Permit Amendment

Reclamation Plan Revision

J.B. King Mine

July 1995

PFO

UMC 782.19 - IDENTIFICATION OF OTHER LICENSES AND PERMITS

Permission was granted to apply biosolids (sewage sludge) to the reclaimed mine site as a soil amendment by the following two regulatory agencies and their letters of approval are attached for documentation:

1. October 11, 1994 - Approval granted by the United States Environmental Protection Agency, Region VIII

2. October 14, 1994 - Finding of minimum impact; waived the requirement for groundwater permit; and approval granted by the State of Utah, Department of Environmental Quality, Division of Water Quality

Permission was granted to remove gravel material (pit run) from a Sand and Gravel Lease #37912 (amended), by the following regulatory agency and a letter is attached for documentation:

1. January 24, 1994 - Permission granted by the State of Utah, Utah Department of Transportation (UDOT) - Application of this gravel is discussed later in the text as a measure to promote erosional stability on the side slopes of the refuse pile.

Payment for the gravel material (from Sand and Gravel Lease #37912 (amended)) and reclamation of the site is noted in the attached documentation:

1. January 13, 1995 - Payment to Mr. John Blake, Utah Natural Resources, Division of State Lands and Forestry; and reclamation of the disturbance.

RECEIVED
OCT 19 1995
DIVISION OF OIL
GAS & MINING PRICE UTAH

INCORPORATED
EFFECTIVE:
OCT 05 1995
94C
UTAH DIVISION OIL, GAS AND MINING

RECEIVED OCT 1 3 1994

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2466

OCT 11 1994

Ref: 8WM-C

Mr. E.M. Gerick
V.P. Operations
Western States Minerals Corp.
250 S. Rock Blvd. Suite 130
Reno, NV 89502

RE: Approval for Land Application of Biosolids at J.B. King Reclaimed Minesite

Dear Mr. Gerick;

Approval for application of biosolids above the annual agronomic rate is granted by EPA, as the permitting authority, under 40 CFR 503.14(d) for the reclamation demonstration project. The maximum rate approved for the demonstration project is **25 tons/acre.**

EPA reviewed the land reclamation proposal dated September 19, 1994 and has based its approval on that plan. EPA must be contacted if the application rates are substantially different from the project proposal. EPA's approval does not release the facility from any required approvals from State and local authorities. Western States Minerials Corporation shall comply with all site restrictions and management practices as specified in 40 CFR 503.

Western States Minerials Corporation is to provide copies of any interim reports produced and a copy the a final report, assessing the effectiveness of the use of biosolids for mined land reclamation at the J.B. King Reclaimed Minesite to EPA Region VIII at the address above.

If you have any questions or concerns on this project feel free to contact Bob Brobst at the address above or by telephone at (303)293-1627.

Sincerely,

Robert B. Brobst, P.E.
Biosolids Program Manager
Water Management Division

cc: UTDOGM
UTDEQ
Claron Bjork SE Health
Jeffrey Richens PRWID

INCORPORATED
EFFECTIVE: OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Printed on Recycled Paper

RECEIVED OCT 2 4 1994

State of Utah

DEPARTMENT OF ENVIRONMENTAL QUALITY
DIVISION OF WATER QUALITY

Michael O. Leavitt
Governor
Dianne R. Nielson, Ph.D.
Executive Director
Don A. Ostler, P.E.
Director

288 North 1460 West
P.O. Box 144870
Salt Lake City, Utah 84114-4870
(801) 538-6146
(801) 538-6016 Fax
(801) 536-4414 T.D.D.

Water Quality Board
William A. Luce
Chairman
Kay S. Jensen
Vice Chairman
Don A. Ostler, P.E.
Executive Secretary
R. Rex Ausburn
Patricia S. Briggs
Nan Bunker
Dianne R. Nielson, Ph.D.
Joe C. Nielson
Lynn F. Pett
Keith W. Welch
Leroy H. Wullstein

October 14, 1994

Mr. E.M. Gerick
V.P. Operations
250 S. Rock Blvd. Suite 130
Reno, NV 89502

Re: Mine-land Reclamation with Biosolids,
J.B. King Mine Site

Dear Mr. Gerick:

Thank you for your proposal to use biosolids for relamation, dated September 19, 1994. After review of the project, we have determined that it is expected to have *de minimis* impact on ground water quality because of the small area to be reclaimed, the one-time nature of the application and the present ground water quality. The small risks resulting from sludge application will be balanced by decreased leaching throught the waste rock pile due to revegetation.. A groundwater permit for this project is not required. We have already received a copy of the 503-required EPA approval for the exceedance of the agronomic application rate. Therefore, this project is hereby approved.

If you have any questions or if we may be of further assistance, please call Lisa Rogers of my staff, at 538-6917.

Sincerely,

Utah Water Quality Board

Don A. Ostler, P.E.
Executive Secretary

DAO:LR:ja
cc: Bob Brobst, EPA Region VIII
Claron Bjork, Southeastern District Health Dept.
Wayne Hedberg, DOGM
Jeff Richens, Price River WID

P:JBKING.LTR
FILE:UPDES

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Printed on recycled paper

(801) 896-8241
Paul Larsen

State of Utah

UTAH DEPARTMENT OF TRANSPORTATION

Michael O. Leavitt
Governor
W. Craig Zwick
Executive Director
Howard H. Richardson, P.E.
Assistant Director
Dan F. Nelson
Southern Region Director

1345 South 350 West
P.O. Box 700
Richfield, Utah 84701
(801) 896-9501
Fax (801) 896-6458

Transportation Commission
Samuel J. Taylor
Chairman
Wayne S. Winters
Vice Chairman
Todd G. Weston
James G. Larkin
Ted D. Lewis
Shirley J. Iverson
Secretary

Jan. 24, 1994

State of Utah
Division of State Land and Forestry
3 Triad Center, Suite 400
355 West North Temple
Salt Lake City Utah 84180-1204
Attn: Gary Bagley

Dear Gary:

As per request of Mr. Buzz Gerick representing Western States Mineral Corporation. 250 South, Rock Boulevard, Suite 130, Reno. Nevada. has requested permission to remove 5,000 cu. yds. of pit-run material from a Sand and Gravel Lease #37912 (amended), granted to the Utah Dept. of Transportation. Permission is hereby granted to remove the material from the following area:T.23S, R5E, SLB&M Sec.36:S2NE4NE4,S2NW4NE4,SW4NE4,NE4NW4,SE4NW4,SW4NW4,NW4NW4, containing 280 acres more or less.

This letter is to correct the area of removal that was stated in a letter dated Jan 24, 1994. The letter of that date should have stated, that would be the area of placement instead of removal.

Payment to be made to the U.D.O.T. at the rate of $0.45 per cu. yd., and will be forwarded to the State Land Board upon inventory, and completion of the removal operation.

Mr. Al Spensko will be the contact person to designate the removal area and see that the rehabilitation is done as per lease agreement.

If we can be of further help or assistance, please keep in contact with us.

Sincerely,

Paul L. Larsen
Mat'ls Eng'r Ass't

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING
RECEIVED FEB - 7 1994

WESTERN STATES MINERALS CORPORATION

January 13, 1995

Mr. John Blake
Utah Natural Resources
Division of State Lands and Forestry
3 Triad Center, Suite 400
355 West North Temple
Salt Lake City, Utah 84180-1204

RE: Sand and Gravel Lease #37912 - Payment for gravel used at the J.B. King reclaimed minesite

Dear Mr. Blake:

The enclosed check is payment for gravel used from Sand and Gravel Lease #37912 (amended), as per the attached letter from Mr. Paul Larsen. The quantity used was 1474 cubic yards. At $0.45 per cubic yard, the amount owed is $663.30 and the payment is attached. The quantity taken was verified by Johansen & Tuttle Engineering, Inc. They performed a survey of the pile prior to any excavation, and also a survey at the end of excavation. Correspondence from them is attached for your review and records. Upon completion of excavation, WSMC personnel reclaimed the excavation area by reducing the cut slope, roughing the surface to prevent erosion, and reseeding the disturbed area.

If you have any questions concerning this correspondence, please call me at your convenience. On behalf of Western States Minerals Corporation, I would like to thank you for the opportunity of using this gravel. I believe it has been mutually beneficial for both our organizations.

Sincerely,

E.M. (Buzz) Gerick
Vice President, Operations

CC: Mr. Paul Larsen
Utah Dept. of Transportion
P.O. Box 700
Richfield, Utah 84701

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

250 S. Rock Blvd., Suite 130 ▲ Reno, NV 89502 ▲ (702) 856-3339 ▲ FAX (702) 856-1818

UMC 784.13 - RECLAMATION PLAN: GENERAL REQUIREMENTS

The following is a summary of proposed actions that will abate NOV's #91-32-6-1; #93-25-3-1; and #93-25-5-1. Details of the designs for each of the following actions are found in the appropriate sections of the permit.

1. The Feeder Ditch and Main Feeder Ditch have been redesigned to match naturally occurring, undisturbed drainages that are adjacent to the J.B. King reclaimed mine site. The purpose was to protect this area from the naturally occurring water flows from off-site drainage areas.

2. Rock mulch (gravel) will be applied to the side slopes of the refuse pile, where needed, as an erosional control measure.

3. Revegetation efforts will be initiated on those areas disturbed during reconstruction of the drainages and where rock mulch (gravel) is applied as an erosional control measure. In addition, an area identified along the western edge of the reclamation boundary will be revegetated. In addition to surface roughing prior to reseeding, biosolids (sewage sludge) will be used as a soil amendment and thoroughly mixed into the roughened soil surface.

In addition to the proposed actions to abate the outstanding NOV's, the permitee will be applying a soil cover over the existing vegetation test plots at the request and direction of the Division. The Division recognizes its responsibility in this matter, and assumes responsibility for the vegetation test plot area as outlined in the Division's October 19, 1988 correspondence from Lowell Braxton to Robert Hagen. The Division is willing to reimburse WSMC for all reasonable costs associated with the earthen placement, soil amendments, and reseeding of the test plot area.

Site map showing proposed action

A map showing the proposed activities is attached in the clear map pocket entitled **JBK-3 : Proposed Reclamation Plan Revision**.

The following summarizes previous activities and gives updates since 1990 where applicable.

Site Monitoring

Post reclamation monitoring was conducted on a monthly basis during the first year after reclamation was completed and quarterly thereafter. The sedimentation pond has never overflowed, even during 1992 and 1993 when precipitation was above average. There has been no contribution of suspended solids to runoff outside of the reclaimed area. Post reclamation concerns have consisted primarily of erosion control and vegetative cover onsite. The site has been periodically monitored for revegetation/cover, density, and general site conditions as required by the permit condition UMC 784.13 (b)(5)(vi). In addition, during the summers of 1991 to 1993 the site was monitored for vegetation cover and density for trend analysis during years with no monitoring requirements.

Erosion

The main diversion channel and the feeder ditch were originally designed to be shallow, unarmored, and meandering with gently sloping revegetated banks. The design did not take into account the naturally occurring evolution of adjacent drainage channels located on undisturbed areas; or allow for

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

the intensity of the rainfall events nor the relatively low vegetative cover common to this region. This resulted in storm water over-flowing the channels, as well as excessive erosion of the feeder channnel and the upper reaches of the main channel. In May 1987, riprap was installed in the eroded channel areas. However, in late 1987 the riprap also eroded due to intense storm activity that exceeded design criteria. In June 1988, the channels were again recontoured and the riprap reinstalled. The check dams in the feeder ditch were also installed. During severe storms in 1989, these installations failed and were repaired. They failed again in 1991. The Division issued NOV's subsequent to these failures, citing failure to meet design criteria.

A second area of erosional concern has been the west and southwest facing slopes of the refuse pile. Contour furrows in combination with straw bales and silt fences were initially used to control erosion. In late summer, 1986, the contour furrows filled with sediment and breached after the occurrence of several major storm events. This resulted in rilling along most of the slope area. the larger rills have been periodically filled with rock anchored straw, or controlled with additional silt fences. The rills and gullies do not interfere with the post-mining land use, and they appear to be stabilizing with natural rock armoring. The silt fences were removed during the summer of 1993, since their purpose for controlling sediment runoff during the early stages of revegetation was complete.

Revegetation

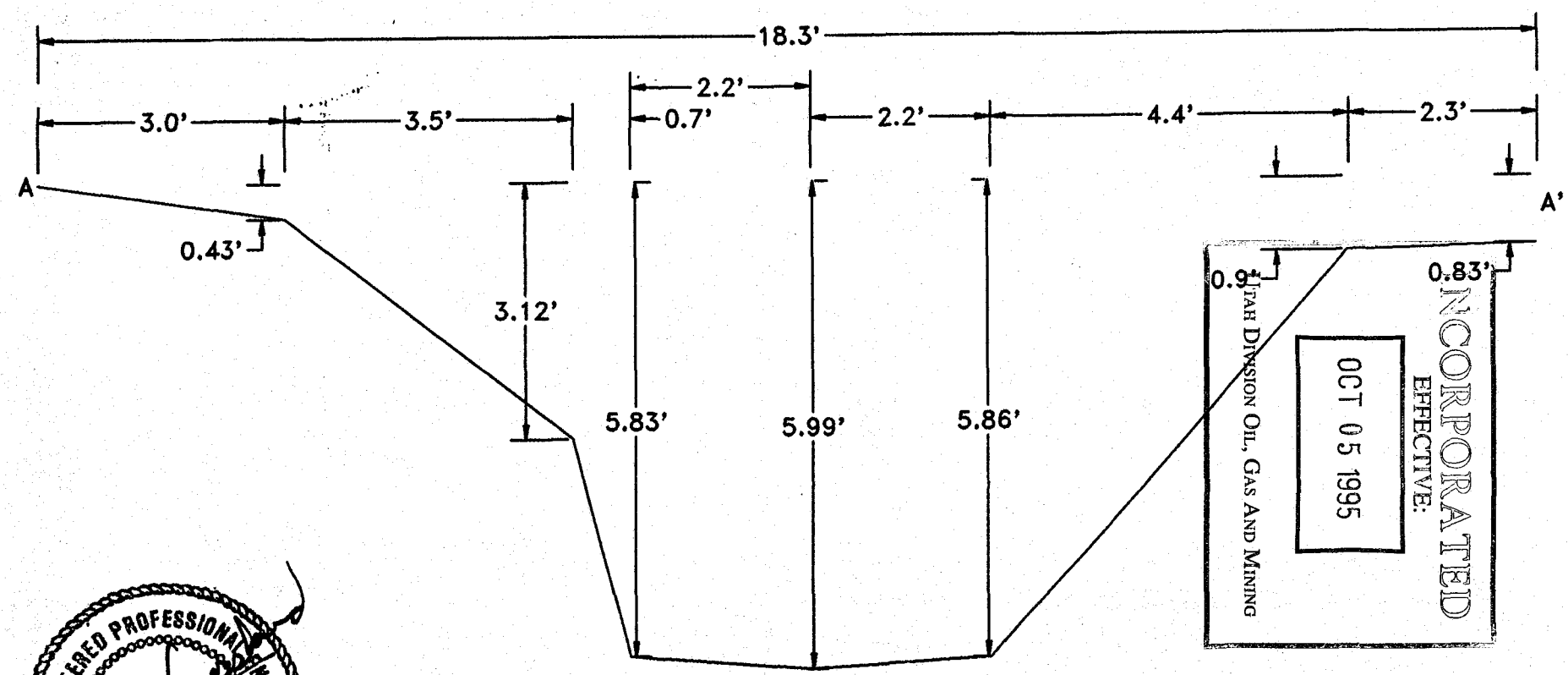
Revegetation on the site has generally resulted in a vegetative cover and density that is comparable to the reference area, and other vegetation in the vicinity of the site. The west and southwest facing slopes of the reclaimed refuse area have been the most difficult area of the site to revegetate. This is due to a combination of the southern exposure, early unauthorized cattle grazing, poor soil conditions, and low precipitation from 1988-1990. In 1989, a grazing permit was secured from the State of Utah, and the perimeter fence was completely rebuilt, and sections added. A road was relocated outside of the reclaimed area in order to control vehicle entry and to prevent cattle trespass. The road on the site and some of the areas which were traversed by heavy equipment during channel rebuilding (comprising approximately two acres) were ripped, redeeded, and mulched in mid-October 1989.

The general condition and phenology of the vegetation on site has improved significantly since 1989, due to abundant precipitaion during 1991 to 1993. Plant species cover has increased from 1989, and some shrubs and grasses have germinated to produce numerous seedlings. Grasses and shrubs have increased in size and cover. The plant cover on the reclaimed site is comparable to the region, and the increased growth in 1993 was proportional to the reference area. The general trend in vegetation on the site has been a gradual increase in shrub density, also an increase of plant species of desirable forage quality with a simultameous decrease in weedy species. There has also been a general increase in total plant cover of desirable plants (from 13% in 1989 to 25% in 1993). The reclaimed site does not have the same dominant species as the natural vegetation, but the species present provide good cover and quality habitat for animals. The reclaimed site has become a functional ecosystem with a diverse assemblage of plants and animals, and habitats in good condition. Due to the vegetation seeded and planted during reclamation, the J.B. King minesite contains more desirable vegetation for grazing than the surrounding area, which has been heavily utilized as winter pasture for many years.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

JB KING PROJECT

AS-BUILT CONSTRUCTION DETAIL
NOV-DEC 1994



TYPICAL X-SECTION A-A' OF NEW DRAINAGE CHANNEL
Designated as Feeder Ditch (also Ditch #1)
Refer to plan map (JBK-3 AS BUILT) for location of x-section
Scale: 1"=2'

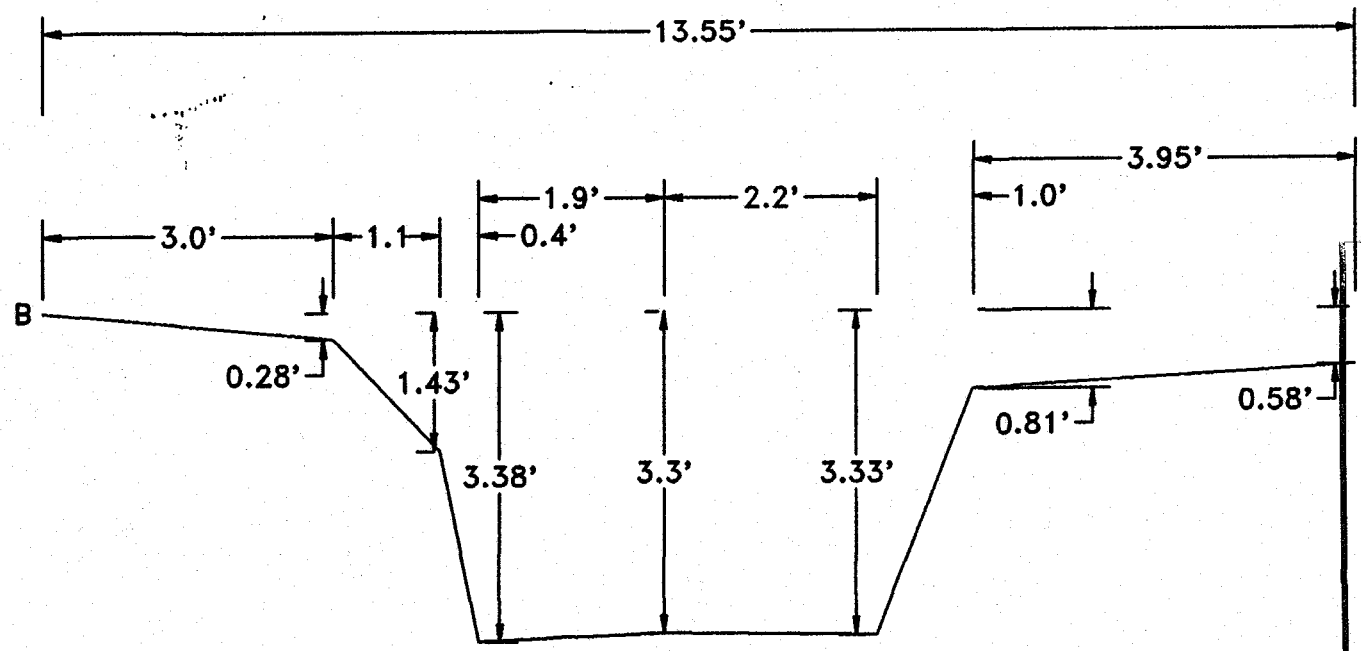
REGISTERED PROFESSIONAL ENGINEER
DWIGHT C. CROSSLAND
NO. 3643
STATE OF UTAH

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

WESTERN STATES MINERALS CORP.	
TITLE: 1994 Reclamation Plan Revision showing typical x-section A-A' of new drainage channel	
PROJECT: J.B.KING RECLAMATION	
STATE: UTAH	COUNTY: EMERY
SCALE: 1"=2'	DATA: EMG/DJC
DATE: 4-5-95	DRWN BY:DRM REV.:7/12/95

JB KING PROJECT

AS-BUILT CONSTRUCTION DETAIL
NOV-DEC 1994



INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

REGISTERED PROFESSIONAL ENGINEER
DWIGHT C. ROSLAND
NO. 3643
STATE OF UTAH

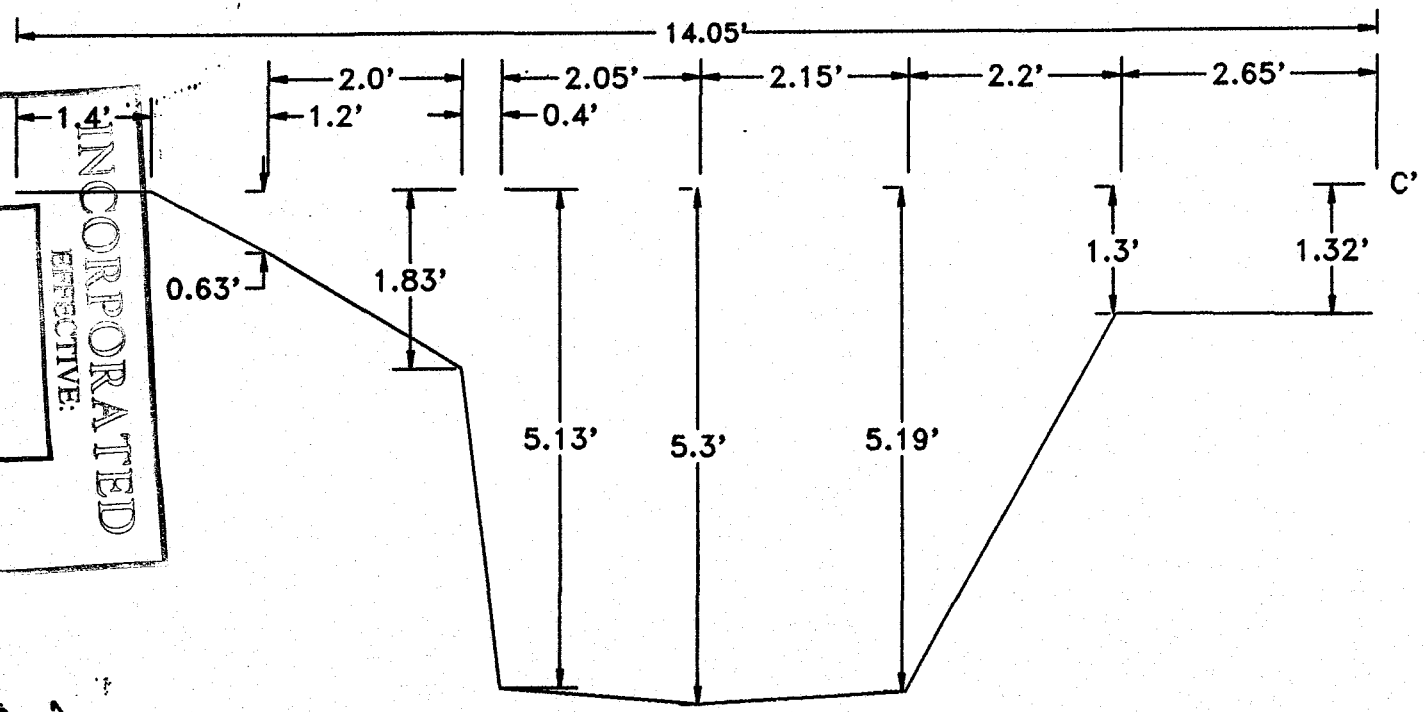
TYPICAL X-SECTION B-B' OF NEW DRAINAGE CHANNEL
Designated as Feeder Ditch (also Ditch#1)
Refer to plan map (JBK-3 AS BUILT) for location of x-section

Scale: 1"=2'

WESTERN STATES MINERALS CORP.		
TITLE: 1994 Reclamation Plan Revision showing typical x-section B-B' of new drainage channel		
PROJECT: J.B.KING RECLAMATION		
STATE: UTAH	COUNTY: EMERY	
SCALE: 1"=2'	DATA: EMG/DJC	
DATE: 4-5-95	DRWN BY:DRM	REV.:7/12/95

JB KING PROJECT

AS-BUILT CONSTRUCTION DETAIL
NOV-DEC 1994



UTAH DIVISION OIL, GAS AND MINING
OCT 05 1995
INCORPORATED
EFFECTIVE:

REGISTERED PROFESSIONAL ENGINEER
DWIGHT C. CROSSLAND
NO. 3643
STATE OF UTAH

TYPICAL X-SECTION C-C' OF NEW DRAINAGE CHANNEL
Designated as Main Feeder Ditch (also Ditch #2)
Refer to plan map (JBK-3 AS BUILT) for location of x-section

Scale: 1"=2'

WESTERN STATES MINERALS CORP.

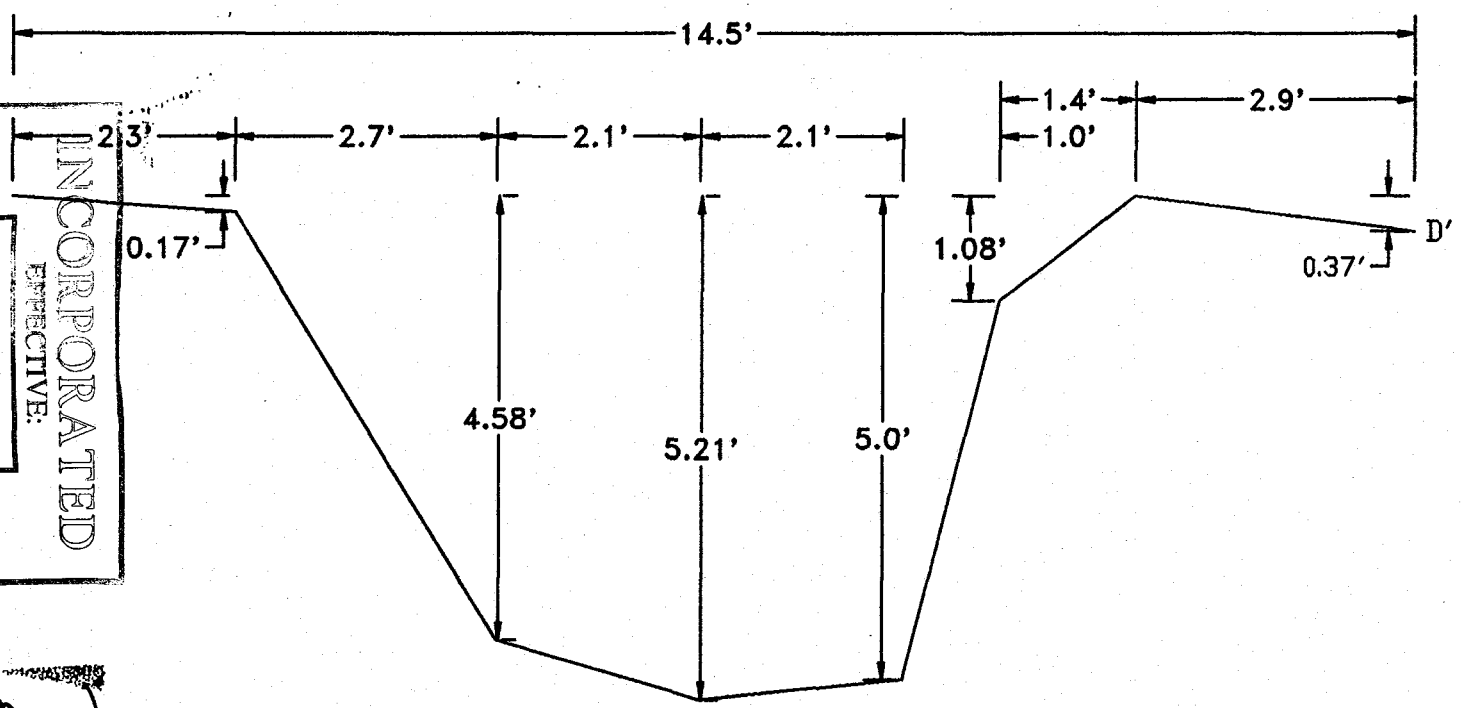
TITLE: 1994 Reclamation Plan Revision showing typical x-section C-C' of new drainage channel

PROJECT: J.B.KING RECLAMATION

STATE: UTAH	COUNTY: EMERY	
SCALE: 1"=2'	DATA: EMG/DJC	
DATE: 4-5-95	DRWN BY: DRM	REV.: 7/12/95

JB KING PROJECT

AS-BUILT CONSTRUCTION DETAIL
NOV-DEC 1994



UTAH DIVISION OIL, GAS AND MINING
OCT 05 1995
INCORPORATED
EFFECTIVE:

REGISTERED PROFESSIONAL ENGINEER
DWIGHT J. CROSSLAND
NO. 3843
STATE OF UTAH

TYPICAL X-SECTION D-D' OF NEW DRAINAGE CHANNEL
Designated as Main Feeder Ditch (also Ditch #2)
Refer to plan map (JBK-3 AS BUILT) for location of x-section

Scale: 1"=2'

WESTERN STATES MINERALS CORP.

TITLE: 1994 Reclamation Plan Revision showing typical x-section D-D' of new drainage channel

PROJECT: J.B.KING RECLAMATION

STATE: UTAH	COUNTY: EMERY
SCALE: 1"=2'	DATA: EMG/DJC
DATE: 4-5-95	DRWN BY: DRM / REV.: 7/12/95

UMC 784.15 - RECLAMATION PLAN: POSTMINING LAND USE

During meetings with Division staff (DOGM) in December, 1993 and January, 1994; it was implied that the permitee of the J.B. King reclaimed mine site, Western States Minerals Corporation (WSMC), should work out an agreement with the landowner, State of Utah - Trust Lands Administration, concerning issues associated with the post reclamation land use and maintenance at the J.B. King reclaimed mine site. The two (2) issues specifically identified were the disposition of existing on-site facilities during the post reclamation phase of the project as follows:

1. The sediment impoundment facility, and...

2. The perimeter range fence

The attached letters document the request made to the State of Utah, Trust Land Manager and his affirmative response to that request.

1. Letter dated August 17, 1994 - From E.M. Gerick (WSMC) to Mr. Jan Parmenter,Trust Land Manager - Utah Division of State Lands & Forestry

2. Letter dated September 14, 1994 - From Mr. Jan Parmenter, Trust Land Manager to Mr. E.M. Gerick

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

WESTERN STATES MINERALS CORPORATION

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

August 17, 1994

Mr. Jan Parmenter, Trust Land Mgr.
Utah Division of State Lands & Forestry
Southeastern Area Office
89 East Center Street
Moab, UT 84532

RE: J.B. KING RECLAIMED MINESITE - POST RECLAMATION LAND USE AND MAINTENANCE

Dear Mr. Parmenter:

I telephoned you on January 25, 1994 and personally came by your office and introduced myself on May 4, 1994. The purpose of both occasions were to request that you please give consideration to two requests concerning the post reclamation land use and maintenance at the J.B. King reclaimed minesite located in Emery Co., Utah or more specifically identified as follows:

Those lands or portions thereof located in SE 1/4 NW 1/4, SW 1/4 NW 1/4, and NE 1/4 SW 1/4 Section 32 T.23S, R6E SLB&M.

Those two requests that I need your concurrance on are as follows:

1) Western States Minerals Corporation (WSMC) believes that the existing sediment impoundment facility would be a benefit to the land in the post reclamation phase (i.e. in support of wildlife habitat and rangeland grazing). It normally collects and holds some water through parts of the year. It is built below ground level, so limited to no maintenance is required to keep it in acceptable operating condition.

2) In addition, there is presently a range fence (barbed wire) around the reclaimed area boundary to prevent cattle from coming onto the property. This could be used later on, to control cattle grazing on the property. Again, I believe this would be to the State's benefit to have this structure remain after WSMC's reclamation responsibility ends.

250 S. Rock Blvd., Suite 130 ▲ Reno, NV 89502 ▲ (702) 856-3339 ▲ FAX (702) 856-1818

I would appreciate your careful consideration of allowing WSMC to leave these two facilities in place at the site (obviously both would be in good working order upon release) after WSMC's reclamation responsibility ends.

Thank you for your consideration of this request. If you have any questions concerning this letter, please call me at your convenience.

Sincerely,

E.M. (Buzz) Gerick
V.P. Operations

cc: Ms. Pam Grubaugh-Littig UDOGM
J.B. King file

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

RECEIVED SEP 1 9 1994

State of Utah
School and Institutional
Trust Lands Administration

Michael O. Leavitt
Governor

Scott Hirschi
Director

Southeastern Area Office
1165 South Highway 191, Ste 5
Moab, UT 84532
Phone: 801 259-3760
Fax: 801 259-3755

September 14, 1994

E.M. Buzz Gerick
Western States Minerals Corp.
250 S. Rock Blvd., Suite 130
Reno, NV 89502

RE: JB King Minesite - Post Reclamation Maintenance

Dear Mr. Gerick:

I concur with your request to leave both reclamation facilities in place. Both facilities will enhance grazing practices on the rangeland for this area.

Should you have any questions or concerns, please feel free to contact our office in Moab at (801) 259-3760.

Sincerely,

Jan Parmenter
Trust Land Manager

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

UMC 784.16 - RECLAMATION PLAN: PONDS, IMPOUNDMENTS, BANKS, DAMS, AND EMBANKMENTS

In section UMC 784.15 please find documentation whereby WSMC requested permission to leave certain existing facilities at the J.B. King reclaimed mine site during the post reclamation period; and the current landowner, State of Utah - Trust Lands Administration, granted permission to do so. It is therefore WSMC's intent to leave the existing sediment impoundment facility in place upon final bond release and termination of its reclamation liability at the site.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

UMC 784.18 - RELOCATION OR USE OF PUBLIC ROADS

The existing public road from the intersection of I-70 and State Highway 10 (Fremont Junction), will be utilized to transport men and equipment to the J.B. King jobsite. In addition, the biosolids and rock mulch (gravel) will be transported over this route. This road is routinely maintained by Sevier and Emery County road crews, and this presently planned activity will not cause any adverse impacts to normal traffic patterns or the general condition of the road.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

UMC 805.11 - BOND AMOUNT

The total site disturbance from the proposed reclamation work planned during 1994, as outlined in section UMC 784.13, will vary between six (6) and nine (9) acres; depending upon the amount of excavation required for drainage channels and the total area covered by rock mulch on the side slopes of the refuse pile. The vegetation test plot area amounts to approximately one (1) acre in size and requires about 1812 cubic yards (3 yds.) to cover the entire plot with a minimum of two (2) feet of suitable earthen cover material. For purposes of the following calculation it will be assumed that the ditch excavations will provide just the right amount of material to cover the test plot with the minimum 2 ft. (in reality ditch excavation may not provide enough material and another source of material will be required), and a total of 9 acres will be redisturbed in the process.

Therefore, the total estimated cost, by category, to complete the proposed work is tabulated below:

Cost Estimate for Entire Project

1. Channel Excavation:

Includes excavation, transport, and stockpiling of the material removed from ditches 1 & 2, and plunge pools 1 & 2.

1812 yds 3 X $6.00/ yds 3 = $10,872.00

2. Placement of Excavated Material:

Rehandle from stockpile, transport, and spread earthen material over vegetation test plot area to a minimum depth of 2 ft.

1812 yds 3 X $3.00/yds 3 = $5,436.00

3. Aggregate for Plunge Pools:

Cost to purchase, transport, and place aggregate products in the plunge pools per engineering design.

30 yds3 X $28/yds3 =	$ 840.00	(for granular filter)
104 yds3 X $28/yds3 =	$2912.00	(for rip rap)
134 yds3 X $6.00/yds3 =	$ 804.00	(for placement of aggregate)
	$4556.00	Subtotal

4. "Softening" Existing Drainage Channels:

Total estimated cost of $1000.00

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

5. Rock mulch (gravel) required on Side Slope of Refuse Pile as an Erosional Control:

Run of pit rock and gravel (rock mulch) purchased from a UDOT Sand and Gravel Lease, will be used to cover the side slopes of the refuse pile as an erosional control measure.

Excavation and Haulage- 2000 yds3 X $6.00/Yds3 =	$ 12,000.00
Surface Prep. and Placement- 2000 yds3 X $3.00/yds3 =	$ 6,000.00
UDOT royalty- 2000 yds3 X $0.45/yds3 =	$ 900.00
Subtotal	$18,900.00

6. Application of Biosolids (sewage sludge) as a Soil Amendment:

It is assumed that Biosolids obtained from the Price River Water Improvement District (PRWID) will be transported from Price,UT. to the site, and thoroughly mixed into the soil layer over the 9 acres redisturbed. The application rate is estimated at approximately 15 tons per acre. The following tabulation breaks down the unit costs:

Haulage- 6 loads X $500.00/load =	$ 3,000.00
Loader rental @ Price,UT.- 2 days X $800.00/day =	$ 1,600.00
Placement and mixing @ J.B. King- 9 acres X $1500/acre =	$ 13,500.00
	$18,100.00

7. Revegetation:

This category includes labor, seed, equipment, and straw mulch (if req'd.).

9 acres X $1500.00/acre = $13,500.00

8. Supervision and Technical Support:

WSMC Supervision of project work-	$ 10,000.00
Survey Control-	$ 7,500.00
Technical Support-	$ 15,000.00
	$ 32,500.00

9. Equipment Mobilization and De-mobilization:

Flat rate estimated at $4,500.00 (for mob. & de-mob.)

Cost Estimate Summary:

1. $10,872.00
2. $ 5,436.00
3. $ 4,556.00
4. $ 1,000.00
5. $18,900.00

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Cost Estimate Summary (continued) :

6. $18,100.00
7. $13,500.00
8. $32,500.00
9. $ 4,500.00

$102, 695.00 **Total Project Cost**

The portion of the estimated costs that are assigned to covering the vegetation test plot is tabulated below. The DOGM assumes full responsibility for this amount.

Cost Estimate for Work on Vegetation Test Plot only
(Note: This cost is extracted from the Cost Estimate for the Entire Project)

Assume the following parameters:
-1,812 yds3 soil cover required to meet 2 ft. minimum cover requirement
-1.0 acre revegetated
-Categories 6,7,8,&9 above are each divided by 9 acres to get a proportionate cost allocateable to the Vegetation Test Plot rework.

1. Excavate Material -

1812 yds3 X $6.00/yds3 = $10,878.00

2. Soil Placement -

1812 yds3 X $3.00/yds3 = $5,436.00

3. Biosolids apportioned -

$\frac{\$18,100.00}{9 \text{ acres}}$ = $2,011.00/acre X 1 acre = $2,011.00

4. Revegetation-

1 acre X $1500.00/acre = $1,500.00

5. Supervision and Technical Support-

$\frac{\$32,500.00}{9 \text{ acres}}$ = $3,611/acre X 1 acre = $3,611.00

6. Mobilization and Demobilization-

$\frac{\$4,500.00}{9 \text{ acres}}$ = $500.00/acre X 1 acre = $500.00

Total cost assignable to Vegetation Test Plots rework = $ 23,936.00

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Therefore, the current posted bond of $126,078.00 is not only adequate to cover the presently proposed work, but is also enough to cover on-going post reclamation monitoring and maintenance at the site.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

UMC 817.22 - TOPSOIL SUBSTITUTES AND SUPPLEMENTS

During February 1994, WSMC submitted the **J.B. King Mine - Reclamation Plan Revision** to the Division for conceptual approval. WSMC received a response from the Division dated April 14, 1994, which allowed sampling and analysis of: the soil material in the location of the proposed ditch excavations; the biosolids proposed as a soil amendmen; and the rock product to be used as an erosional control measure on the side slopes of the refuse pile.

A. Topsoil Substitution:

Sampling and analysis of the soil material from the proposed ditch excavations was completed to ensure that no adverse materials existed in those locations that would preclude excavation of the ditches, or use of the excavated materials as a topsoil substitute. The results showed this material to be acceptable plant growth media; and once drainage channels were excavated, this material was transported and distributed on the DOGM Vegetation Test Plot and the designated area west of the refuse pile. Both areas of placement are shown on Drawing JBK-3 (AS BUILT).

Approximately 84 loads of this earthen material, from the drainage excavation and adjacent area, was placed on DOGM Test Plot to provide the required 24 inches of cover (substitute topsoil). Prior to mixing, spreading, and roughening the surface, a new silt fence was constructed along the east side of the Test Plot (approx. 300 ft. in length) that tied in to the existing silt fence (approx. 50 ft. in lenght) located on the north end. The silt fence construction was necessary to prevent the elevated substitute topsoil material from reaching the directly adjacent undisturbed drainage ditch.

Upon completion of the new portion of the silt fence installation, the cover material was mixed, spread, and roughened. Seeding of each completed roughened area was done on a daily basis.

No biosolids or rock mulch was placed on the DOGM Test Plot; however, a substantial amount of rock was contained in the earthen material excavated from the drainage ditches and placed on the test plot area.

In addition, approx. 26 loads of earthen material from the ditch excavation was placed on the area west of the Refuse Pile and shown on the Drawing JBK-3 (AS BUILT). This was handled in exactly the same manner as the previously described DOGM Test Plot, except that biosolids were applied to the south half of this area as shown on Drawing JBK-3 (AS BUILT).

The sampling and analysis of the soil material from the proposed ditch excavation is contained in an Aug. 1994 report entitled **Drilling and Sampling Program at the J.B. King Mine.** Additional boron and selenium tests were performed at a later date (October 24, 1994) using splits of the original samples, and submitted as supplemental information to the Division on October 26, 1994. These results of these analyses are attached hereto as Addendum I to this section.

RECEIVED
OCT 05 1995
DIVISION OF OIL, GAS AND MINING

B. Soil Amendments:

The results of the biosolids testwork were submitted to the DOGM staff and the Division of Water Quality. Permission was granted to apply the biosolids at the site as a soil amendment by EPA, Region VIII and the Utah Division of Water Quality. These approvals are located in section UMC 782.19 as attachments.

The biosolids approved for useage at the J.B. King site for a soil amendment were provided to WSMC by the Price River Water Improvement District (PRWID). Specific analyses associated with these biosolids; and the rate and location of their application is discussed in section UMC 817.25 of this Permit.

C. Soil Stabilization:

Approximately 1474 cubic yds. of gravel material (rock mulch), from Utah Sand and Gravel lease #37912 (amended), was used as an erosion control measure (or soil stabilization procedure) on the side slope of the refuse pile. The location of that application is identified on Drawing JBK-3 (AS BUILT). The rock mulch (gravel) material and biosolids were distributed evenly over the identified area of the refuse pile, the products were mixed with the available topsoil, and then the surface was entirely roughened prior to seeding.

The results of testwork on the rock mulch (gravel) material used as an erosional control measure for the side slopes of the refuse pile is attached as Addendum II to this section of the Permit..

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

ADDENDUM I

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

RECEIVED OCT 24 1994

Mr. E.M. "Buzz" Gerick
Vice President Operations
Western States Minerals Corporation
250 S. Rock Blvd., Suite 130
Reno, Nevada 89502

October 24, 1994

Re: Additional Boron and Selenium Testing of J.B. King Samples.

Dear Mr. Gerick:

At your request we submitted the last splits of samples taken at the J.B. King site in May of this year to Inter-Mountain Laboratories, Inc. for additional testing for boron and selenium. The results of this testing were received October 11 and are attached.

The following tables show the boron and selenium values of the individual samples as well as the length weighted average concentrations for the channel area and for the refuse material. For locations of the sample sites please refer to the report "Drilling and Sampling Program at the J.B. King Mine", submitted to Western States Minerals Corporation in August 1994.

INCORPORATED
EFFECTIVE:
OCT 05 1995
DIVISION OF OIL, GAS AND MINING

TABLE 1
SAMPLE OF MATERIALS IN CHANNEL AREA

Composite #	Length	Boron	Wt. Boron	Selenium	Wt. Selenium
1/12	9′	1.83	16.47	<0.02	<0.02
1/345	12′	0.83	9.96	<0.02	<0.02
2/12	9.5′	0.47	4.47	<0.02	<0.02
2/34	16.5′	2.07	34.16	<0.02	<0.02
3/123	14′	1.84	25.76	<0.02	<0.02
4/123	12.5′	1.06	13.25	<0.02	<0.02
5/12	9′	3.52	31.68	<0.02	<0.02
5/34	9.25	2.04	18.87	<0.02	<0.02
11/12	4.5′	0.62	2.79	<0.02	<0.02
Total	96.25′		157.41		<0.02
Wt. Average			1.6354		<0.02

HANSEN ALLEN & LUCE inc

TABLE 2
SAMPLE OF MATERIAL IN REFUSE PILE

Composite #	Length	Boron	Wt. Boron	Selenium	Wt. Selenium
6/12	6.5′	1.39	9.04	0.18	1.17
6/34	10′	1.06	10.60	0.28	2.80
6/56	8′	1.02	8.16	0.14	1.12
7/12	6.8′	1.72	11.70	0.14	0.95
7/34	10′	2.25	22.50	0.26	2.60
7/56	9.75′	2.18	21.26	0.06	0.59
8/12	6.4′	1.88	12.03	0.20	1.28
8/34	10′	2.37	23.70	0.16	1.60
8/56	7.75	2.08	16.12	0.06	0.47
9/12	6.75′	1.75	11.81	0.10	0.68
10/123	7.5′	2.98	22.35	0.10	0.75
Total	89.45′		169.27		14.01
Wt. Average			1.8923		0.1566

In June 1994 Dr. Sam Bamberg took two additional samples of soil material adjacent to the J.B. King site. The remaining splits of these samples were also sent to IML and the results of testing are shown in Table 3 below.

TABLE 3
SAMPLES OF OFF-SITE MATERIALS

Sample #	Boron	Selenium
Off-site 1	0.32	<0.02
Off-site 2	0.38	<0.02

The results of analyses reported herein plus the results contained in the August 1994 report allow the following conclusions:

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

- According to the Division's guidelines, as referenced in the 1994 report, the material into which the proposed channels at the J.B. King site might erode is not toxic.

- Also the materials represented by the two off-site samples are not toxic.

- The material contained in the refuse pile exceeds the Division's guidelines for allowable selenium by 0.0566 ppm. All other parameters are in the non-toxic ranges of the guidelines.

If there are any questions, please contact us.

Very truly yours,

Barry J. Barnum

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE inc

Inter-Mountain Laboratories, Inc.
1633 Terra Avenue
Sheridan, Wyoming 82801
Tel. (307) 672-8945

HANSEN, ALLEN & LUCE
MIDVALE, UTAH

October 6, 1994

Lab No.	Location	Depths	Boron ppm	Selenium ppm
115717	1/12		1.83	<0.02
115718	1/345		0.83	<0.02
115719	2/12		0.47	<0.02
115720	2/34		2.07	<0.02
115721	3/123		1.84	<0.02
115722	4/123		1.06	<0.02
115723	5/12		3.52	<0.02
115724	5/34		2.04	<0.02
115725	6/12		1.39	0.18
115726	6/34		1.06	0.28
115727	6/56		1.02	0.14
115728	7/12		1.72	0.14
115729	7/34		2.25	0.26
115730	7/56		2.18	0.06
115731	8/12		1.08	0.20
115732	8/34		2.37	0.16
115733	8/56		2.08	0.06
115734	9/12		1.75	0.10
115735	10/123		2.98	0.10
115736	11/12		0.62	<0.02

UTAH DIVISION OIL, GAS AND MINING
OCT 05 1995
EFFECTIVE:

Inter-Mountain Laboratories, Inc.
1633 Terra Avenue
Sheridan, Wyoming 82801
Tel. (307) 672-8945

HANSEN, ALLEN & LUCE
MIDVALE, UTAH

October 6, 1994

Lab No.	Location	Depths	Boron ppm	Selenium ppm
115737	OFFSITE 1		0.32	<0.02
115738	OFFSITE 2		0.38	<0.02

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Inter-Mountain Laboratories, Inc.
1633 Terra Avenue
Sheridan, Wyoming 82801
Tel. (307) 672-8945

HANSEN, ALLEN & LUCE
MIDVALE, UTAH

October 6, 1994

Lab No.	Location	Depths	Boron ppm	Selenium ppm
115720	2/34		2.07	<0.02
115740	115720(DUP)		1.85	<0.02
115736	11/12		0.62	<0.02
115741	115736(DUP)		0.71	<0.02

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Western States Minerals Corp.

DRILLING AND SAMPLING PROGRAM AT THE J. B. KING MINE

AUGUST 1994

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC
SALT LAKE CITY, UTAH

DRILLING AND SAMPLING PROGRAM AT THE J. B. KING MINE

INTRODUCTION

A drilling and sampling program was conducted at the reclaimed J.B. King mine site from May 10 through May 12, 1994. There were three purposes for this program. The first was to obtain samples of material for geotechnical testing to determine acceptable sideslopes for proposed reclamation channels. The second purpose was to explore the material into which the proposed channels could potentially erode to determine if the material could cause acidic or toxic runoff. The third purpose was to determine if the refuse material buried on site is acid or toxic-forming. This program consisted of drilling and sampling eleven drill holes as approved by the Division. The locations of the drill holes are shown on the Reclamation Plan Revision Map contained in Appendix 1. The holes were drilled in sequential order (i.e. drill hole 1 was drilled first, drill hole 2 was drilled second, etc.).

METHODOLOGY

Drilling was accomplished using an ATV auger rig to eliminate the need for construction of access roads to the drill hole locations and to minimize disturbance to the site. The drill rig is owned and operated by Overland Drilling of West Jordan, Utah. The auger drilling method was employed with continuous sampling. Drill holes 1 through 5 and 11, located in the channel area, were drilled until natural inplace material or bedrock was encountered. Samples taken during the drilling of these holes were split for geotechnical and chemical analyses. Drill holes 6 through 10 were drilled through the refuse material.

A description of each sample recovered is provided in a field notebook. Each description includes the drill hole number, the sample number, the depth and interval from which the sample was recovered, and a visual description of the sample. After recovery, the samples were stored in plastic zip-lock bags. Each bag was labeled with the drill hole number and the sample number. The morning following the completion of drilling, one set of sample splits was taken to Chemtech Analytical Laboratory for preparation and chemical analyses. The analyses performed included: pH, EC, SAR, Selenium, Boron, and Acid/Base Potential according to the Division's "Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining", April 1988. Chemtech, using EPA approved methods, was able to analyze the samples for selenium to a detection limit of 5 parts per million. Efforts by Chemtech to lower the selenium detection limit by using graphite furnace techniques were unsuccessful. Splits of the samples were then sent to Colorado State University Soil Testing Lab which has been able to detect as low as 0.01 parts per million of selenium in soil samples. Raw data resulting from the laboratory analyses are contained in Appendix 2. The sample splits for geotechnical analysis were stored until the results of the chemical testing were available.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE inc

In order to provide enough sample material to the laboratory for analysis and to reduce the number of analyses required, some of the samples were composited. Table 1 indicates how individual samples (increments) were composited.

As indicated in Table 1, 44 samples (increments) were combined into 20 composites for testing. The results of the analyses of the composites were further combined by weighted averaging (based on the length of the increment interval) to develop a single sample description representative of the material in the channel area and a single sample description representative of the material in the refuse pile. As will be discussed, this is a conservative approach.

Erosion on the J.B. King site will not take place in a single isolated location but will take place, more or less, uniformly over the whole site. Thus the products of erosion from the refuse pile, for example, will be combined with other material eroded from the site and with material eroded from above the site. The area of the refuse pile is around 12.8 acres and the total area of the site is approximately 30 acres. It is, therefore, reasonable to assume that if the refuse material erodes it will constitute one-half or less of the total products of erosion from the site. It is inconceivable that erosion of the refuse pile would be concentrated on the location of one sample increment, with no erosion from any other part of the refuse pile or from the rest of the site. This provides justification for determining that the average characteristics of the products of erosion will more closely resemble the overall average characteristics of the on-site materials, rather than the characteristics of any individual increment of on-site material. However, to conservatively estimate the characteristics of the products of erosion, we have averaged the characteristics of the material in the channel area and the characteristics of the refuse material separately as though these materials would erode separately without mixing. In this way, the average characteristics of the products of erosion and the off-site impacts of just the refuse material can be determined without accounting for dilution or neutralization by erosional material from other parts of the site (such as from the channel area) or from materials eroded onto the site from upstream. This is the purpose of Tables 2 and 3.

RESULTS

Tables 2 and 3 show the development of two weighted average samples based on the raw data contained in Appendix 2.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

TABLE 1
J.B. KING DRILLING SAMPLE COMPOSITES

Drill Hole #	Sample (Increment)#	Depth Interval	Composite #	Composite Length
1	1	0' - 4'	1/12	9'
	2	4' - 9'		
	3	9' - 14.25'	1/345	12'
	4	14.25' - 19'		
	5	19' - 21'		
2	1	0' - 4.5'	2/12	9.5'
	2	4.5' - 9.5'		
	3	9.5' - 19.5'	2/34	16.5'
	4	19.5' - 28.5'*		
3	1	0' - 4'	3/123	14'
	2	4' - 9'		
	3	9' - 14'		
4	1	0' - 4.5'	4/123	12.5'
	2	4.5' - 9.5'		
	3	9.5' - 12.5'		
5	1	0' - 4'	5/12	9'
	2	4' - 9'		
	3	9' - 14.5'	5/34	9.25'
	4	14.5' - 18.25'		
6	1	3' - 4.5'	6/12	6.5'
	2	4.5' - 9.5'		
	3	9.5' - 14.5'	6/34	10'
	4	14.5' - 19.5'		
	5	19.5' - 24.5'	6/56	8'
	6	24.5' - 27.5'		

INCORPORATED
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE inc

TABLE 1 (Cont.)

Drill Hole #	Sample (Increment)#	Depth Interval	Composite #	Composite Length
7	1	2.7' - 4.5'	7/12	6.8'
	2	4.5' - 9.5'		
	3	9.5' - 14.5'	7/34	10'
	4	14.5' - 19.5'		
	5	19.5' - 24.5'	7/56	9.75'
	6	24.5' - 29.25		
8	1	3.1' - 4.5'	8/12	6.4'
	2	4.5' - 9.5'		
	3	9.5' - 14.5'	8/34	10'
	4	14.5' - 19.5'		
	5	19.5' - 24.5'	8/56	7.75'
	6	24.5' - 27.25'		
9	1	1.5' - 4.5'	9/12	6.75'
	2	4.5' - 8.25'		
10	1	2.25' - 4.5'	10/123	7.5'
	2	4.5' - 8.5'		
	3	8.5' - 9.75'		
11	1B	0' - 2.5'	11/12	4.5'
	2B	2.5' - 4.5'		

In order to compare the chemical properties of soil and refuse material on the J.B. King site with surrounding materials, two additional soil samples were taken by Dr. Sam Bamberg, a soils and vegetation consultant retained by Western States, on June 8. Each sample consisted of approximately two to three-foot composites of soil material from undisturbed sites adjacent to the J.B. King site. These samples were analyzed for the same parameters as shown in the Tables 2 and 3 above, the results of which are presented in Table 4.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

TABLE 2
SAMPLE OF MATERIAL IN CHANNEL AREA

Composite #	Length	pH	Wt. pH	EC	Wt. EC	SAR	Wt. SAR	Sel.	Wt. Sel.	Boron	Wt. Boron	A/B Pot.	Wt. A/B Pot.
1/12	9'	6.92	62.28	4.310	38.79	0.71	6.39	0.48	4.32	17.7	159.3	20.6	185.40
1/345	12'	7.44	89.28	3.350	40.20	0.72	8.64	0.47	5.64	14.4	172.80	31.8	381.60
2/12	9.5'	6.46	61.37	2.850	27.08	0.84	7.98	0.40	3.80	14.4	136.80	3.8	36.10
2/34	16.5'	7.65	126.23	2.580	42.57	0.61	10.07	0.48	7.92	30.9	509.85	26.9	443.85
3/123	14'	8.05	112.70	2.570	35.98	5.80	81.20	0.70	9.80	14.5	203.00	305.0	4270.00
4/123	12.5'	7.79	97.38	1.831	22.89	1.80	22.50	1.12	14.00	24.0	300.00	143.0	1787.50
5/12	9'	7.54	67.86	2.450	22.05	0.11	0.99	0.45	4.05	51.8	466.20	51.4	462.60
5/34	9.25'	7.64	70.67	1.829	16.92	1.20	11.10	0.32	2.96	37.7	348.73	19.8	183.15
11/12	4.5'	7.85	35.33	1.194	5.37	0.76	3.42	0.71	3.20	28.5	128.25	200.0	900.00
Total	96.25'		723.10		251.85		152.29		55.69		2424.93		8650.20
Wt. Average			7.51		2.62		1.58		0.58		25.19		89.87

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

TABLE 3
SAMPLE OF MATERIAL IN REFUSE PILE

Composite #	Length	pH	Wt. pH	EC	Wt. EC	SAR	Wt. SAR	Sel.	Wt. Sel.	Boron	Wt. Boron	A/B Pot.	Wt. A/B Pot.
6/12	6.5'	7.38	47.97	3.180	20.67	2.40	15.60	0.25	1.63	49.3	320.45	-6.1	-39.65
6/34	10'	7.45	74.50	1.425	14.25	1.20	12.00	0.95	9.50	33.8	338.00	3.6	36.00
6/56	8'	3.71	29.68	1.499	11.99	2.40	19.20	0.43	3.44	30.1	240.80	-4.1	-32.80
7/12	6.8'	6.47	44.00	3.820	25.98	1.70	11.56	0.40	2.72	36.7	249.56	-1.2	-8.16
7/34	10'	7.63	76.30	2.110	21.10	1.90	19.00	0.31	3.10	45.8	458.00	-3.9	-39.00
7/56	9.75'	6.94	67.67	3.080	30.03	1.90	18.53	0.57	5.56	30.9	301.28	9.2	89.70
8/12	6.4'	6.83	43.71	3.090	19.78	1.40	8.96	0.57	3.65	67.1	429.44	-4.7	-30.08
8/34	10'	7.49	74.90	3.070	30.70	0.86	8.60	0.58	5.80	52.9	529.00	-2.3	-23.00
8/56	7.75'	6.89	53.40	3.600	27.90	1.20	9.30	1.51	11.70	31.4	243.35	-97.8	-757.95
9/12	6.75'	4.70	31.73	3.290	22.21	0.80	5.40	0.35	2.36	61.5	415.13	-12.9	-87.08
10/123	7.5'	7.23	54.23	3.800	28.50	1.10	8.25	0.56	4.20	55.7	417.75	118.0	885.00
Total	89.45'		598.09		253.11		136.40		53.66		3942.76		-7.02
Wt. Average			6.69		2.83		1.52		0.60		44.08		-0.08

UTAH DIVISION OIL, GAS AND MINING
OCT 05 1995
INCORPORATED
EFFECTIVE:

HANSEN ALLEN & LUCE INC

TABLE 4
SAMPLES OF OFF-SITE MATERIAL

Sample #	Length	pH	EC	SAR	Sel.	Boron	A/B Pot.
Off-site 1	38"	7.87	1.766	5.028	<1	20.3	29.7
Off-site 2	24"	7.88	0.255	1.699	<1	21.2	70.5

The Division has developed a set of guidelines for classifying the suitability of a material as a plant growth medium. Table 5 shows the parameter ranges for each classification.

TABLE 5
CLASSIFICATION OF SOIL MATERIALS*

PARAMETER	pH	EC	SAR	Selenium	Boron	Acid/Base Potential
CLASSIFICATION						
Good	6.1-8.2	0-2	0-4	<0.1	<5.0	>-5
Fair	5.1-6.1 8.2-8.4	2-8	5-10	-	-	-
Poor	4.5-5.0 8.5-9.0	8-15	10-12	-	-	-
Unacceptable	<4.5 >9.0	>15	>12	>0.1	>5.0	<-5

*From: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, State of Utah Department of Natural Resources Division of Oil, Gas and Mining, April 1988, by James Leatherwood and Dan Duce.

The four materials sampled; the material in the channel area, the material in the refuse pile, and the two typical off-site materials, are compared in Table 6 using the Division's classification system contained in Table 5. Parameters which are classified as "unacceptable" by the Division's Guidelines are shaded in Table 6 to make comparison easier.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

TABLE 6
CLASSIFICATION OF MATERIALS

Sample	pH	EC	SAR	Selenium	Boron	A/B Pot.
Channel	Good	Fair	Good	Unacceptable	Unacceptable	Good
Refuse	Good	Fair	Good	Unacceptable	Unacceptable	Good
Off-site 1	Good	Fair	Fair	Unacceptable	Unacceptable	Good
Off-site 2	Good	Good	Good	Unacceptable	Unacceptable	Good

The Channel material and the Refuse material have the same classifications, each with three "good" classifications, one "fair" classification, and two "unacceptable" classifications. The classifications for these two materials are the same for each parameter. One of the off-site undisturbed materials (Off-site 1) appears to have poorer classifications than the J.B. King materials with two "good" classifications, two "fair" classifications, and two "unacceptable" classifications. The other off-site material (Off-site 2) appears to have better classifications than the J.B. King materials with four "good" classifications and two "unacceptable" classifications. In all cases, both "on-site" and "off-site", the "unacceptable" classifications are for high selenium and boron concentrations.

GEOTECHNICAL TESTING

Splits of samples 1 through 5 and 11 were submitted to AGEC, a local geotechnical testing company, for analyses to determine stable side slope angles for the proposed channels. The result of these analyses are contained in Appendix 3. The result is that the channels should be constructed with a side slope angle of 2 horizontal to 1 vertical, with the understanding that as the constructed channels cut and meander the initial side slopes will fail naturally and ultimately the side slopes will attain the optimum natural side slope angle.

CONCLUSIONS

The conclusions which result from applying the Division's Guidelines to the above data are as follows:

- The Refuse material and the Channel material on the J.B. King site are similar in nature and both have similar classifications.

- The J.B. King materials are generally similar to off-site materials - one off-site sample has slightly poorer classifications than the J.B. King material and the other off-site sample has slightly better classifications.

INCORPORATED
EFFECTIVE:
OCT 05 1995

UTAH DIVISION OIL, GAS AND MINING

- Relative to the undisturbed material surrounding the site the J.B. King materials in the channel area and in the refuse pile are not, on average, acid-forming or toxic-forming.

- Since the materials on the J.B. King site are similar to the material surrounding the site, potential products of erosion which might escape from the J.B. King site should not adversely impact plant or wildlife off site.

- The proposed channels should be constructed with side slopes having an angle of 2h:1v. Natural erosion of the channels may cause the channel side slopes to become the optimum angle.

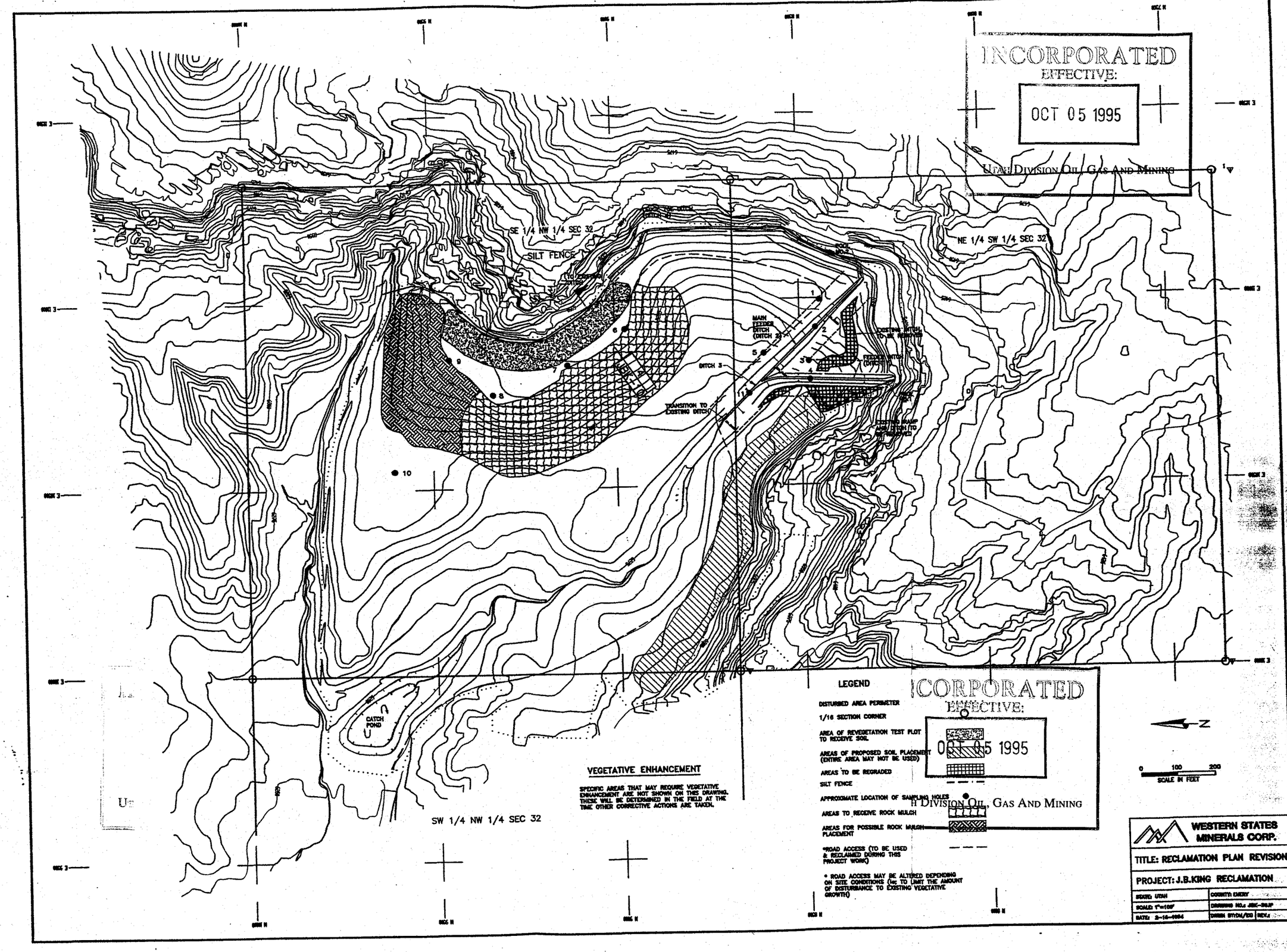
INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

APPENDIX 1

Reclamation Plan Revision Map

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING



INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

APPENDIX 2

Laboratory Analyses Results

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #1 Sample #1&2	
LAB #:	U007180	DATE ANALYZED/METHOD
PARAMETER		
pH Units	6.92	5-25-94 EPA 9045
Conductivity, uhmos/cm	4,310	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	20.6	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	<.05	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	20.6	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	17.7	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	0.71	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	921	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	310	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	97.7	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #1 Sample #3,4,&5	
LAB #:	U007181	DATE ANALYZED/METHOD
PARAMETER		
pH Units	7.44	5-25-94 EPA 9045
Conductivity, uhmos/cm	3,350	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	31.8	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	<.05	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	31.8	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	14.4	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	0.72	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	518	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	201	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	76.2	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: [signature]

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #2 Sample #1&2	
LAB #:	U007182	DATE ANALYZED/METHOD
PARAMETER		
pH Units	6.46	5-25-94 EPA 9045
Conductivity, uhmos/cm	2,850	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	3.8	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	<.05	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	3.8	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	14.4	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	0.84	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	471	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	142	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	81.4	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995

Approved By: _____

UTAH DIVISION OIL, GAS AND MINING

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #2 Sample #3&4	
LAB #:	U007183	DATE ANALYZED/METHOD
PARAMETER		
pH Units	7.65	5-25-94 EPA 9045
Conductivity, uhmos/cm	2,580	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	26.9	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	<.05	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	26.9	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	30.9	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	0.61	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	1,446	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	200	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	93.2	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: [signature]

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #3 Sample #1,2&3	
LAB #:	U007184	DATE ANALYZED/METHOD
PARAMETER		
pH Units	8.05	5-25-94 EPA 9045
Conductivity, uhmos/cm	2,570	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	305	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	<.05	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	305	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	14.5	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	5.8	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	175	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	70.9	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	360	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: [signature]

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #4 Sample #1,2&3	
LAB #:	U007185	DATE ANALYZED/METHOD
PARAMETER		
pH Units	7.79	5-25-94 EPA 9045
Conductivity, uhmos/cm	1,831	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	143	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	<.05	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	143	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	24.0	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	1.8	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	220	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	79.4	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	124	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #5 Sample #1&2	
LAB #:	U007186	DATE ANALYZED/METHOD
PARAMETER		
pH Units	7.54	5-25-94 EPA 9045
Conductivity, uhmos/cm	2,450	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	54.5	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	3.1	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	51.4	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	51.8	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	0.11	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	841	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	112	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	12.6	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By:

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #5 Sample #3&4	
LAB #:	U007187	DATE ANALYZED/METHOD
PARAMETER		
pH Units	7.64	5-25-94 EPA 9045
Conductivity, uhmos/cm	1,829	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	22.0	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	2.2	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	19.8	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	37.7	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	1.2	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	270	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	74.2	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	86.7	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995

Approved By: _____ UTAH DIVISION OIL, GAS AND MINING

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #6 Sample #1&2	
LAB #:	U007188	DATE ANALYZED/METHOD
PARAMETER		
pH Units	7.38	5-25-94 EPA 9045
Conductivity, uhmos/cm	3,180	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	19.5	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	25.6	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	-6.1	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	49.3	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	2.4	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	474	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	145	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	230	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #6 Sample #3&4	
LAB #:	U007189	DATE ANALYZED/METHOD
PARAMETER		
pH Units	7.45	5-25-94 EPA 9045
Conductivity, uhmos/cm	1,425	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	12.0	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	8.4	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	3.6	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	33.8	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	1.2	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	162	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	54.3	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	69.2	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #6 Sample #5&6	
LAB #:	U007190	DATE ANALYZED/METHOD
PARAMETER		
pH Units	3.71	5-25-94 EPA 9045
Conductivity, uhmos/cm	1,499	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	2.5	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	6.6	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	-4.1	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	30.1	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	2.4	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	70.9	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	18.6	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	88.2	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #7 Sample #1&2	
LAB #:	U007191	DATE ANALYZED/METHOD
PARAMETER		
pH Units	6.47	5-25-94 EPA 9045
Conductivity, uhmos/cm	3,820	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	9.1	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	10.3	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	-1.2	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	36.7	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	1.7	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	288	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	90.6	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	129	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
DIVISION OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #7 Sample #3&4	
LAB #:	U007192	DATE ANALYZED/METHOD
PARAMETER		
pH Units	7.63	5-25-94 EPA 9045
Conductivity, uhmos/cm	2,110	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	12.0	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	15.9	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	-3.9	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	45.8	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	1.9	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	317	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	72.2	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	146	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #7 Sample #5&6	
LAB #:	U007193	DATE ANALYZED/METHOD
PARAMETER		
pH Units	6.94	5-25-94 EPA 9045
Conductivity, uhmos/cm		3,080 5-25-94 EPA
120.1		
Neutralization Potential, tons $CaCO_3$/1000 tons soil	15.8	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	6.6	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	9.2	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	30.9	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	1.9	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	264	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	88.3	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	110	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
DIVISION OF OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #8 Sample #1&2	
LAB #:	U007194	DATE ANALYZED/METHOD
PARAMETER		
pH Units	6.83	5-25-94 EPA 9045
Conductivity, uhmos/cm	3,090	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	15.6	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	20.3	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	-4.7	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	67.1	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	1.4	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	592	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	184	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	152	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #8 Sample #3&4	
LAB #:	U007195	DATE ANALYZED/METHOD
PARAMETER		
pH Units	7.49	5-25-94 EPA 9045
Conductivity, uhmos/cm	3,070	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	14.3	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	16.6	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	-2.3	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	52.9	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	0.86	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	388	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	107	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	74.5	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
DIVISION OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #8 Sample #5&6	
LAB #:	U007196	DATE ANALYZED/METHOD
PARAMETER		
pH Units	6.89	5-25-94 EPA 9045
Conductivity, uhmos/cm	3,600	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	5.2	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	103	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	-97.8	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	31.4	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	1.2	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	1,080	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	386	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	184	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #9 Sample #1&2	
LAB #:	U007197	DATE ANALYZED/METHOD
PARAMETER		
pH Units	4.70	5-25-94 EPA 9045
Conductivity, uhmos/cm	3,290	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	4.9	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	17.8	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	-12.9	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	61.5	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	0.80	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	1,077	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	347	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	118	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #10 Sample #1,2,&3		
LAB #:	U007198	DATE ANALYZED	METHOD
PARAMETER			
pH Units	7.23	5-25-94	EPA 9045
Conductivity, uhmos/cm	3,800	5-25-94	EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	131	5-27-94	EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	13.1	5-27-94	EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	118	5-27-94	EPA 2-78-054
Boron as B, mg/Kg	55.7	5-24-94	EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94	EPA 6010
Sodium Adsorption Ratio (SAR)	1.1	--	Calculation
Water Sol. Calcium as Ca, mg/Kg	143	5-20-94	EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	49.2	5-20-94	EPA 6010
Water Sol. Sodium as Na, mg/Kg	57.8	5-20-94	EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By: _____

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-01-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

DATE SUBMITTED: 5-13-94

CERTIFICATE OF ANALYSIS

SAMPLE ID:	Drill Hole #11B Sample #1B,2B	
LAB #:	U007199	DATE ANALYZED/METHOD
PARAMETER		
pH Units	7.85	5-25-94 EPA 9045
Conductivity, uhmos/cm	1,194	5-25-94 EPA 120.1
Neutralization Potential, tons $CaCO_3$/1000 tons soil	200	5-27-94 EPA 2-78-054
Acid Potential, tons $CaCO_3$/1000 tons soil	<.05	5-27-94 EPA 2-78-054
Acid Base Potential, tons $CaCO_3$/1000 tons soil	200	5-27-94 EPA 2-78-054
Boron as B, mg/Kg	28.5	5-24-94 EPA 6010
Selenium as Se, mg/Kg	<5	5-24-94 EPA 6010
Sodium Adsorption Ratio (SAR)	0.76	-- Calculation
Water Sol. Calcium as Ca, mg/Kg	162	5-20-94 EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	32.3	5-20-94 EPA 6010
Water Sol. Sodium as Na, mg/Kg	40.4	5-20-94 EPA 6010

NOTE: Sample temp. when submitted was 19.9°C not on ice.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By:

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-30-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

SAMPLE ID: Lab #U009149

PROJECT: #Bamberg Associates, Offsite #1

DATE SAMPLED: 6-08-94

DATE SUBMITTED: 6-15-94

CERTIFICATE OF ANALYSIS

PARAMETER	DETECTED	DATE ANALYZED	METHOD
pH Units	7.87	6-17-94	EPA 9045
Conductivity (1:1), uhmos/cm	1,766	6-22-94	EPA 120.1
Neut. Potential, Tons $CaCO_3$/1000 tons soil	29.7	6-28-94	**
Acid Potenital, Tons $CaCO_3$/1000 tons soil	<.05	6-28-94	**
Acid Base Potential, Tons $CaCO_3$/1000 tons soil	29.7	6-28-94	**
Boron as B, mg/Kg	20.3	6-22-94	EPA 6010
Selenium as Se, mg/Kg	<1	6-22-94	EPA 6010
SAR	5.028	Calculation	
Water Sol. Calcium as Ca, mg/Kg	89.9	6-23-94	EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	21.2	6-23-94	EPA 6010
Water Sol. Sodium as Na, mg/Kg	204	6-23-94	EPA 6010

NOTE: Sample temp. when submitted was 23.7°C not on ice.
** Method EPA 600/2-78-054

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Approved By:

CHEMTECH

ANALYTICAL LABORATORY

6100 S. STRATLER
MURRAY, UTAH 84107
PHONE: (801) 262-7299
FAX: (801) 262-7378

DATE: 6-30-94

TO: Hansen, Allen & Luce
6771 S. 900 E.
Midvale, Utah 84047

SAMPLE ID: Lab #U009150

PROJECT: #Bamberg Associates, Offsite #2

DATE SAMPLED: 6-08-94

DATE SUBMITTED: 6-15-94

CERTIFICATE OF ANALYSIS

PARAMETER	DETECTED	DATE ANALYZED/METHOD	
pH Units	7.88	6-17-94	EPA 9045
Conductivity (1:1), uhmos/cm	255	6-22-94	EPA 120.1
Neut. Potential, Tons $CaCO_3$/1000 tons soil	70.5	6-28-94	**
Acid Potenital, Tons $CaCO_3$/1000 tons soil	<.05	6-28-94	**
Acid Base Potential, Tons $CaCO_3$/1000 tons soil	70.5	6-28-94	**
Boron as B, mg/Kg	21.2	6-22-94	EPA 6010
Selenium as Se, mg/Kg	<1	6-22-94	EPA 6010
SAR	1.699	Calculation	
Water Sol. Calcium as Ca, mg/Kg	58.4	6-23-94	EPA 6010
Water Sol. Magnesium as Mg, mg/Kg	14.2	6-23-94	EPA 6010
Water Sol. Sodium as Na, mg/Kg	55.8	6-23-94	EPA 6010

NOTE: Sample temp. when submitted was 23.7°C not on ice.
** Method EPA 600/2-78-054

Approved By: [signature]

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Barry Barnum
Hansen, Allen & Luce
6771 S 900 East
Salt Lake City, UT 84121-0146

DATE RECEIVED: 06/21/94
DATE REPORTED: 07/19/94

Colorado State University
Soil, Water and Plant Testing Laboratory
Room 6, Vocational Education Building
Fort Collins, CO 80523
(303) 491-5061 FAX: 491-2930

BILLING:

RESEARCH SOIL ANALYSIS

	Lab #	Sample ID #	mg/kg Total Se
R	8846	1/12	0.48
	8847	2/12	0.40
	8848	5/12	0.45
	8849	6/12	0.25
	8850	7/12	0.40
	8851	8/12	0.57
	8852	9/12	0.35
	8853	11/12	0.71
	8854	2/34	0.48
	8855	5/34	0.32
R	8856	6/34	0.95
	8857	7/34	0.31
	8858	8/34	0.58
	8859	6/56	0.43
	8860	7/56	0.57
	8861	8/56	1.51
	8862	3/123	0.70
	8863	4/123	1.12
	8864	10/123	0.56
	8865	1/345	0.47

Duplicates

R	8850d	7/12	0.48
	8860d	7/56	0.61

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Barry Barnum
Hansen, Allen & Luce
6771 S 900 E
Midvale, UT 84047

DATE RECEIVED: 07/29/94
DATE REPORTED: 08/18/94

Colorado State University
Soil, Water and Plant Testing Laboratory
Room 6, Vocational Education Building
Fort Collins, CO 80523
(303) 491-5061 FAX: 491-2930

BILLING:

RESEARCH SOIL ANALYSIS

	Lab #	Sample ID #	mg/kg Total Se
R	989	Offsite 1	0.31
	990	Offsite 2	0.15

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Applied Geotechnical Engineering Consultants, Inc.

August 19, 1994

Hansen, Allen and Luce, Inc.
6771 South 900 East
Midvale, Utah 84047-1436

Attention: Bill Bigelow

Subject: Drainage Ditch Excavation
J. B. King Mine
Emery County, Utah
Project No. 39794

Gentlemen:

Applied Geotechnical Engineering Consultants, Inc. was requested to provide recommendations for cut slopes for drainage ditches to be excavated through existing fill material at the J. B. King Mine located in Emery County, Utah.

Proposed Construction

Drainage ditches are planned to be excavated at the J. B. King Mine as part of the reclamation project for the mine. We understand that there will be two drainage ditches which will connect to each other at the northwest end (see Figure 1). The proposed drainage ditches will have a length of approximately 500 feet. The ditches are planned to have a bottom ditch width of 5 feet and will be excavated to a depth of approximately 10 feet into the existing fill material. The drain ditches will connect into natural drainages at each end.

We understand that it is desired to excavate the ditches as steep as possible, but provide a stable slope at the time of excavation. Erosion of the ditches is anticipated after construction. We anticipate that erosion will extend into the constructed ditch walls, as well as the ditch bottom.

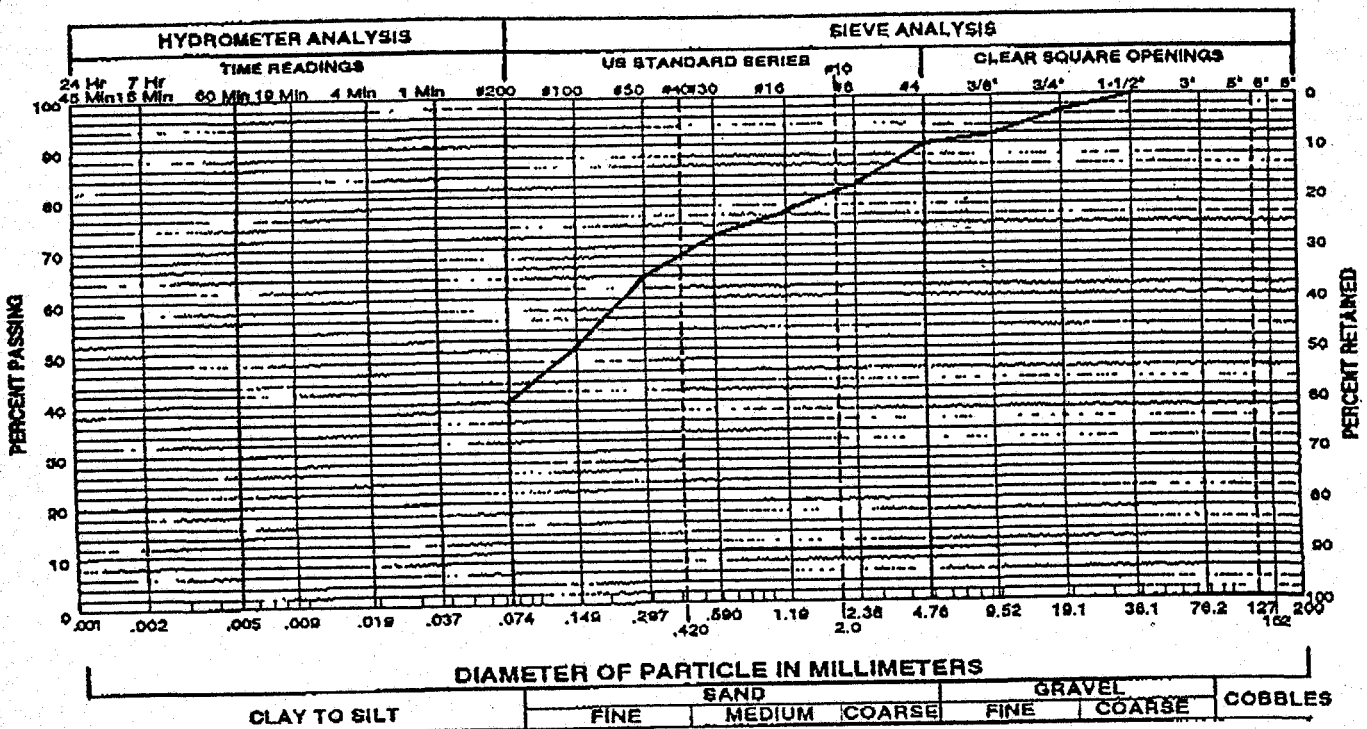
INCORPORATED
OCT 05 1995
UTAH DIVISION OF OIL, GAS AND MINING

Subsurface Conditions

The subsurface conditions in the area of the proposed drain ditches were investigated by Hansen, Allen and Luce. Six test pits were excavated in the area of the proposed drain ditches. The excavations extended to depths of up to approximately 28½ feet. The logs provided to us indicate that fill was encountered to depths of up to approximately 24½ feet.

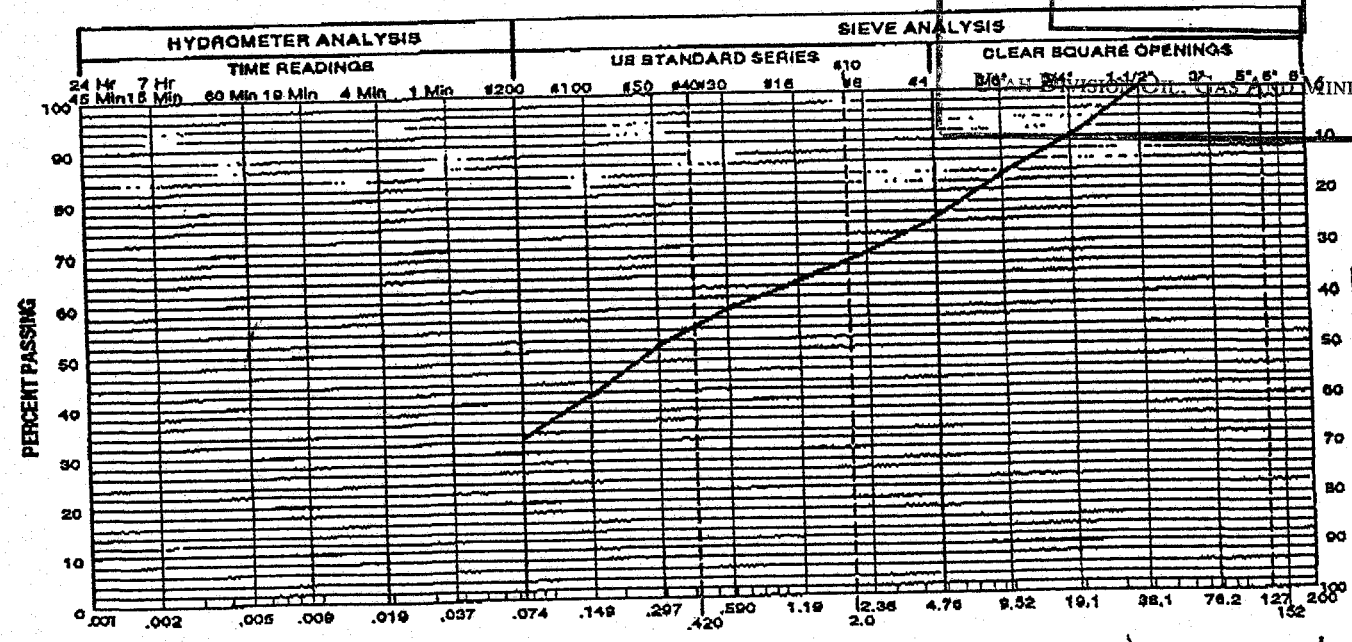
The fill generally consists of silty to clayey sand with gravel. Some zones of coal were encountered within the fill material. One of the test pits (#5) consisted of a significant amount of coal.

Applied Geotechnical Engineering Consultants, Inc.



Gravel 10 % Sand 50 % Silt and Clay 40 %
Liquid Limit 23 % Plasticity Index 5 %
Sample of Fill: Silty Clayey Sand From Exploration #1 @ 0-4 feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
DIVISION OF OIL, GAS AND MINING



Gravel 26 % Sand 41 % Silt and Clay 33 %
Liquid Limit 25 % Plasticity Index 6 %
Sample of Fill: Silty Clayey Sand w/Gravel From Exploration #1 @ 4-9 feet

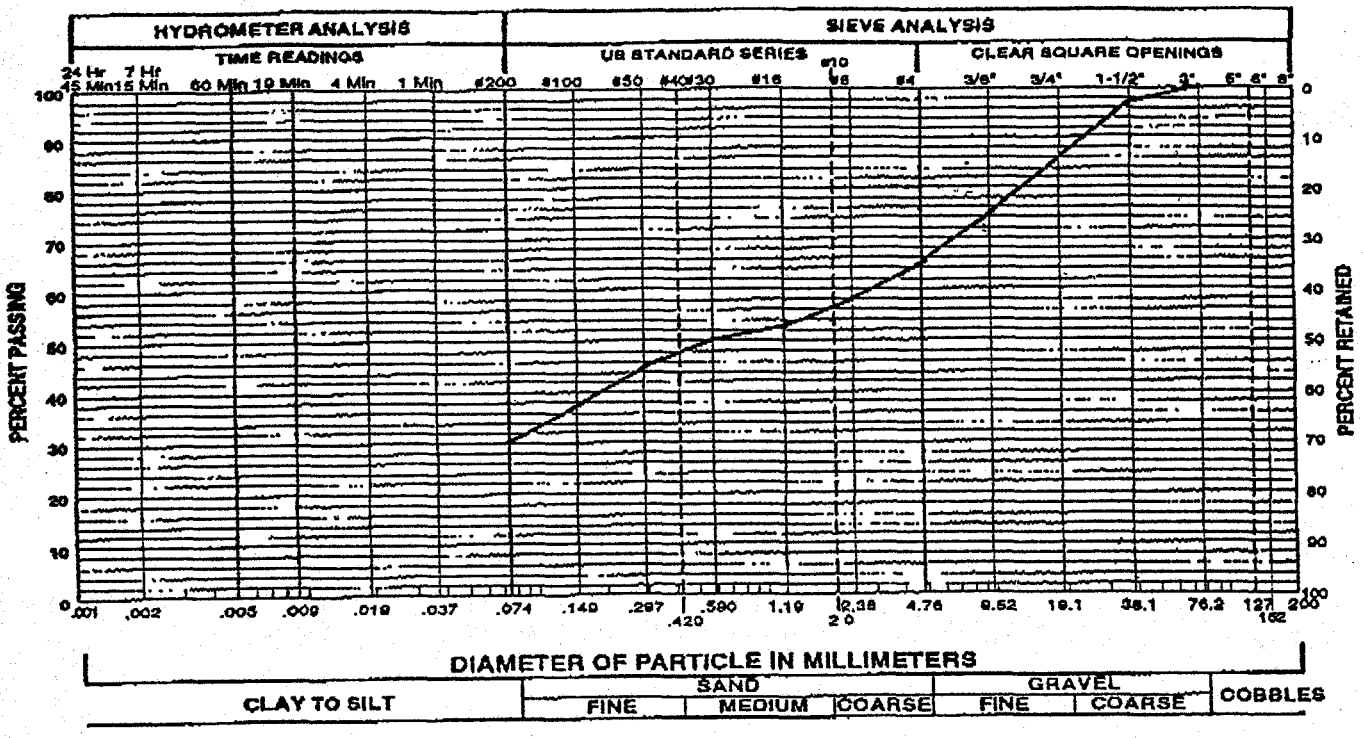
Project No. 39794 **GRADATION TEST RESULTS** Figure 2

APPENDIX 3

Geotechnical Testing Results

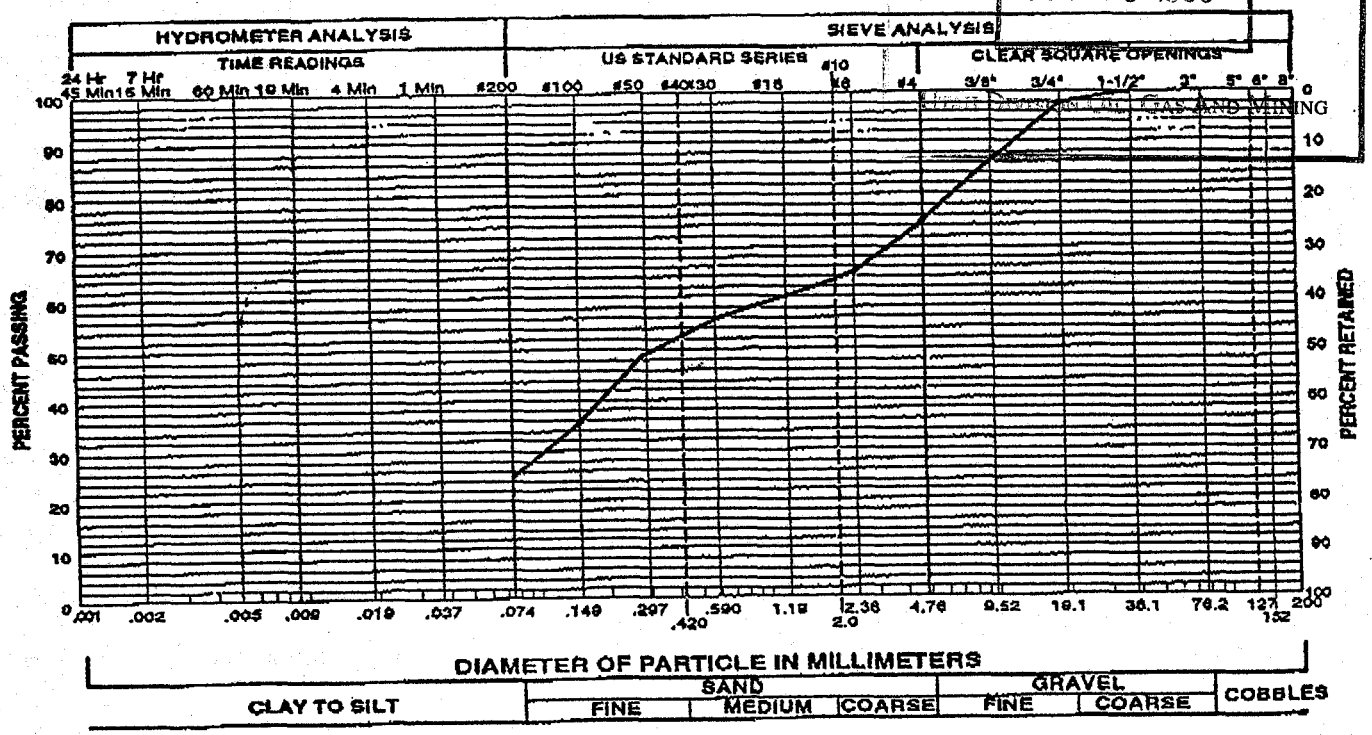
INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Applied Geotechnical Engineering Consultants, Inc.



Gravel 35 % Sand 35 % Silt and Clay 30 %
Liquid Limit ____ % Plasticity Index ____ %
Sample of Fill; Silty Clayey Sand w/Gravel From Exploration #2 @ 0-4½ feet

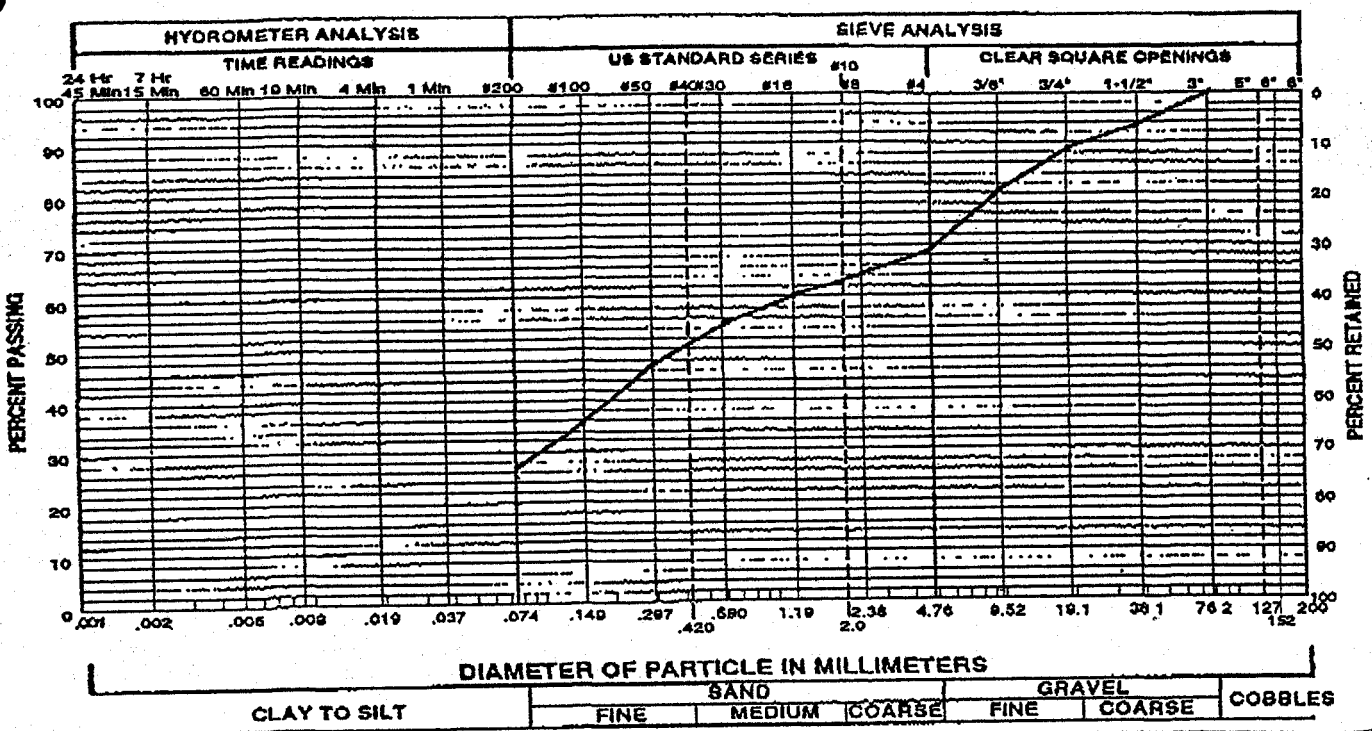
INCORPORATED
OCT 05 1995
DIVISION OF OIL, GAS AND MINING



Gravel 25 % Sand 50 % Silt and Clay 25 %
Liquid Limit ____ % Plasticity Index Non-Plastic %
Sample of Fill; Silty Sand with Gravel From Exploration #4 @ 0-4½ feet

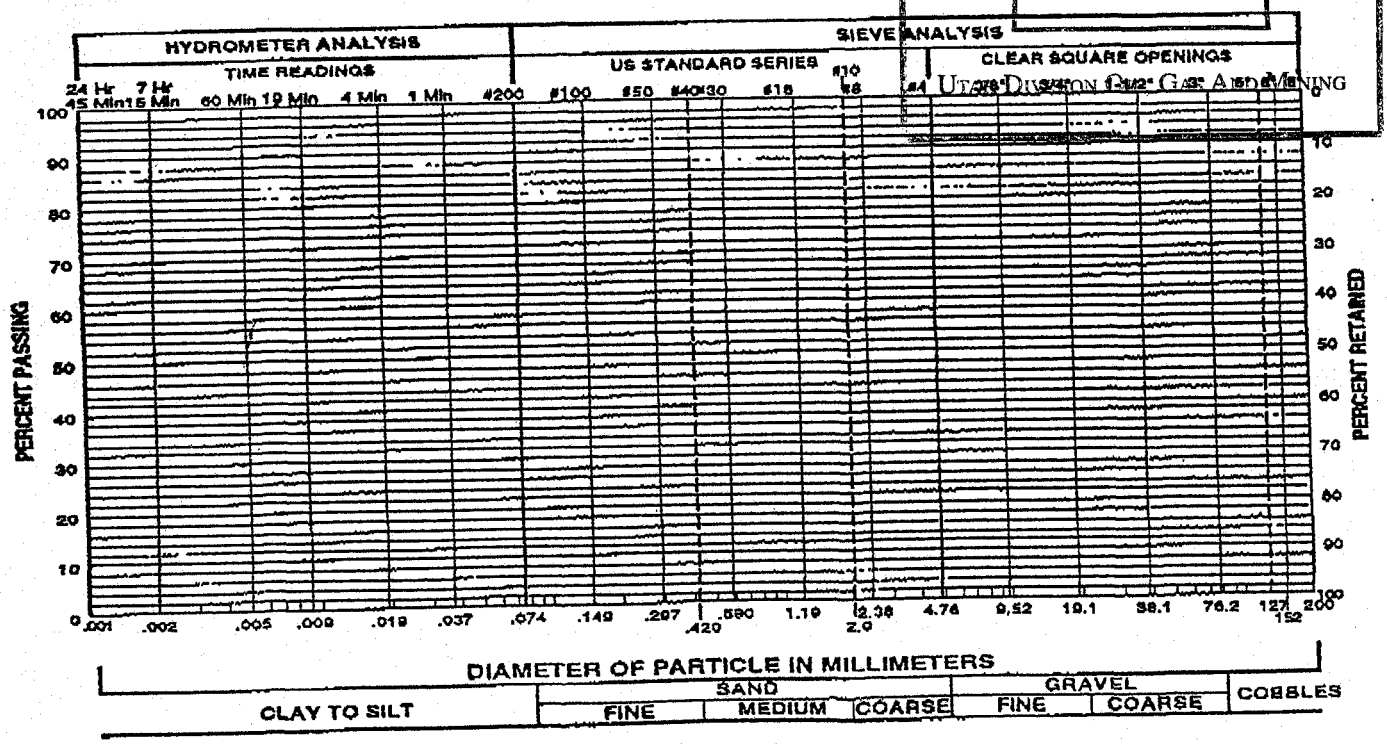
Project No. 39794 **GRADATION TEST RESULTS** Figure 3

Applied Geotechnical Engineering Consultants, Inc.



Gravel 31 % Sand 42 % Silt and Clay 27 %
Liquid Limit ____ % Plasticity Index ____ %
Sample of Fill; Clayey Sand w/Gravel (Coal) From Exploration #5 @ 0-4 feet

INCORPORATED
EFFECTIVE
OCT 05 1995
UTAH DIVISION OF OIL, GAS AND MINING



Gravel ____ % Sand ____ % Silt and Clay ____ %
Liquid Limit ____ % Plasticity Index ____ %
Sample of ____ From ____

Project No. 39794 **GRADATION TEST RESULTS** Figure 4

APPLIED GEOTECHNICAL ENGINEERING CONSULTANTS, INC.

TABLE I
SUMMARY OF LABORATORY TEST RESULTS

PROJECT NUMBER 39794

SAMPLE LOCATION		NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (PCF)	GRADATION			ATTERBERG LIMITS		UNCONFINED COMPRESSIVE STRENGTH (PSF)	WATER SOLUBLE SULFATE (ppm)	SAMPLE CLASSIFICATION
EST PIT	DEPTH (FEET)			GRAVEL (%)	SAND (%)	SILT/ CLAY (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)			
#1	0-4	7		10	50	40	23	5			Fill; Silty Clayey Sand
	4-9	4		26	41	33	25	6			Fill; Silty Clayey Sand w/Gravel
#2	0-4½	4		35	35	30					Fill; Silty Clayey Sand w/Gravel
#4	0-4½	3		25	50	25		Non-Plastic			Fill; Silty Sand w/Gravel
#5	0-4	4		31	42	27					Fill; Clayey Sand w/Gravel (Coal)

UTAH DIVISION OIL, GAS AND MINING
OCT 05 1995
INCORPORATED
EFFECTIVE:

ADDENDUM II

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

TO: J.B. KING FILE

FROM: BUZZ ~~GERICK~~ Buzz Gerick

DATE: AUGUST 17, 1994

SUBJECT: QUALITATIVE AND QUANTITATIVE ANALYSIS OF ROCK MULCH MATERIAL PROPOSED FOR J.B. KING RECLAMATION

The rock mulch (rock aggregate) that has been acquired from the Utah Department of Transportation (DOT) for the J.B. King Mine reclamation project has the following general qualitative and quantitative characteristics:

Screen Analysis: Analysis performed by American Assay Laboratories Inc. (attached)

Size Fraction	(Kg) WT.	(%) Distribution
+ 1"	5.40	33.48
<1" to > 1/2"	1.49	9.24
<1/2" to > 1/4"	1.84	11.41
<1/4"	7.39	45.87
TOTAL	16.12 kg.	100%

The minus 1/4 inch component of the above screen analysis was further analyzed by Colorado Analytical Laboratory below:

Description	%
sand	71
silt	19
clay	10
TOTAL	100

USDA Texture = > Sandy Loam

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

In addition, the following chemical analyses were conducted on this sample:

Description	Amt.
pH	8.3
EC	2.2 MMHOS/CM
Saturation	22.5% or water holding capacity
SAR	1.3

Soluble cations:

Description	(MEQ/L) Amt.
Ca	10.35
Mg	11.65
Na	4.43

Based upon the results of the preceding lab tests for the minus 1/4" inch fraction of the proposed rock aggregate, the material is not an adequate plant growth medium and therefore, WSMC cannot guarantee any sustainable vegetative cover (i.e. or vegetative performance standard).

This material can be considered as a very effective erosion prevention medium, but will not sustain any permanent vegetative cover. Therefore, WSMC cannot and will not guarantee a vegetative performance standard on any area where this gravel is used.

Original test results are attached.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

BAMBERG ASSOCIATES
Environmental Services

FACSIMILE TRANSMISSION

Date: 6-27-94 # of pages (including cover): 3

Attention: Bazz Gerick

Company: WSM

Fax #: 1-702-856-1818

From: Sam Bamberg

Project #: JB King

Message: Results of lab tests on the sand/silt fraction of the borrow materials. The main problem with the soil is that it is droughty (water holding capacity (saturation %) is low at 22.5%) and texture is mostly sand (71%). The material is a good mulch, but is not a good plant growth medium. WSM can't guarantee what plant cover will be, and cannot accept this area for perf standards on the site.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Please contact (303) 690-7402 with any problems or comments regarding this transmission

COLORADO ANALYTICAL LABORATORY

SOIL WATER ENVIRONMENTAL

LABORATORY ANALYSIS REPORT

TO: SAM BAMBERG

LAB NO: 4778

COMPANY: BAMBERG ASSOCIATES
26050 E. JAMISON CIR.
AURORA, CO 80016

DATE RCVD: 06/07/94

REPORTED: 06/22/94

PROJECT: J.B. KING MINE SITE

PARAMETER	METHOD REFERENCE	MIN. REPORTING LIMIT	UNITS
TEXTURE - HYDROMETER	ASA1 43-5	1	PERCENT*
pH-PASTE	USDA60 6(21a)	0.1	UNITS
ELECTRICAL CONDUCTIVITY-EC	USDA60 6(3a)	0.01	MMHOS/CM
SATURATION PERCENTAGE	USDA60 6(27a)	0.1	PERCENT
SOLUBLE CATIONS	USDA60 6(3a)	0.1	MEQ/L
SODIUM ADSORPTION RATIO-SAR	USDA60 6(20b)	0.1	UNITS

MMHOS/CM = MILLIMHOS PER CENTIMETER
MEQ/L = MILLEQUIVALENTS PER LITER

ASA1 = "METHODS OF SOIL ANALYSIS, PART 1"; ASA NO. 9; AMERICAN SOCIETY OF AGRONOMY; 2ND EDITION, 1965; C.A. BLACK
USDA60 = "DIAGNOSIS & IMPROVEMENT OF SALINE & ALKALI SOILS"; USDA HANDBOOK 60; UNITED STATES SALINITY LABORATORY STAFF; 2ND EDITION, 1969; L.A. RICHARDS

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

ANALYSIS SUPERVISED BY

DATA APPROVED FOR RELEASE BY

240 S. Main Street • Brighton, Colorado 80601 • (303) 659-2313

COLORADO ANALYTICAL LABORATORY
SOIL WATER ENVIRONMENTAL

BAMBERG ASSOCIATES
SAM BAMBERG
06/22/94 PROJECT: J.B. KING MINE SITE
PAGE 2 OF 2

	J.B. KING BORROW MATERIAL
SAND (%)	71
SILT (%)	19
CLAY (%)	10
USDA TEXTURE	Sandy Loam
pH (UNITS)	8.3
EC (MMHOS/CM)	2.2
SATURATION (%)	22.5
SOLUBLE CATIONS:	
Ca (MEQ/L)	10.35
Mg (MEQ/L)	11.65
Na (MEQ/L)	4.43
SAR (UNITS)	1.3

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

240 S. Main Street • Brighton, Colorado 80601 • (303) 659-2313
Mailing Address: P.O. Drawer 507, Brighton, CO 80601

RECEIVED MAY 2 3 1994

American Assay Laboratories Inc.

Sparks Office
1500 Glendale Ave.
Nevada 89431
Box 71060
Reno, NV 89570
Telephone
(702) 356-0606
Fax
(702) 356-1413

Elko Office
2320 Last Chance Rd.
Nevada 89801
Box 2908
Elko, NV 89801
Telephone
(702) 738-9100
Fax
(702) 738-2594

REPORT OF ANALYSIS

Client:	WESTERN STATES MINERAL CORP.
	Mr. Buzz Gerick
AAL Ref:	SP029201
Report Date:	5-23-94
Samples received by:	Joe Young
Date Received:	5-20-94
Time Received:	10:30 am
Purchase Order Number:	02-13097
Samples Received:	1 Soil sample for screen analysis

Samples Labeled:
Soil and Rock

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

CLIENT: WESTERN STATES MINERAL
AAL REFERENCE: SP029201
ATTN: BUZZ GERICK

RECEIVED MAY 2 3 1994

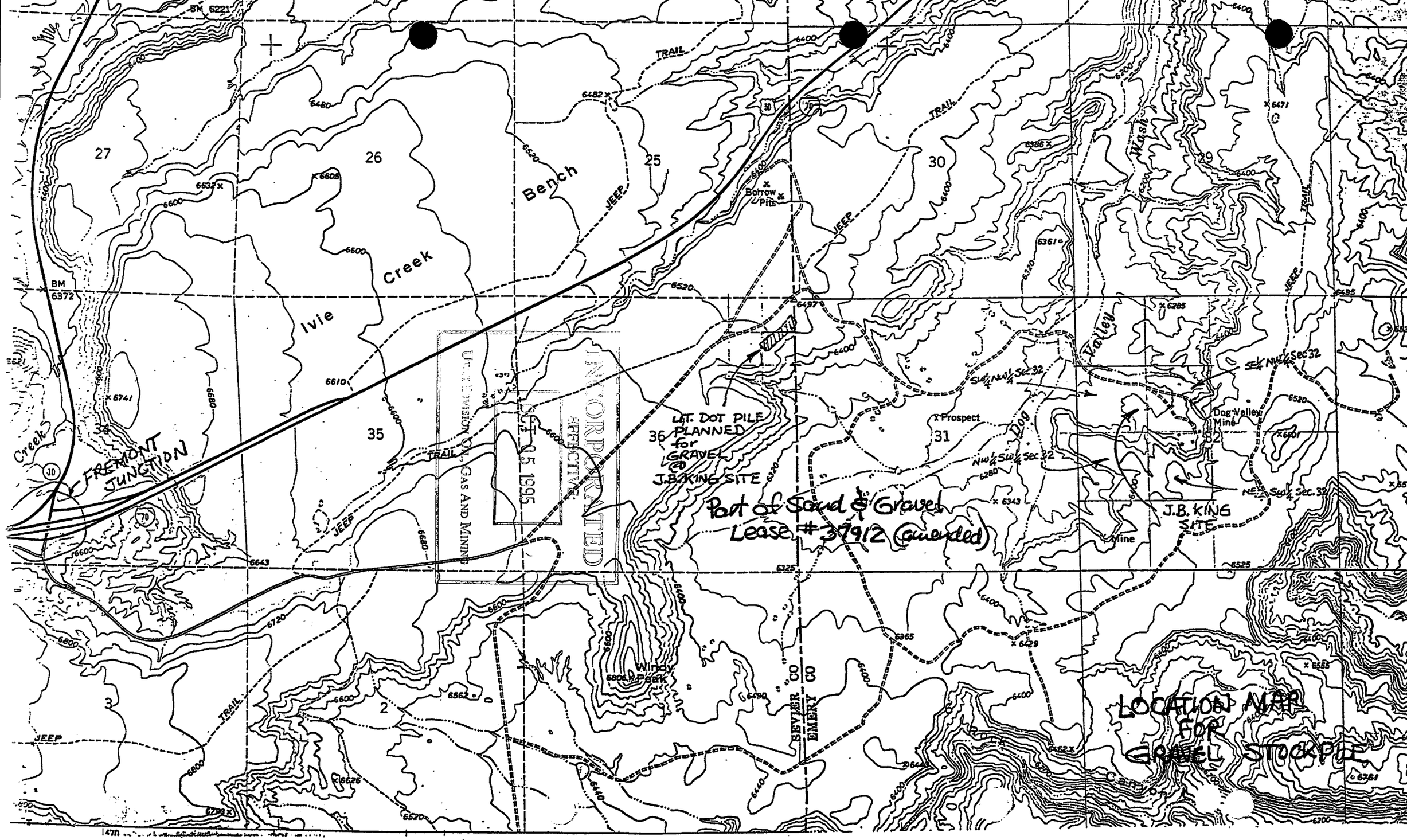
TOTAL SAMPLE WEIGHT: 16.12 Kilograms

SCREEN FRACTION	WEIGHT (Kg)	DISTRIBUTION Percent (%)
+1"	5.40	33.48
<1" TO >1/2"	1.49	9.24
<1/2" TO >1/4"	1.84	11.41
<1/4" TO >1/16"	2.62	16.24
<1/16" TO >35 M	1.74	10.79
<35 M TO >48 M	0.81	5.02
<48 M TO >65 M	0.60	3.71
<65 M TO >100 M	0.65	4.03
<100 M TO >200 M	0.76	4.71
Minus 200 meah	0.22	1.36
TOTAL WEIGHT	16.13 Kg	99.99%

Joe Young
Metallurgist

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

American Assay


LOCATION MAP FOR GRAVEL STOCKPILE
Part of Sand & Gravel Lease # 37912 (amended)
LT. DOT PILE PLANNED for GRAVEL @ J.B. KING SITE
J.B. KING SITE
Dog Valley Mine
Prospect
Mine
Borrow Pits
Windy Peak
Ivie Creek
Bench
Dog Valley Wash
FREMONT JUNCTION
Creek
TRAIL
JEEP
SEVIER CO
EMERY CO
BM 6221
BM 6372
27
26
25
30
29
34
35
36
31
32
3
2
UTAH DIVISION OF OIL, GAS AND MINING
INCORPORATED
OCT 05 1995
SEC.
TWP.
RGE.
SE¼ NW¼ Sec 32
SW¼ NW¼ Sec 32
NW¼ SW¼ Sec 32
NE¼ SW¼ Sec. 32

UMC 817.25 - TOPSOIL: NUTRIENTS AND SOIL AMENDMENTS

Biosolids received from the Price River Water Improvement District (PRWID) in Price, UT. were applied as a soil amendment to those areas shown on Drawing JBK-3 (AS BUILT). The application rate was approximately 24 tons per acre (dry weight). The analyses of the Biosolids applied are attached to this section of the Addendum.

Approval for this application is discussed in section UMC 782.19 of this Permit. No other soil nutrients were added.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

RECEIVED SEP 2 9 1994

CHEMTECH/FORD

ANALYTICAL LABORATORIES

DATE: 09/19/94

WESTERN STATES MIN.
% E.M. GERICK
250 S ROCK BLVD #130
RENO, NV 89502

94-082070

SAMPLE: SLUDGE SAMPLE FROM PRICE RIVER WATER IMP. DISTRICT
RECEIVED 8-23-94 FOR ANALYSIS.

	Results	Method Detection Limit
- DRY WEIGHT BASIS		
Arsenic As mg/kg EPA 6010	.686	.0100
Cadmium Cd mg/kg EPA 6010	5.9	1.0
Chromium Cr mg/kg EPA 6010	45.5	1.0
Copper Cu mg/kg EPA 6010	382	1.00
E. Coli/gram FDA BAM	27400	
Lead Pb mg/kg EPA 6010	107	2.000
Mercury Hg mg/kg EPA 7471	3.81	.20
Molybdenum Mo mg/kg EPA 6010	3.4	1.0
Nickel Ni mg/kg EPA 6010	26.4	1.00
Salmonella/Gram(dry wt basis)	<2	
Selenium Se mg/kg EPA 6010	9.83	1.000
Zinc Zn mg/kg EPA 6010	1070	1.0
Nitrate NO3N mg/kg SM4500NO3	212	1
Nitrite NO2-N mg/kg EPA 354.1	9.04	
Tot.Kjel.Nit. mg/kg EPA 351.4	15300	

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

CHEMTECH/FORD

ANALYTICAL LABORATORIES

94-082070

	Results	Method Detection Limit
Total Solids % SM 2540 G	87.5	.05

FORD ANALYTICAL LABORATORIES

* ND - None Detected Above Specified Detection Limit *

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

FORD • 40 West Louise Avenue • Salt Lake City, Utah 84115 • (801) 466-8761 • Fax (801) 466-8763

CHEMTECH/FORD

ANALYTICAL LABORATORIES

September 27, 1994

Western States Mineral
250 So. Rock Blvd. #130
Reno, NV 89502

94-082070A

attn: E.M. Gerick

SAMPLE: Sludge sample from Price River Water Imp. District received 8-23-94 for Organic Carbon analysis

	RESULTS
Organic Carbon Method 9060	19.5 +/- 4.7 %

Joe Workman

FORD LABORATORIES, INC.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

FORD • 40 West Louise Avenue • Salt Lake City, Utah 84115 • (801) 466-8761 • Fax (801) 466-8763
CHEMTECH • 6100 South Stratler • Murray, Utah 84107 • (801) 262-7299 • Fax (801) 262-7378

RECEIVED SEP 1 9 1994

PRICE RIVER WATER
IMPROVEMENT DISTRICT
P.O. Box 903
265 South Fairgrounds Road
Price, Utah 84501
Telephone (801) 637-6350
FAX (801) 637-6374

September 15, 1994

E.M. (Buzz) Gerick, V.P. Operations
Western States Minerals Corp.
250 South Rock Blvd., Suite 130
Reno, Nevada 89502

RE: VAR Volatile Solids testing

Dear Buzz,

Following is the information pertaining to the Volatile Solids reduction for our sludge to satisfy the Vector Attraction Reduction requirements for the State. The minimum is 38% reduction.

Sample Date	Sample Location	Raw Sludge % Vol.	Dig. Sludge % Vol.
Dec. 30, 93	No. Dig. Ovrflo	91%	47%
Mar. 28, 94	No. Dig. Ovrflo	89%	47%
May 30, 94	No. Dig. Ovrflo	92%	46%
Sep. 14, 94	No. Dig. Ovrflo	89%	48%

This information is the most current which we possess. Contact me if there is something more required.

Sincerely,

Jeffrey R. Richens, Superintendent
P.R.W.I.D. Wastewater Treatment Plant

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

CLEAN WATER

PRICE RIVER WATER
IMPROVEMENT DISTRICT
PRWID
P.O. Box 903
265 South Fairgrounds Road
Price, Utah 84501
Telephone (801) 637-6350
FAX (801) 637-6374

September 9, 1994

E.M. (Buzz) Gerick, V.P. Operations
Western States Minerals Corporation
250 South Rock Blvd., Suite 130
Reno, Nevada 89502

RE: Beneficial use of Municipal Sludge from Price River Water

Dear Buzz,

In response to your letter dated Sept. 8, the Price River Water Improvement District treats its sewage sludge by anaerobic process which involves an average detention time of 60 days at a constant temperature of 96 degrees F. (36 degrees C.). I am quite certain that this along with our storage lagoon detention time more than meets the regulations.

As for Vector Attraction Reduction, our process lowers the volatile content well below the 38% level and since we ship it at over 75% solids before mixing on your ground, then the VAR standard is met.

The District does require your company to guarantee no public access to the application site for the period of at least one year to prevent any possibility of violation of the regulations. This would include all livestock also.

If you require further assistance or actual log records, let me know. This may become a ponderous thing to do, but we can if the State deems necessary. Thank you.

Sincerely,

Jeffrey R. Richens, Superintendent
P.R.W.I.D. Wastewater Treatment Plant

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

CLEAN WATER

RICHARDS LABORATORIES INC
RICHARDS INDUSTRIAL MICROBIOLOGY LABORATORY • 55 East Center • Pleasant Grove, Utah 84062 • (801) 785-2500 • Salt Lake: (801) 355-5579 • Watts: (800) 453-1210

Result Report

June 22, 1994

CUSTOMER NAME:
Price River WID
P.O. Box 903
Price, UT 84501

PHONE: 637-8547

SAMPLE DESCRIPTION:
Plant wastewater collected by Ron, 5/31/94.

Sample Source	Test Performed	Log Number	Test Results	Lab Tech	Date Comp
Effluent	Oil & Grease (EPA 413.1)	8256	<1.0 mg/L	L.R.	6/7
	TTO (EPA 8240)	8255	*	CT	6/6
North Digestor	Arsenic (EPA 206.5 modified)	8254	3.74 mg/kg dry	P.M.	6/17
	Cadmium (EPA 213.1/213.2)	8254	23.35 mg/kg dry	P.M.	6/15
	Chromium (EPA 218.1/218.2)	8254	Nd <78 mg/kg dry	P.M.	6/15
	Copper (EPA 220.1)	8254	269.82 mg/kg dry	P.M.	6/15
	Mercury (EPA 245.1)	8254	6.50 mg/kg dry	P.M.	6/2
	Molybdenum (EPA 246.1/246.2)	8254	37.36 mg/kg dry	P.M.	6/20
	Nickel (EPA 249.1/249.2)	8254	Nd <119 mg/kg dry	P.M.	6/15
	Lead (EPA 239.1/239.2)	8254	54.48 mg/kg dry	P.M.	6/15
	Selenium (EPA 206.5 modified)	8254	7.78 mg/kg dry	P.M.	6/17
	Zinc (EPA 289.1)	8254	983.29 mg/kg dry	P.M.	6/15

* See attached

INCORPORATED
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Lee Rawlings

Analyst: Lee Rawlings, Chemist
Richards Industrial Microbiology Laboratories, Inc.

FORD ANALYTICAL LABORATORIES

CHEMICAL AND BACTERIOLOGICAL ANALYSIS

DATE: 04/12/94 CERTIFICATE OF ANALYSIS

PRICE RIVER WATER
ATTN: RON PIERCE
P.O. BOX 903
PRICE, UTAH 84501

94-032470

SAMPLE: SLUDGE SAMPLE #1 NORTH DIGESTOR COLLECTED 3-31-94, 14:00
RECEIVED 4-1-94 FOR ANALYSIS.

	Results	Method Detection Limit
DRY WEIGHT BASIS		
Arsenic As mg/kg EPA 6010	7.1	1.00
Cadmium Cd mg/kg EPA 6010	9	1.0
Chromium Cr mg/kg EPA 6010	303	1.0
Copper Cu mg/kg EPA 6010	25.1	1.00
Lead Pb mg/kg EPA 6010	52.6	1.00
Mercury Hg mg/kg EPA 7471	ND	9.0
Molybdenum Mo mg/kg EPA 6010	1	1.0
Nickel Ni mg/kg EPA 6010	17.6	1.00
Selenium Se mg/kg EPA 6010	4.4	1.000
Total Solids % EPA 160.3	1.53	.05
Zinc Zn mg/kg EPA 6010	832	1.0
Temp. deg C at Receipt	20	
pH at Receipt	7	

Gale Workman
FORD ANALYTICAL LABORATORIES

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

* ND - None Detected Above Specified Detection Limit *
Analysis performed by Chemtech.

All reports are submitted as the confidential property of clients. Authorization for publication of our reports, conclusions, or extracts from or regarding them, is reserved pending our written approval as a mutual protection to clients, the public and ourselves.

50 West Louise Avenue • Salt Lake City, Utah 84115 • PHONE (801) 466-8761 • FAX (801) 466-8763

FORD ANALYTICAL LABORATORIES

CHEMICAL AND BACTERIOLOGICAL ANALYSIS

DATE: 02/07/94 CERTIFICATE OF ANALYSIS

PRICE RIVER WATER
ATTN: RON PIERCE
P.O. BOX 903
PRICE, UTAH 84501

94-010030

SAMPLE: SLUDGE SAMPLE COLLECTED 12-30-93, 7:35 A.M. BY RON PIERCE
RECEIVED 1-3-94 FOR ANALYSIS.
SLUDGE NORTH DIGESTOR

	Results	Method Detection Limit
DRY WEIGHT BASIS		
Arsenic As mg/kg EPA 6010	ND	5.00
Cadmium Cd mg/kg EPA 6010	6.05	.20
Chromium Cr mg/kg EPA 6010	33.5	.50
Copper Cu mg/kg EPA 7210	413	1.5
Lead Pb mg/kg EPA 6010	82.3	5.0
Mercury Hg mg/kg EPA 245.1	.31	.0005
Molybdenum Mo mg/kg EPA 7480	ND	5.0
Nickel Ni mg/kg EPA 7520	24	1.5
Selenium Se mg/kg EPA 6010	17.6	5.00
Total Solids % SM 2540 G	.84	.05
Zinc Zn mg/kg EPA 7950	1180	5.0

Joel Workman
FORD ANALYTICAL LABORATORIES

* ND - INDICATES NONE DETECTED *
** < - INDICATES THE SMALLEST QUANTITY DETECTABLE DUE TO REQUIRED DILUTION
Mercury analysis performed by Chemtech.

RECEIVED
OCT 05 1995
DIVISION OF OIL, GAS AND MINING

All reports are submitted as the confidential property of clients. Authorization for publication of our reports, conclusions, or, extracts from or regarding them is reserved pending our written approval as a mutual protection to clients, the public and ourselves.

50 West Louise Avenue • Salt Lake City, Utah 84115 • PHONE (801) 466-8761 • FAX (801) 466-8763

UMC 817.42 - HYDROLOGIC BALANCE: WATER QUALITY STANDARDS AND EFFLUENT LIMITATIONS

Section UMC 784.15 discusses arrangements with the current landowner of the J.B. King reclaimed mine site (State of Utah- Trust Lands Administration) to leave the existing sediment impoundment facility during the post reclamation phase.

INCORPORATED
EFFECTIVE:
OCT 05 1995
11/94
UTAH DIVISION OIL, GAS AND MINING

UMC 817.44 - HYDROLOGIC BALANCE: STREAM CHANNEL DIVERSIONS

The Feeder Ditch and Main Feeder Ditch have been redesigned to match naturally occurring, undisturbed drainages that are adjacent to the J.B. King reclaimed mine site. The previous design proved to be inadequate as evidenced by repeated failures, that resulted in the ditch flows escaping the containment channel. In reference to the Utah Coal Mining Regulations R645-301-742.333, the design capacity for permanent diversions is that they must be adequate to pass safely the peak runoff of a 10 year, 6 hour precipitation event. The design consultant, with agreement from the Division and WSMC, has used the 100 year, 6 hour storm event for the channel design. According to the calculations attached from the consultant, a channel dimension of a minimum 3 feet deep and 3 feet wide will provide flow capacity in excess of the design 100 year, 6 hour storm event requirement.

According to Utah Coal Mining Regulation R645-301-742.313 *"....A permanent diversion or a stream channel reclaimed after the removal of a temporary diversion will be designed and constructed so as to restore or approximate the premining characteristics of the original stream channel including the natural riparian vegetation to promote the recovery and the enhancement of the aquatic habitat."* Therefore, the premining characteristics of the J.B. King stream channels can be approximated through comparisons to the adjacent natural channels located on undisturbed land.

Characteristics of Adjacent Channels:

Adjacent drainages to the J.B. King site are shown on Figure JBK-5.

South Drainage: Located approximately 4000 feet southwest of the J.B. King site in Section 31.

The channel is highly incised just below the sandstone cliffs with channel depths of about 14 feet and near vertical side slopes. About 850 feet downstream from where sandstone ledge rock dominates the channel, the channel disperses into an alluvial outwash area. Most of the channel below the sandstone ledges is eroded into past alluvial deposits. Cross section characteristics were examined at 12 locations starting at the downstream end of the channel (see the following table). Average channel characteristics for the four upper most cross sections (#9,10,11, & 12) are: top width 21 feet, bottom width 19 feet, and channel depth 12 feet. Channel side slopes are near vertical (about 1 horizontal to 12 vertical). The maximum identified channel meander limit is 85 feet.

North Drainage: Located about 4500 feet north of the J.B. King mine site in Section 29. The Dog Valley channel upstream from the confluence is incised with steep vegetated banks. Sediment deposition has occurred at the confluence of the north drainage with Dog Valley channel. At the confluence the north drainage is about 8' deep and 11' wide with steep banks. Meander limit of the north drainage appears to be about 48'.

Adjacent Channel: Located just north of the J.B. King mine site . This channel has an average channel slope of 5% which consists of reaches of about 2% slope interspersed with drops formed at sandstone ledges. This channel is likely the most similar to the premining channel through J.B. King mine site. The drainage area is very similar to the total area tributary to the main J.B. King channel (less than 5% difference in tributary area). The measured channel width varied from about 2.5 feet wide in the upper reach to about 4 feet below the confluence with the side tributary (see Figure JBK-5). Channel depth varied from 2 feet in the upper reach to over 7 feet below the confluence with the side tributary. The channel side slopes varied from ~~near vertical in the upper reach to about 0.~~7 horizontal to 1 vertical just below the confluence with the side tributary (top width varied from about 3 feet to about 14 feet).

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Side Tributary Channel: This channel is tributary to the above described Adjacent Channel from the north (see Figure JBK-5). The Side Tributary Channel has a small tributary area (about 5 acres). The channel appears to be actively cutting just above the confluence with the Adjacent Channel. Channel slope varies from about 7% just above the confluence with the Adjacent Channel to 5% in upper reaches. The channel is very narrow and incised. Channel depth varies from the same as the Adjacent Channel at the confluence (about 7 feet) to less than a foot in upper reaches. Bottom width varies from about 0.8 feet to 1.2 feet with near vertical side slopes.

Proposed Channel Design and Analysis

The natural landscape is erosional, and therefore natural channels in the vicinity have the following characteristics: 1) concave slope, 2) lower channel reaches are depositional and channels tend to be less defined (characteristic of alluvial outwash plains), 3) channel depths generally increase and widths generally decrease as the upstream sandstone ledge rock is approached, 4) non-disturbed channels tend to have steep side slopes, and 5) upstream channel gradients are controlled by sandstone blocks and ledges. Natural channels in the vicinity are very poorly vegetated with a vegetation cover of less than 5%.

Bottom Width. A comparison of channel bottom width versus tributary area is presented on Figure JBK-6. Projecting a channel bottom width for the tributary area associated with the J.B. King Mine main channel on figure JBK-6 indicates a bottom width of about 5 feet would be appropriate. However, design capacity requires a 3 ft. width minimum, but the actual will be determined in the field.

Depth. Comparing channel depths of adjacent streams and the stream profiles of adjacent streams suggests that an appropriate channel depth is about 10 feet. Again, the design capacity requires a 3 ft. depth minimum, but the actual will be determined in the field.

Top Width. Side slopes of adjacent undisturbed channels vary between nearly vertical to near 1 horizontal to 1 vertical with top widths just slightly larger than bottom widths. Channel side slopes through the J.B. King mine site will be chosen from the slopes of adjacent undisturbed channels and during the actual field excavation determination.

Meander Width. The natural channels in adjacent drainages are free to wander and show evidence of active meandering. Through time the J.B. King reclaimed channels can also be expected to wander. Adjacent stream channels have measured meander widths of 85 feet and 48 feet (from the south and north drainages respectively). Many factors influence the meander width, however, if a meander width equal to the larger south drainage (about 85 feet) is provided, this should be adequate. A recommended meander limit of 100 feet (50 feet each side of the channel center line) is shown on Drawing JBK-7 & JBK-3. On Drawing JBK-3 AS BUILT, the meander limit is identified as the lateral performance boundary. The channel meander limits were being checked during the test drilling phase to assess the potential for exposing coal refuse. Any significant amounts of material found to be toxic or acid forming during the excavation phase will be handled appropriately.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Channel Hydraulics and Drawings

Calculated runoff flows were used to design plunge pools and to check the capacity of proposed channels. Plunge pools were designed using the methodology described by V.T. Chow in "Open Channel Hydraulics." Details are contained in Appendix 2. It is proposed that two plunge pools be constructed, one at the head of the main feeder ditch and the other at the head of the feeder ditch as shown on Drawing JBK-7. Channels will be excavated to the approximate lines and grades shown on Drawing JBK-9. The final depths of the channel excavations will be based on actual conditions such as the presence of any rockledges and the depth to shale. The designs shown herein are based on estimates and the "as built" channels may differ from these designs as required by field conditions. The channels will be constructed approximately to the alignments and profiles shown in the designs.

The south side feeder ditch (Ditch 1 - See Drawing JBK-7) has capacity well in excess of the design flow (30.5 cubic feet per second). The main feeder ditch (Ditch 2) has capacity well in excess of the design flow (15.9 cubic feet per second). The confluence of ditches 1 and 2 and has capacity well in excess of the design flow (51.5 cubic feet per second. Calculations of channel capacities are based on Manning's Equation (see computations of Addendum I) and details shown on Drawings JBK-7, JBK-8, and JBK-9. Feeder ditch #3 was designed to accept the runoff from off-site drainage area #7 and was likewise conservatively designed to handle flows well in excess of the design storm event (5.28 cubic feet per second). Computations for this design are located under Addendum II.

Monitoring of Channel Performance

Channel performance is defined as acceptable if channels keep within the meander limits shown on Drawing JBK-7 (or more specifically, the lateral performance boundary shown on Drawing # JBK-3 (AS BUILT) and within the stable profile limits shown on Drawing JBK-9.

The following documents are attached as backup for the design:

1. Figure-4 : Drainage Basins
2. Figure-5 : J.B. King Mine & Adjacent Drainages
3. Figure-6 : Tributary Area vs. Channel Bottom Width
4. Figure-7 : Proposed Reclamation Channel Reconstruction-Plan View
5. Figure-8 : Proposed Reclamation Channel Reconstruction-Typical Sections & Details
6. Figure-9 : Proposed Reclamation Channel Reconstruction-Profile
7. Appendix 1 : Runoff Calculations
8. Appendix 2 : Plunge Pool Design
9. Appendix 3 : Ditch Design

As-built drawings of the actual field construction are included in this submittal as Drawing JBK-3 (AS BUILT) and channel Cross-sections A-A' through D-D', inclusive.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

ADDENDUM I

HA & L- February 1994
Drainage Area Collection
&
Channel Design

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

N

CUT OFF DITCH

APPROXIMATE LOCATION - TEMPORARY ACCESS ROAD

AREA 6 AKA: DOG VALLEY MINE

AREA 4

APPROXIMATE LOCATION - TEMPORARY HAUL ROAD

32

AREA 3

AREA 2

AREA 1

AREA 5

DROP POOLS

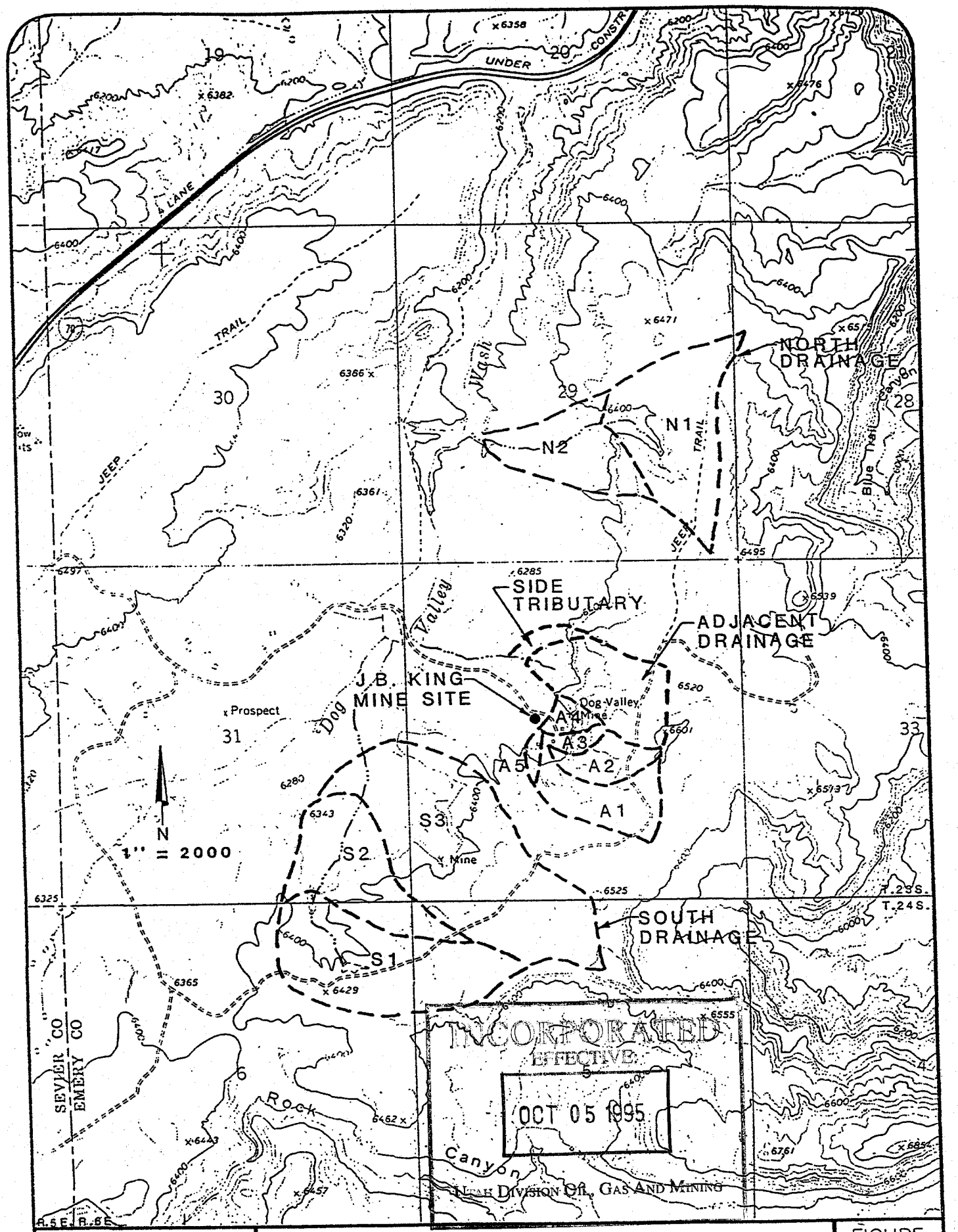
6520 6275 6450 6475 6500 6350 6375 6330 6535 6550 6560 6601 6600 6320 6360 6400 6440 6480

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC. CONSULTANTS ENGINEERS Salt Lake City	DESIGNED	3			SCALE 1" = 600'	WESTERN STATES MINERAL CORPORATION J.B. KING MINE	DRAINAGE BASINS	FIGURE NO. JBK-4
	DRAFTED	2						
	CHECKED	1						
	DATE SEPT 1991	NO.	DATE	REVISIONS	BY	APVD.		

VERIFY SCALE 0" 1/2" BAR IS ONE HALF INCH ON ORIGINAL DRAWING. IF NOT ONE HALF INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

ORIGIN: DWGN. XREF: NAME: PLOT OPTIONS: PLOT IN = DWG UNITS: PLOT AREA: FILE DATE FILE NAME



HANSEN ALLEN & LUCE INC.

J.B. KING MINE & ADJACENT DRAINAGES

FIGURE JBK-5

SOUTH DRAINAGE CHANNEL (SEC. 31)
CROSS SECTION DATA

X-SEC #	Bottom Width (ft)	Channel Depth (ft)	Channel Top Width (ft)	Width of Channel Meander (ft)	Comment
1	10	3.5	25	60	near downstream end of channel
2	25	2.4	34	60	channel side banks impacted by cattle
3	27	3.8	33	61	channel slope about 1.5%
4	16	5.9	24	85	
5	44	5.5	61	85	confluence with side channel, side channel length about 25'
6	19	6	32		
7	20	6.5	29		channel slope about 2.1%, confluence of side channel with side channel length of about 52'
8	21		22		straight channel reach
9	22	9	25		
10	12	11.8	15		
11	24	12	25		channel slope about 2.5%
12	18	14.5	20	85	100' upstream from this section the channel becomes controlled by sandstone blocks which have fallen into channel.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

TRIBUTARY AREA VS CHANNEL BOTTOM WIDTH

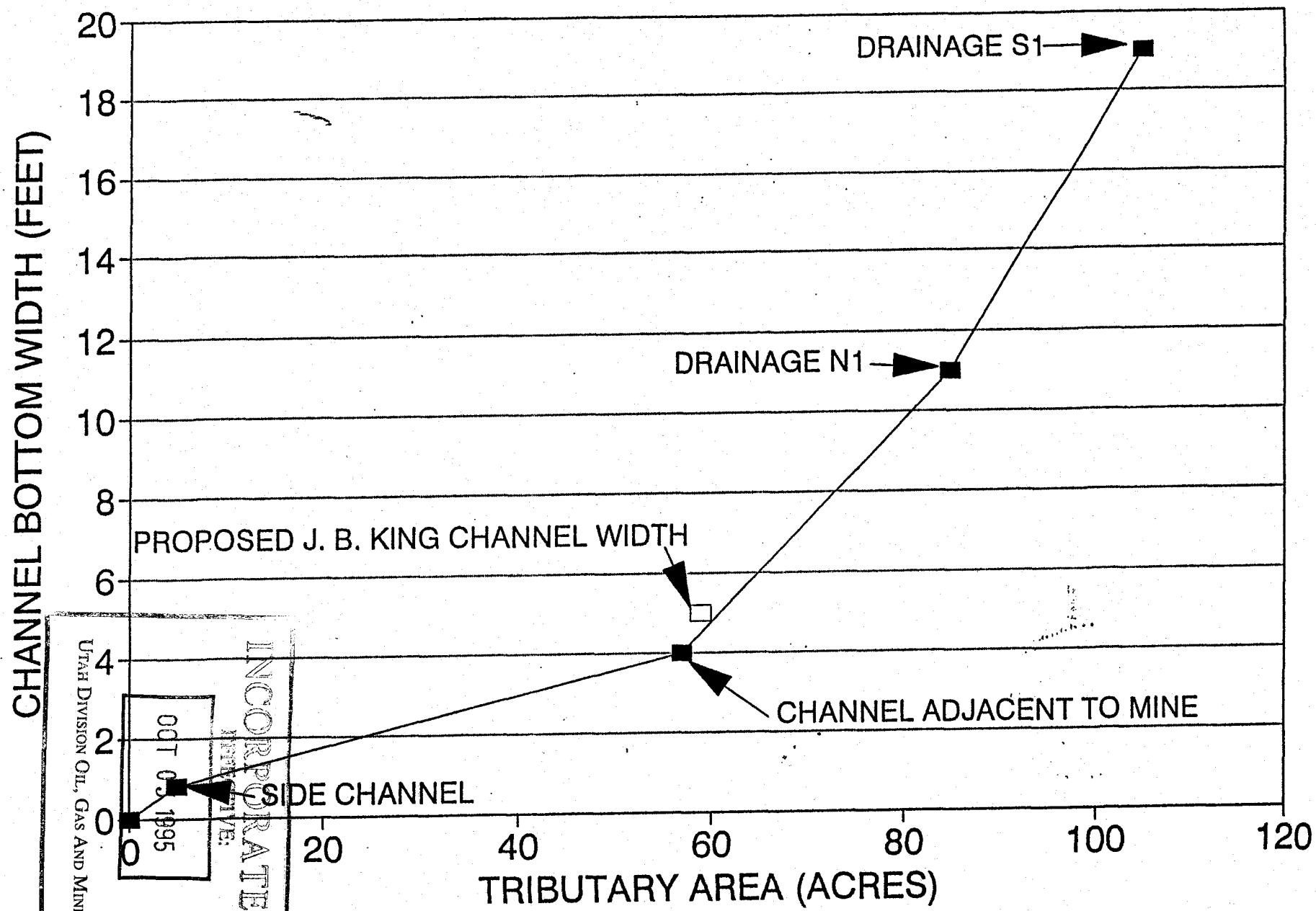
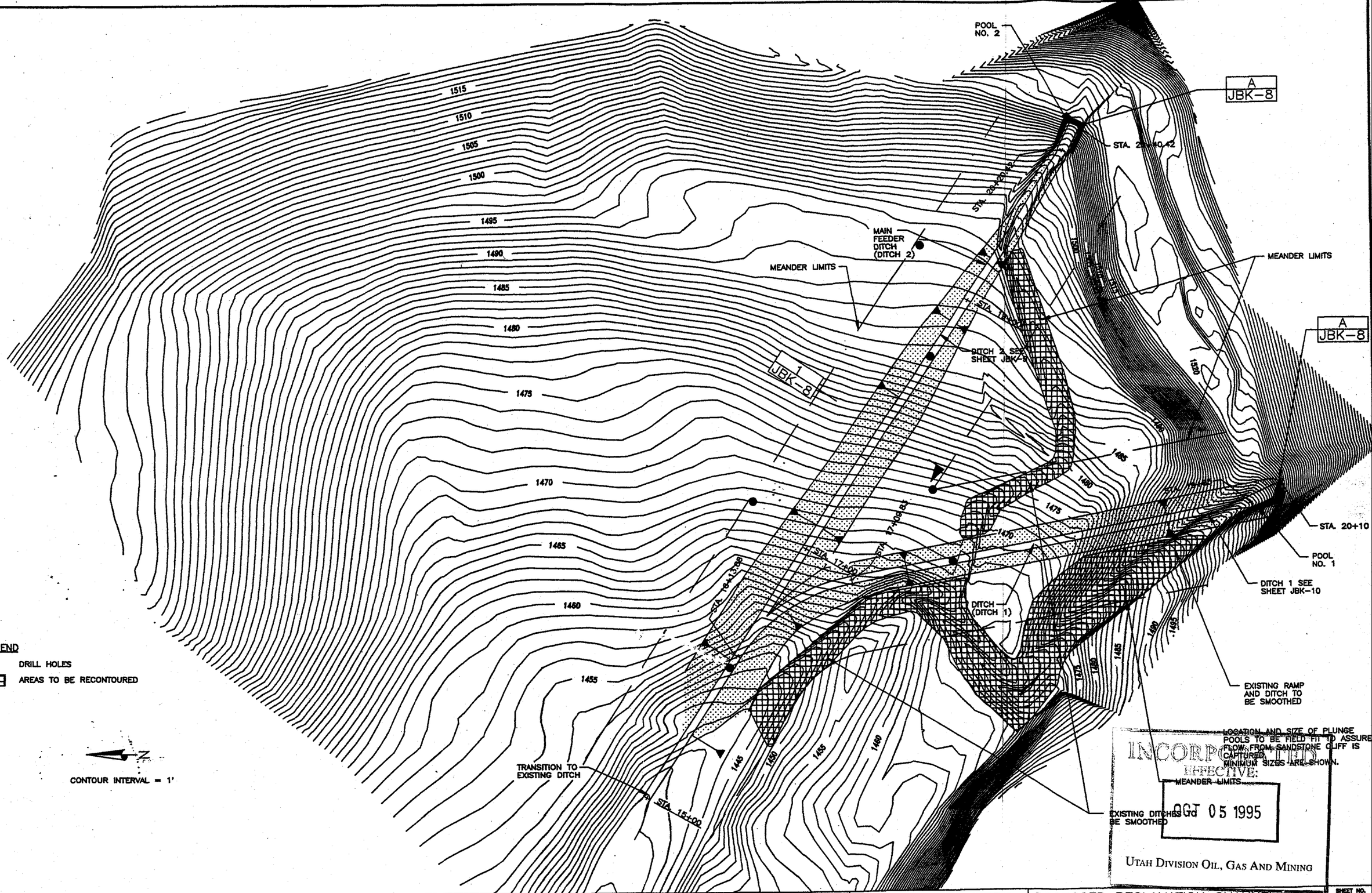


FIGURE JBK-6

INCORPORATED
EFFECTIVE:
OCT 03 1995
UTAH DIVISION OIL, GAS AND MINING



INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

FILE NAME \102\02-100\KINGMINE FILE DATE SEPT 22, 1994 PLOT OPTIONS PLOT IN = DWG. UNITS. 1=30 PLOT AREA: 33,32.5 DRAWN: DWG#: XREF FILE NAME(S)

HANSEN ALLEN & LUCE INC.
CONSULTANTS ENGINEERS
Salt Lake City Utah

PROJECT ENGINEER

DESIGNED	KCS	3				
DRAFTED	RSE	2	11/94	REMOVED TOE DITCH AND MODIFIED LANGUAGE	EMG	
CHECKED	GJP	1	9/22/94	ADDED REFERENCE TO DITCH PROFILES	RGA	GJP
DATE	FEB. 1994	NO.	DATE	REVISIONS	BY	APVD.

SCALE 1" = 60'

VERIFY SCALE 0" 1/2" BAR IS ONE HALF INCH ON ORIGINAL DRAWING IF NOT ONE INCH, ADJUST SCALES ACCORDINGLY.

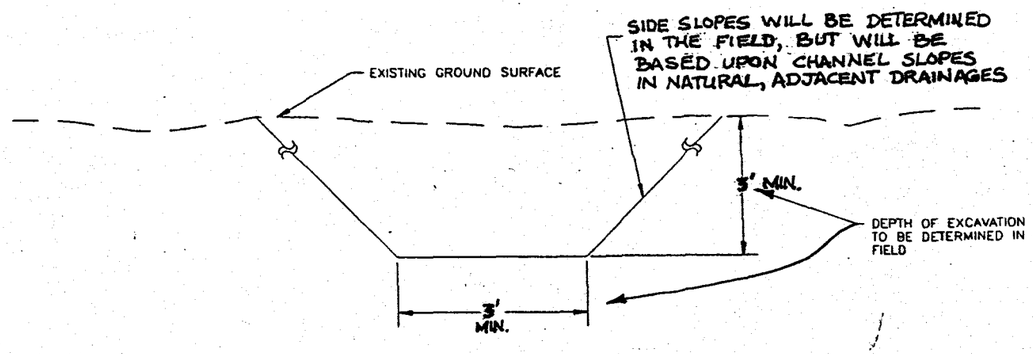
WESTERN STATES MINERAL CORPORATION
J.B. KING MINE

PROPOSED RECLAMATION CHANNEL RECONSTRUCTION
PLAN VIEW

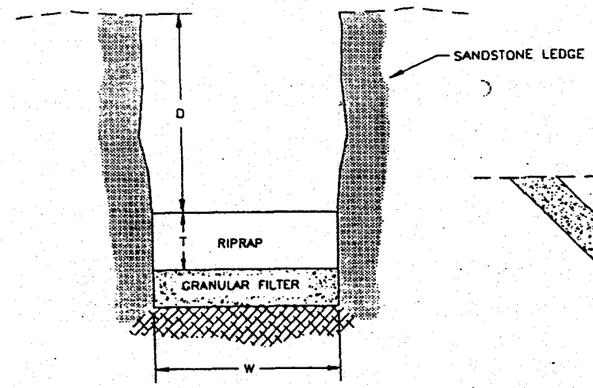
SHEET NO. JBK-7

1/93

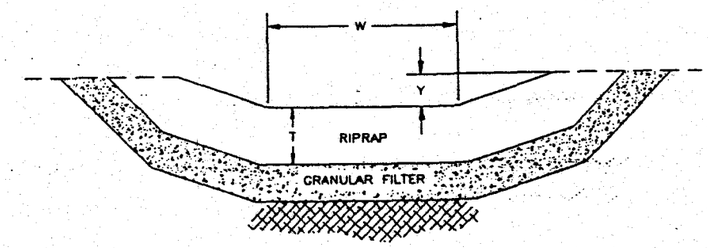
	D (FT.)	W MIN. (FT.)	L MIN. (FT.)	Y MIN. (FT.)	MIN. RIPRAP D50 (IN.)	T MIN. (FT.)
DROP 1	10	8	25	3.5	12	3.0
	15	8	25	3.6	14	4.0
	20	8	25	3.8	14	5.1
DROP 2	10	7	20	2.8	12	2.9
	15	7	20	2.9	14	3.8
	20	7	20	3.0	14	4.2



SECTION 1 / JBK-7

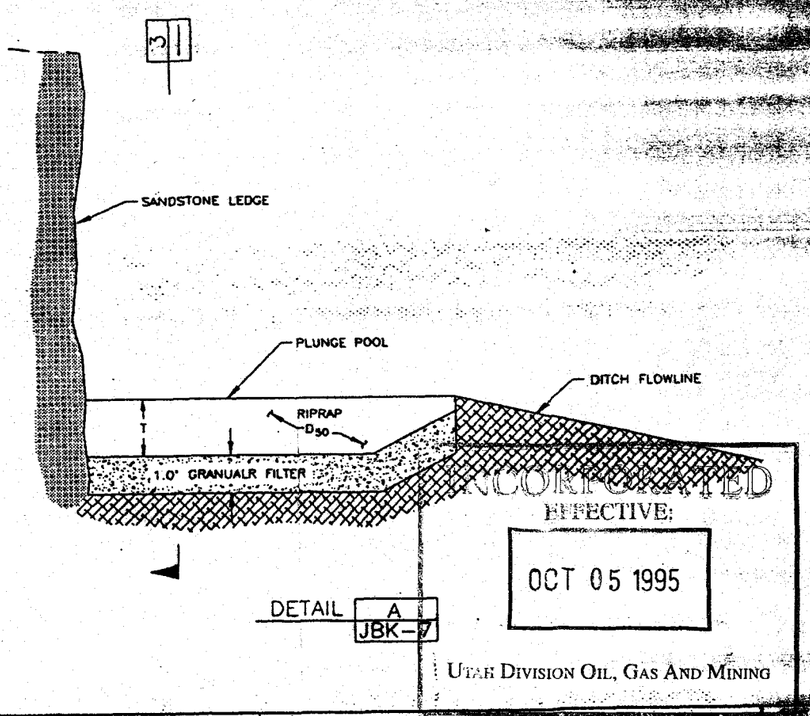


OPTION A



OPTION B

SECTION 3 / —



DETAIL A / JBK-7

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

REGISTERED PROFESSIONAL ENGINEER
NO. 165467
GREGORY J. POOLE
STATE OF UTAH

HANSEN ALLEN & LUCE INC.

CHECKED	KCS	3	11/94	DELETED TOE DITCH X-SECTION AND MODIFIED CHANNEL X-SECTION TO SHOW MINIMUMS	EMG	
DRAWN	RSE	2				
CHECKED	GJP	1				
DATE	FEB. 1994	NO.	DATE	REVISIONS	BY	APVD.

SCALE: NOT TO SCALE

VERIFY SCALE: BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

WESTERN STATES MINERAL CORPORATION
J.B. KING MINE

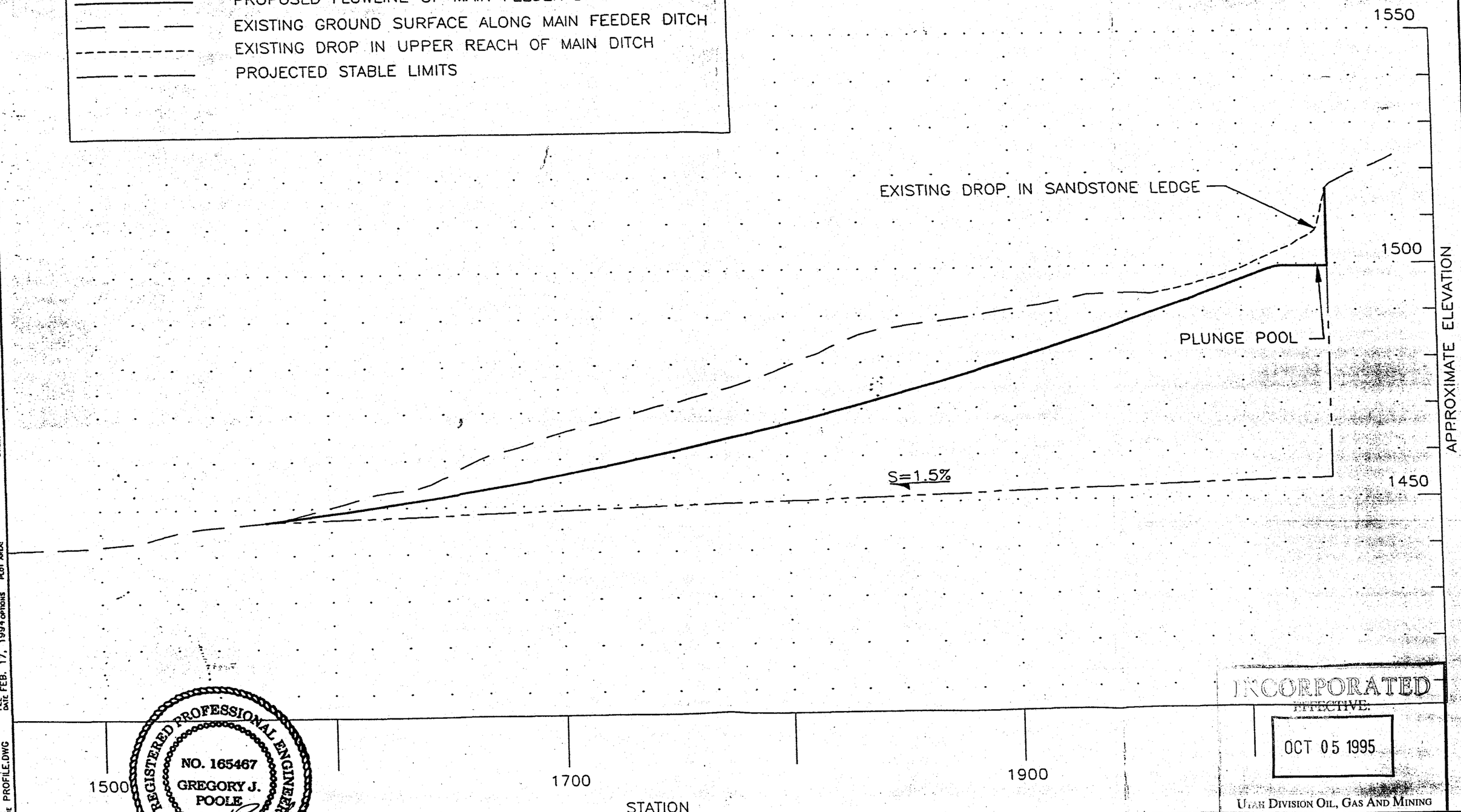
PROPOSED RECLAMATION CHANNEL RECONSTRUCTION
TYPICAL SECTIONS & DETAILS

JBK-8

FILE NAME: \102\02-100\KINGMN02 FILE DATE: FEB. 17, 1994 PLOT OPTIONS: PLOT #: - DWG PLOT AREA: UNITS: ORIGIN: DVIEW: XREF FILE NAME(S):

LEGEND

- PROPOSED FLOWLINE OF MAIN FEEDER DITCH
- EXISTING GROUND SURFACE ALONG MAIN FEEDER DITCH
- EXISTING DROP IN UPPER REACH OF MAIN DITCH
- PROJECTED STABLE LIMITS



REGISTERED PROFESSIONAL ENGINEER
NO. 165467
GREGORY J. POOLE
STATE OF UTAH

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

FILE NAME: PROFILE.DWG | FILE DATE: FEB. 17, 1994 | PLOT OPTIONS: PLOT IN = DWG UNITS; PLOT AREA: | ORIGIN: DVIEW: | XREF FILE NAME(S):

HANSEN ALLEN & LUCE INC.
CONSULTING ENGINEERS
Salt Lake City Utah

PROJECT ENGINEER

DESIGNED	GJP	3	
DRAFTED	JSJ	2	
CHECKED	GJP	1	
DATE	FEB. 1994	NO.	DATE

REVISIONS | BY | APVD.

SCALE: AS SHOWN

VERIFY SCALE: 0" 1" BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

WESTERN STATES MINERAL CORPORATION
J.B. KING MINE

PROPOSED RECLAMATION CHANNEL RECONSTRUCTION PROFILE

SHEET NO. JBK-9

Appendix 1
Runoff Calculations

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

RUNOFF CALCULATION SUMMARY

DRAINAGE AREA	SUB-AREA	AREA (ACRES)	SLOPE (%)	PEAK RUNOFF (CFS)
1	Upper Area	30.8	10.1	24.9
	Middle Area	6.4	10.1	5.6
	Lower Area	0.6	14.0	0.6
2	Upper Area	10.7	18.9	9.3
	Middle Area	5.3	18.9	4.7
	Lower Area	1.0	14.0	0.9
3	Upper Area	2.1	29.9	1.9
	Lower Area	2.1	17.0	1.9
4	Upper Area	5.0	26.2	4.5
	Lower Area	2.9	25.0	2.6
5	N/A	3.2	23.0	3.0
6	N/A	2.5	41.5	2.3

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Mine Area 1

AREA= 37.9 ACRES
AVERAGE BASIN SLOPE= 10.1 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 3000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .1878 HOURS QPCFS= 152.62 CFS QPIN= 3.9934 INCHES
C3= 19.6637 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2212	.0000	.0000	.0	.00
1.43	.2286	.0000	.0000	7.7	.00
1.46	.2360	.0002	.0001	47.4	.00
1.50	.2438	.0004	.0002	101.3	.01
1.54	.2567	.0010	.0006	140.1	.03
1.58	.2695	.0019	.0009	152.6	.09
1.62	.2824	.0031	.0012	143.0	.17
1.65	.2952	.0045	.0014	120.7	.30
1.69	.3081	.0062	.0017	94.4	.47
1.73	.3209	.0080	.0019	69.6	.67
1.77	.3337	.0102	.0021	49.1	.89
1.80	.3466	.0125	.0023	33.3	1.11
1.84	.3594	.0151	.0026	22.0	1.35
1.88	.3723	.0179	.0028	14.1	1.59
1.92	.3851	.0208	.0030	8.8	1.82
1.95	.3980	.0240	.0032	5.5	2.06
1.99	.4108	.0274	.0034	3.3	2.28
2.03	.4516	.0393	.0119	2.0	2.57
2.07	.5017	.0562	.0169	1.2	3.22
2.10	.5517	.0754	.0192	.7	4.52
2.14	.6017	.0966	.0213	.4	6.49
2.18	.6518	.1198	.0231	.2	8.96
2.22	.7018	.1446	.0248	.1	11.66
2.25	.7518	.1709	.0264	.0	14.39
2.29	.8018	.1987	.0278	.0	17.00
2.33	.8519	.2278	.0290	.0	19.42
2.37	.9019	.2580	.0302	.0	21.63
2.40	.9519	.2893	.0313	.0	23.62
2.44	1.0020	.3215	.0323	.0	25.41
2.48	1.0520	.3547	.0332	.0	27.02
2.52	1.0860	.3778	.0230	.0	28.39
2.55	1.0995	.3870	.0093	.0	29.07
2.59	1.1130	.3964	.0093	.0	28.46
2.63	1.1265	.4057	.0094	.0	26.51
2.67	1.1400	.4152	.0094	.0	23.69

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Mine Area 1
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.70	1.1536	.4247	.0095	.0	20.63
2.74	1.1671	.4342	.0095	.0	17.80
2.78	1.1806	.4438	.0096	.0	15.45

HYDROGRAPH PEAK= 29.07 cfs
TIME TO PEAK= 2.55 Hours
RUNOFF VOLUME= 2.91 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

AREA 2

CONTOUR LENGTH = 17¼" x 200 FT/IN = 3450

CONTOUR INTERVAL = 40 FT.

AREA = 16.8 ACRES = 731,808 SQUARE FT.

$$\text{SLOPE} = \frac{3450 \times 40 \times 100}{731,808} = 18.9\%$$

HYDRAULIC LENGTH = 2,000 FT.

100 YEAR 6 HOUR STORM = 1.8"

CURVE NUMBER = 90

FROM "HYDRO" THE PEAK FLOW IS 14.19 CFS **USE 14.5 CFS.**
SEE PAGES 5 & 6.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Mine Area 2

AREA= 16.8 ACRES
AVERAGE BASIN SLOPE= 18.9 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0993 HOURS QPCFS= 128.00 CFS QPIN= 7.5560 INCHES
C3= 37.2434 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2211	.0000	.0000	.0	.00
1.41	.2251	.0000	.0000	6.4	.00
1.43	.2290	.0000	.0000	39.8	.00
1.45	.2329	.0001	.0000	85.0	.00
1.47	.2369	.0002	.0000	117.5	.00
1.49	.2408	.0003	.0001	128.0	.01
1.51	.2460	.0005	.0002	119.9	.03
1.53	.2528	.0008	.0003	101.2	.04
1.55	.2595	.0012	.0004	79.2	.07
1.57	.2663	.0017	.0005	58.4	.10
1.59	.2731	.0022	.0005	41.2	.15
1.61	.2799	.0028	.0006	28.0	.20
1.63	.2867	.0035	.0007	18.4	.26
1.65	.2935	.0043	.0008	11.8	.32
1.67	.3003	.0051	.0008	7.4	.38
1.69	.3071	.0060	.0009	4.6	.44
1.71	.3139	.0070	.0010	2.8	.50
1.73	.3206	.0080	.0010	1.7	.56
1.75	.3274	.0091	.0011	1.0	.62
1.77	.3342	.0103	.0012	.6	.68
1.79	.3410	.0115	.0012	.3	.74
1.81	.3478	.0128	.0013	.2	.80
1.83	.3546	.0141	.0013	.1	.85
1.85	.3614	.0155	.0014	.0	.91
2.40	.9494	.2877	.0166	.0	12.57
2.42	.9759	.3046	.0169	.0	12.97
2.44	1.0023	.3218	.0172	.0	13.27
2.46	1.0288	.3392	.0174	.0	13.55
2.48	1.0552	.3569	.0177	.0	13.81
2.50	1.0804	.3740	.0171	.0	14.06
2.52	1.0876	.3789	.0049	.0	14.19
2.54	1.0947	.3838	.0049	.0	13.86
2.56	1.1019	.3887	.0049	.0	12.91
2.58	1.1090	.3936	.0049	.0	11.54

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OF OIL, GAS AND MINING

PROJECT : J.B. King Mine Area 2
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.60	1.1162	.3986	.0049	.0	10.01
2.62	1.1233	.4035	.0050	.0	8.56
2.64	1.1305	.4085	.0050	.0	7.33

HYDROGRAPH PEAK= 14.19 cfs
TIME TO PEAK= 2.52 Hours
RUNOFF VOLUME= 1.30 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE inc

CLIENT WSMC
PROJECT JB. KING
FEATURE
PROJECT NO.

SHEET 7 OF 31
COMPUTED
CHECKED
DATE

AREA 3

CONTOUR LENGTH = 7" × 200 FT./IN = 1400 FT.

CONTOUR INTERVAL = 40 FT.

AREA = 4.3 ACRES = 187,308 SQUARE FT.

SLOPE = $\frac{1400 \times 40 \times 100}{187,308}$ = 29.9%

HYDRAULIC LENGTH = 900 FEET

100 YEAR 6 HOUR STORM = 1.8 IN.

CURVE NUMBER = 90

FROM "HYDRO" THE PEAK FLOW IS 3.79 CFS USE 4 CFS
SEE PAGE 8

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Mine Area 3

AREA= 4.3 ACRES
AVERAGE BASIN SLOPE= 29.9 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 900. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0417 HOURS QPCFS= 78.06 CFS QPIN=18.0022 INCHES
C3= 58.7328 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	19.0	.00
1.42	.2281	.0000	.0000	65.3	.00
1.44	.2311	.0000	.0000	77.2	.00
1.45	.2341	.0001	.0000	59.1	.00
1.47	.2371	.0002	.0000	35.6	.00
1.48	.2400	.0003	.0000	18.5	.01
1.50	.2430	.0004	.0001	8.6	.02
1.51	.2481	.0006	.0002	3.7	.02
1.53	.2533	.0008	.0003	1.5	.04
1.54	.2584	.0011	.0003	.6	.05
1.56	.2635	.0015	.0003	.2	.06
1.57	.2686	.0019	.0004	.0	.08
2.40	.9468	.2860	.0126	.0	3.51
2.41	.9668	.2987	.0127	.0	3.56
2.43	.9868	.3116	.0129	.0	3.61
2.45	1.0067	.3247	.0130	.0	3.66
2.46	1.0267	.3379	.0132	.0	3.71
2.48	1.0467	.3512	.0133	.0	3.75
2.49	1.0667	.3647	.0135	.0	3.79
2.51	1.0818	.3749	.0103	.0	3.77
2.52	1.0872	.3786	.0037	.0	3.47
2.54	1.0926	.3823	.0037	.0	2.81
2.55	1.0980	.3860	.0037	.0	2.12
2.57	1.1034	.3897	.0037	.0	1.63
2.58	1.1088	.3935	.0037	.0	1.34

HYDROGRAPH PEAK= 3.79 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .33 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

AREA 4

CONTOUR LENGTH = 15.25" x 200 FT/IN = 3050

CONTOUR INTERVAL = 40 FT.

AREA = 8.09 ACRES = 352,268 SQUARE FT.

SLOPE = $\frac{3050 \times 40 \times 100}{352,268}$ = 34.6

HYDRAULIC LENGTH = 5.25" x 200 FT/IN = 1050 FT.

100 YEAR 6 HOUR STORM = 1.8"

CURVE NUMBER = 90

FROM "HYDRO" THE PEAK FLOW IS 7.12 CFS. USE 7¼ CFS
SEE PAGE 10

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Mine Area 4

AREA= 8.1 ACRES
AVERAGE BASIN SLOPE= 34.6 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1050. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0438 HOURS QPCFS= 139.65 CFS QPIN=17.1187 INCHES
C3= 84.3780 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	30.2	.00
1.42	.2281	.0000	.0000	110.5	.00
1.44	.2311	.0000	.0000	139.5	.00
1.45	.2341	.0001	.0000	113.9	.01
1.47	.2371	.0002	.0000	73.3	.02
1.48	.2400	.0003	.0000	40.6	.02
1.50	.2430	.0004	.0001	20.2	.03
1.51	.2481	.0006	.0002	9.3	.04
1.53	.2533	.0008	.0003	4.1	.06
1.54	.2584	.0011	.0003	1.7	.09
1.56	.2635	.0015	.0003	.7	.12
1.57	.2686	.0019	.0004	.3	.14
1.59	.2738	.0023	.0004	.1	.17
1.60	.2789	.0028	.0005	.0	.19
2.40	.9468	.2860	.0126	.0	6.59
2.41	.9668	.2987	.0127	.0	6.69
2.43	.9868	.3116	.0129	.0	6.78
2.45	1.0067	.3247	.0130	.0	6.87
2.46	1.0267	.3379	.0132	.0	6.96
2.48	1.0467	.3512	.0133	.0	7.04
2.49	1.0667	.3647	.0135	.0	7.12
2.51	1.0818	.3749	.0103	.0	7.10
2.52	1.0872	.3786	.0037	.0	6.60
2.54	1.0926	.3823	.0037	.0	5.47
2.55	1.0980	.3860	.0037	.0	4.21
2.57	1.1034	.3897	.0037	.0	3.24
2.58	1.1088	.3935	.0037	.0	2.64

HYDROGRAPH PEAK= 7.12 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .62 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

AREA 5

CONTOUR LENGTH = 4 IN. × 200 FT./IN = 800 FT.

CONTOUR INTERVAL = 40 FT.

AREA = 3.2 ACRES = 139,392 SQUARE FT.

$$\text{SLOPE} = \frac{800 \times 40 \times 100}{139,392} = 23.0\ \%$$

HYDRAULIC LENGTH = 800 FT.

100 YEAR 6 HOUR STORM = 1.8"

CURVE NUMBER = 90

FROM "HYDRO" THE PEAK FLOW IS 2.82 CFS. USE 3 CFS
SEE PAGE 12.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Mine Area 5

AREA= 3.2 ACRES
AVERAGE BASIN SLOPE= 23.0 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 800. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0432 HOURS QPCFS= 55.98 CFS QPIN=17.3491 INCHES
C3= 85.5135 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	12.5	.00
1.42	.2281	.0000	.0000	45.0	.00
1.44	.2311	.0000	.0000	55.8	.00
1.45	.2341	.0001	.0000	44.8	.00
1.47	.2371	.0002	.0000	28.4	.00
1.48	.2400	.0003	.0000	15.4	.00
1.50	.2430	.0004	.0001	7.6	.01
1.51	.2481	.0006	.0002	3.4	.02
1.53	.2533	.0008	.0003	1.5	.03
1.54	.2584	.0011	.0003	.6	.04
1.56	.2635	.0015	.0003	.2	.05
1.57	.2686	.0019	.0004	.0	.06
2.40	.9468	.2860	.0126	.0	2.61
2.41	.9668	.2987	.0127	.0	2.65
2.43	.9868	.3116	.0129	.0	2.68
2.45	1.0067	.3247	.0130	.0	2.72
2.46	1.0267	.3379	.0132	.0	2.75
2.48	1.0467	.3512	.0133	.0	2.79
2.49	1.0667	.3647	.0135	.0	2.82
2.51	1.0818	.3749	.0103	.0	2.81
2.52	1.0872	.3786	.0037	.0	2.60
2.54	1.0926	.3823	.0037	.0	2.14
2.55	1.0980	.3860	.0037	.0	1.64
2.57	1.1034	.3897	.0037	.0	1.26
2.58	1.1088	.3935	.0037	.0	1.03

HYDROGRAPH PEAK= 2.82 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .25 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

REVISED RUNOFF CALCULATIONS FOR ALTERNATIVE 3

ALTERNATIVE 3 INVOLVES DIVERTING FLOW FROM THE UPPER ENDS ON AREAS 1 AND 2: IN ORDER TO DETERMINE DITCH SIZES FOR THE DIVERSIONS AS WELL AS FOR THE RUNOFF WHICH WILL BE CONTROLLED ON SITE IT IS NECESSARY TO SUB-DIVIDE EACH AREA. AREAS 1 AND 2 HAVE BEEN DIVIDED INTO 3 SUBAREAS – THE UPPER AREA WHICH IS ABOVE THE OFF SITE DIVERSION DITCHES, THE "MIDDLE" WHICH IS AREA BELOW THE DIVERSION DITCHES AND ABOVE THE CLIFF, AND THE LOWER WHICH IS THE AREA BELOW THE CLIFF. AREAS 3 AND 4 HAVE BEEN DIVIDED INTO THE UPPER AREAS ABOVE THE CLIFF AND THE LOWER AREAS WHICH ARE BELOW THE CLIFF.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE inc

CLIENT WSMC
PROJECT J.B. KING
FEATURE
PROJECT NO.

COMPUTED
CHECKED
DATE

REVISED RUNOFF CALCULATIONS - ALTERNATIVES 2 & 3

AREA - 1

UPPER	11.00 × 3.0473 × 40,000	=	30.8 ACRES
MIDDLE	2.29	=	6.4
LOWER	0.22	=	0.6

AREA - 2

UPPER	3.82	=	10.7
MIDDLE	1.89	=	5.3
LOWER	0.34	=	1.0

AREA 3

UPPER	0.74	=	2.1
LOWER	0.75	=	2.1

AREA 4

UPPER	1.78	=	5.0
LOWER	1.05	=	2.9

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

REVISED RUNOFF FROM AREA 1

UPPER: AREA 30.8 ACRES
SLOPE 10.1%
HYDRAULIC LENGTH 2,050 FT.
100 YR. 6HR STORM 1.8"
CURVE NUMBER 90

FROM "HYDRO" PEAK RUNOFF FLOW IS 24.9 CFS

MIDDLE: AREA 6.4 ACRES
SLOPE 10.1%
HYDRAULIC LENGTH 700 FT.
100 YR. 6 HR. STORM 1.8"
CURVE NUMBER 90

FROM "HYDRO" PEAK RUNOFF FLOW IS 5.6 CFS

LOWER: AREA 0.6 ACRES
SLOPE 14%
HYDRAULIC LENGTH 200 FT.
100 YR. 6HR STORM 1.8"
CURVE NUMBER 90

FROM "HYDRO" PEAK RUNOFF FLOW IS: 0.6 CFS

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

16

PROJECT : J.B. King Revised Area 1 Top (UPPER)

AREA= 30.8 ACRES
AVERAGE BASIN SLOPE= 10.1 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2050. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OF OIL, GAS AND MINING

TP= .1385 HOURS QPCFS= 168.19 CFS QPIN= 5.4165 INCHES
C3= 26.6932 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.38	.2202	.0000	.0000	.0	.00
1.41	.2257	.0000	.0000	8.4	.00
1.44	.2312	.0000	.0000	52.2	.00
1.47	.2367	.0002	.0001	111.7	.00
1.50	.2421	.0004	.0002	154.4	.02
1.52	.2510	.0007	.0004	168.2	.04
1.55	.2605	.0013	.0005	157.6	.07
1.58	.2699	.0020	.0007	133.0	.13
1.61	.2794	.0028	.0008	104.0	.22
1.63	.2889	.0038	.0010	76.8	.32
1.66	.2983	.0049	.0011	54.1	.45
1.69	.3078	.0061	.0012	36.7	.59
1.72	.3173	.0075	.0014	24.2	.73
1.74	.3268	.0090	.0015	15.5	.88
1.77	.3362	.0106	.0016	9.8	1.03
1.80	.3457	.0124	.0017	6.0	1.18
1.83	.3552	.0142	.0019	3.6	1.33
1.86	.3647	.0162	.0020	2.2	1.47
1.88	.3741	.0183	.0021	1.3	1.62
1.91	.3836	.0205	.0022	.7	1.76
1.94	.3931	.0228	.0023	.4	1.89
1.97	.4025	.0252	.0024	.2	2.02
1.99	.4120	.0277	.0025	.1	2.16
2.02	.4432	.0366	.0090	.0	2.34
2.35	.8859	.2482	.0221	.0	19.89
2.38	.9228	.2709	.0227	.0	20.93
2.41	.9596	.2942	.0233	.0	21.88
2.44	.9965	.3180	.0238	.0	22.76
2.47	1.0334	.3423	.0243	.0	23.58
2.49	1.0703	.3671	.0248	.0	24.34
2.52	1.0874	.3787	.0116	.0	24.93
2.55	1.0973	.3856	.0068	.0	24.84
2.58	1.1073	.3924	.0069	.0	23.67
2.60	1.1173	.3993	.0069	.0	21.55

PROJECT : J.B. King Revised Area 1 Top
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.63	1.1272	.4063	.0069	.0	18.95
2.66	1.1372	.4132	.0070	.0	16.33
2.69	1.1472	.4202	.0070	.0	14.02

HYDROGRAPH PEAK= 24.93 cfs
TIME TO PEAK= 2.52 Hours
RUNOFF VOLUME= 2.37 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 1 Middle

AREA= 6.4 ACRES
AVERAGE BASIN SLOPE= 10.1 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 700. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0586 HOURS QPCFS= 82.56 CFS QPIN=12.7928 INCHES
C3= 63.0558 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	8.4	.00
1.42	.2281	.0000	.0000	42.2	.00
1.44	.2311	.0000	.0000	73.3	.00
1.45	.2341	.0001	.0000	82.5	.00
1.47	.2371	.0002	.0000	73.1	.00
1.48	.2400	.0003	.0000	55.7	.01
1.50	.2430	.0004	.0001	38.2	.02
1.51	.2481	.0006	.0002	24.3	.03
1.53	.2533	.0008	.0003	14.6	.04
1.54	.2584	.0011	.0003	8.4	.05
1.56	.2635	.0015	.0003	4.6	.07
1.57	.2686	.0019	.0004	2.5	.09
1.59	.2738	.0023	.0004	1.3	.11
1.60	.2789	.0028	.0005	.7	.13
1.62	.2840	.0033	.0005	.3	.15
1.63	.2892	.0038	.0005	.2	.16
1.65	.2943	.0044	.0006	.0	.18
2.41	.9668	.2987	.0127	.0	5.19
2.43	.9868	.3116	.0129	.0	5.26
2.45	1.0067	.3247	.0130	.0	5.34
2.46	1.0267	.3379	.0132	.0	5.41
2.48	1.0467	.3512	.0133	.0	5.48
2.49	1.0667	.3647	.0135	.0	5.54
2.51	1.0818	.3749	.0103	.0	5.58
2.52	1.0872	.3786	.0037	.0	5.45
2.54	1.0926	.3823	.0037	.0	4.98
2.55	1.0980	.3860	.0037	.0	[illegible]
2.57	1.1034	.3897	.0037	.0	[illegible]
2.58	1.1088	.3935	.0037	.0	2.87
2.60	1.1142	.3972	.0037	.0	2.39

HYDROGRAPH PEAK= 5.58 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .49 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 1 Bottom (LOWER)

AREA= .6 ACRES
AVERAGE BASIN SLOPE= 14.0 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 200. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0183 HOURS QPCFS= 24.83 CFS QPIN=41.0321 INCHES
C3=202.2473 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	23.2	.00
1.42	.2281	.0000	.0000	14.5	.00
1.44	.2311	.0000	.0000	3.1	.00
1.45	.2341	.0001	.0000	.4	.00
1.47	.2371	.0002	.0000	.0	.00
2.40	.9468	.2860	.0126	.0	.52
2.41	.9668	.2987	.0127	.0	.52
2.43	.9868	.3116	.0129	.0	.53
2.45	1.0067	.3247	.0130	.0	.54
2.46	1.0267	.3379	.0132	.0	.54
2.48	1.0467	.3512	.0133	.0	.55
2.49	1.0667	.3647	.0135	.0	.55
2.51	1.0818	.3749	.0103	.0	.46
2.52	1.0872	.3786	.0037	.0	.28
2.54	1.0926	.3823	.0037	.0	.18
2.55	1.0980	.3860	.0037	.0	.16
2.57	1.1034	.3897	.0037	.0	.15
2.58	1.1088	.3935	.0037	.0	.15

HYDROGRAPH PEAK= .55 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .05 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

REVISED RUNOFF FROM AREA 2

UPPER: AREA .. 10.7 ACRES
SLOPE 18.9 %
HYDRAULIC LENGTH 1000 FT.
100 YR. 6 HR. STORM 1.8"
CURVE NUMBER 90

FROM "HYDRO" PEAK RUNOFF FLOW IS 9.3 CFS

MIDDLE: AREA 5.3 ACRES
SLOPE 18.9%
HYDRAULIC LENGTH 600 FT.
100 YR. 6 HR STORM 1.8"
CURVE NUMBER 90

FROM "HYDRO" PEAK RUNOFF FLOW IS 4.7 CFS

LOWER: AREA 1.0 ACRES
SLOPE 14 %
HYDRAULIC LENGTH 350 FT.
100 YR. 6 HR STORM 1.8"
CURVE NUMBER 90

FROM "HYDRO" PEAK RUNOFF FLOW IS 0.9 CFS

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 2 Top (UPPER)

AREA= 10.7 ACRES
AVERAGE BASIN SLOPE= 18.9 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0570 HOURS QPCFS= 141.94 CFS QPIN=13.1557 INCHES
C3= 64.8446 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	15.5	.00
1.42	.2281	.0000	.0000	76.2	.00
1.44	.2311	.0000	.0000	129.0	.00
1.45	.2341	.0001	.0000	141.2	.00
1.47	.2371	.0002	.0000	121.8	.01
1.48	.2400	.0003	.0000	90.4	.02
1.50	.2430	.0004	.0001	60.4	.03
1.51	.2481	.0006	.0002	37.4	.04
1.53	.2533	.0008	.0003	21.9	.06
1.54	.2584	.0011	.0003	12.2	.09
1.56	.2635	.0015	.0003	6.6	.12
1.57	.2686	.0019	.0004	3.4	.15
1.59	.2738	.0023	.0004	1.7	.18
1.60	.2789	.0028	.0005	.9	.22
1.62	.2840	.0033	.0005	.4	.25
1.63	.2892	.0038	.0005	.2	.28
1.65	.2943	.0044	.0006	.0	.31
2.41	.9668	.2987	.0127	.0	8.69
2.43	.9868	.3116	.0129	.0	8.82
2.45	1.0067	.3247	.0130	.0	8.94
2.46	1.0267	.3379	.0132	.0	9.06
2.48	1.0467	.3512	.0133	.0	9.18
2.49	1.0667	.3647	.0135	.0	9.29
2.51	1.0818	.3749	.0103	.0	9.34
2.52	1.0872	.3786	.0037	.0	9.09
2.54	1.0926	.3823	.0037	.0	8.25
2.55	1.0980	.3860	.0037	.0	7.00
2.57	1.1034	.3897	.0037	.0	5.72
2.58	1.1088	.3935	.0037	.0	4.65
2.60	1.1142	.3972	.0037	.0	[illegible]

HYDROGRAPH PEAK= 9.34 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .83 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 2 Middle

AREA= 5.3 ACRES
AVERAGE BASIN SLOPE= 18.9 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 600. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0379 HOURS QPCFS= 105.80 CFS QPIN=19.7968 INCHES
C3= 97.5782 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	32.1	.00
1.42	.2281	.0000	.0000	96.4	.00
1.44	.2311	.0000	.0000	99.8	.00
1.45	.2341	.0001	.0000	66.9	.00
1.47	.2371	.0002	.0000	35.3	.01
1.48	.2400	.0003	.0000	16.0	.02
1.50	.2430	.0004	.0001	6.6	.02
1.51	.2481	.0006	.0002	2.5	.03
1.53	.2533	.0008	.0003	.9	.05
1.54	.2584	.0011	.0003	.3	.07
1.56	.2635	.0015	.0003	.0	.08
2.40	.9468	.2860	.0126	.0	4.36
2.41	.9668	.2987	.0127	.0	4.42
2.43	.9868	.3116	.0129	.0	4.48
2.45	1.0067	.3247	.0130	.0	4.53
2.46	1.0267	.3379	.0132	.0	4.59
2.48	1.0467	.3512	.0133	.0	4.64
2.49	1.0667	.3647	.0135	.0	4.70
2.51	1.0818	.3749	.0103	.0	4.64
2.52	1.0872	.3786	.0037	.0	4.15
2.54	1.0926	.3823	.0037	.0	3.22
2.55	1.0980	.3860	.0037	.0	2.36
2.57	1.1034	.3897	.0037	.0	1.81
2.58	1.1088	.3935	.0037	.0	1.53

HYDROGRAPH PEAK= 4.70 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .41 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 2 Bottom (LOWER)

AREA= 1.0 ACRES
AVERAGE BASIN SLOPE= 14.0 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 350. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0286 HOURS QPCFS= 26.44 CFS QPIN=26.2237 INCHES
C3=129.2565 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	14.1	.00
1.42	.2281	.0000	.0000	26.3	.00
1.44	.2311	.0000	.0000	17.0	.00
1.45	.2341	.0001	.0000	7.1	.00
1.47	.2371	.0002	.0000	2.3	.00
1.48	.2400	.0003	.0000	.7	.00
1.50	.2430	.0004	.0001	.2	.00
1.51	.2481	.0006	.0002	.0	.00
2.40	.9468	.2860	.0126	.0	.83
2.41	.9668	.2987	.0127	.0	.85
2.43	.9868	.3116	.0129	.0	.86
2.45	1.0067	.3247	.0130	.0	.87
2.46	1.0267	.3379	.0132	.0	.88
2.48	1.0467	.3512	.0133	.0	.89
2.49	1.0667	.3647	.0135	.0	.90
2.51	1.0818	.3749	.0103	.0	.86
2.52	1.0872	.3786	.0037	.0	.69
2.54	1.0926	.3823	.0037	.0	.46
2.55	1.0980	.3860	.0037	.0	.33
2.57	1.1034	.3897	.0037	.0	.27
2.58	1.1088	.3935	.0037	.0	.26

HYDROGRAPH PEAK= .90 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .08 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

CLIENT WSMC
PROJECT J. B. KING
FEATURE
PROJECT NO.

SHEET 24 OF 31
COMPUTED
CHECKED
DATE

REVISED RUNOFF AREA 3

UPPER: AREA 2.1 ACRES
SLOPE 29.9%
HYDRAULIC LENGTH 450'
CURVE NUMBER 90
100 YR. 6HR. STORM 1.8"

FROM "HYDRO" PEAK RUNOFF FLOW IS 1.9 CFS

LOWER: AREA 2.1 ACRES
SLOPE 17%
HYDRAULIC LENGTH 500'
CURVE NUMBER 90
100 YR. 6 HR. STORM 1.8"

FROM "HYDRO" PEAK RUNOFF FLOW IS 1.9 CFS

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 3 Top (UPPER)

AREA= 2.1 ACRES
AVERAGE BASIN SLOPE= 29.9 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 450. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0239 HOURS QPCFS= 66.37 CFS QPIN=31.3437 INCHES
C2=154.4928 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	46.9	.00
1.42	.2281	.0000	.0000	59.9	.00
1.44	.2311	.0000	.0000	26.4	.00
1.45	.2341	.0001	.0000	7.5	.00
1.47	.2371	.0002	.0000	1.7	.00
1.48	.2400	.0003	.0000	.3	.00
1.50	.2430	.0004	.0001	.0	.01
2.40	.9468	.2860	.0126	.0	1.77
2.41	.9668	.2987	.0127	.0	1.80
2.43	.9868	.3116	.0129	.0	1.82
2.45	1.0067	.3247	.0130	.0	1.84
2.46	1.0267	.3379	.0132	.0	1.86
2.48	1.0467	.3512	.0133	.0	1.88
2.49	1.0667	.3647	.0135	.0	1.90
2.51	1.0818	.3749	.0103	.0	1.77
2.52	1.0872	.3786	.0037	.0	1.27
2.54	1.0926	.3823	.0037	.0	.80
2.55	1.0980	.3860	.0037	.0	.60
2.57	1.1034	.3897	.0037	.0	.54
2.58	1.1088	.3935	.0037	.0	.53

HYDROGRAPH PEAK= 1.90 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .16 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 3 Bottom (LOWER)

AREA= 2.1 ACRES
AVERAGE BASIN SLOPE= 17.0 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0345 HOURS QPCFS= 46.00 CFS QPIN=21.7236 INCHES
C3=107.0758 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	17.1	.00
1.42	.2281	.0000	.0000	44.4	.00
1.44	.2311	.0000	.0000	39.9	.00
1.45	.2341	.0001	.0000	23.2	.00
1.47	.2371	.0002	.0000	10.6	.00
1.48	.2400	.0003	.0000	4.2	.00
1.50	.2430	.0004	.0001	1.5	.01
1.51	.2481	.0006	.0002	.5	.01
1.53	.2533	.0008	.0003	.2	.02
1.54	.2584	.0011	.0003	.0	.03
2.40	.9468	.2860	.0126	.0	1.73
2.41	.9668	.2987	.0127	.0	1.76
2.43	.9868	.3116	.0129	.0	1.78
2.45	1.0067	.3247	.0130	.0	1.80
2.46	1.0267	.3379	.0132	.0	1.83
2.48	1.0467	.3512	.0133	.0	1.85
2.49	1.0667	.3647	.0135	.0	1.87
2.51	1.0818	.3749	.0103	.0	1.83
2.52	1.0872	.3786	.0037	.0	1.59
2.54	1.0926	.3823	.0037	.0	1.17
2.55	1.0980	.3860	.0037	.0	.84
2.57	1.1034	.3897	.0037	.0	.66
2.58	1.1088	.3935	.0037	.0	.57

HYDROGRAPH PEAK= 1.87 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .16 Acre-Feet

INCORPORATED
OCT 05 199
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

CLIENT WSMC
PROJECT J.B. KING
FEATURE
PROJECT NO.

SHEET 27 OF 31
COMPUTED
CHECKED
DATE

REVISED RUNOFF AREA 4

UPPER: AREA 5.0 ACRES
SLOPE 26.2%
HYDRAULIC LENGTH 450'
CURVE NUMBER 90
100 YR. 6HR. STORM 1.8"

FROM "HYDRO" PEAK RUNOFF FLOW IS 4.5 CFS

LOWER: AREA 2.9 ACRES
SLOPE 25%
HYDRAULIC LENGTH 550 FT.
CURVE NUMBER 90
100 YR. 6HR. STORM 1.8"

FROM "HYDRO" PEAK RUNOFF FLOW IS 2.6 CFS

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 4 Top (UPPER)

AREA= 5.0 ACRES
AVERAGE BASIN SLOPE= 26.2 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 450. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0256 HOURS QPCFS= 147.93 CFS QPIN=29.3403 INCHES
C3=144.6184 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	95.0	.00
1.42	.2281	.0000	.0000	140.7	.00
1.44	.2311	.0000	.0000	72.0	.00
1.45	.2341	.0001	.0000	23.8	.01
1.47	.2371	.0002	.0000	6.2	.02
1.48	.2400	.0003	.0000	1.4	.02
1.50	.2430	.0004	.0001	.3	.03
1.51	.2481	.0006	.0002	.0	.04
2.40	.9468	.2860	.0126	.0	4.20
2.41	.9568	.2987	.0127	.0	4.26
2.43	.9868	.3116	.0129	.0	4.31
2.45	1.0067	.3247	.0130	.0	4.37
2.46	1.0267	.3379	.0132	.0	4.42
2.48	1.0467	.3512	.0133	.0	4.47
2.49	1.0667	.3647	.0135	.0	4.52
2.51	1.0818	.3749	.0103	.0	4.25
2.52	1.0872	.3786	.0037	.0	3.19
2.54	1.0926	.3823	.0037	.0	2.04
2.55	1.0980	.3860	.0037	.0	1.49
2.57	1.1034	.3897	.0037	.0	1.32
2.58	1.1088	.3935	.0037	.0	1.27

HYDROGRAPH PEAK= 4.52 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .39 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 4 Bottom (LOWER)

AREA= 2.9 ACRES
AVERAGE BASIN SLOPE= 25.0 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 550. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0307 HOURS QPCFS= 71.38 CFS QPIN=24.4098 INCHES
CS=120.3158 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	33.4	.00
1.42	.2281	.0000	.0000	71.3	.00
1.44	.2311	.0000	.0000	52.5	.00
1.45	.2341	.0001	.0000	25.0	.00
1.47	.2371	.0002	.0000	9.4	.00
1.48	.2400	.0003	.0000	3.0	.01
1.50	.2430	.0004	.0001	.9	.01
1.51	.2481	.0006	.0002	.2	.02
1.53	.2533	.0008	.0003	.0	.03
2.40	.9468	.2860	.0126	.0	2.41
2.41	.9668	.2987	.0127	.0	2.44
2.43	.9868	.3116	.0129	.0	2.48
2.45	1.0067	.3247	.0130	.0	2.51
2.46	1.0267	.3379	.0132	.0	2.54
2.48	1.0467	.3512	.0133	.0	2.57
2.49	1.0667	.3647	.0135	.0	2.59
2.51	1.0818	.3749	.0103	.0	2.51
2.52	1.0872	.3786	.0037	.0	2.08
2.54	1.0926	.3823	.0037	.0	1.44
2.55	1.0980	.3860	.0037	.0	1.02
2.57	1.1034	.3897	.0037	.0	.83
2.58	1.1088	.3935	.0037	.0	.76

HYDROGRAPH PEAK= 2.59 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .22 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

CLIENT WSMC
PROJECT J.B. KING
FEATURE
PROJECT NO.

SHEET 30 OF 31
COMPUTED
CHECKED
DATE

CALCULATION OF FLOW INTO EXISTING CUT-OFF DITCH

AREA - 6

0.88 PLANIMETER READING
× 3.0473

2.68 SQ. IN. @ 1" = 200' => 2.5 ACRES.

CONTOUR LENGTH = 1130 FT.

CONTOUR INTERVAL = 40 FT.

$$\text{SLOPE} = \frac{1130 \times 40 \times 100}{2.5 \times 43560} = 41.5\%$$

HYDRAULIC LENGTH = 500 FT.

100 YR. 6 HR. STORM = 1.8"

CURVE NUMBER = 90

FROM "HYDRO" THE PEAK FLOW IS 2.3 CFS.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Area 6

AREA= 2.5 ACRES
AVERAGE BASIN SLOPE= 41.5 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0221 HOURS QPCFS= 85.56 CFS QPIN=33.9416 INCHES
CS=167.2980 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	67.0	.00
1.42	.2281	.0000	.0000	70.6	.00
1.44	.2311	.0000	.0000	25.7	.00
1.45	.2341	.0001	.0000	6.1	.00
1.47	.2371	.0002	.0000	1.1	.00
1.48	.2400	.0003	.0000	.2	.01
1.50	.2430	.0004	.0001	.0	.01
2.40	.9468	.2860	.0126	.0	2.12
2.41	.9668	.2987	.0127	.0	2.15
2.43	.9868	.3116	.0129	.0	2.18
2.45	1.0067	.3247	.0130	.0	2.20
2.46	1.0267	.3379	.0132	.0	2.23
2.48	1.0467	.3512	.0133	.0	2.25
2.49	1.0667	.3647	.0135	.0	2.28
2.51	1.0818	.3749	.0103	.0	2.08
2.52	1.0872	.3786	.0037	.0	1.42
2.54	1.0926	.3823	.0037	.0	.87
2.55	1.0980	.3860	.0037	.0	.58
2.57	1.1034	.3897	.0037	.0	.64
2.58	1.1088	.3935	.0037	.0	.64

HYDROGRAPH PEAK= 2.28 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .19 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Appendix 2
Plunge Pool Design

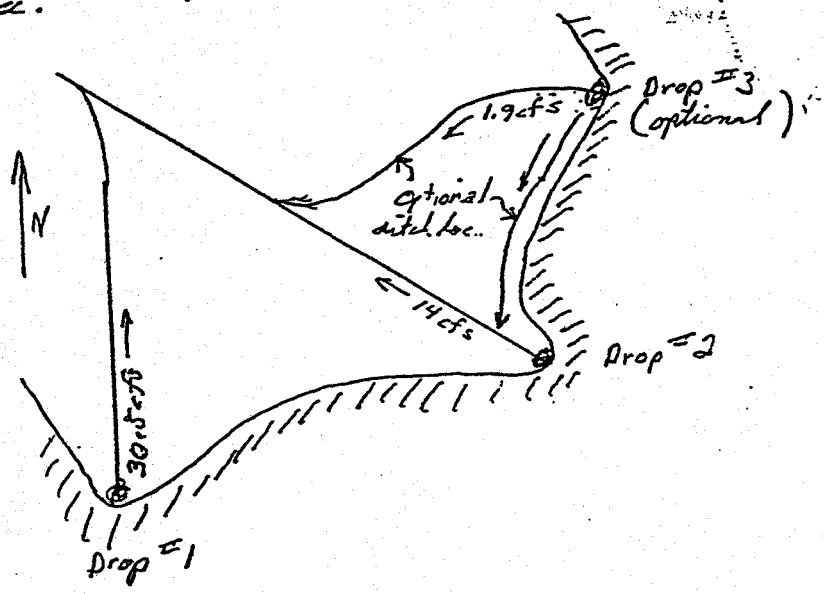
INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

CLIENT Western States Minerals
PROJECT J.B. King Mine
FEATURE Plunge Pool Design
PROJECT NO. 102.02.100

SHEET 1 OF 8
COMPUTED KCS
CHECKED
DATE 9-3-93

Three possible plunge pools need to be analyzed for the three channels receiving concentrated flows from the sandstone ledges. The height of the ledges will depend on the conditions found as excavation of the channels takes place.



Design of the plunge pool size is based on procedures in "Open Channel Hydraulics," by Ven T. Chow, 1959. The procedures assume a flowrate per unit width across the drop to establish a drop number, D. The drop number is then used to determine the plunge pool hydraulics.

Hydrologic calculations for the flowrates provided were obtained from "J.B. King Mine Proposed Erosion Control Plan," June 1992, prepared by Hansen, Allen & Luce, Inc.

Assume the following:

Drop #1
Q = 30.5 cfs
drop width = 6 feet
flowrate per unit width = 5.08 cfs/ft

Drop #2
Q = 14 cfs
drop width = 5 feet
flowrate per unit width = 2.8 cfs/ft

Drop #3 (optional)
Q = 2 cfs
drop width = 3 feet
flowrate per unit width = 0.67 cfs/ft

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

CLIENT Western States Minerals
PROJECT VR King Mine
FEATURE Plunge Pool Design
PROJECT NO. 102 02.100

SHEET 2 OF 8
COMPUTED VCS
CHECKED
DATE 9-3-97

The following presents the equations for the plunge pool hydraulics (from "Open Channel Hydraulics").

15-15. The Straight Drop Spillway. The aerated free-falling nappe in a straight drop spillway (Fig. 15-18) will reverse its curvature and turn smoothly into supercritical flow on the apron. Consequently, a hydraulic jump may be formed downstream. Based on his own experimental data

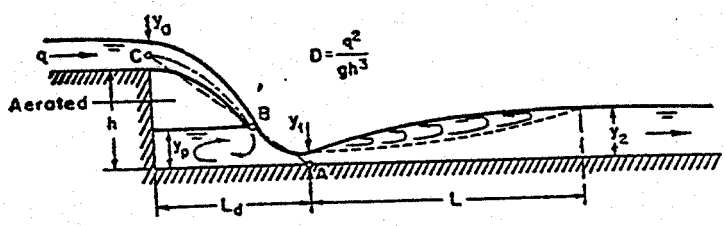


FIG. 15-18. Flow geometry of a straight drop spillway.

and those of Moore [40] and Bakhmeteff and Feodoroff [65], Rand [66] found that the flow geometry at straight drop spillways can be described by functions of the *drop number*, which is defined as

$$D = \frac{q^2}{gh^3} \tag{15-9}$$

where q is the discharge per unit width of the crest of overfall, g is the acceleration of gravity, and h is the height of the drop. The functions are

$$\frac{L_d}{h} = 4.30D^{0.27} \tag{15-10}$$

$$\frac{y_p}{h} = 1.00D^{0.22} \tag{15-11}$$

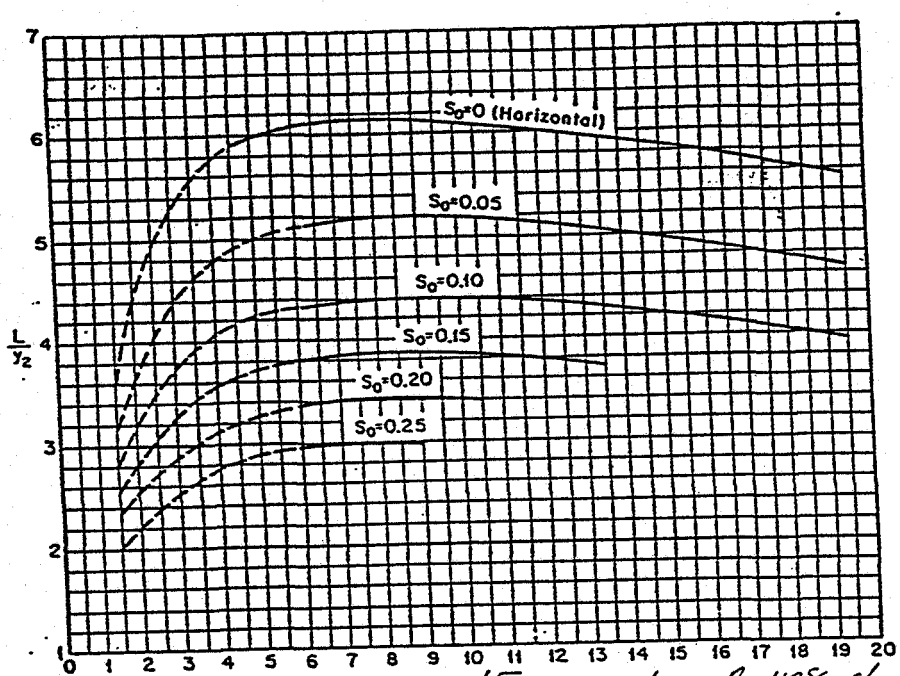
$$\frac{y_1}{h} = 0.54D^{0.425} \tag{15-12}$$

$$\frac{y_2}{h} = 1.66D^{0.27} \tag{15-13}$$

where L_d is the drop length, that is, the distance from the drop wall to the position of the depth y_1; y_p is the pool depth under the nappe; y_1 is the depth at the toe of the nappe or the beginning of the hydraulic jump; and y_2 is the tailwater depth sequent to y_1. The position of the depth y_1 can be approximately determined by the straight line ABC which joins the point A on the apron at the position of y_1, the point B on the axis of the nappe at the height of pool depth, and the point C on the axis of the nappe at the crest of the fall. The fact that these three points lie on a straight line was also verified by experiment.

For a given height h and discharge q per unit width of the fall crest, the sequent depth y_2 and the drop length L_d can be computed by Eqs. (15-10) and (15-13). On the one hand, if the tailwater depth is less than

INCORPORATED
OCT 05 1995
HAISLIP LIBRARY AND MINING



from Pg 428, Chow

after sizing the plunge pool using the procedures in "Open Channel Hydraulics", the riprap is designed using procedures in "Evaluation of and Design Recommendations for Drop Structures in the Denver Metropolitan Area" Prepared for: Urban Drainage and Flood Control District, Dec. 1986.

The publication referenced above contains several graphs based on drop height (D) to riprap mean diameter (D_{50}).

or D/D_{50} for a ratio of 6, 12 & 24

Several curves are presented on each graph representing the sequent depth (y_2) to drop height ratio.

or y_2/D

To use the graphs, calculate ratio of upstream flow depth, H (which was assumed) to drop height

or H/D to locate a position on the horizontal axis.

INCORPORATED
EFFECTIVE:
OCT 03 1995
UTAH DIVISION OF OIL, GAS AND MINING

Project a vertical line to the curve represented by y_2/D and from the intersection of the line H/D and the curve y_2/D, project a horizontal line to the vertical axis for a d_s/D value where d_s is the scour depth. Using an

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

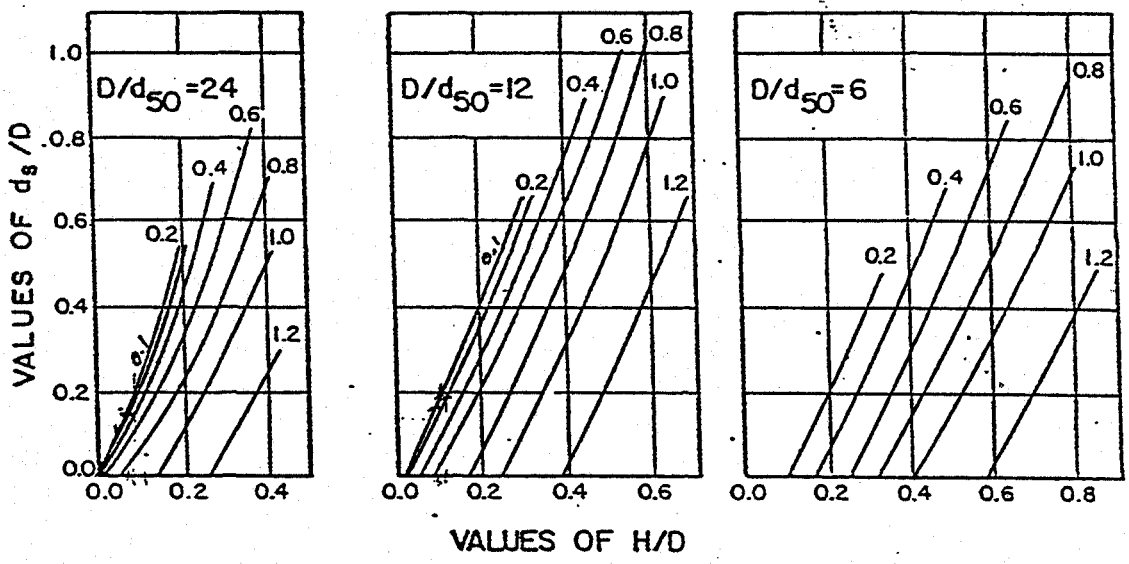
HANSEN ALLEN & LUCE INC

CLIENT Western States Minerals
PROJECT U.B. King Mine
FEATURE Plunge Pool Design
PROJECT NO. 102.02.100

SHEET 4 OF 8
COMPUTED KLS
CHECKED
DATE 9-8-93

Figure XII-2

NUMBERS ON CURVES ARE VALUES OF y_2/D



The attached computer printouts present the plunge pool design results for each of the plunge pools based on the procedures presented herein.

Note that the computer printouts present variable plunge pool dimensions based on the height of the drop. The riprap thickness is also presented as a variable dependant upon the height of the drop and the D_{50} size of the riprap. An exact design for the plunge pool and riprap will be determined after the exploration phase of construction when the drop height is determined.

Options for design details for the plunge pool begin on sheet 8 of these calculations.

INCORPORATED
EFFECTIVE
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

5/8

CLIENT: Western States Minerals
PROJECT: JB King Mine
FEATURE: Plunge Pool #1 Design
PROJ. #: 102.02.100
DATE: 09/03/93

POOL SIZE DESIGN - Based on "Open-Channel Hydraulics", Ven T. Chow, 1959

Flowrate: 30.5 cfs
Channel Width
upstream: 6 feet
downstream: 6 feet
Flowrate per foot
upstream: 5.08333 cfs/f

Drop Height D (ft)	Drop Number	Drop Length Ld (ft)	Pool Depth Yp (ft)	Toe Depth Y1 (ft)	Sequent Depth Y2 (ft)	Toe Vel. (fps)	Froude Number F1	L/Y2 From Chow Pg. 428	Pool Length L (ft)	Total Length (ft)
10	8.02E-04	6.276	2.08	0.261	2.423	19.5	6.715	6.10	14.8	21.1
12	4.64E-04	6.497	2.22	0.248	2.508	20.5	7.240	6.15	15.4	21.9
14	2.92E-04	6.690	2.34	0.238	2.583	21.4	7.715	6.15	15.9	22.6
16	1.96E-04	6.862	2.45	0.229	2.649	22.2	8.152	6.15	16.3	23.2
18	1.38E-04	7.017	2.55	0.222	2.709	22.9	8.558	6.15	16.7	23.7
20	1.00E-04	7.159	2.64	0.216	2.764	23.6	8.938	6.15	17.0	24.2
22	7.54E-05	7.290	2.73	0.210	2.814	24.2	9.296	6.10	17.2	24.5
24	5.81E-05	7.412	2.81	0.205	2.861	24.8	9.636	6.10	17.5	24.9
26	4.57E-05	7.525	2.88	0.201	2.905	25.3	9.959	6.07	17.6	25.2
28	3.66E-05	7.632	2.96	0.197	2.946	25.8	10.268	6.05	17.8	25.5
30	2.97E-05	7.733	3.03	0.193	2.985	26.3	10.565	6.03	18.0	25.7

RIPRAP DESIGN - Based on "Evaluation of and Design Recommendations for Drop Structures in the Denver Metropolitan Area", Urban Drainage and Flood Control District, 1986

Channel Width: 6 feet
Upstream Depth H: 1.5 feet
Riprap Density: 150 pcf
H2O Density: 62.4 pcf
H2O Mass Dens.: 1.936 lb-s2/f4
Sideslopes: 3 ?H:1V
Safety Factor: 1.5

Drop Height D (ft)	Riprap D50 (in)	Y2/D	D/D50	H/D	ds/D From Graphs Fig. XII-2	Scour Depth ds (ft)	Riprap Thick. (ft)
10	12	0.24	10.00	0.15	0.20	2.00	3.00
12	12	0.21	12.00	0.13	0.19	2.28	3.42
14	14	0.18	12.00	0.11	0.18	2.52	3.78
16	14	0.17	13.71	0.09	0.18	2.88	4.32
18	14	0.15	15.43	0.08	0.18	3.24	4.86
20	14	0.14	17.14	0.08	0.17	3.40	5.10
22	14	0.13	18.86	0.07	0.17	3.74	5.61
24	14	0.12	20.57	0.06	0.16	3.84	5.76
26	14	0.11	22.29	0.06	0.16	4.16	6.24
28	14	0.11	24.00	0.05	0.15	4.20	6.30
30	16	0.10	22.50	0.05	0.15	4.50	6.75

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

6/8

CLIENT: Western States Minerals
PROJECT: JB King Mine
FEATURE: Plunge Pool #2 Design
PROJ. #: 102.02.100
DATE: 09/03/93

POOL SIZE DESIGN - Based on "Open-Channel Hydraulics", Ven T. Chow, 1959

Flowrate: 14 cfs
Channel Width
upstream: 5 feet
downstream: 5 feet
Flowrate per foot
upstream: 2.8 cfs/f

Drop Height D (ft)	Drop Number	Drop Length Ld (ft)	Pool Depth Yp (ft)	Toe Depth Y1 (ft)	Sequent Depth Y2 (ft)	Toe Vel. (fps)	Froude Number F1	L/Y2 From Chow Pg. 428	Pool Length L (ft)	Total Length (ft)
10	2.43E-04	4.548	1.60	0.157	1.756	17.8	7.912	6.10	10.7	15.3
12	1.41E-04	4.708	1.71	0.150	1.818	18.7	8.530	6.13	11.1	15.9
14	8.87E-05	4.848	1.80	0.143	1.872	19.5	9.090	6.15	11.5	16.4
16	5.94E-05	4.973	1.88	0.138	1.920	20.3	9.604	6.15	11.8	16.8
18	4.17E-05	5.085	1.96	0.134	1.963	20.9	10.083	6.15	12.1	17.2
20	3.04E-05	5.188	2.03	0.130	2.003	21.5	10.530	6.15	12.3	17.5
22	2.29E-05	5.283	2.10	0.127	2.039	22.1	10.953	6.15	12.5	17.8
24	1.76E-05	5.371	2.16	0.124	2.073	22.7	11.353	6.15	12.8	18.1
26	1.39E-05	5.453	2.22	0.121	2.105	23.2	11.734	6.13	12.9	18.4
28	1.11E-05	5.531	2.28	0.118	2.135	23.6	12.098	6.13	13.1	18.6
30	9.02E-06	5.604	2.33	0.116	2.163	24.1	12.448	6.10	13.2	18.8

RIPRAP DESIGN - Based on "Evaluation of and Design Recommendations for Drop Structures in the Denver Metropolitan Area", Urban Drainage and Flood Control District, 1986

Channel Width: 5 feet
Upstream Depth H: 1 feet
Riprap Density: 150 pcf
H2O Density: 62.4 pcf
H2O Mass Dens.: 1.936 lb-s2/f4
Sideslopes: 3 ?H:1V
Safety Factor: 1.5

Drop Height D (ft)	Riprap D50 (in)	Y2/D	D/D50	H/D	ds/D From Graphs Fig. XII-2	Scour Depth ds (ft)	Riprap Thick. (ft)
10	12	0.18	10.00	0.10	0.19	1.90	2.85
12	12	0.15	12.00	0.08	0.19	2.28	3.42
14	14	0.13	12.00	0.07	0.18	2.52	3.78
16	14	0.12	13.71	0.06	0.16	2.56	3.84
18	14	0.11	15.43	0.06	0.16	2.88	4.32
20	14	0.10	17.14	0.05	0.14	2.80	4.20
22	14	0.09	18.86	0.05	0.14	3.08	4.62
24	14	0.09	20.57	0.04	0.13	3.12	4.68
26	14	0.08	22.29	0.04	0.13	3.38	5.07
28	14	0.08	24.00	0.04	0.13	3.64	5.46
30	16	0.07	22.50	0.03	0.12	3.60	5.40

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

7/8

CLIENT: Western States Minerals
PROJECT: JB King Mine
FEATURE: Plunge Pool #3 Design (optional)
PROJ. #: 102.02.100
DATE: 09/03/93

POOL SIZE DESIGN - Based on "Open-Channel Hydraulics", Ven T. Chow, 1959

Flowrate: 2 cfs
Channel Width
upstream: 3 feet
downstream: 3 feet
Flowrate per foot
upstream: 0.66667 cfs/f

Drop Height D (ft)	Drop Number	Drop Length Ld (ft)	Pool Depth Yp (ft)	Toe Depth Y1 (ft)	Sequent Depth Y2 (ft)	Toe Vel. (fps)	Froude Number F1	L/Y2 From Chow Pg. 428	Pool Length L (ft)	Total Length (ft)
10	1.38E-05	2.095	0.85	0.046	0.809	14.4	11.740	6.02	4.9	7.0
12	7.99E-06	2.169	0.91	0.044	0.837	15.1	12.657	6.00	5.0	7.2
14	5.03E-06	2.234	0.96	0.042	0.862	15.7	13.488	5.95	5.1	7.4
16	3.37E-06	2.291	1.00	0.041	0.884	16.3	14.252	5.90	5.2	7.5
18	2.37E-06	2.343	1.04	0.040	0.904	16.9	14.961	5.85	5.3	7.6
20	1.73E-06	2.390	1.08	0.038	0.923	17.4	15.626	5.82	5.4	7.8
22	1.30E-06	2.434	1.11	0.037	0.940	17.8	16.252	5.80	5.4	7.9
24	9.98E-07	2.475	1.15	0.037	0.955	18.3	16.846	5.75	5.5	8.0
26	7.85E-07	2.512	1.18	0.036	0.970	18.7	17.412	5.70	5.5	8.0
28	6.29E-07	2.548	1.21	0.035	0.984	19.1	17.952	5.65	5.6	8.1
30	5.11E-07	2.582	1.24	0.034	0.997	19.4	18.470	5.60	5.6	8.2

RIPRAP DESIGN - Based on "Evaluation of and Design Recommendations for Drop Structures in the Denver Metropolitan Area", Urban Drainage and Flood Control District, 1986

Channel Width: 6 feet
Upstream Depth H: 1.5 feet
Riprap Density: 150 pcf
H2O Density: 62.4 pcf
H2O Mass Dens.: 1.936 lb-s2/f4
Sideslopes: 3 ?H:1V
Safety Factor: 1.5

Drop Height D (ft)	Riprap D50 (in)	Y2/D	D/D50	H/D	ds/D From Graphs Fig. XII-2	Scour Depth ds (ft)	Riprap Thick. (ft)
10	12	0.08	10.00	0.15	0.18	1.80	2.70
12	12	0.07	12.00	0.13	0.19	2.28	3.42
14	14	0.06	12.00	0.11	0.18	2.52	3.78
16	14	0.06	13.71	0.09	0.16	2.56	3.84
18	14	0.05	15.43	0.08	0.16	2.88	4.32
20	14	0.05	17.14	0.08	0.14	2.80	4.20
22	14	0.04	18.86	0.07	0.14	3.08	4.62
24	14	0.04	20.57	0.06	0.13	3.12	4.68
26	14	0.04	22.29	0.06	0.13	3.38	5.07
28	14	0.04	24.00	0.05	0.13	3.64	5.46
30	16	0.03	22.50	0.05	0.12	3.60	5.40

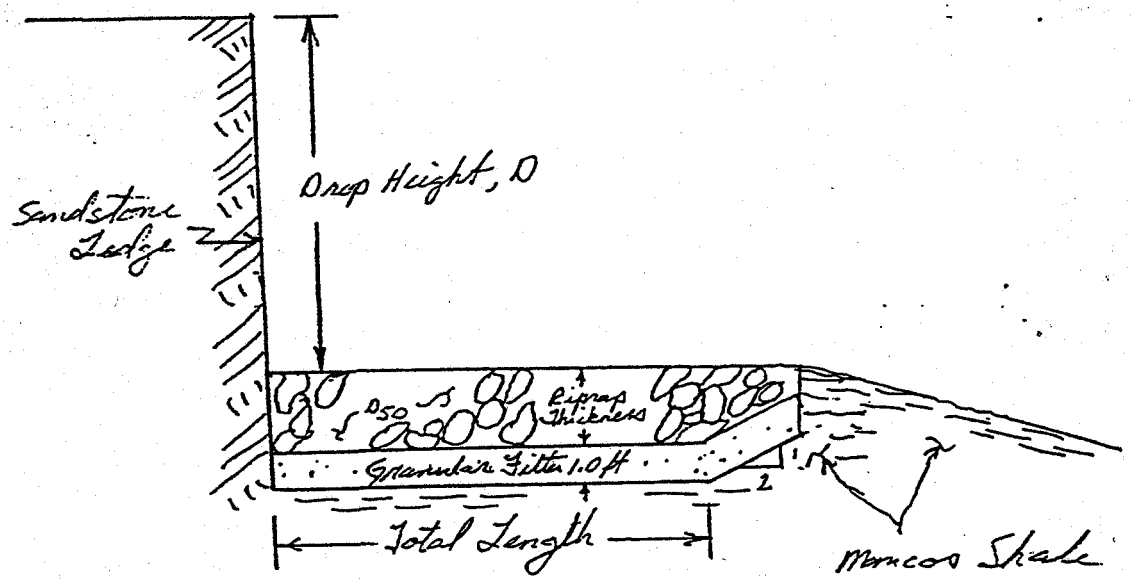
INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

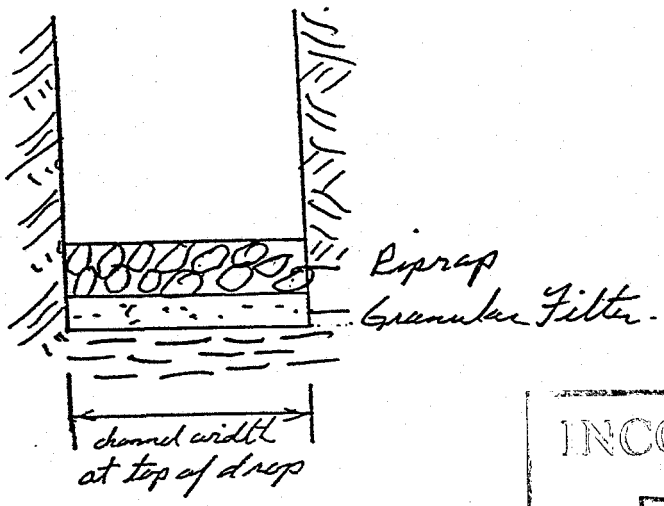
CLIENT Western States Minerals
PROJECT J.B. King Mine
FEATURE Plunge Pool Design
PROJECT NO. 102102.100

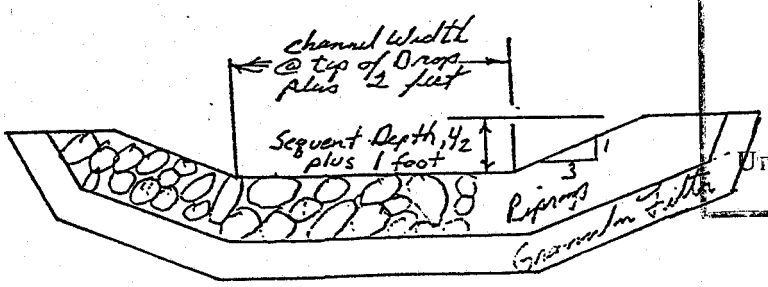
SHEET 8 OF 8
COMPUTED KLS
CHECKED
DATE 9-8-93

Plunge Pool Design Details
See computer printout pages for dimensions



section where drop is cut back into the sandstone ledge





INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Appendix 3
Ditch Design

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Trapezoidal Channel Flow Calculations using Mannings Equation

Client	: J.B. King	Date	: 23-Aug-94
Project No.	: 102.02.100	Time	: 10:25 AM
Channel Section:	Ditch 3	Computed:	BJB

			UNITS
GENERAL CRITERIA:	Design Flow:	51.50	cfs
	Bottom Width:	3.0	feet
	Side Slope1:	1.0	1/m1
	Side Slope2:	1.0	1/m2
	Friction Factor:		
	Assumed D50:	0.00	feet
	Calc n Value:	0.000	
	Used:	0.035	
	Min. Bottom Slope:	0.090	ft/ft
	Max. Bottom Slope:	0.090	ft/ft
	Freeboard:	1.00	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	1.16	feet
	Q-1.49AR(2/3)S(1/2)/n=	-0.002	Accuracy
	Required Depth:	2.16	feet
	Area:	4.81	ft2
	Perimeter:	6.27	feet
	Hydraulic Radius:	0.77	feet
	Velocity:	10.70	ft/sec
	Riprap Ck (V<5?):	Required	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.05	feet
	Q-1.49AR(2/3)S(1/2)/n=	51.260	Accuracy
	Required Depth:	0.55	feet
	Area:	0.15	ft2
	Perimeter:	3.13	feet
	Hydraulic Radius:	0.05	feet
	Velocity:	354.39	ft/sec
	Riprap Ck (V<5?):	Required	

DESIGN CRITERIA:	Bottom Width:	3.0	feet
	Side Slope 1:	1.0	1/m1
	Side Slope 2:	1.0	1/m2
	Min. Bottom Slope:	9.0	%
	Max. Bottom Slope:	9.0	%
	Min Channel Depth:	2.16	feet
	Riprap (Min S):	Required	
	Riprap (Max S):	Required	

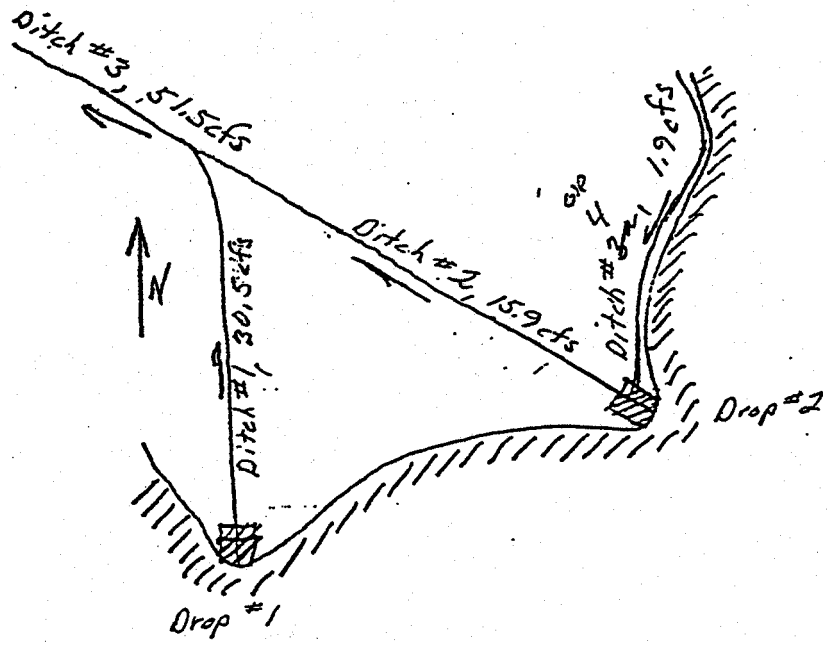
INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

CLIENT Western States Minerals
PROJECT JB King Mine
FEATURE Ditch Hydraulics
PROJECT NO. 102 020 100

SHEET 1 OF 3
COMPUTED KCS
CHECKED
DATE 9-8-93

Determine the ditch dimensions downstream of the plunge pools required to carry the determined flowrates from the 100yr 6hr precipitation event. The flowrates used in these calculations were obtained from "JB King Mine Proposed Erosion Control Plan," June 1992.



Assume ditches 1, 2 & 3 are to be excavated into the underlying noncoos shale material which will provide natural erosion control similar to the other natural and undisturbed channels in the area. The controlling design criteria will be the channel dimensions along the flattest slopes of the ditches. The steeper reaches of the ditches, in profile, will not exceed the steepness of other natural drainage channels in the area. Assume the channels to be naturally erodible comparable to the other natural drainage channels in the area.

Assume for Manning's equation $n = 0.03$

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Ditch No. 1: $Q = 30.5$ cfs
$S = 5\%$ approx. min.

Ditch No. 2: $Q = 15.9$ cfs
$S = 5\%$ approx. min.

Ditch No 3a: $Q = 1.9$ cfs (4 cfs)

HANSEN ALLEN & LUCE INC

CLIENT Western States Minerals
PROJECT J B King Mine
FEATURE Ditch Hydraulics
PROJECT NO. 102.02.100

SHEET 2 OF 3
COMPUTED KCS
CHECKED
DATE 9-9-93

CLIENT: Western States Minerals
PROJECT: J B King Mine
FEATURE: Ditch Hydraulics
PROJECT#: 102.02.100
DATE: 08-Sep-93

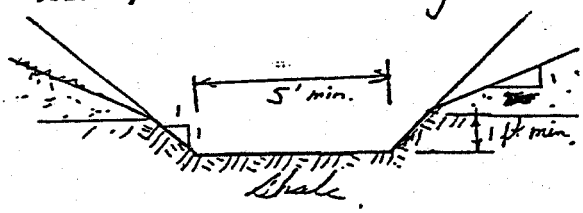
FIND: Ditch No. 1 Dimensions

Manning Equation Solution for Normal Flow Depth
(Trapezoidal Channel)

Flow (Q)	=	30.5 cfs
Manning n (n)	=	0.03
Botton Width (b)	=	5 feet
Sideslope 1 (z1)	=	1 ?H:1V
Sideslope 2 (z2)	=	1 ?H:1V
Slope (So)	=	0.05
Normal Depth (y)	=	0.700 feet
Flow x-section area (A)	=	3.988 sq. ft.
Flow Top Width (T)	=	6.399 feet
Perimeter (P)	=	6.979 feet
Flow Velocity (V)	=	7.648 ft/sec.
Froude Number	=	1.707
Solve Equation	=	0.000

Ditch No. 1

excavate to a minimum depth of 1 ft into the shale. Ditch sideslopes in the shale may be 1H:1V.



Sideslopes above the shale should be 2.5:1 or flatter from the top of the shale to the existing ground surface. Freeboard is provided in the ditch by 0.3' in the shale and the rest (0.7' min) above the shale.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

CLIENT: Western States Minerals
PROJECT: J B King Mine
FEATURE: Ditch Hydraulics
PROJECT#: 102.02.100
DATE: 08-Sep-93

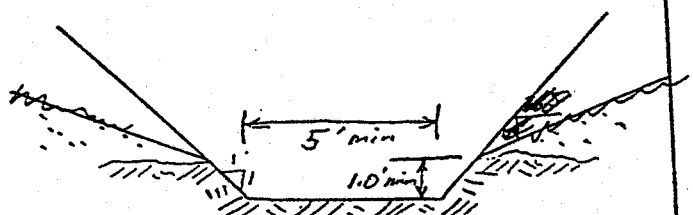
FIND: Ditch No. 2 Dimensions

Ditch No. 2

Excavate to a minimum depth of 1 ft. into the shale. Ditch sideslopes in the shale may be 1H:1V. Excavated sideslopes above the shale should be 2.5 H:1V or flatter from the top of the shale to the existing ground surface. Freeboard is provided by 0.5 ft in the shale and the rest (0.5' min.) in the excavation above the shale.

Manning Equation Solution for Normal Flow Depth
(Trapezoidal Channel)

Flow (Q)	=	15.9 cfs
Manning n (n)	=	0.03
Botton Width (b)	=	5 feet
Sideslope 1 (z1)	=	1 ?H:1V
Sideslope 2 (z2)	=	1 ?H:1V
Slope (So)	=	0.05
Normal Depth (y)	=	0.474 feet
Flow x-section area (A)	=	2.596 sq. ft.
Flow Top Width (T)	=	5.949 feet
Perimeter (P)	=	6.342 feet
Flow Velocity (V)	=	6.124 ft/sec.
Froude Number	=	1.633



HANSEN ALLEN & LUCE inc

CLIENT Western States Minerals
PROJECT J B King Mine
FEATURE Ditch Hydraulics
PROJECT NO. 102.02.100

SHEET 3 OF 3
COMPUTED KCS
CHECKED
DATE 9-9-93

CLIENT: Western States Minerals
PROJECT: J B King Mine
FEATURE: Ditch Hydraulics
PROJECT#: 102.02.100
DATE: 08-Sep-93

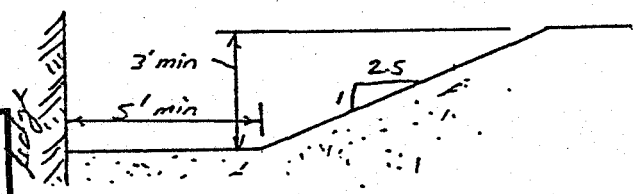
FIND: Ditch No. 3a Dimensions

Manning Equation Solution for Normal Flow Depth
(Trapezoidal Channel)

Flow (Q)	=	1.9 cfs	1.9 cfs
Manning n (n)	=	0.03	0.03
Bottom Width (b)	=	0 feet	5 feet
Sideslope 1 (z1)	=	0 ?H:1V	0 ?H:1V
Sideslope 2 (z2)	=	2.5 ?H:1V	2.5 ?H:1V
Slope (So)	=	0.09	0.09
Normal Depth (y)	=	0.557 feet	0.111 feet
Flow x-section area (A)	=	0.388 sq. ft.	0.571 sq. ft.
Flow Top Width (T)	=	1.392 feet	5.278 feet
Perimeter (P)	=	2.057 feet	5.410 feet
Flow Velocity (V)	=	4.899 ft/sec.	3.328 ft/sec.
Froude Number	=	1.636	1.783
Solve Equation	=	0.000	0.000

Ditch No. ~~3~~ 4 GIP

To be excavated at the base of the sand stone ledge to receive runoff from above the ledge and direct the runoff to ditch no. 2. Construct the ditch with 5' min. bottom width, 3' min depth, vertical side against the ledge, 2.5H:1V or flatter sideslopes otherwise, Max. ditch slope is 9% to reduce erosion potential. This will also reduce erosion potential from concentrated flows in the 5' wide channel. The ditch is constructed larger to reduce effects of spalling material from the ledge falling the ditch.



INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

CLIENT: Western States Minerals
PROJECT: J B King Mine
FEATURE: Ditch Hydraulics
PROJECT#: 102.02.100
DATE: 08-Sep-93

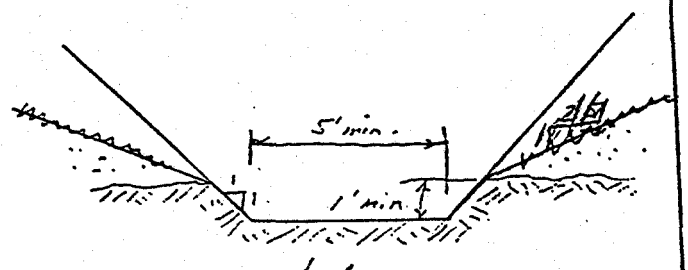
FIND: ~~Ditch No. 3 Dimensions~~

Ditch No. 3

Excavate to a minimum depth of 1 ft. into the shale. Ditch sideslopes in the shale may be 1H:1V. Excavated sideslopes above the shale should be 2.5H:1V or flatter from the top of the shale to the existing ground surface. Freeboard is provided by 1.0' minimum in the excavation above the shale.

Manning Equation Solution for Normal Flow Depth
(Trapezoidal Channel)

Flow (Q)	=	51.5 cfs
Manning n (n)	=	0.03
Bottom Width (b)	=	5 feet
Sideslope 1 (z1)	=	1 ?H:1V
Sideslope 2 (z2)	=	1 ?H:1V
Slope (So)	=	0.05
Normal Depth (y)	=	0.954 feet
Flow x-section area (A)	=	5.679 sq. ft.
Flow Top Width (T)	=	6.908 feet
Perimeter (P)	=	7.698 feet
Flow Velocity (V)	=	9.068 ft/sec.
Froude Number	=	1.762



REVISED RUNOFF CALCULATIONS FOR ALTERNATIVE 3

ALTERNATIVE 3 INVOLVES DIVERTING FLOW FROM THE UPPER ENDS ON AREAS 1 AND 2: IN ORDER TO DETERMINE DITCH SIZES FOR THE DIVERSIONS AS WELL AS FOR THE RUNOFF WHICH WILL BE CONTROLLED ON SITE IT IS NECESSARY TO SUB-DIVIDE EACH AREA. AREAS 1 AND 2 HAVE BEEN DIVIDED INTO 3 SUBAREAS – THE UPPER AREA WHICH IS ABOVE THE OFF SITE DIVERSION DITCHES, THE "MIDDLE" WHICH IS AREA BELOW THE DIVERSION DITCHES AND ABOVE THE CLIFF, AND THE LOWER WHICH IS THE AREA BELOW THE CLIFF. AREAS 3 AND 4 HAVE BEEN DIVIDED INTO THE UPPER AREAS ABOVE THE CLIFF AND THE LOWER AREAS WHICH ARE BELOW THE CLIFF.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE inc

CLIENT WSMC
PROJECT J.B. KING
FEATURE
PROJECT NO.

COMPUTED
CHECKED
DATE

REVISED RUNOFF CALCULATIONS - ALTERNATIVES 2 & 3

AREA - 1

UPPER	11.00 × 3.0473 × 40,000	=	30.8 ACRES
MIDDLE	2.29	=	6.4
LOWER	0.22	=	0.6

AREA - 2

UPPER	3.82	=	10.7
MIDDLE	1.89	=	5.3
LOWER	0.34	=	1.0

AREA 3

UPPER	0.74	=	2.1
LOWER	0.75	=	2.1

AREA 4

UPPER	1.78	=	5.0
LOWER	1.05	=	2.9

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

REVISED RUNOFF FROM AREA 1

UPPER: AREA 30.8 ACRES
SLOPE 10.1%
HYDRAULIC LENGTH 2,050 FT.
100 YR. 6HR STORM 1.8"
CURVE NUMBER 90

FROM "HYDRO" PEAK RUNOFF FLOW IS 24.9 CFS

MIDDLE: AREA 6.4 ACRES
SLOPE 10.1%
HYDRAULIC LENGTH 700 FT.
100 YR. 6 HR. STORM 1.8"
CURVE NUMBER 90

FROM "HYDRO" PEAK RUNOFF FLOW IS 5.6 CFS

LOWER: AREA 0.6 ACRES
SLOPE 14%
HYDRAULIC LENGTH 200 FT.
100 YR. 6HR STORM 1.8"
CURVE NUMBER 90

FROM "HYDRO" PEAK RUNOFF FLOW IS: 0.6 CFS

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

16

PROJECT : J.B. King Revised Area 1 Top (UPPER)

AREA= 30.8 ACRES
AVERAGE BASIN SLOPE= 10.1 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 2050. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OF OIL, GAS AND MINING

TP= .1385 HOURS QPCFS= 168.19 CFS QPIN= 5.4165 INCHES
C3= 26.6932 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.38	.2202	.0000	.0000	.0	.00
1.41	.2257	.0000	.0000	8.4	.00
1.44	.2312	.0000	.0000	52.2	.00
1.47	.2367	.0002	.0001	111.7	.00
1.50	.2421	.0004	.0002	154.4	.02
1.52	.2510	.0007	.0004	168.2	.04
1.55	.2605	.0013	.0005	157.6	.07
1.58	.2699	.0020	.0007	133.0	.13
1.61	.2794	.0028	.0008	104.0	.22
1.63	.2889	.0038	.0010	76.8	.32
1.66	.2983	.0049	.0011	54.1	.45
1.69	.3078	.0061	.0012	36.7	.59
1.72	.3173	.0075	.0014	24.2	.73
1.74	.3268	.0090	.0015	15.5	.88
1.77	.3362	.0106	.0016	9.8	1.03
1.80	.3457	.0124	.0017	6.0	1.18
1.83	.3552	.0142	.0019	3.6	1.33
1.86	.3647	.0162	.0020	2.2	1.47
1.88	.3741	.0183	.0021	1.3	1.62
1.91	.3836	.0205	.0022	.7	1.76
1.94	.3931	.0228	.0023	.4	1.89
1.97	.4025	.0252	.0024	.2	2.02
1.99	.4120	.0277	.0025	.1	2.16
2.02	.4432	.0366	.0090	.0	2.34
2.35	.8859	.2482	.0221	.0	19.89
2.38	.9228	.2709	.0227	.0	20.93
2.41	.9596	.2942	.0233	.0	21.88
2.44	.9965	.3180	.0238	.0	22.76
2.47	1.0334	.3423	.0243	.0	23.58
2.49	1.0703	.3671	.0248	.0	24.34
2.52	1.0874	.3787	.0116	.0	24.93
2.55	1.0973	.3856	.0068	.0	24.84
2.58	1.1073	.3924	.0069	.0	23.67
2.60	1.1173	.3993	.0069	.0	21.55

PROJECT : J.B. King Revised Area 1 Top
(Continued)

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
2.63	1.1272	.4063	.0069	.0	18.95
2.66	1.1372	.4132	.0070	.0	16.33
2.69	1.1472	.4202	.0070	.0	14.02

HYDROGRAPH PEAK= 24.93 cfs
TIME TO PEAK= 2.52 Hours
RUNOFF VOLUME= 2.37 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 1 Middle

AREA= 6.4 ACRES
AVERAGE BASIN SLOPE= 10.1 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 700. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0586 HOURS QPCFS= 82.56 CFS QPIN=12.7928 INCHES
C3= 63.0558 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	8.4	.00
1.42	.2281	.0000	.0000	42.2	.00
1.44	.2311	.0000	.0000	73.3	.00
1.45	.2341	.0001	.0000	82.5	.00
1.47	.2371	.0002	.0000	73.1	.00
1.48	.2400	.0003	.0000	55.7	.01
1.50	.2430	.0004	.0001	38.2	.02
1.51	.2481	.0006	.0002	24.3	.03
1.53	.2533	.0008	.0003	14.6	.04
1.54	.2584	.0011	.0003	8.4	.05
1.56	.2635	.0015	.0003	4.6	.07
1.57	.2686	.0019	.0004	2.5	.09
1.59	.2738	.0023	.0004	1.3	.11
1.60	.2789	.0028	.0005	.7	.13
1.62	.2840	.0033	.0005	.3	.15
1.63	.2892	.0038	.0005	.2	.16
1.65	.2943	.0044	.0006	.0	.18
2.41	.9668	.2987	.0127	.0	5.19
2.43	.9868	.3116	.0129	.0	5.26
2.45	1.0067	.3247	.0130	.0	5.34
2.46	1.0267	.3379	.0132	.0	5.41
2.48	1.0467	.3512	.0133	.0	5.48
2.49	1.0667	.3647	.0135	.0	5.54
2.51	1.0818	.3749	.0103	.0	5.58
2.52	1.0872	.3786	.0037	.0	5.45
2.54	1.0926	.3823	.0037	.0	4.98
2.55	1.0980	.3860	.0037	.0	[illegible]
2.57	1.1034	.3897	.0037	.0	[illegible]
2.58	1.1088	.3935	.0037	.0	2.87
2.60	1.1142	.3972	.0037	.0	2.39

HYDROGRAPH PEAK= 5.58 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .49 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 1 Bottom (LOWER)

AREA= .6 ACRES
AVERAGE BASIN SLOPE= 14.0 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 200. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0183 HOURS QPCFS= 24.83 CFS QPIN=41.0321 INCHES
C3=202.2473 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	23.2	.00
1.42	.2281	.0000	.0000	14.5	.00
1.44	.2311	.0000	.0000	3.1	.00
1.45	.2341	.0001	.0000	.4	.00
1.47	.2371	.0002	.0000	.0	.00
2.40	.9468	.2860	.0126	.0	.52
2.41	.9668	.2987	.0127	.0	.52
2.43	.9868	.3116	.0129	.0	.53
2.45	1.0067	.3247	.0130	.0	.54
2.46	1.0267	.3379	.0132	.0	.54
2.48	1.0467	.3512	.0133	.0	.55
2.49	1.0667	.3647	.0135	.0	.55
2.51	1.0818	.3749	.0103	.0	.46
2.52	1.0872	.3786	.0037	.0	.28
2.54	1.0926	.3823	.0037	.0	.18
2.55	1.0980	.3860	.0037	.0	.16
2.57	1.1034	.3897	.0037	.0	.15
2.58	1.1088	.3935	.0037	.0	.15

HYDROGRAPH PEAK= .55 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .05 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

REVISED RUNOFF FROM AREA 2

UPPER: AREA .. 10.7 ACRES
SLOPE 18.9 %
HYDRAULIC LENGTH 1000 FT.
100 YR. 6 HR. STORM 1.8"
CURVE NUMBER 90

FROM "HYDRO" PEAK RUNOFF FLOW IS 9.3 CFS

MIDDLE: AREA 5.3 ACRES
SLOPE 18.9%
HYDRAULIC LENGTH 600 FT.
100 YR. 6 HR STORM 1.8"
CURVE NUMBER 90

FROM "HYDRO" PEAK RUNOFF FLOW IS 4.7 CFS

LOWER: AREA 1.0 ACRES
SLOPE 14 %
HYDRAULIC LENGTH 350 FT.
100 YR. 6 HR STORM 1.8"
CURVE NUMBER 90

FROM "HYDRO" PEAK RUNOFF FLOW IS 0.9 CFS

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 2 Top (UPPER)

AREA= 10.7 ACRES
AVERAGE BASIN SLOPE= 18.9 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 1000. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0570 HOURS QPCFS= 141.94 CFS QPIN=13.1557 INCHES
C3= 64.8446 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	15.5	.00
1.42	.2281	.0000	.0000	76.2	.00
1.44	.2311	.0000	.0000	129.0	.00
1.45	.2341	.0001	.0000	141.2	.00
1.47	.2371	.0002	.0000	121.8	.01
1.48	.2400	.0003	.0000	90.4	.02
1.50	.2430	.0004	.0001	60.4	.03
1.51	.2481	.0006	.0002	37.4	.04
1.53	.2533	.0008	.0003	21.9	.06
1.54	.2584	.0011	.0003	12.2	.09
1.56	.2635	.0015	.0003	6.6	.12
1.57	.2686	.0019	.0004	3.4	.15
1.59	.2738	.0023	.0004	1.7	.18
1.60	.2789	.0028	.0005	.9	.22
1.62	.2840	.0033	.0005	.4	.25
1.63	.2892	.0038	.0005	.2	.28
1.65	.2943	.0044	.0006	.0	.31
2.41	.9668	.2987	.0127	.0	8.69
2.43	.9868	.3116	.0129	.0	8.82
2.45	1.0067	.3247	.0130	.0	8.94
2.46	1.0267	.3379	.0132	.0	9.06
2.48	1.0467	.3512	.0133	.0	9.18
2.49	1.0667	.3647	.0135	.0	9.29
2.51	1.0818	.3749	.0103	.0	9.34
2.52	1.0872	.3786	.0037	.0	9.09
2.54	1.0926	.3823	.0037	.0	8.25
2.55	1.0980	.3860	.0037	.0	7.00
2.57	1.1034	.3897	.0037	.0	5.72
2.58	1.1088	.3935	.0037	.0	4.65
2.60	1.1142	.3972	.0037	.0	[illegible]

HYDROGRAPH PEAK= 9.34 cfs
TIME TO PEAK= 2.50 Hours
RUNOFF VOLUME= .83 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 2 Middle

AREA= 5.3 ACRES
AVERAGE BASIN SLOPE= 18.9 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 600. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0379 HOURS QPCFS= 105.80 CFS QPIN=19.7968 INCHES
C3= 97.5782 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	32.1	.00
1.42	.2281	.0000	.0000	96.4	.00
1.44	.2311	.0000	.0000	99.8	.00
1.45	.2341	.0001	.0000	66.9	.00
1.47	.2371	.0002	.0000	35.3	.01
1.48	.2400	.0003	.0000	16.0	.02
1.50	.2430	.0004	.0001	6.6	.02
1.51	.2481	.0006	.0002	2.5	.03
1.53	.2533	.0008	.0003	.9	.05
1.54	.2584	.0011	.0003	.3	.07
1.56	.2635	.0015	.0003	.0	.08
2.40	.9468	.2860	.0126	.0	4.36
2.41	.9668	.2987	.0127	.0	4.42
2.43	.9868	.3116	.0129	.0	4.48
2.45	1.0067	.3247	.0130	.0	4.53
2.46	1.0267	.3379	.0132	.0	4.59
2.48	1.0467	.3512	.0133	.0	4.64
2.49	1.0667	.3647	.0135	.0	4.70
2.51	1.0818	.3749	.0103	.0	4.64
2.52	1.0872	.3786	.0037	.0	4.15
2.54	1.0926	.3823	.0037	.0	3.22
2.55	1.0980	.3860	.0037	.0	2.36
2.57	1.1034	.3897	.0037	.0	1.81
2.58	1.1088	.3935	.0037	.0	1.53

HYDROGRAPH PEAK= 4.70 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .41 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 2 Bottom (LOWER)

AREA= 1.0 ACRES
AVERAGE BASIN SLOPE= 14.0 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 350. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0286 HOURS QPCFS= 26.44 CFS QPIN=26.2237 INCHES
C3=129.2565 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	14.1	.00
1.42	.2281	.0000	.0000	26.3	.00
1.44	.2311	.0000	.0000	17.0	.00
1.45	.2341	.0001	.0000	7.1	.00
1.47	.2371	.0002	.0000	2.3	.00
1.48	.2400	.0003	.0000	.7	.00
1.50	.2430	.0004	.0001	.2	.00
1.51	.2481	.0006	.0002	.0	.00
2.40	.9468	.2860	.0126	.0	.83
2.41	.9668	.2987	.0127	.0	.85
2.43	.9868	.3116	.0129	.0	.86
2.45	1.0067	.3247	.0130	.0	.87
2.46	1.0267	.3379	.0132	.0	.88
2.48	1.0467	.3512	.0133	.0	.89
2.49	1.0667	.3647	.0135	.0	.90
2.51	1.0818	.3749	.0103	.0	.86
2.52	1.0872	.3786	.0037	.0	.69
2.54	1.0926	.3823	.0037	.0	.46
2.55	1.0980	.3860	.0037	.0	.33
2.57	1.1034	.3897	.0037	.0	.27
2.58	1.1088	.3935	.0037	.0	.26

HYDROGRAPH PEAK= .90 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .08 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

CLIENT WSMC
PROJECT J. B. KING
FEATURE
PROJECT NO.

SHEET 24 OF 31
COMPUTED
CHECKED
DATE

REVISED RUNOFF AREA 3

UPPER: AREA 2.1 ACRES
SLOPE 29.9%
HYDRAULIC LENGTH 450'
CURVE NUMBER 90
100 YR. 6HR. STORM 1.8"

FROM "HYDRO" PEAK RUNOFF FLOW IS 1.9 CFS

LOWER: AREA 2.1 ACRES
SLOPE 17%
HYDRAULIC LENGTH 500'
CURVE NUMBER 90
100 YR. 6 HR. STORM 1.8"

FROM "HYDRO" PEAK RUNOFF FLOW IS 1.9 CFS

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 3 Top (UPPER)

AREA= 2.1 ACRES
AVERAGE BASIN SLOPE= 29.9 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 450. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0239 HOURS QPCFS= 66.37 CFS QPIN=31.3437 INCHES
C2=154.4928 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	46.9	.00
1.42	.2281	.0000	.0000	59.9	.00
1.44	.2311	.0000	.0000	26.4	.00
1.45	.2341	.0001	.0000	7.5	.00
1.47	.2371	.0002	.0000	1.7	.00
1.48	.2400	.0003	.0000	.3	.00
1.50	.2430	.0004	.0001	.0	.01
2.40	.9468	.2860	.0126	.0	1.77
2.41	.9668	.2987	.0127	.0	1.80
2.43	.9868	.3116	.0129	.0	1.82
2.45	1.0067	.3247	.0130	.0	1.84
2.46	1.0267	.3379	.0132	.0	1.86
2.48	1.0467	.3512	.0133	.0	1.88
2.49	1.0667	.3647	.0135	.0	1.90
2.51	1.0818	.3749	.0103	.0	1.77
2.52	1.0872	.3786	.0037	.0	1.27
2.54	1.0926	.3823	.0037	.0	.80
2.55	1.0980	.3860	.0037	.0	.60
2.57	1.1034	.3897	.0037	.0	.54
2.58	1.1088	.3935	.0037	.0	.53

HYDROGRAPH PEAK= 1.90 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .16 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 3 Bottom (LOWER)

AREA= 2.1 ACRES
AVERAGE BASIN SLOPE= 17.0 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0345 HOURS QPCFS= 46.00 CFS QPIN=21.7236 INCHES
C3=107.0758 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	17.1	.00
1.42	.2281	.0000	.0000	44.4	.00
1.44	.2311	.0000	.0000	39.9	.00
1.45	.2341	.0001	.0000	23.2	.00
1.47	.2371	.0002	.0000	10.6	.00
1.48	.2400	.0003	.0000	4.2	.00
1.50	.2430	.0004	.0001	1.5	.01
1.51	.2481	.0006	.0002	.5	.01
1.53	.2533	.0008	.0003	.2	.02
1.54	.2584	.0011	.0003	.0	.03
2.40	.9468	.2860	.0126	.0	1.73
2.41	.9668	.2987	.0127	.0	1.76
2.43	.9868	.3116	.0129	.0	1.78
2.45	1.0067	.3247	.0130	.0	1.80
2.46	1.0267	.3379	.0132	.0	1.83
2.48	1.0467	.3512	.0133	.0	1.85
2.49	1.0667	.3647	.0135	.0	1.87
2.51	1.0818	.3749	.0103	.0	1.83
2.52	1.0872	.3786	.0037	.0	1.59
2.54	1.0926	.3823	.0037	.0	1.17
2.55	1.0980	.3860	.0037	.0	.84
2.57	1.1034	.3897	.0037	.0	.66
2.58	1.1088	.3935	.0037	.0	.57

HYDROGRAPH PEAK= 1.87 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .16 Acre-Feet

INCORPORATED
OCT 05 199
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

CLIENT WSMC
PROJECT J.B. KING
FEATURE
PROJECT NO.

SHEET 27 OF 31
COMPUTED
CHECKED
DATE

REVISED RUNOFF AREA 4

UPPER: AREA 5.0 ACRES
SLOPE 26.2%
HYDRAULIC LENGTH 450'
CURVE NUMBER 90
100 YR. 6HR. STORM 1.8"

FROM "HYDRO" PEAK RUNOFF FLOW IS 4.5 CFS

LOWER: AREA 2.9 ACRES
SLOPE 25%
HYDRAULIC LENGTH 550 FT.
CURVE NUMBER 90
100 YR. 6HR. STORM 1.8"

FROM "HYDRO" PEAK RUNOFF FLOW IS 2.6 CFS

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 4 Top (UPPER)

AREA= 5.0 ACRES
AVERAGE BASIN SLOPE= 26.2 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 450. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0256 HOURS QPCFS= 147.93 CFS QPIN=29.3403 INCHES
C3=144.6184 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	95.0	.00
1.42	.2281	.0000	.0000	140.7	.00
1.44	.2311	.0000	.0000	72.0	.00
1.45	.2341	.0001	.0000	23.8	.01
1.47	.2371	.0002	.0000	6.2	.02
1.48	.2400	.0003	.0000	1.4	.02
1.50	.2430	.0004	.0001	.3	.03
1.51	.2481	.0006	.0002	.0	.04
2.40	.9468	.2860	.0126	.0	4.20
2.41	.9568	.2987	.0127	.0	4.26
2.43	.9868	.3116	.0129	.0	4.31
2.45	1.0067	.3247	.0130	.0	4.37
2.46	1.0267	.3379	.0132	.0	4.42
2.48	1.0467	.3512	.0133	.0	4.47
2.49	1.0667	.3647	.0135	.0	4.52
2.51	1.0818	.3749	.0103	.0	4.25
2.52	1.0872	.3786	.0037	.0	3.19
2.54	1.0926	.3823	.0037	.0	2.04
2.55	1.0980	.3860	.0037	.0	1.49
2.57	1.1034	.3897	.0037	.0	1.32
2.58	1.1088	.3935	.0037	.0	1.27

HYDROGRAPH PEAK= 4.52 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .39 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Revised Area 4 Bottom (LOWER)

AREA= 2.9 ACRES
AVERAGE BASIN SLOPE= 25.0 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 550. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0307 HOURS QPCFS= 71.38 CFS QPIN=24.4098 INCHES
CS=120.3158 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	33.4	.00
1.42	.2281	.0000	.0000	71.3	.00
1.44	.2311	.0000	.0000	52.5	.00
1.45	.2341	.0001	.0000	25.0	.00
1.47	.2371	.0002	.0000	9.4	.00
1.48	.2400	.0003	.0000	3.0	.01
1.50	.2430	.0004	.0001	.9	.01
1.51	.2481	.0006	.0002	.2	.02
1.53	.2533	.0008	.0003	.0	.03
2.40	.9468	.2860	.0126	.0	2.41
2.41	.9668	.2987	.0127	.0	2.44
2.43	.9868	.3116	.0129	.0	2.48
2.45	1.0067	.3247	.0130	.0	2.51
2.46	1.0267	.3379	.0132	.0	2.54
2.48	1.0467	.3512	.0133	.0	2.57
2.49	1.0667	.3647	.0135	.0	2.59
2.51	1.0818	.3749	.0103	.0	2.51
2.52	1.0872	.3786	.0037	.0	2.08
2.54	1.0926	.3823	.0037	.0	1.44
2.55	1.0980	.3860	.0037	.0	1.02
2.57	1.1034	.3897	.0037	.0	.83
2.58	1.1088	.3935	.0037	.0	.76

HYDROGRAPH PEAK= 2.59 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .22 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

CLIENT WSMC
PROJECT J.B. KING
FEATURE
PROJECT NO.

SHEET 30 OF 31
COMPUTED
CHECKED
DATE

CALCULATION OF FLOW INTO EXISTING CUT-OFF DITCH

AREA - 6

0.88 PLANIMETER READING
× 3.0473

2.68 SQ. IN. @ 1" = 200' => 2.5 ACRES.

CONTOUR LENGTH = 1130 FT.

CONTOUR INTERVAL = 40 FT.

$$\text{SLOPE} = \frac{1130 \times 40 \times 100}{2.5 \times 43560} = 41.5\%$$

HYDRAULIC LENGTH = 500 FT.

100 YR. 6 HR. STORM = 1.8"

CURVE NUMBER = 90

FROM "HYDRO" THE PEAK FLOW IS 2.3 CFS.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

PROJECT : J.B. King Area 6

AREA= 2.5 ACRES
AVERAGE BASIN SLOPE= 41.5 PERCENT
CURVE NUMBER= 90.0
DESIGN STORM= 1.80 INCHES
STORM DURATION= 6.0 HOURS
HYDRAULIC LENGTH= 500. FEET
MINIMUM INFILTRATION RATE= .00 IN/HR

TP= .0221 HOURS QPCFS= 85.56 CFS QPIN=33.9416 INCHES
CS=167.2980 ITERATIONS= 8 SCS 6-hour

TIME HOURS	ACCUMULATED RAINFALL INCHES	RUNOFF INCHES	RAINFALL EXCESS INCHES	UNIT HYDROGRAPH CFS	OUTFLOW HYDROGRAPH CFS
1.39	.2222	.0000	.0000	.0	.00
1.41	.2252	.0000	.0000	67.0	.00
1.42	.2281	.0000	.0000	70.6	.00
1.44	.2311	.0000	.0000	25.7	.00
1.45	.2341	.0001	.0000	6.1	.00
1.47	.2371	.0002	.0000	1.1	.00
1.48	.2400	.0003	.0000	.2	.01
1.50	.2430	.0004	.0001	.0	.01
2.40	.9468	.2860	.0126	.0	2.12
2.41	.9668	.2987	.0127	.0	2.15
2.43	.9868	.3116	.0129	.0	2.18
2.45	1.0067	.3247	.0130	.0	2.20
2.46	1.0267	.3379	.0132	.0	2.23
2.48	1.0467	.3512	.0133	.0	2.25
2.49	1.0667	.3647	.0135	.0	2.28
2.51	1.0818	.3749	.0103	.0	2.08
2.52	1.0872	.3786	.0037	.0	1.42
2.54	1.0926	.3823	.0037	.0	.87
2.55	1.0980	.3860	.0037	.0	.58
2.57	1.1034	.3897	.0037	.0	.64
2.58	1.1088	.3935	.0037	.0	.64

HYDROGRAPH PEAK= 2.28 cfs
TIME TO PEAK= 2.49 Hours
RUNOFF VOLUME= .19 Acre-Feet

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Appendix 2
Plunge Pool Design

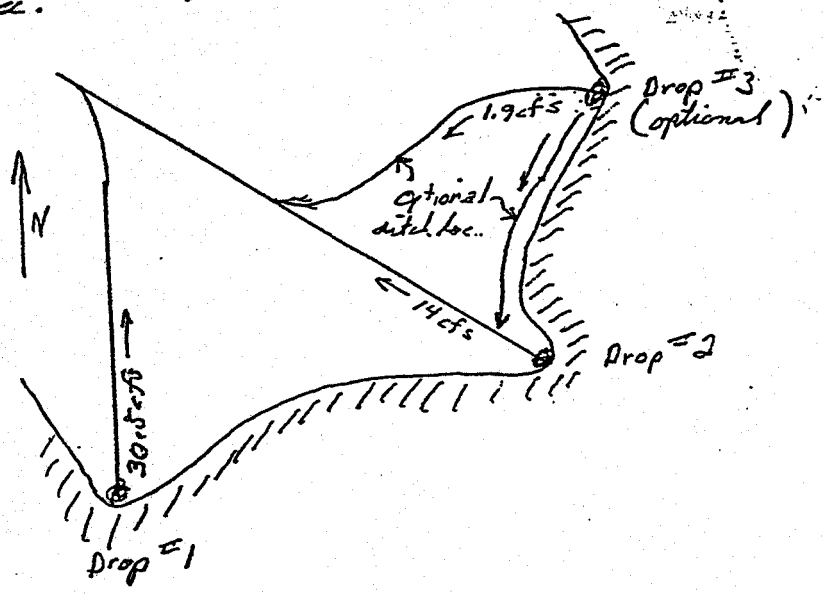
INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

CLIENT Western States Minerals
PROJECT J.B. King Mine
FEATURE Plunge Pool Design
PROJECT NO. 102.02.100

SHEET 1 OF 8
COMPUTED KCS
CHECKED
DATE 9-3-93

Three possible plunge pools need to be analyzed for the three channels receiving concentrated flows from the sandstone ledges. The height of the ledges will depend on the conditions found as excavation of the channels takes place.



Design of the plunge pool size is based on procedures in "Open Channel Hydraulics," by Ven T. Chow, 1959. The procedures assume a flowrate per unit width across the drop to establish a drop number, D. The drop number is then used to determine the plunge pool hydraulics.

Hydrologic calculations for the flowrates provided were obtained from "J.B. King Mine Proposed Erosion Control Plan," June 1992, prepared by Hansen, Allen & Luce, Inc.

Assume the following:

Drop #1
Q = 30.5 cfs
drop width = 6 feet
flowrate per unit width = 5.08 cfs/ft

Drop #2
Q = 14 cfs
drop width = 5 feet
flowrate per unit width = 2.8 cfs/ft

Drop #3 (optional)
Q = 2 cfs
drop width = 3 feet
flowrate per unit width = 0.67 cfs/ft

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

CLIENT Western States Minerals
PROJECT VR King Mine
FEATURE Plunge Pool Design
PROJECT NO. 102 02.100

SHEET 2 OF 8
COMPUTED VCS
CHECKED
DATE 9-3-97

The following presents the equations for the plunge pool hydraulics (from "Open Channel Hydraulics").

15-15. The Straight Drop Spillway. The aerated free-falling nappe in a straight drop spillway (Fig. 15-18) will reverse its curvature and turn smoothly into supercritical flow on the apron. Consequently, a hydraulic jump may be formed downstream. Based on his own experimental data

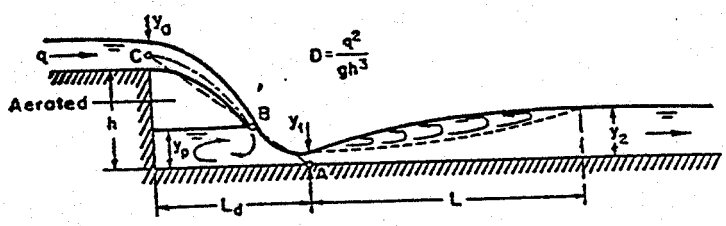


FIG. 15-18. Flow geometry of a straight drop spillway.

and those of Moore [40] and Bakhmeteff and Feodoroff [65], Rand [66] found that the flow geometry at straight drop spillways can be described by functions of the *drop number*, which is defined as

$$D = \frac{q^2}{gh^3} \tag{15-9}$$

where q is the discharge per unit width of the crest of overfall, g is the acceleration of gravity, and h is the height of the drop. The functions are

$$\frac{L_d}{h} = 4.30D^{0.27} \tag{15-10}$$

$$\frac{y_p}{h} = 1.00D^{0.22} \tag{15-11}$$

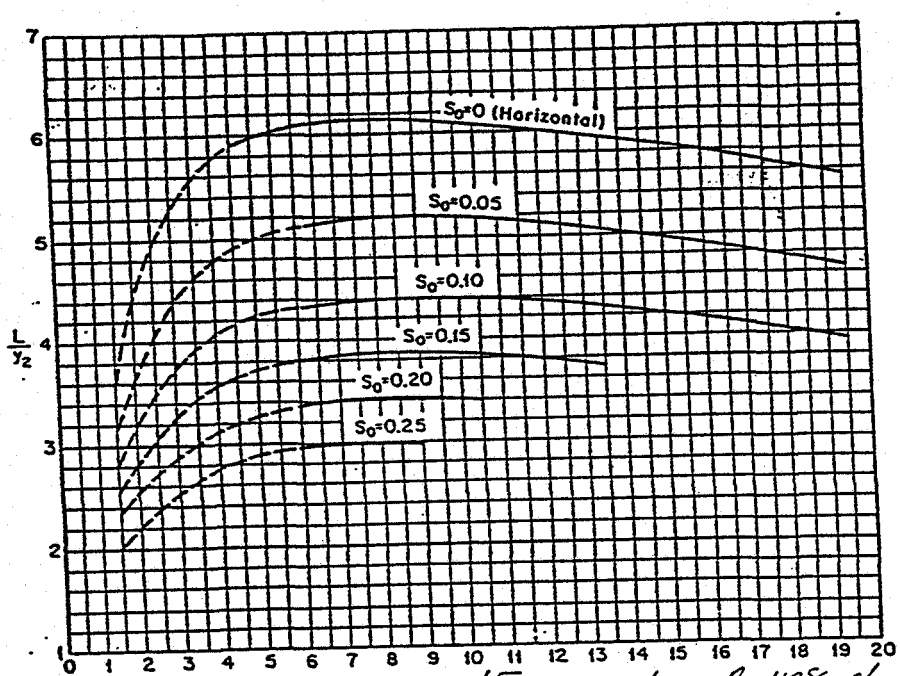
$$\frac{y_1}{h} = 0.54D^{0.425} \tag{15-12}$$

$$\frac{y_2}{h} = 1.66D^{0.27} \tag{15-13}$$

where L_d is the drop length, that is, the distance from the drop wall to the position of the depth y_1; y_p is the pool depth under the nappe; y_1 is the depth at the toe of the nappe or the beginning of the hydraulic jump; and y_2 is the tailwater depth sequent to y_1. The position of the depth y_1 can be approximately determined by the straight line ABC which joins the point A on the apron at the position of y_1, the point B on the axis of the nappe at the height of pool depth, and the point C on the axis of the nappe at the crest of the fall. The fact that these three points lie on a straight line was also verified by experiment.

For a given height h and discharge q per unit width of the fall crest, the sequent depth y_2 and the drop length L_d can be computed by Eqs. (15-10) and (15-13). On the one hand, if the tailwater depth is less than

INCORPORATED
OCT 05 1995
HAISLIP LIBRARY AND MINING



from Pg 428, Chow

after sizing the plunge pool using the procedures in "Open Channel Hydraulics", the riprap is designed using procedures in "Evaluation of and Design Recommendations for Drop Structures in the Denver Metropolitan Area" Prepared for: Urban Drainage and Flood Control District, Dec. 1986.

The publication referenced above contains several graphs based on drop height (D) to riprap mean diameter (D_{50}).

or D/D_{50} for a ratio of 6, 12 & 24

Several curves are presented on each graph representing the sequent depth (y_2) to drop height ratio.

or y_2/D

To use the graphs, calculate ratio of upstream flow depth, H (which was assumed) to drop height

or H/D to locate a position on the horizontal axis.

INCORPORATED
EFFECTIVE:
OCT 03 1995
UTAH DIVISION OF OIL, GAS AND MINING

Project a vertical line to the curve represented by y_2/D and from the intersection of the line H/D and the curve y_2/D, project a horizontal line to the vertical axis for a d_s/D value where d_s is the scour depth. Using an

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

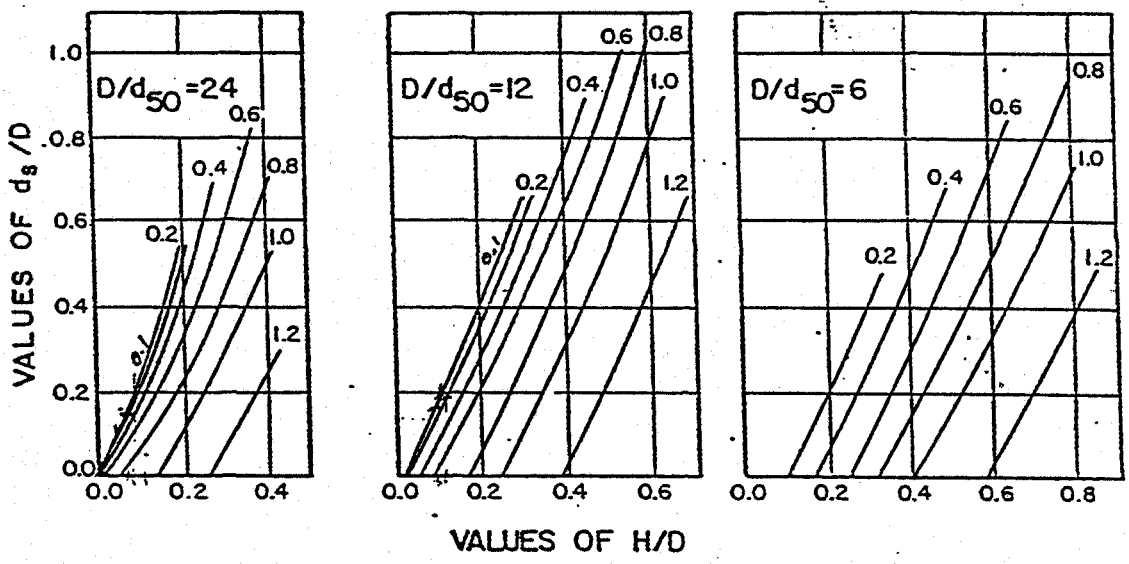
HANSEN ALLEN & LUCE INC

CLIENT Western States Minerals
PROJECT U.B. King Mine
FEATURE Plunge Pool Design
PROJECT NO. 102.02.100

SHEET 4 OF 8
COMPUTED KLS
CHECKED
DATE 9-8-93

Figure XII-2

NUMBERS ON CURVES ARE VALUES OF y_2/D



The attached computer printouts present the plunge pool design results for each of the plunge pools based on the procedures presented herein.

Note that the computer printouts present variable plunge pool dimensions based on the height of the drop. The riprap thickness is also presented as a variable dependant upon the height of the drop and the D_{50} size of the riprap. An exact design for the plunge pool and riprap will be determined after the exploration phase of construction when the drop height is determined.

Options for design details for the plunge pool begin on sheet 8 of these calculations.

INCORPORATED
EFFECTIVE
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

5/8

CLIENT: Western States Minerals
PROJECT: JB King Mine
FEATURE: Plunge Pool #1 Design
PROJ. #: 102.02.100
DATE: 09/03/93

POOL SIZE DESIGN - Based on "Open-Channel Hydraulics", Ven T. Chow, 1959

Flowrate: 30.5 cfs
Channel Width
upstream: 6 feet
downstream: 6 feet
Flowrate per foot
upstream: 5.08333 cfs/f

Drop Height D (ft)	Drop Number	Drop Length Ld (ft)	Pool Depth Yp (ft)	Toe Depth Y1 (ft)	Sequent Depth Y2 (ft)	Toe Vel. (fps)	Froude Number F1	L/Y2 From Chow Pg. 428	Pool Length L (ft)	Total Length (ft)
10	8.02E-04	6.276	2.08	0.261	2.423	19.5	6.715	6.10	14.8	21.1
12	4.64E-04	6.497	2.22	0.248	2.508	20.5	7.240	6.15	15.4	21.9
14	2.92E-04	6.690	2.34	0.238	2.583	21.4	7.715	6.15	15.9	22.6
16	1.96E-04	6.862	2.45	0.229	2.649	22.2	8.152	6.15	16.3	23.2
18	1.38E-04	7.017	2.55	0.222	2.709	22.9	8.558	6.15	16.7	23.7
20	1.00E-04	7.159	2.64	0.216	2.764	23.6	8.938	6.15	17.0	24.2
22	7.54E-05	7.290	2.73	0.210	2.814	24.2	9.296	6.10	17.2	24.5
24	5.81E-05	7.412	2.81	0.205	2.861	24.8	9.636	6.10	17.5	24.9
26	4.57E-05	7.525	2.88	0.201	2.905	25.3	9.959	6.07	17.6	25.2
28	3.66E-05	7.632	2.96	0.197	2.946	25.8	10.268	6.05	17.8	25.5
30	2.97E-05	7.733	3.03	0.193	2.985	26.3	10.565	6.03	18.0	25.7

RIPRAP DESIGN - Based on "Evaluation of and Design Recommendations for Drop Structures in the Denver Metropolitan Area", Urban Drainage and Flood Control District, 1986

Channel Width: 6 feet
Upstream Depth H: 1.5 feet
Riprap Density: 150 pcf
H2O Density: 62.4 pcf
H2O Mass Dens.: 1.936 lb-s2/f4
Sideslopes: 3 ?H:1V
Safety Factor: 1.5

Drop Height D (ft)	Riprap D50 (in)	Y2/D	D/D50	H/D	ds/D From Graphs Fig. XII-2	Scour Depth ds (ft)	Riprap Thick. (ft)
10	12	0.24	10.00	0.15	0.20	2.00	3.00
12	12	0.21	12.00	0.13	0.19	2.28	3.42
14	14	0.18	12.00	0.11	0.18	2.52	3.78
16	14	0.17	13.71	0.09	0.18	2.88	4.32
18	14	0.15	15.43	0.08	0.18	3.24	4.86
20	14	0.14	17.14	0.08	0.17	3.40	5.10
22	14	0.13	18.86	0.07	0.17	3.74	5.61
24	14	0.12	20.57	0.06	0.16	3.84	5.76
26	14	0.11	22.29	0.06	0.16	4.16	6.24
28	14	0.11	24.00	0.05	0.15	4.20	6.30
30	16	0.10	22.50	0.05	0.15	4.50	6.75

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

6/8

CLIENT: Western States Minerals
PROJECT: JB King Mine
FEATURE: Plunge Pool #2 Design
PROJ. #: 102.02.100
DATE: 09/03/93

POOL SIZE DESIGN - Based on "Open-Channel Hydraulics", Ven T. Chow, 1959

Flowrate: 14 cfs
Channel Width
upstream: 5 feet
downstream: 5 feet
Flowrate per foot
upstream: 2.8 cfs/f

Drop Height D (ft)	Drop Number	Drop Length Ld (ft)	Pool Depth Yp (ft)	Toe Depth Y1 (ft)	Sequent Depth Y2 (ft)	Toe Vel. (fps)	Froude Number F1	L/Y2 From Chow Pg. 428	Pool Length L (ft)	Total Length (ft)
10	2.43E-04	4.548	1.60	0.157	1.756	17.8	7.912	6.10	10.7	15.3
12	1.41E-04	4.708	1.71	0.150	1.818	18.7	8.530	6.13	11.1	15.9
14	8.87E-05	4.848	1.80	0.143	1.872	19.5	9.090	6.15	11.5	16.4
16	5.94E-05	4.973	1.88	0.138	1.920	20.3	9.604	6.15	11.8	16.8
18	4.17E-05	5.085	1.96	0.134	1.963	20.9	10.083	6.15	12.1	17.2
20	3.04E-05	5.188	2.03	0.130	2.003	21.5	10.530	6.15	12.3	17.5
22	2.29E-05	5.283	2.10	0.127	2.039	22.1	10.953	6.15	12.5	17.8
24	1.76E-05	5.371	2.16	0.124	2.073	22.7	11.353	6.15	12.8	18.1
26	1.39E-05	5.453	2.22	0.121	2.105	23.2	11.734	6.13	12.9	18.4
28	1.11E-05	5.531	2.28	0.118	2.135	23.6	12.098	6.13	13.1	18.6
30	9.02E-06	5.604	2.33	0.116	2.163	24.1	12.448	6.10	13.2	18.8

RIPRAP DESIGN - Based on "Evaluation of and Design Recommendations for Drop Structures in the Denver Metropolitan Area", Urban Drainage and Flood Control District, 1986

Channel Width: 5 feet
Upstream Depth H: 1 feet
Riprap Density: 150 pcf
H2O Density: 62.4 pcf
H2O Mass Dens.: 1.936 lb-s2/f4
Sideslopes: 3 ?H:1V
Safety Factor: 1.5

Drop Height D (ft)	Riprap D50 (in)	Y2/D	D/D50	H/D	ds/D From Graphs Fig. XII-2	Scour Depth ds (ft)	Riprap Thick. (ft)
10	12	0.18	10.00	0.10	0.19	1.90	2.85
12	12	0.15	12.00	0.08	0.19	2.28	3.42
14	14	0.13	12.00	0.07	0.18	2.52	3.78
16	14	0.12	13.71	0.06	0.16	2.56	3.84
18	14	0.11	15.43	0.06	0.16	2.88	4.32
20	14	0.10	17.14	0.05	0.14	2.80	4.20
22	14	0.09	18.86	0.05	0.14	3.08	4.62
24	14	0.09	20.57	0.04	0.13	3.12	4.68
26	14	0.08	22.29	0.04	0.13	3.38	5.07
28	14	0.08	24.00	0.04	0.13	3.64	5.46
30	16	0.07	22.50	0.03	0.12	3.60	5.40

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

7/8

CLIENT: Western States Minerals
PROJECT: JB King Mine
FEATURE: Plunge Pool #3 Design (optional)
PROJ. #: 102.02.100
DATE: 09/03/93

POOL SIZE DESIGN - Based on "Open-Channel Hydraulics", Ven T. Chow, 1959

Flowrate: 2 cfs
Channel Width
upstream: 3 feet
downstream: 3 feet
Flowrate per foot
upstream: 0.66667 cfs/f

Drop Height D (ft)	Drop Number	Drop Length Ld (ft)	Pool Depth Yp (ft)	Toe Depth Y1 (ft)	Sequent Depth Y2 (ft)	Toe Vel. (fps)	Froude Number F1	L/Y2 From Chow Pg. 428	Pool Length L (ft)	Total Length (ft)
10	1.38E-05	2.095	0.85	0.046	0.809	14.4	11.740	6.02	4.9	7.0
12	7.99E-06	2.169	0.91	0.044	0.837	15.1	12.657	6.00	5.0	7.2
14	5.03E-06	2.234	0.96	0.042	0.862	15.7	13.488	5.95	5.1	7.4
16	3.37E-06	2.291	1.00	0.041	0.884	16.3	14.252	5.90	5.2	7.5
18	2.37E-06	2.343	1.04	0.040	0.904	16.9	14.961	5.85	5.3	7.6
20	1.73E-06	2.390	1.08	0.038	0.923	17.4	15.626	5.82	5.4	7.8
22	1.30E-06	2.434	1.11	0.037	0.940	17.8	16.252	5.80	5.4	7.9
24	9.98E-07	2.475	1.15	0.037	0.955	18.3	16.846	5.75	5.5	8.0
26	7.85E-07	2.512	1.18	0.036	0.970	18.7	17.412	5.70	5.5	8.0
28	6.29E-07	2.548	1.21	0.035	0.984	19.1	17.952	5.65	5.6	8.1
30	5.11E-07	2.582	1.24	0.034	0.997	19.4	18.470	5.60	5.6	8.2

RIPRAP DESIGN - Based on "Evaluation of and Design Recommendations for Drop Structures in the Denver Metropolitan Area", Urban Drainage and Flood Control District, 1986

Channel Width: 6 feet
Upstream Depth H: 1.5 feet
Riprap Density: 150 pcf
H2O Density: 62.4 pcf
H2O Mass Dens.: 1.936 lb-s2/f4
Sideslopes: 3 ?H:1V
Safety Factor: 1.5

Drop Height D (ft)	Riprap D50 (in)	Y2/D	D/D50	H/D	ds/D From Graphs Fig. XII-2	Scour Depth ds (ft)	Riprap Thick. (ft)
10	12	0.08	10.00	0.15	0.18	1.80	2.70
12	12	0.07	12.00	0.13	0.19	2.28	3.42
14	14	0.06	12.00	0.11	0.18	2.52	3.78
16	14	0.06	13.71	0.09	0.16	2.56	3.84
18	14	0.05	15.43	0.08	0.16	2.88	4.32
20	14	0.05	17.14	0.08	0.14	2.80	4.20
22	14	0.04	18.86	0.07	0.14	3.08	4.62
24	14	0.04	20.57	0.06	0.13	3.12	4.68
26	14	0.04	22.29	0.06	0.13	3.38	5.07
28	14	0.04	24.00	0.05	0.13	3.64	5.46
30	16	0.03	22.50	0.05	0.12	3.60	5.40

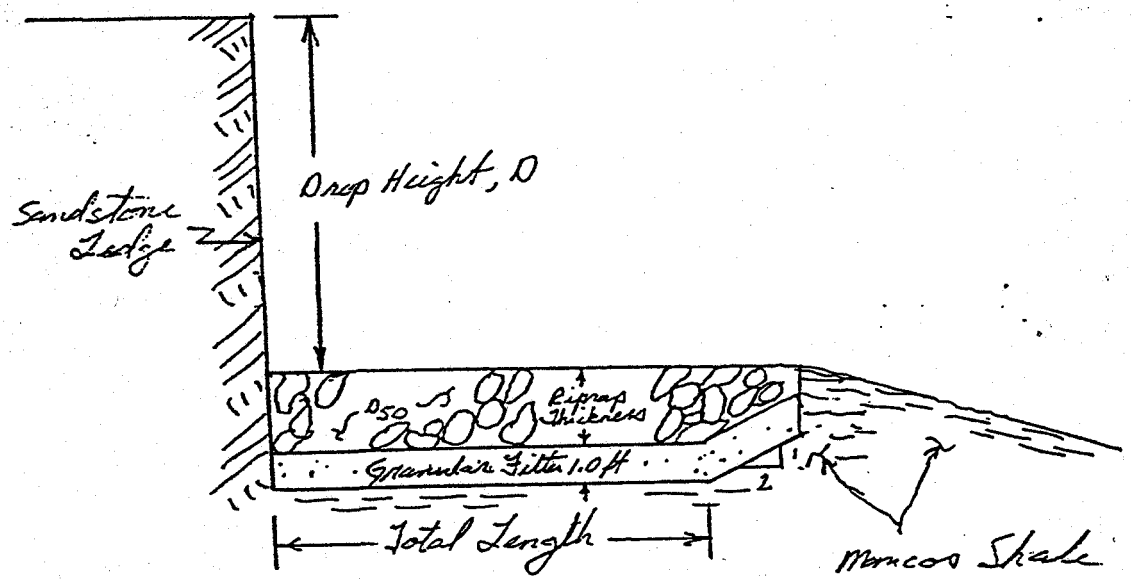
INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

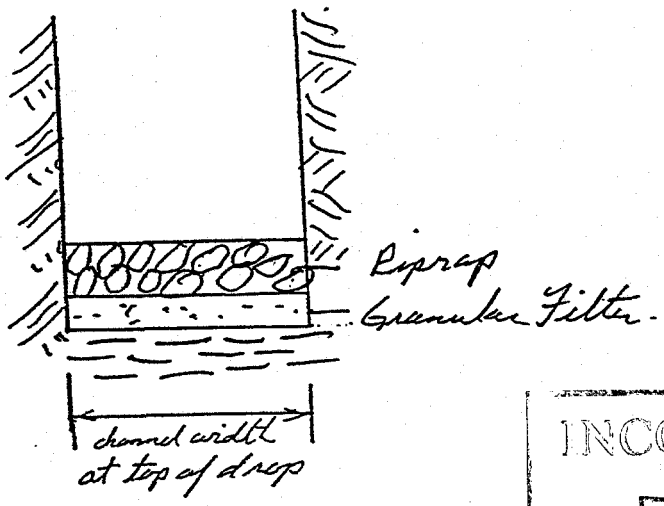
CLIENT Western States Minerals
PROJECT J.B. King Mine
FEATURE Plunge Pool Design
PROJECT NO. 102102.100

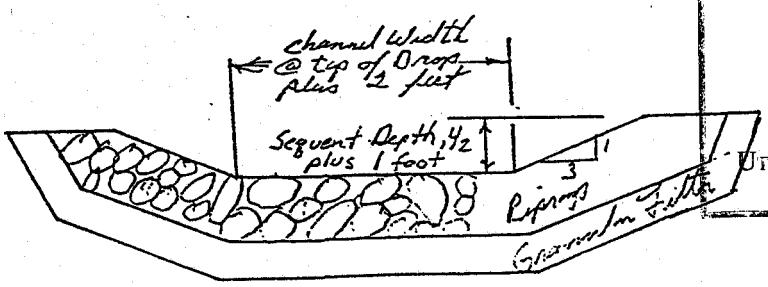
SHEET 8 OF 8
COMPUTED KLS
CHECKED
DATE 9-8-93

Plunge Pool Design Details
See computer printout pages for dimensions



section where drop is cut back into the sandstone ledge





INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Appendix 3
Ditch Design

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Trapezoidal Channel Flow Calculations using Mannings Equation

Client	: J.B. King	Date	: 23-Aug-94
Project No.	: 102.02.100	Time	: 10:25 AM
Channel Section:	Ditch 3	Computed:	BJB

			UNITS
GENERAL CRITERIA:	Design Flow:	51.50	cfs
	Bottom Width:	3.0	feet
	Side Slope1:	1.0	1/m1
	Side Slope2:	1.0	1/m2
	Friction Factor:		
	Assumed D50:	0.00	feet
	Calc n Value:	0.000	
	Used:	0.035	
	Min. Bottom Slope:	0.090	ft/ft
	Max. Bottom Slope:	0.090	ft/ft
	Freeboard:	1.00	feet
CALCULATION: (Channel Depth)	Depth (Min. S):	1.16	feet
	Q-1.49AR(2/3)S(1/2)/n=	-0.002	Accuracy
	Required Depth:	2.16	feet
	Area:	4.81	ft2
	Perimeter:	6.27	feet
	Hydraulic Radius:	0.77	feet
	Velocity:	10.70	ft/sec
	Riprap Ck (V<5?):	Required	
CALCULATION: (Velocity Check)	Depth (Max. S):	0.05	feet
	Q-1.49AR(2/3)S(1/2)/n=	51.260	Accuracy
	Required Depth:	0.55	feet
	Area:	0.15	ft2
	Perimeter:	3.13	feet
	Hydraulic Radius:	0.05	feet
	Velocity:	354.39	ft/sec
	Riprap Ck (V<5?):	Required	

DESIGN CRITERIA:	Bottom Width:	3.0	feet
	Side Slope 1:	1.0	1/m1
	Side Slope 2:	1.0	1/m2
	Min. Bottom Slope:	9.0	%
	Max. Bottom Slope:	9.0	%
	Min Channel Depth:	2.16	feet
	Riprap (Min S):	Required	
	Riprap (Max S):	Required	

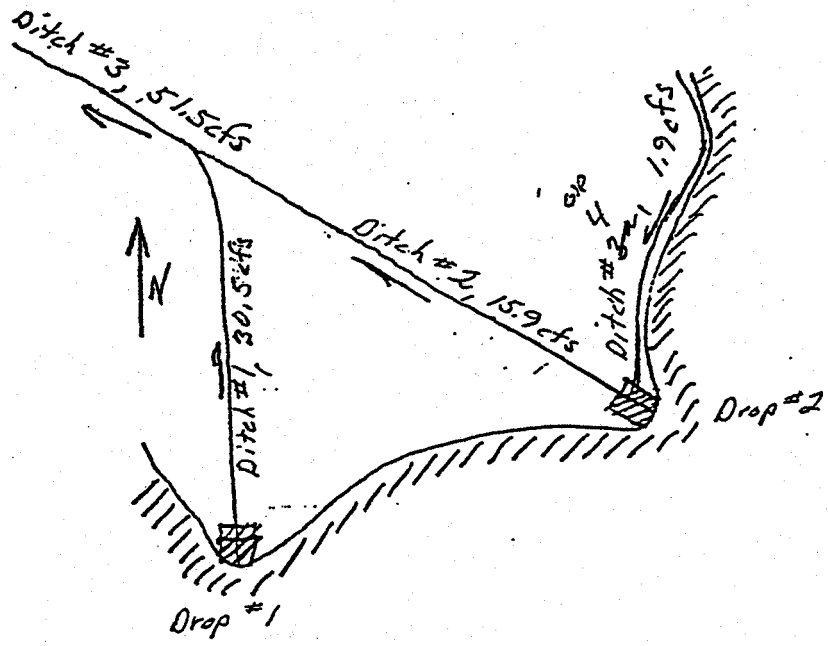
INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

HANSEN ALLEN & LUCE INC

CLIENT Western States Minerals
PROJECT JB King Mine
FEATURE Ditch Hydraulics
PROJECT NO. 102 020 100

SHEET 1 OF 3
COMPUTED KCS
CHECKED
DATE 9-8-93

Determine the ditch dimensions downstream of the plunge pools required to carry the determined flowrates from the 100yr 6hr precipitation event. The flowrates used in these calculations were obtained from "JB King Mine Proposed Erosion Control Plan," June 1992.



Assume ditches 1, 2 & 3 are to be excavated into the underlying noncoos shale material which will provide natural erosion control similar to the other natural and undisturbed channels in the area. The controlling design criteria will be the channel dimensions along the flattest slopes of the ditches. The steeper reaches of the ditches, in profile, will not exceed the steepness of other natural drainage channels in the area. Assume the channels to be naturally erodible comparable to the other natural drainage channels in the area.

Assume for Manning's equation $n = 0.03$

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

Ditch No. 1: $Q = 30.5$ cfs
$S = 5\%$ approx. min.

Ditch No. 2: $Q = 15.9$ cfs
$S = 5\%$ approx. min.

Ditch No 3a: $Q = 1.9$ cfs (4 cfs)

HANSEN ALLEN & LUCE INC

CLIENT Western States Minerals
PROJECT J B King Mine
FEATURE Ditch Hydraulics
PROJECT NO. 102.02.100

SHEET 2 OF 3
COMPUTED KCS
CHECKED
DATE 9-9-93

CLIENT: Western States Minerals
PROJECT: J B King Mine
FEATURE: Ditch Hydraulics
PROJECT#: 102.02.100
DATE: 08-Sep-93

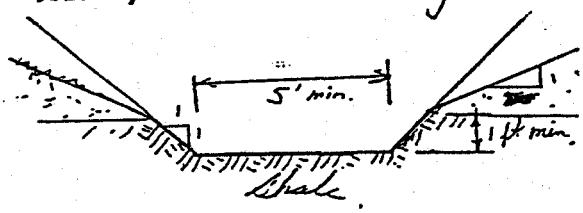
FIND: Ditch No. 1 Dimensions

Manning Equation Solution for Normal Flow Depth
(Trapezoidal Channel)

Flow (Q)	=	30.5 cfs
Manning n (n)	=	0.03
Botton Width (b)	=	5 feet
Sideslope 1 (z1)	=	1 ?H:1V
Sideslope 2 (z2)	=	1 ?H:1V
Slope (So)	=	0.05
Normal Depth (y)	=	0.700 feet
Flow x-section area (A)	=	3.988 sq. ft.
Flow Top Width (T)	=	6.399 feet
Perimeter (P)	=	6.979 feet
Flow Velocity (V)	=	7.648 ft/sec.
Froude Number	=	1.707
Solve Equation	=	0.000

Ditch No. 1

excavate to a minimum depth of 1 ft into the shale. Ditch sideslopes in the shale may be 1H:1V.



Sideslopes above the shale should be 2.5:1 or flatter from the top of the shale to the existing ground surface. Freeboard is provided in the ditch by 0.3' in the shale and the rest (0.7' min) above the shale.

INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

CLIENT: Western States Minerals
PROJECT: J B King Mine
FEATURE: Ditch Hydraulics
PROJECT#: 102.02.100
DATE: 08-Sep-93

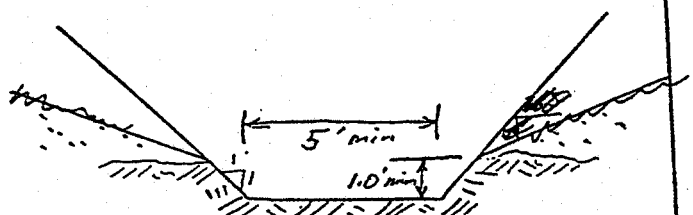
FIND: Ditch No. 2 Dimensions

Ditch No. 2

Excavate to a minimum depth of 1 ft. into the shale. Ditch sideslopes in the shale may be 1H:1V. Excavated sideslopes above the shale should be 2.5 H:1V or flatter from the top of the shale to the existing ground surface. Freeboard is provided by 0.5 ft in the shale and the rest (0.5' min.) in the excavation above the shale.

Manning Equation Solution for Normal Flow Depth
(Trapezoidal Channel)

Flow (Q)	=	15.9 cfs
Manning n (n)	=	0.03
Botton Width (b)	=	5 feet
Sideslope 1 (z1)	=	1 ?H:1V
Sideslope 2 (z2)	=	1 ?H:1V
Slope (So)	=	0.05
Normal Depth (y)	=	0.474 feet
Flow x-section area (A)	=	2.596 sq. ft.
Flow Top Width (T)	=	5.949 feet
Perimeter (P)	=	6.342 feet
Flow Velocity (V)	=	6.124 ft/sec.
Froude Number	=	1.633



HANSEN ALLEN & LUCE inc

CLIENT Western States Minerals
PROJECT J B King Mine
FEATURE Ditch Hydraulics
PROJECT NO. 102.02.100

SHEET 3 OF 3
COMPUTED KCS
CHECKED
DATE 9-9-93

CLIENT: Western States Minerals
PROJECT: J B King Mine
FEATURE: Ditch Hydraulics
PROJECT#: 102.02.100
DATE: 08-Sep-93

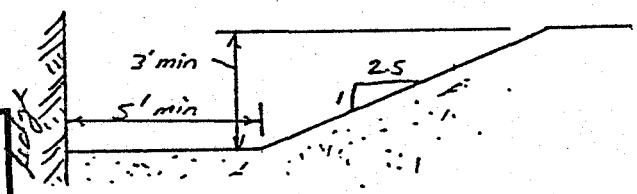
FIND: Ditch No. 3a Dimensions

Manning Equation Solution for Normal Flow Depth
(Trapezoidal Channel)

Flow (Q)	=	1.9 cfs	1.9 cfs
Manning n (n)	=	0.03	0.03
Bottom Width (b)	=	0 feet	5 feet
Sideslope 1 (z1)	=	0 ?H:1V	0 ?H:1V
Sideslope 2 (z2)	=	2.5 ?H:1V	2.5 ?H:1V
Slope (So)	=	0.09	0.09
Normal Depth (y)	=	0.557 feet	0.111 feet
Flow x-section area (A)	=	0.388 sq. ft.	0.571 sq. ft.
Flow Top Width (T)	=	1.392 feet	5.278 feet
Perimeter (P)	=	2.057 feet	5.410 feet
Flow Velocity (V)	=	4.899 ft/sec.	3.328 ft/sec.
Froude Number	=	1.636	1.783
Solve Equation	=	0.000	0.000

Ditch No. ~~3~~ 4 GIP

To be excavated at the base of the sand stone ledge to receive runoff from above the ledge and direct the runoff to ditch no. 2. Construct the ditch with 5' min. bottom width, 3' min depth, vertical side against the ledge, 2.5H:1V or flatter sideslopes otherwise, Max. ditch slope is 9% to reduce erosion potential. This will also reduce erosion potential from concentrated flows in the 5' wide channel. The ditch is constructed larger to reduce effects of spalling material from the ledge falling the ditch.



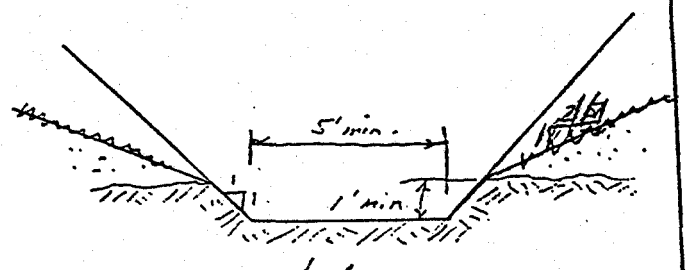
INCORPORATED
EFFECTIVE:
OCT 05 1995
UTAH DIVISION OIL, GAS AND MINING

CLIENT: Western States Minerals
PROJECT: J B King Mine
FEATURE: Ditch Hydraulics
PROJECT#: 102.02.100
DATE: 08-Sep-93

FIND: ~~Ditch No. 3 Dimensions~~

Ditch No. 3

Excavate to a minimum depth of 1 ft. into the shale. Ditch sideslopes in the shale may be 1H:1V. Excavated sideslopes above the shale should be 2.5H:1V or flatter from the top of the shale to the existing ground surface. Freeboard is provided by 1.0' minimum in the excavation above the shale.

Manning Equation Solution for Normal Flow Depth
(Trapezoidal Channel)

Flow (Q)	=	51.5 cfs
Manning n (n)	=	0.03
Bottom Width (b)	=	5 feet
Sideslope 1 (z1)	=	1 ?H:1V
Sideslope 2 (z2)	=	1 ?H:1V
Slope (So)	=	0.05
Normal Depth (y)	=	0.954 feet
Flow x-section area (A)	=	5.679 sq. ft.
Flow Top Width (T)	=	6.908 feet
Perimeter (P)	=	7.698 feet
Flow Velocity (V)	=	9.068 ft/sec.
Froude Number	=	1.762