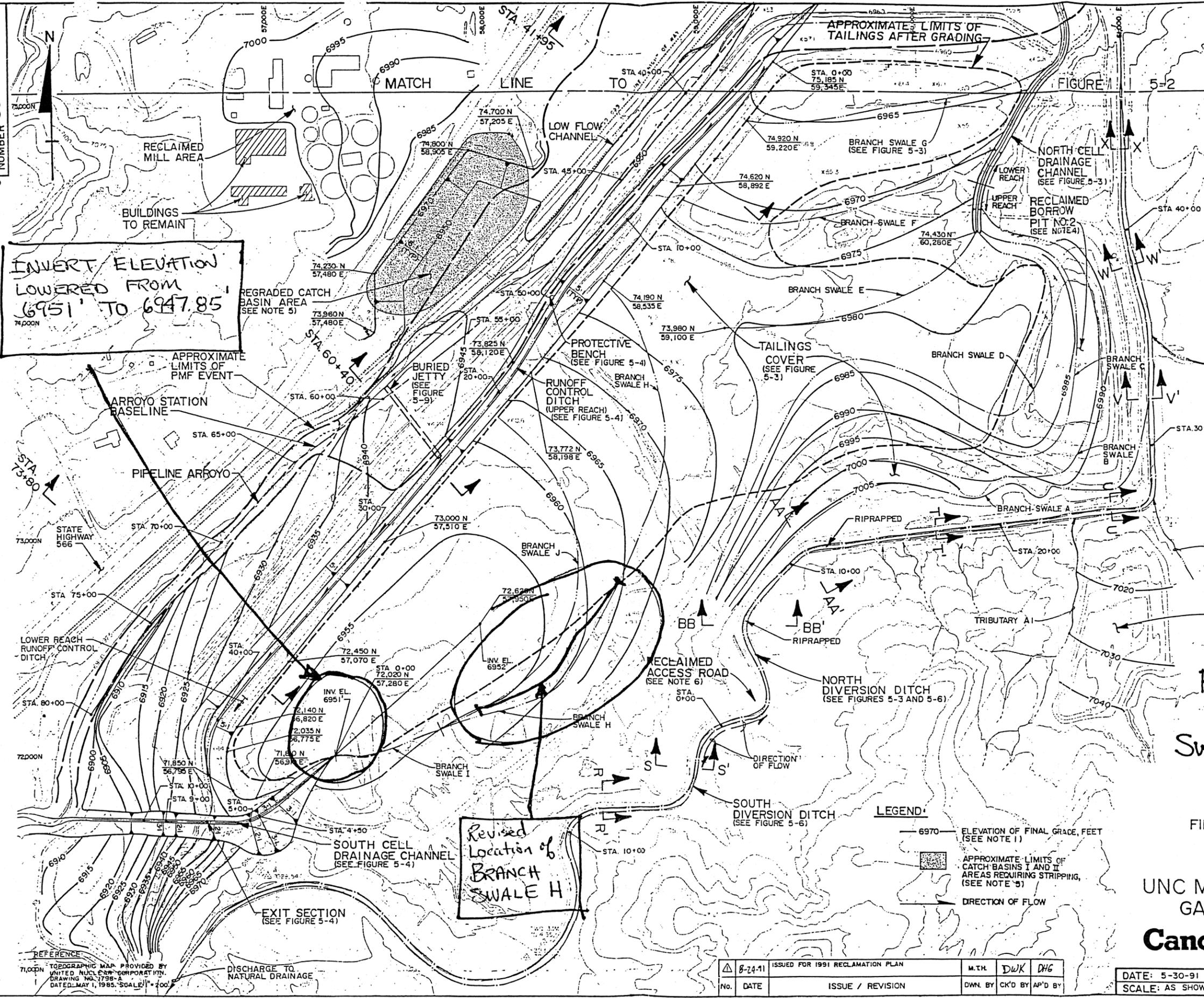
Frank J. Filas, P.E.
Project Engineer

FJF/wde

Enclosures

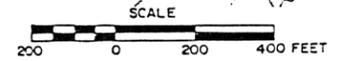
cc: Mr. Juan Velasquez, United Nuclear Corporation

DRAWING 86-060-E544
NUMBER
E639



- NOTES:**
- DESIGN ELEVATION CONTOURS ON THE TAILINGS IMPOUNDMENT ALLOW FOR A 1.5 FOOT RADON BARRIER AND A 6 INCH SOIL/ROCK MATRIX EROSION PROTECTION LAYER OVER REGRADED TAILINGS SEE FIGURE 5-3 FOR SOIL COVER PROFILE.
 - CROSS SECTIONS ARE SHOWN ON FIGURES 5-3 AND 5-6.
 - DETAILS ARE SHOWN ON FIGURES 5-3, 5-4, AND 5-9.
 - BORROW PIT NO. 2 WILL BE RECLAIMED BY BACKFILLING WITH MILL DEMOLITION DEBRIS, ORE PAD MATERIALS, CATCH BASIN MATERIALS AND SOIL EXCAVATION FROM THE SOIL STOCKPILE, IF NECESSARY.
 - THE AREA SURROUNDING THE CATCH BASINS WILL BE RECLAIMED BY STRIPPING THE UPPER SIX INCHES OF SOIL - ALL REMAINING ORE AND TAILINGS MATERIAL WILL BE EXCAVATED TO A MINIMUM DEPTH OF 5 FEET IN THE CATCH BASINS. ALL MATERIALS WILL BE USED AS BACKFILL WITHIN THE BORROW PIT NO. 2. THE ENTIRE CATCH BASIN AREA WILL THEN BE REGRADED TO THE LINES AND GRADES SHOWN.
 - ACCESS ROADS WHICH CURRENTLY EXIST OR WHICH HAVE BEEN ADDED FOR THE CONVENIENCE OF THE CONTRACTOR WILL BE RECLAIMED IN ACCORDANCE WITH THE SPECIFICATIONS.
 - THE EXISTING SOIL STOCKPILE WILL BE USED AS A SOURCE OF BACKFILL FOR BORROW PIT NO. 2. SUBSEQUENT TO BACKFILLING, THE STOCKPILE AREA WILL BE REGRADED TO MEET THE CONTOURS SHOWN.
 - AFTER DRAWING No. 86-060-E499 (FIGURE 2-2) IN THE MARCH 4, 1991 RESPONSE TO NRC COMMENTS.

FIELD DESIGN MODIFICATION SWALES H, I & J



FINAL RECLAMATION PLAN
SOUTH END
PREPARED FOR

UNC MINING AND MILLING
GALLUP, NEW MEXICO

Canonie Environmental

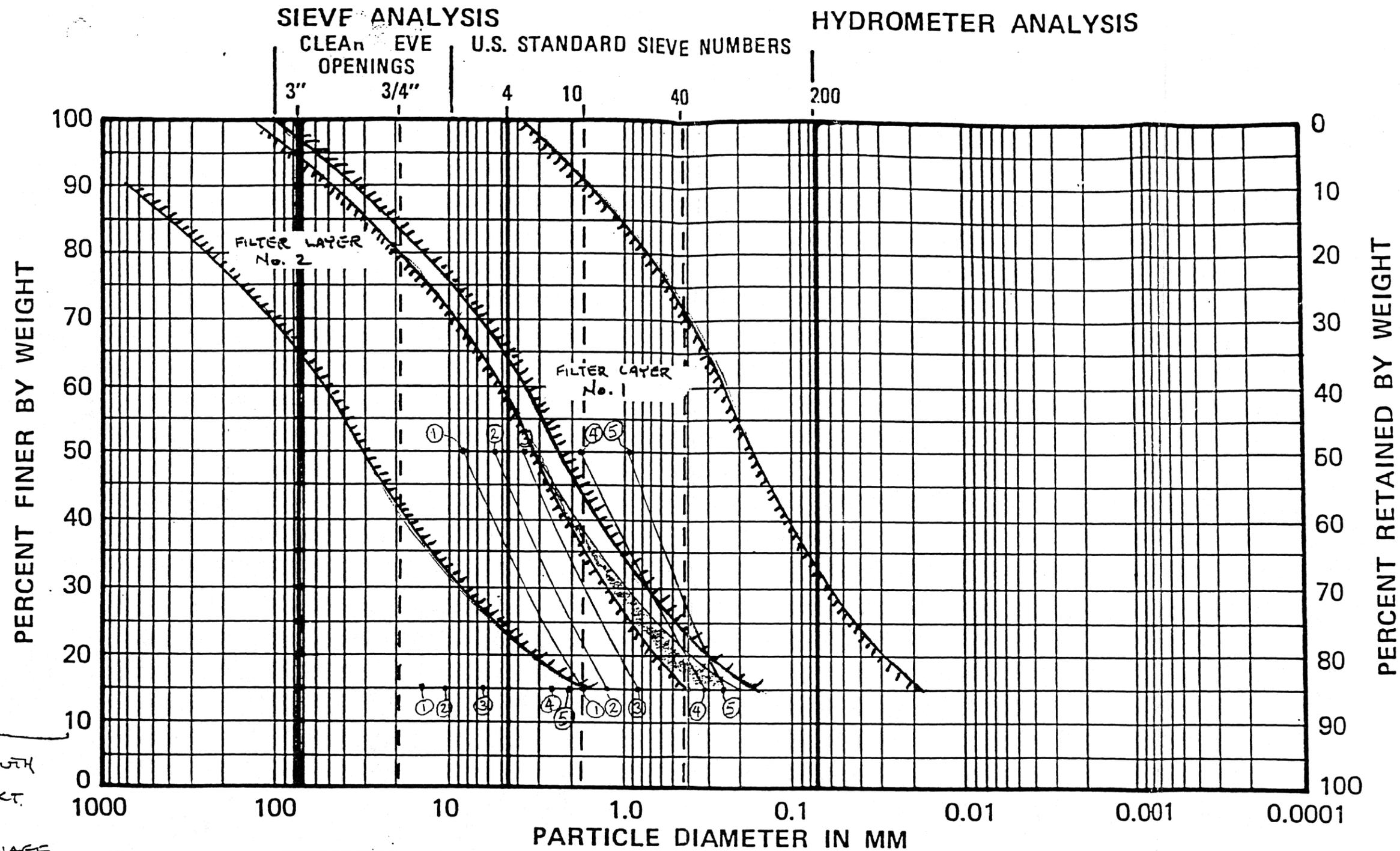
REFERENCE
71,000N TOPOGRAPHIC MAP PROVIDED BY UNITED NUCLEAR CORPORATION
DRAWING NO. 7788-5
DATED MAY 1, 1985. SCALE: 1" = 200'

DISCHARGE TO NATURAL DRAINAGE

Revised Location of BRANCH SWALE H

8-24-91	ISSUED FOR 1991 RECLAMATION PLAN	M.T.H.	D.W.K.	D.H.G.
No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY

DATE: 5-30-91	FIGURE 5-1	DRAWING NUMBER
SCALE: AS SHOWN		86-060-E544



- ① UPPER SECTION SOUTH CELL DRAINAGE SECT.
- ② NORTH CELL DRAINAGE.
- ③ NORTH DIVERSION DITCH, BURIED JETTY
- ④ SWALES H.I., LOWER REACH OF RUNOFF CONTROL
- ⑤ SOIL/ROCK MATRIX, SWALES, UPPER REACH RUNOFF CONTROL DITCH.

TYPICAL FORMAT
GRAIN SIZE DISTRIBUTION DATA

LOWER BOUND OF FILTER CRITERIA W/RESPECT TO 5 RIPRAP SIZES

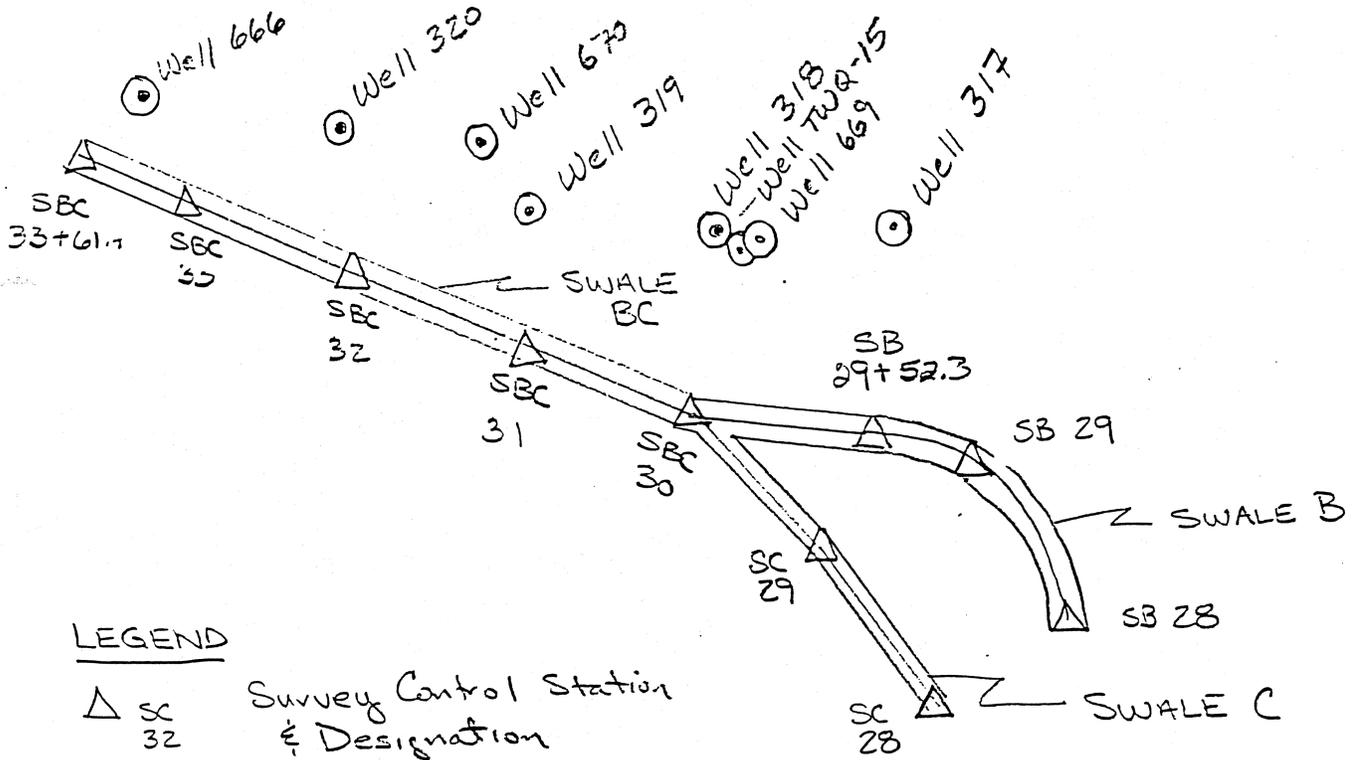
FIGURE 1

SMITH

CALCULATIONS

BRANCH SWALES B AND C

CHURCH ROCK SITE
CENTRAL CELL RECLAMATION



LEGEND

- SC 32 Survey Control Station & Designation
- Well 320 Well Location & Designation

MODIFIED DESIGN OF SWALES B & C
Scale : 1" = 100'

RIPRAP DETERMINATION B. SAFETY FACTOR METHOD

REF: "Applied Hydrology and Sedimentology
for Disturbed Areas", pages 185-194

LOCATION: UNC -- DRAINAGE SWALE B FIELD MODIFICATION

DISCHARGE =	137 CFS	(Drainage swales A+B)	
BOTTOM WIDTH =	20 FT		
Z (SIDE SLOPE)	3	Alpha =	18.43 Degrees
CHANNEL SLOPE =	0.0102	Theta =	0.58 Degrees
RIPRAP S.G. =	2.72	Phi =	37.00 Degrees
COEF FOR t =	0.75	see Fig 3.16, ref.	

CHANNEL BOTTOM

CHANNEL SIDE SLOPES

D50 (ASSUM) =	0.25 FT	
n =	0.031	
d =	1.20 FT	-
A =	28.32 FT ²	
R =	1.03 FT	
Q (CALC) =	138.0 CFS	-
v =	4.87 FPS	
t =	0.76 PSF	
nb =	0.598	
SFb =	1.64	

D50 (ASSUM) =	0.25 FT	
n =	0.031	
d =	1.20 FT	-
A =	28.32 FT ²	
R =	1.03 FT	
Q (CALC) =	138.0 CFS	-
v =	4.87 FPS	
t =	0.57 PSF	
nb =	0.45	
Beta =	27.98	
n' =	0.33	
SFs =	1.35	

Design values

Channel Depth 1.70 FT Depth from top of freeboard to top of riprap
 Dmax 0.5 FT = 2* D50
 Layer Thickness 0.5 FT = 2* D50

Design Modification

Specific Gravity increased from 2.5 to 2.72 to match as-built conditions
 Rip rap D50 increased from 0.125 FT to 0.25 FT
 Swale A discharge of 40 cfs added to original 97 cfs

REFERENCE: FILE RIPSF105.WR1

RIPRAP DETERMINATION L. SAFETY FACTOR METHOD

REF: "Applied Hydrology and Sedimentology
for Disturbed Areas", pages 185-194

LOCATION: UNC -- DRAINAGE SWALE B + C

DISCHARGE =	212 CFS	(Drainage swales A+B and Swale C)
BOTTOM WIDTH =	20 FT	(assume same width as Swale B)
Z (SIDE SLOPE)	3	Alpha = 18.43 Degrees
CHANNEL SLOPE =	0.0102	Theta = 0.58 Degrees
RIPRAP S.G. =	2.72	Phi = 37.00 Degrees
COEF FOR t =	0.75	see Fig 3.16, ref.

CHANNEL BOTTOM

D50 (ASSUM) =	0.25 FT	
n =	0.031	
d =	1.54 FT	-
A =	37.91 FT ²	
R =	1.27 FT	
Q (CALC) =	213.4 CFS	-
v =	5.63 FPS	
t =	0.98 PSF	
nb =	0.767	
SFb =	1.28	

CHANNEL SIDE SLOPES

D50 (ASSUM) =	0.25 FT	
n =	0.031	
d =	1.58 FT	-
A =	39.09 FT ²	
R =	1.30 FT	
Q (CALC) =	223.3 CFS	-
v =	5.71 FPS	
t =	0.75 PSF	
nb =	0.59	
Beta =	34.93	
n' =	0.47	
SFs =	1.17	

Design values

Channel Depth	2.04 FT	Depth from top of freeboard to top of riprap
Dmax	0.5 FT	= 2* D50
Layer Thickness	0.5 FT	= 2* D50

REFERENCE: FILE RIPS103.WR1

RIPRAP DETERMINATION B. SAFETY FACTOR METHOD

REF: "Applied Hydrology and Sedimentology
for Disturbed Areas", pages 185-194

LOCATION: UNC -- DRAINAGE SWALE B + C

DISCHARGE = 212 CFS (Drainage swales A+B and Swale C)
 BOTTOM WIDTH = 20 FT (assume same width as Swale B)
 Z (SIDE SLOPE) = 3 Alpha = 18.43 Degrees
 CHANNEL SLOPE = 0.0083 Theta = 0.48 Degrees
 RIPRAP S.G. = 2.72 Phi = 37.00 Degrees
 COEF FOR t = 0.75 see Fig 3.16, ref.

CHANNEL BOTTOM

D50 (ASSUM) = 0.25 FT
 n = 0.031
 d = 1.63 FT -
 A = 40.57 FT²
 R = 1.34 FT
 Q (CALC) = 212.8 CFS -
 v = 5.24 FPS
 t = 0.84 PSF
 nb = 0.661
 SFb = 1.49

CHANNEL SIDE SLOPES

D50 (ASSUM) = 0.25 FT
 n = 0.031
 d = 1.58 FT -
 A = 39.09 FT²
 R = 1.30 FT
 Q (CALC) = 201.4 CFS -
 v = 5.15 FPS
 t = 0.61 PSF
 nb = 0.48
 Beta = 29.67
 n' = 0.36
 SFs = 1.31

Design values

Channel Depth 2.13 FT Depth from top of freeboard to top of riprap
 Dmax 0.5 FT = 2* D50
 Layer Thickness 0.5 FT = 2* D50

REFERENCE: FILE RIPS113.WR1

SMITH

CALCULATIONS

BRANCH SWALES H, I AND J

RIPSF106.WR1

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD

REF: "Applied Hydrology and Sedimentology
for Disturbed Areas", pages 185-194

LOCATION: UNC -- DRAINAGE SWALE I FIELD MODIFICATION

DISCHARGE = 385 CFS
BOTTOM WIDTH = 20 FT
Z (SIDE SLOPE) = 3 Alpha = 18.43 Degrees
CHANNEL SLOPE = 0.0067 Theta = 0.38 Degrees
RIPRAP S.G. = 2.72 Phi = 37.00 Degrees
COEF FOR t = 0.75 see Fig 3.16, ref.

CHANNEL BOTTOM

D50 (ASSUM) = 0.25 FT
n = 0.031
d = 2.42 FT -
A = 65.97 FT²
R = 1.87 FT
Q (CALC) = 388.3 CFS -
v = 5.89 FPS
t = 1.01 PSF
nb = 0.792
SFb = 1.25

CHANNEL SIDE SLOPES

D50 (ASSUM) = 0.25 FT
n = 0.031
d = 1.90 FT -
A = 48.83 FT²
R = 1.53 FT
Q (CALC) = 251.0 CFS -
v = 5.14 FPS
t = 0.60 PSF
nb = 0.47
Beta = 28.96
n' = 0.35
SFs = 1.33

Design values

Channel Depth 2.92 FT Depth from top of freeboard to top of riprap
Dmax 0.50 FT = 2* D50
Layer Thickness 0.50 FT = 2* D50

DESIGN MODIFICATION

SPECIFIC GRAVITY INCREASED FROM 2.5 TO 2.72 TO MATCH AS-BUILT CONDITIONS
CHANNEL SLOPE INCREASED TO 0.067 (ASSUMES 3.5 FT DEPTH AT END OF SWALE I)

RIPSF107.WR1

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD

REF: "Applied Hydrology and Sedimentology
for Disturbed Areas", pages 185-194

LOCATION: UNC -- DRAINAGE SWALE H FIELD MODIFICATION

DISCHARGE = 284 CFS
BOTTOM WIDTH = 20 FT
Z (SIDE SLOPE) = 3 Alpha = 18.43 Degrees
CHANNEL SLOPE = 0.01 Theta = 0.57 Degrees
RIPRAP S.G. = 2.72 Phi = 37.00 Degrees
COEF FOR t = 0.75 see Fig 3.16, ref.

CHANNEL BOTTOM

D50 (ASSUM) = 0.25 FT
n = 0.031
d = 1.82 FT -
A = 46.34 FT²
R = 1.47 FT
Q (CALC) = 284.0 CFS -
v = 6.13 FPS
t = 1.14 PSF
nb = 0.889
SFb = 1.11

CHANNEL SIDE SLOPES

D50 (ASSUM) = 0.25 FT
n = 0.031
d = 1.90 FT -
A = 48.83 FT²
R = 1.53 FT
Q (CALC) = 306.7 CFS -
v = 6.28 FPS
t = 0.89 PSF
nb = 0.70
Beta = 39.43
n' = 0.57
SFs = 1.06

Design values

Channel Depth 2.32 FT Depth from top of freeboard to top of riprap
Dmax 0.50 FT = 2* D50
Layer Thickness 0.50 FT = 2* D50

DESIGN MODIFICATION

SPECIFIC GRAVITY INCREASED FROM 2.5 TO 2.72 TO MATCH AS-BUILT CONDITIONS
SLOPE INCREASED FROM 0.0085 TO 0.010

FIGURE 1

BEDDING LAYER GRADATIONS



CALCULATIONS

SOUTH CELL DRAINAGE CHANNEL

RIPSF109.WR1

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD

REF: "Applied Hydrology and Sedimentology
for Disturbed Areas", pages 185-194

LOCATION: South Cell Drainage Channel

DISCHARGE = 694 CFS
BOTTOM WIDTH = 10 FT
Z (SIDE SLOPE) = 3 Alpha = 18.43 Degrees
CHANNEL SLOPE = 0.0174 Theta = 1.00 Degrees
RIPRAP S.G. = 2.7 Phi = 37.00 Degrees
COEF FOR t = 0.75 see Fig 3.16, ref.

CHANNEL BOTTOM

D50 (ASSUM) = 0.83 FT
n = 0.038
d = 3.70 FT -
A = 78.07 FT²
R = 2.34 FT
Q (CALC) = 703.9 CFS -
v = 9.02 FPS
t = 4.02 PSF
nb = 0.958
SFb = 1.02

CHANNEL SIDE SLOPES

D50 (ASSUM) = 0.83 FT
n = 0.038
d = 3.70 FT -
A = 78.07 FT²
R = 2.34 FT
Q (CALC) = 703.9 CFS -
v = 9.02 FPS
t = 3.01 PSF
nb = 0.72
Beta = 40.15
n' = 0.60
SFs = 1.04

Design values

Channel Depth 4.2 ft. Depth from top of freeboard to top of riprap
Dmax 1.66 ft = 2* D50
Layer Thickness 1.66 FT. = 2* D50

RIPSF110.WR1

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD

REF: "Applied Hydrology and Sedimentology
for Disturbed Areas", pages 185-194

LOCATION: South Cell Drainage Channel

DISCHARGE = 694 CFS
BOTTOM WIDTH = 12 FT
Z (SIDE SLOPE) = 3 Alpha = 18.43 Degrees
CHANNEL SLOPE = 0.0174 Theta = 1.00 Degrees
RIPRAP S.G. = 2.72 Phi = 37.00 Degrees
COEF FOR t = 0.75 see Fig 3.16, ref.

CHANNEL BOTTOM

D50 (ASSUM) = 0.75 FT
n = 0.038
d = 3.45 FT -
A = 77.11 FT²
R = 2.28 FT
Q (CALC) = 695.4 CFS -
v = 9.02 FPS
t = 3.75 PSF
nb = 0.977
SFb = 1.00

CHANNEL SIDE SLOPES

D50 (ASSUM) = 0.75 FT
n = 0.038
d = 3.45 FT -
A = 77.11 FT²
R = 2.28 FT
Q (CALC) = 695.4 CFS -
v = 9.02 FPS
t = 2.81 PSF
nb = 0.73
Beta = 40.70
n' = 0.61
SFs = 1.02

Design values

Channel Depth 4.0 ft. Depth from top of freeboard to top of riprap
Dmax 1.5 ft. = 2* D50
Layer Thickness 1.5 FT. = 2* D50

Memo

TO: File April 8, 1996
FROM: Todd Ramsden 86-060-39
SUBJECT: Riprap Size for North Cell Drainage Channel

Calculations accompanying the "Minor Design Modification of Swale A" dated May 24, 1994 showed that with rerouting of Swale A the safety factor for the upper section of the North Cell Drainage channel was 0.98, slightly below the required safety factor of 1.0. However, the calculation used a very conservative value of 2.5 for the specific gravity of the riprap. The average specific gravity of riprap used in the North Cell Drainage Channel was 2.74. As shown on the attached spreadsheet, when using the actual specific gravity for the riprap, the safety factor for the North Cell Drainage Channel is 1.12.

RIPRAP DETERMINATION BY SAFETY FACTOR METHOD

LOCATION: UPPER REACH, NORTH CELL DRAINAGE CHANNEL

Maximum Discharge (Q_{max}) = 399 ft³/sec
 Calculated Discharge (Q) = 398 ft³/sec

CHANNEL SPECIFICATIONS

Flow depth (d) = 2.68 ft
 Bottom Width = 10 ft
 Z (Side slope) = 3 : 1 (h:v)
 Channel Gradient (S) = 0.020 ft/ft

RIPRAP SPECIFICATIONS

Median Riprap Diameter D_{50} = 0.75 ft
 Riprap Specific Gravity = 2.74
 Coefficient for τ = 0.75 see Fig 3.16, ref.
 Riprap angle of repose (ϕ) = 37.00 degrees (Fig. 3.14)

CHANNEL BOTTOM

Safety factor - bottom (SF_b) = 1.12 Equation 3.28

Median Riprap Diameter D_{50} = 0.75 ft
 Manning's n = 0.038
 Flow depth (d) = 2.68 ft
 Flow Area = 48.35 ft²
 Hydraulic Radius (R) = 1.79 ft
 Calculated Discharge (Q) = 398.4 ft³/sec
 Calculated velocity (v) = 8.24 ft/sec
 Unit weight of water (γ) = 62.40 lb/ft³
 Shear (τ) = 3.34 lb/ft²
 Stability factor (η_b) = 0.863

CHANNEL SIDE SLOPES

Safety factor (SF_s) = 1.11

Median Riprap Diameter D_{50} = 0.75 ft
 Manning's n = 0.038
 Flow depth = 2.68 ft
 Flow Area = 48.35 ft²
 Hydraulic Radius (R) = 1.79 ft
 Calculated Discharge (Q) = 398.4 ft³/sec
 Calculated velocity (v) = 8.24 ft/sec
 Unit weight of water (γ) = 62.40 lb/ft³
 Shear (τ) = 2.51 lb/ft²
 Stability factor (η_s) = 0.65

Equation 3.35

Equation 3.34

Manning's Equation

$\tau = \gamma d S$
Equation 3.33

Equation 3.38

Equation 3.36

Side slope (α) = 18.43 Degrees
 Channel bed slope (θ) = 1.15 Degrees

Reference: "Applied Hydrology and Sedimentology for Disturbed Areas", pages 185-199