Hecla Mining Company

ESCALANTE UNIT

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SEP 08 1989
DIVISION OF
OIL, GAS & MINING

September 5, 1989

1ST

"ORIGINAL" VERSION
TAILING CLOSURE
PLAN

Lowell Braxton
Administrator
Natural Resources Department
Utah Division of Oil, Gas & Mining
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

SUBJECT: Proposal for Closure of the Hecla Escalante Unit's Tailings Facility

Dear Mr. Braxton:

Hecla Mining Company is submitting a tailings facility closure plan for our Escalante Unit. As you may know, we are in the process of shutting down all Escalante Unit operations. We have recently closed the mining operations and have initiated approved reclamation activities on those sites. Our stockpiled ore will be depleted in August of 1990. At that time Hecla will shut down our milling and tailings operations. The plan submitted here is for the tailings facility and associated roads. A reclamation plan for mill and operation buildings will be submitted at a later date after salvage and disposal questions can be thoroughly evaluated by Hecla.

The plan is being submitted at this time so that funds can be allocated for specific reclamation activities. Through early planning, we hope to begin the material purchases, contractor bidding process, and other logistics, well in advance of the August 1990 shutdown date. By understanding your requirements, we can initiate these planning steps in the near future. We would like to take full advantage of the 1990 fall reclamation season while some of our employees are still on the payroll.

Hecla understands that other agencies may wish to review our proposal. Since Hecla recognizes the Division of Oil, Gas, and Mining to be the lead mining agency, we have enclosed four copies of the tailing closure proposal for your review and dispersal.

Please feel free to call me if any questions or comments arise.

Very truly yours,

Brent Willoughby
Manager - Escalante Unit

BW:am

Enclosures

cc: Bryan Johnson

P.O. BOX 310 / ENTERPRISE, UTAH 84725 / (801) 439-5355

RECEIVED
SEP 08 1989
DIVISION OF
OIL, GAS & MINING

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MINERALS PROGRAM
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PROPOSAL FOR CLOSURE OF

HECLA'S ESCALANTE SILVER MINE TAILINGS FACILITY

Submitted to

DEPARTMENT OF NATURAL RESOURCES,
DIVISION OF OIL, GAS AND MINING
STATE OF UTAH

By

HECLA MINING COMPANY

ESCALANTE UNIT

August 25, 1989

PROPOSAL FOR CLOSURE OF HECLA'S ESCALANTE SILVER MINE TAILINGS FACILITY

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1.0 INTRODUCTION

Hecla Mining Company and its predecessor Rancher's Exploration and Development Company have committed to reclamation requirements through the permitting, development, and production phases of the Escalante Silver Mine. Hecla recognizes that the Utah Division of Oil, Gas and Mining (Division) has authority over all lands disturbed by mining and milling. This authority is given to the Division under the Utah State Reclamation Act effective May 14, 1975 and the Amended and New Rules Minerals Reclamation Program of December 1, 1988. The later rules do not apply to existing mining operations approved prior to the December 1, 1988 effective date. Hecla's mining operations were approved in 1980.

Since the majority of the tailings impoundment reclamation requirements are described in Rule M-10 of the Utah State Reclamation Act, the proposal will follow that format and outline plans for complying with the Act.

pond depth = 52' by dam

2.0 LAND USE

The tailings impoundment is located on BLM land. Adjacent parcels of land are owned by the BLM as well as Hecla. The pre-operational use of this land included occasional grazing, mining and exploration activities, and wildlife habitat. The probable land uses during the post mining stage will be occasional grazing, minerals exploration activities, and wildlife habitat. Hecla should have no difficulty in returning the disturbed area to a condition capable of supporting these types of land uses.

3.0 PUBLIC SAFETY AND WELFARE

To effectively reclaim the tailings pond, some fences may need to be dismantled temporarily. However, there will be sufficient signs to warn the public during the earth moving stage. Hecla proposes to maintain the current fence and warning signs until the Division and Hecla agree that revegetation is complete and the tailings are immobilized. At that time, the fence and signs will be removed from the property to support post-mining land use as described above.

4.0 IMPOUNDMENTS

The tailings area will be re-contoured in a manner that will not impound water. See the "Revegetation" section, "Toxic Materials" section and "Dams" section for details.

5.0 SLOPES

The downstream slope of the embankment containing the tailings is stable at its present 2 horizontal to 1 vertical slope ratio. Revegetation results from past seeding (1980) on the embankment are successful. This vegetation

will suffice in preventing wind erosion. Water erosion will be controlled by preventing surface water flow from crossing the embankment.

6.0 TOXIC MATERIALS

We will comply with the toxic materials provision of the Act by leaving the mill tailings in an isolated condition, as planned, such that adverse environmental effects are eliminated or controlled.

6.1 Ground Water Protection

Immediately after milling operations have been terminated, the tailings "underdrain" and reclaim solutions from the tailings areas will be diluted with fresh water and returned to the surface of the tailings area for a three months "wash" period. As the weather will allow, the diluted solutions will be distributed over the surface of the tailings to maximize evaporation and to promote neutralization by ultraviolet rays and by lowering the pH. After the initial three month wash, any remaining underdrain solutions will be returned to the surface of the tailings area for further treatment and evaporation. After a treatment period of approximately six to nine months, it is expected that there will be essentially no solution to pump and treat. At this point, the tailings area drains will be permanently sealed by pumping cement grout into the reclaim and underdrain systems.

The net average evaporation loss in the area is about 4 feet per year. Evaporation, capillary action, transpiration and the permeability of the tailings will combine to assure that hydraulic conditions will not affect the containment. Please note however, that the containment is designed for full hydraulic conditions. 585.4 cm/yr = 19.05 ft/yr

The August 1984 investigations by Fox Consultants, Inc., from boring through the tailings and the liner confirm earlier test work concluding that average vertical permeability of the tailings is 1.85×10^{-5} cm/sec. The report also stated that a "wetted front" could not be identified in the liner material. The moisture content in the liner was within the original range for compaction moisture. If the assumed 3 inches of penetration is correct, the penetration rate is several orders of magnitude slower than the original theoretical prediction.

Groundwater lvl?, 190' or 390'

This work indicates that, if solutions were continually applied to the surface of the tailings area, the rate of penetration into the tailings would be about 19 feet per year. However, with an average rainfall of 12 inches per year and the 60 inches per year evaporation rate, the tailings will not become saturated. Thus, water from a precipitation or storm event will not contact the liner. As an extra safety factor, a 390 foot clayey soil layer lies below the liner and above the ground water. what's its permeability rating

This ground water protection process will provide effective isolation of the mill tailings and residual liquids, and will protect

ground water quality below the tailings.

6.2 Air Quality and Revegetation

In order to ensure that the surface of the impoundment is protected from wind erosion, Hecla will prepare the site for revegetation. These reclamation activities can begin after the surface of the tailings is driveable.

A mound of tailings will be dozed to the center of the impoundment to allow any large runoff events originating on the impoundment to be safely diverted off the impoundment. A six-inch layer of waste rock will be placed on top of the tailings and will provide an armorment to wind erosion as well as minimize any contaminant uptake by vegetation. A four-inch layer of topsoil will be spread over the surface of the wasterock. The topsoil will then be drilled and seeded with the seed mix identified in the Revegetation Section.

7.0 ROADS AND PADS

The road to the tailings area will be reduced to a one-lane road. Disturbed areas adjacent to this one vehicle width road will be ripped and seeded with appropriate seed mixture. This road will be needed for periodic reclamation inspections and general land management use. Hecla will leave this road in a condition suitable for continued use, complete with the existing drainage structures.

8.0 DRAINAGES

As stated above, the tailings will remain in place. Hecla will recontour the tailings area with the use of wasterock and topsoil to assure the area is left in a stable condition. The recontouring will involve completely filling the tailings pond area such that no water will be impounded on the site and that surface flow and run-off will be directed around the site and into the natural channel without affecting the face of the original containment structure. Storm events or runoff occurring in the basin above the tailings containment area will be diverted via existing canals around both sides of the impoundment so that surface flow is not channeled across the reclaimed surface and the face of the impoundment structure. Any storm events or runoff originating on the containment will be diverted to the containment sides and then to the above mentioned canals. The present canals are currently conditioned to contain a one-hundred (100) year, six hour flood event. The canals will channel storm water to the natural water course below the tailings. Considering the size of this small arid basin (with no visible gullies or watercourses), we believe that the basin will be left in a stable condition that will avoid future damage to the hydrologic system.

9.0 STRUCTURES AND EQUIPMENT

All structures and equipment will be removed from the surface prior to regrading and reclamation. Two exceptions will be ground water monitoring wells and the fence around the tailings perimeter. Hecla proposes to permanently remove the fence around the impoundment when it is agreed that self-sustaining vegetative cover is established. Hecla plans to correctly seal and abandon the ground water monitoring wells when Hecla and the Division agree that monitoring is no longer needed. Hecla believes that if no ground water monitoring anomalies occur through the dewatering, regrading and reseeding phases, then the wells should properly be abandoned.

10.0 SEDIMENT CONTROL

Sediment will be controlled by revegetating the surface of the tailings, revegetating the topsoil storage area and by placing water bars in the access road to the tailings. Other measures to control sediment are described in the "Drainages" section of this proposal.

11.0 REVEGETATION

The tailings impoundment revegetation process will consist of wasterock placement, topsoil placement, seedbed preparation, seeding, vegetation establishment and maintenance. The revegetation process will begin once equipment can work on the impoundment without sinking. Vegetation on the impoundment embankment has already been established.

11.1 Wasterock Placement

Hecla has stockpiled mine wasterock near the mill site. This wasterock will be trammed to and spread out on the impoundment surface. There is adequate supply of wasterock to place six (6) inches of rock over the surface. The wasterock will be hauled by trucks and graded with a dozer.

11.2 Topsoil Placement

will provide @ 7.35 inches topsoil over a 60 acre area

The topsoil stockpile is located southwest of the tailings impoundment near the basin ridge. It is estimated that 59,300 cubic yards of topsoil has been stored for tailings revegetation. Hecla will spread no less than an average four inches of topsoil across the tailings area. The topsoil will be groomed by use of a dozer. Some small irregularities or depressions in the topsoil placement may be left to create microsite for bitterbrush and serviceberry, and other species.

11.3 Seedbed Preparation

After topsoil placement, the topsoil will be drilled with seed. Some wasterock may be brought to the surface during this process. This wasterock, if any, will help establish a natural look and create

microsites for seeded and natural pioneering species.

11.4 Seeding

The topsoil stockpile was seeded in the early 1980's with the following seed species:

Crested Wheatgrass
Russian Wildrye
Alfalfa
Clover

The stockpile now supports a healthy vegetation mix. Some native species have invaded the topsoil stockpile. It appears the most dominant species is the crested wheatgrass. In October 22, 1980, James W. Smith Jr., of the Division recommended a species mix and seeding rate. Depending on seed availability, Hecla plans to follow the Division's 1980 recommendation described below:

Species	lbs/ac
Great Basin wildrye (*Elymus cinereus*)	3
Indian ricegrass (*Oryzopsis hymenoides*)	2
Western wheatgrass (*Agropyron smithii*)	3
Slender wheatgrass (*Agropyron trachycaulum*) or pubescent (*A. trichphorum*)	2
Yellow sweetclover (*Melitotus officinalus*) or Utah sweetvetch (*Hedysarum boreale*)	3
Lewis flax (*Linum lewisii*) or Arrowleaf balsamroot (*Balsamorhiza sagittata*)	1
Palmer penstemon (*Penstemon palmeri*)	½
Flourwing saltbush (*Atriplex canescens*) or gardner (*A. gardneri*)	1
Ephedra (*Ephedra spp.*)	1
Winterfat (*Ceratoides lanata*)	1
	17½ TOTAL

We realize that almost ten years has past since this recommendation has been made. If the Division has found that a different seed mix would be more successful in establishing a diversity of vegetation, we would be open to suggestions. It is expected that many of the species currently growing in the topsoil will continue to grow in the tailings area.

12.0 DAMS

As described in the "Toxic Materials" section, the tailings impoundment will not impound water although the impoundment was designed for hydraulic conditions. The impoundment will impound tailings but will be mechanically stable, protected from erosion, and protected from contaminant mobility.

13.0 SOILS

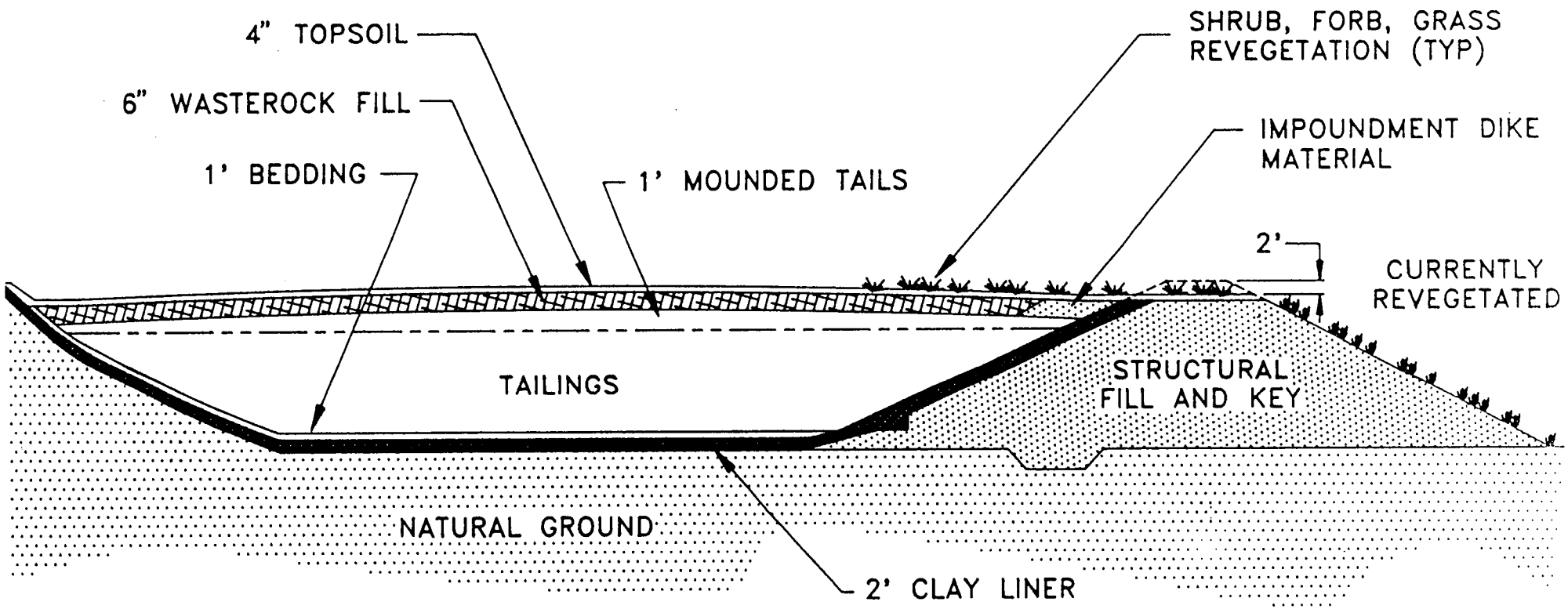
The topsoil, wasterock and tailings materials have been sampled and analyzed for nutrients, metals, and other soil indicators. The "washing" cycles of the tailings material will lower the pH which should also reduce the potential for any metals uptake by vegetation. Since there will be a six inch buffer material of wasterock between the tailings and the topsoil, and the metals levels are relatively low and immobile for tailings, vegetative toxicity due to metals is not a concern.

14.0 CLOSURE SCHEDULE

Activity	Anticipated Date
1. Escalante Mill Shuts Down	August, 1990
2. Start a Three-month Tailing Wash Cycle	September - November, 1990
3. Residual Tailings Solution Capture and Treatment	November, 1990 - August, 1991
4. Cap and Grout Tailings Water Underdrains	September, 1991
5. Earth Moving	
• Wasterock	September 1 - 15
• Topsoil	September 15 - 31
6. Seeding and Fertilizing	October, 1991
7. Erosion Control and Revegetation Maintenance	October, 1991
8. Bond Release	December, 1994

15.0 DIAGRAM

The attached diagram shows an East/West cross section through the tailings impoundment. This section shows the original ground surface, the clay liner, tailing material, wasterock, topsoil and vegetation layers.



NO SCALE

EAST/WEST SECTION
ESCALANTE SILVER MINE TAILINGS
CLOSURE PLAN

Hecla
MINING COMPANY

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MINERALS PROGRAM
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April 12 1994

April 8, 1994

Mr. Wayne Hedberg
Minerals Regulatory Program
Division of Oil, Gas, and Mining
3 Triad Center, Suite 350
355 West North Temple
Salt Lake City, Utah 84140-1203

RE: Use of manure to replace hay for Escalante tailings pond reclamation, seeding schedule

Dear Mr. Hedberg:

The approved reclamation plan for the Escalante tailings pond calls for applying 2,000 to 3,000 pounds of hay per acre to the subsoil and topsoil surfaces. Hecla proposes applying a layer of manure to the subsoil and topsoil layers instead of hay. Manure would be superior to hay in several ways. Manure will provide nutrients that are immediately available to the new vegetation. Although hay will provide organic material, it will rob nutrients from the soil as it decomposes. Since the surface of the subsoil is quite rocky, it will be difficult to effectively disc the hay into the subsoil and some of the hay may be blown off the surface during high wind events. Manure will be more stable due to its higher moisture content and other physical characteristics. Hecla's general contractor has secured a source that can provide sufficient manure for the project.

I have talked to the Cedar City office of the Soil Conservation Service about this issue and they recommended applying manure at a rate that will provide an equivalent amount of organic material. They also provided moisture content estimates. Hay was to be applied at the rate of 2,000 to 3,000 pounds per acre. Assuming 10% moisture for the hay, this results in 1,800 to 2,700 pounds of organic material per acre. Moisture of manure varies considerably, but the source for this project is material that has been stacked and drained for several months. Moisture content has been conservatively estimated at 45%. The application rate will have to be 3,500 to 5,000 pounds per acre to achieve the equivalent pounds of organic material found in the hay.

6500 Mineral Drive • Box C-8000 • Coeur d'Alene, Idaho 83814-1931 • 208/769-4100 • FAX 208/769-4107

The Soil Conservation Service suggested seeding the disturbed areas some time after Thanksgiving to maximize the rate of germination. The reclamation plan called for seeding about one month earlier. Since an earlier seeding date would be counterproductive, Hecla proposes to seed in late November. The actual date will be weather dependent.

I appreciate your consideration of these proposed modifications to our plan. Feel free to call if you have any questions.

Sincerely yours,

Alan Wilson

Alan Wilson
Senior Reclamation Engineer

cc: G. L. Wilhelm

Hecla
MINING COMPANY

MAR 24 1994

March 22, 1994

D. Wayne Hedberg
Department of Natural Resources
Division of Oil, Gas, and Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

RE: Reclamation Contract for Escalante Silver Mine, M/021/004

Dear Mr. Hedberg:

I am enclosing the signed reclamation contract for the Escalante Silver Mine. The legal description and necessary signatures are included this time. I apologize for the oversight on the previous submittal. Also enclosed is a copy of all the data we have on the tailings underdrain.

Give me a call if you have any questions.

Sincerely yours,

Alan Wilson

Alan Wilson
Senior Reclamation Engineer

6500 Mineral Drive • Box C-8000 • Coeur d'Alene, Idaho 83814-1931 • 208/769-4100 • FAX 208/769-4107

Escalante Underdrain

Date	Flow (gpm)		Date	Flow (gpm)
9/26/88			7/21/92	
9/26/90	10.0		7/23/92	1.60
10/04/90			8/20/92	1.60
10/24/90	9.2		11/15/92	1.54
11/20/90	8.7		1/24/93	1.86
12/21/90	8.0		2/25/93	2.0
1/21/91	7.3		3/19/93	2.0
2/21/91	6.1		3/7/94	1.1
3/26/91	5.4			
4/30/91	3.75			
5/30/91	3.25			
6/30/91	3.21			
7/29/91	2.85			
8/28/91	2.85			
9/23/91	3.21			
10/30/91	3.05			
11/18/91	3.05			
12/18/91	3.20			
1/22/92	3.10			
2/28/92	3.05			
3/22/92	2.65			
4/22/92	1.66			
6/23/92	1.60			

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
James W. Carter
Division Director

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801-538-5319 (TDD)

March 14, 1994

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Mr. Alan Wilson
Senior Reclamation Engineer
Hecla Mining Company
6500 Mineral Drive
Box C-8000
Coeur d'Alene, Idaho 83814-1931

Re: Final Approval, Escalante Tailings Impoundment Reclamation Plan, Hecla Mining Company, Escalante Silver Mine, M/021/004, Iron County, Utah

Dear Mr. Wilson:

The Division has received your February 25, 1994 letter, sent in response to our February 17, 1994 conditional approval of Hecla Mining Company's (Hecla) Tailing Impoundment Reclamation Plan. Your letter indicated that Hecla accepts the conditions regarding monthly discharge monitoring and leaving the underdrain open for another two (2) year period before making a final decision on capping the underdrain. You also indicated you would forward all underdrain information that Hecla presently has available as soon as it can be compiled.

It is our understanding that Hecla's contractor has initiated the reclamation work last week on the impoundment. Surface compaction efforts of the tailings and laying down of the wasterock layer are presently underway. You indicated that you have been directly involved in overseeing the initial reclamation work thus far.

On March 7, 1994, we received Hecla's revised Reclamation Contract agreement and the replacement $77~~0~~,000 surety bond. The documents have been found incomplete. Page 5 of 9, of the Reclamation Contract has not been signed and dated by an authorized officer of Hecla Mining Company. Also, page 7 of 9, has not been appropriately signed by the corporate officer and notarized. Attachment "A", page 9 of 9, has not been completed, which is a legal description of the disturbed area covered by the reclamation surety. Attachment "A" should describe the disturbed area to *at least* the 1/4, 1/4 section, Township, Range, base meridian and county.

The original pages are being returned to you for the required information. Please try and have the pages completed and returned to this office no later than April 8, 1994. This information will be included in the Board of Oil, Gas and Mining's briefing packages to be mailed out during the week of April 11-15th. We plan on presenting the amount and form of revised reclamation surety to the Board during its April 27, 1994 hearing.

Thank you for your continued cooperation and patience in completing this permitting action. Please call me should you have any remaining questions or concerns in this regard.

Sincerely,

D. Wayne Hedberg

D. Wayne Hedberg
Permit Supervisor
Minerals Regulatory Program

jb
Enclosures
cc: Richard Hall, Division Water Rights
Don Ostler, DWQ
Arthur Tait, BLM, Beaver River RA
M021004.fnl

M/021/004

Hecla
MINING COMPANY

MAR 2

February 25, 1994

D. Wayne Hedberg
Department of Natural Resources
Division of Oil, Gas, and Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

Re: Escalante Tailings Impoundment Reclamation Plan, final agreement

Dear Mr. Hedberg:

In response to your February 17, 1994 letter, Hecla accepts the requirement for monthly discharge measurements of the tailings pond underflow. We will keep records on the rate of flow for two years so we can determine if there are any trends. After the two year monitoring period we can make a final decision on capping the underdrain. You also requested any underdrain discharge records we have. I will forward all the underdrain information that we have as soon as I can get it together.

We plan to start earthwork as soon as the contractor is available, which should be the second week of March. I will keep you posted of the start date as soon as it is firmed up.

I appreciate your help in getting the reclamation plan finalized and look forward to getting the job done.

Sincerely yours,

Alan Wilson
Senior Reclamation Engineer

cc: G. Wilhelm

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MINING COMPANY

RECEIVED
FEB 11 1994
DIVISION OF
OIL GAS & MINING

February 8, 1994

Mr. D. Wayne Hedberg
Department of Natural Resources
Division of Oil, Gas, and Mining
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, UT 84180-1203

Dear Mr. Hedberg:

I appreciate your response to Revision 2 of the Escalante Tailings Pond Reclamation Plan. Hecla agrees to all clarifications and conditions except Item 2. The installation of the tailings cap will essentially eliminate any recharge to the tailings from precipitation. The only drainage coming from the tailings will be the contained moisture. Given the low permeability of the tailings, this flow could continue at very low rates for a number of years. The quantities of water would still be small, however. Since the tailings impoundment was constructed to be water tight, and Hecla feels that the construction was effective, the small amount of water that remains impounded within the tailings will be isolated from the environment. Hecla would offer to allow the underdrain flow to continue for two years after the impoundment cap has been installed, then permanently seal the underdrain.

In response to Item 5, Hecla intends to use a surety bond to cover the project.

Please give me a call if you have any questions.

Sincerely yours,

Alan Wilson

Alan Wilson
Senior Reclamation Engineer

cc: G. Wilhelm

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State of Utah

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

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February 2, 1994

Mr. Alan Wilson
Senior Reclamation Engineer
Hecla Mining Company
6500 Mineral Drive
Box C-8000
Coeur d'Alene, Idaho 83814-1931

Re: Tentative Approval of Escalante Tailings Impoundment Reclamation Plan - Revision 2, Hecla Mining Company, Escalante Silver Mine, M/021/004, Iron County, Utah

Dear Mr. Wilson:

The Division has completed its review of your latest draft Tailings Impoundment reclamation proposal, received January 18, 1994. Hecla Mining Company has now satisfied the majority of the requirements as outlined in our previous reviews. Overall, the proposal is now conceptually complete and the Division is prepared to grant its approval of the latest proposal. We have consulted with the Bureau of Land Management and the State Division of Water Quality regarding their review of the proposal as well. As a result of those discussions, our approval will be based upon Hecla's acceptance of the following clarifications and conditions:

1, On page 3, Section 7.0 - Structures and Equipment, the plan indicates that after implementation of revegetation measures, the impoundment fencing will be modified to allow safe passage for wildlife, while restricting livestock usage.

For clarification, it is our interpretation that this statement means that the fence will be modified after successful establishment of revegetation on the impoundment, and not immediately following completion of the seeding efforts. The overall effectiveness of the proposed reclamation/closure plan, in preventing a leachate buildup within the impoundment, depends upon a successful and sustainable revegetation effort. Therefore, the Division recommends that the impoundment fence remain intact to discourage access to **both** livestock and wildlife until an acceptable level of vegetation is achieved. Following revegetation establishment, wildlife may have controlled access to the impoundment area. Installation of a one-way wildlife gate(s) allowing deer and/or antelope to exit the impoundment, should they manage to get inside the fence during or after revegetation establishment, may be appropriate. Should smaller mammals (i.e., rabbits, etc.) prove to be a problem in vegetation establishment, then supplemental measures may be required of Hecla to correct the situation. We recommend that Hecla seek assistance/advise from the Utah Division of Wildlife Resources in determining the design for the wildlife gate(s).

2. On page 4, Section 9.1 - Tailing Impoundment Reclamation, the plan indicates that after reclamation, the tailings underdrain will be capped and sealed.

Again for clarification, the underdrain should **not** be permanently capped and sealed until it is confirmed that all drainage from the impoundment has ceased. It is our understanding that the underdrain is still discharging leachate into the holding tanks at the millsite area.

3. On page 5, Section 9.2 - Subsoil Borrow Area Reclamation, the plan indicates that the cut slopes will be graded back to at least a two to one or flatter slope to blend in with the natural topography.

   The BLM is requesting that the cut slopes be recontoured to a 3H : 1V configuration or flatter, to help insure revegetative success. If steeper slopes are necessary to fit natural contours, then alternate methods of erosion and sediment control may be required.

4. Page 8, Section 10 - Closure Schedule, lists 2/1/95 as the anticipated date for bond release. For clarification, the Division previously agreed to Hecla's request for a **phased** release of the reclamation surety. A phased release would be based upon Division and BLM approval of a formal request from Hecla for release from those reclamation components determined successfully completed. The latest draft closure plan schedule should be revised to clarify Hecla's intentions in this regard. Full release of reclamation surety will not occur until all reclamation requirements (including meeting the revegetation standards) are achieved.

5. The reclamation surety must be increased to $771,000 (1999 dollars). The reclamation estimate has been recalculated to reflect the conditions described in the latest reclamation proposal. The Division's final approval will not be effective until the replacement surety is filed with and found acceptable by the Division and BLM. The reclamation surety will need to be made jointly payable to both the Division and BLM. We will seek concurrence and approval from the Board of Oil, Gas and Mining on the amount and form of revised surety at a regularly scheduled Board hearing, following our receipt of the surety and revised Reclamation Contract (FORM MR-RC). Please notify this office at your earliest convenience as to the form of surety Hecla will pursue. We will then send you the appropriate surety forms to be used.

Thank you for your cooperation and patience in finalizing this permitting action. Please contact me if you have questions regarding the requirements of this letter.

Sincerely,

D. Wayne Hedberg
Permit Supervisor
Minerals Regulatory Program

jb
Enclosure
cc: Gina Pack, BLM, Beaver River RA
Don Ostler, DWQ
Lowell Braxton, DOGM
M021004.imp

RECLAMATION ESTIMATE

Hecla Mining Company

Escalante Silver Mine - Mill Tailings Facility — Iron County

M/021/004 — last revision 02/01/94

Prepared by Utah State Division of Oil, Gas & Mining — filename M21-04RV.WQ1

Reclamation Details

-All structures and equipment to be removed from the office site (1.5 acre EST)

-Revised tailings cover: 10" capillary, 18" subsoil, 6" topsoil (65 acres)

-Hay incorporated into tailings subsoil & topsoil caps (2-3,000 lb/acre)

-Road to tailings reduced via ripping & seeding(5,800' x 12'= 1.6 acre)

-Impoundment runoff ditch constructed around tailings cap (7,200')

-Subsoil borrow areas ripped, topsoiled & seeded (HECLA ESTIMATE 31 acres)

-Surface layer of tailings to be compacted (ASSUME with a dozer)

-Rip topsoil stockpile area & drill seed (9 acre ESTIMATE)

-Monitor groundwater wells for 4 years after reclamation (quarterly)

-Fence maintenance 3 years (7,900 + ~10,000 LF, quarterly)

-Areas revegetated via drill seeding unless impractical (=>hand seeding)

-Disturbed acreage = office+tailings+borrow+roads+stockpile= **108**

Description	Amount		$/Unit	Cost-$
Structure demolition/removal	sum-ASSUMED		5,000	5,000
Compaction of tailings surface(0.60 MPH)*	65	acre	407	26,455
Waste rock capillary barrier 10" *	**87,389**	CY	2.46	**214,977**
Tailings subsoil cap 18" *	157,300	CY	1.51	237,523
Tailings topsoil cap 6" *	52,433	CY	1.55	81,272
Disc hay into tailings soils *	65	acre	250	16,250
Ripping tailings road (0.40 mph) **	1.6	acre	603	965
Runoff ditch construction **	7,200	ft	0.32	2,304
Ripping borrow areas (0.60 mph) **	**31**	acre	407	**12,617**
Rip topsoil stockpile area**	9.0	acre	407	3,663
Reseed all disturbed areas	**108**	acre	290	**31,320**
Monitor groundwater (quarterly)	4	yr	1,200	4,800
Fencing-borrow areas(LF estimated)	10,000	LF	1.00	10,000
Mobilization	5	units	1,000	5,000
Fence maintenance (quarterly)	3	yr	400	1,200
	SUBTOTAL			653,345
	+ 10% CONTINGENCY			65,335
	SUBTOTAL			718,680
	+5yr ESCAL (1.42%)			52,496
	TOTAL			771,176
	ROUNDED TOTAL IN 1999-$			**$771,000**

* Phase I Surety Reduction

** Phase II Surety Reduction

Average cost per acre = **7,139** *$/acre*

M/021/004

Hecla
MINING COMPANY

January 13, 1994

Mr. Wayne Hedberg
State of Utah
Department of Natural Resources
Division of Oil, Gas, and Minerals
355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, UT 84180-1203

JAN 18 1994

RE: Escalante Tailings Impoundment Reclamation Plan, Revision 2

Dear Mr. Hedberg:

I am enclosing a Draft Second Revision of the Reclamation Plan incorporating all the changes to the January 2, 1992 Plan that have been previously discussed through correspondence between Hecla and the State. The text of the plan includes references to sources of modifications to the earlier Plan. With the exception of the change in impoundment runoff ditch slopes, there are no changes to the plan that have not been discussed and accepted by both Hecla and the State.

Hecla would like to start work on this project in March. It is important to have a response from the State as soon as possible so we can finalize our Request for Proposal and get the bid process started. I appreciate your assistance in finalizing this process. Give me a call if you have any questions.

Sincerely yours,

Alan Wilson
Senior Reclamation Engineer

enclosures
cc: George Wilhelm, HMC (w/o enclosures)
Don Ostler, Utah DWQ
Gina Pack, BLM

6500 Mineral Drive • Box C-8000 • Coeur d'Alene, Idaho 83814-1931 • 208/769-4100 • FAX 208/769-4107

DRAFT

HECLA MINING COMPANY

RECLAMATION PLAN

ESCALANTE UNIT
MILL TAILINGS FACILITY

Revision 2
January 13, 1993

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1.0 INTRODUCTION

This document is submitted to incorporate the previously agreed to modifications to the reclamation plan submitted by Hecla dated January 2, 1992. This plan includes a ten inch layer of waste rock to replace the six inch clay cap layer. As stated in a November 1, 1993 letter to UDOGM, Hecla will to the extent practicable, select coarse rock with a diameter of 0.5 inch and larger. This specification was approved by UDOGM in a December 1 1993 letter to Hecla. The subsoil layer thickness has been increased from 14 to 18 inches. This is the thickness stipulated in the December 1, 1993 letter from UDOGM to Hecla.

The side slopes of the impoundment runoff ditch have been increased from 4H:1V to 3H:1V to minimize the area of disturbance on the south side of the pond. The natural slope of the land is greater than 4H:1V so there would have been an extensive amount of stripping necessary to install the ditch with the 4H:1V slope. The width of the ditch bottom has been increased from 8 to 9.5 feet to maintain the 1.5 foot water depth at the maximum flow rate. The riprap specifications for the ditch included in the March 17, 1993 letter from Hecla to UDOGM have been included in this document.

2.0 LAND USE

The tailings impoundment is located on U.S. Bureau of Land Management (BLM) land. Adjacent parcels of land are owned by the BLM, as well as Hecla. The pre-operational use of this land included occasional grazing, mining and exploration activities, and wildlife habitat. The probable land uses during the post Escalante mining stage will be occasional grazing, minerals exploration and mining activities, and wildlife habitat. There should be no difficulty in returning the disturbed area to a condition capable of supporting these types of land uses.

3.0 PUBLIC SAFETY AND WELFARE

To effectively reclaim the tailings impoundment, some fences may need to be dismantled temporarily. However, there will be sufficient signs to warn the public during the earth moving stage. Because future uncontrolled livestock grazing could damage revegetation efforts, the existing fence will be modified, after implementation of revegetation measures, to prevent grazing by domestic stock. The fence will be modified to allow safe passage for wildlife, while restricting usage by livestock.

4.0 SLOPES

The downstream slope of the embankment containing the tailings is stable at its present 2 horizontal to 1 vertical slope ratio. Revegetation results from past seeding (1980) on the embankment are successful. This revegetation will suffice in preventing wind erosion. Water erosion will be controlled by preventing surface water flow from crossing the embankment. The tailings cap will be sloped gently (0.25% to 0.5%) away from the tailings embankment.

This shallow slope will result in a low runoff velocity without causing ponding, which will reduce the likelihood of erosion of the cover material.

The new impoundment runoff ditch will also be sloped gently (about 0.2%) in the longitudinal direction to preclude erosion. The side slopes of the ditch will also be constructed to prevent erosion. After construction the impoundment runoff ditches will be seeded with the mix for borrow areas specified by the BLM for borrow areas. Mulch will be applied to stabilize the bottom and sides of the ditch until vegetation becomes established.

5.0 GROUNDWATER MONITORING SYSTEM

The ground-water monitoring system is comprised of four wells (TMW-1, TMW-2, TMW-3, TMW-4). Two of these wells, TMW-1 and TMW-3, are upslope and west of the tailings area. The other wells, TMW-2 and TMW-4, are downslope of the tailings dam, to the east of the tailings area. TMW-2 and TMW-4 are also downgradient of the tailings area, while the other two wells are upgradient.

Hecla and DEQ agreed on the terms of a groundwater monitoring program which was formalized in a Consent Decree signed on February 5, 1993. Hecla will continue to conduct water quality sampling at the four wells in accordance with the Consent Decree signed with Utah Department of Environmental Quality.

6.0 DRAINAGES

Hecla will recontour the tailings area through the use of waste rock, subsoil, and topsoil to assure the area is left in a stable condition. The recontouring will involve completely filling the tailings impoundment area such that no water will be ponded on the site. Stormwater runoff will be directed around the site and into the natural channel below the tailings dam without affecting the face of the original containment structure. Storm events or runoff occurring in the basin above the tailings containment area will be diverted via the existing basin interceptor trench and newly constructed impoundment runoff ditch constructed around both sides of the impoundment. This will assure that surface water flow is not channeled across the reclaimed surface and the face of the impoundment structure. Any storm events or runoff originating on the tailings cap will be diverted off the cap to the new impoundment runoff ditch. The runoff conveyances are designed for the 100-yr, 6-hr flood event. These structures will channel storm water to the natural water course below the tailings. Considering the size of this small arid basin (with no visible gullies or watercourses), the basin will be left in a stable condition that will avoid future damage to the hydrologic system.

The longitudinal slope of the tailings cap will range from approximately 0.25% to 0.5%. Based upon a 100-yr, 6-hr design storm, the new impoundment runoff ditch will have a longitudinal slope of approximately 0.2% (0.002 ft/ft), a trapezoidal cross-section with side slopes of 3 to 1, and a bottom width of 9.5 ft, as shown in Detail 2, Drawing No. 11358A. The 2.5-foot deep ditch, which includes 1-foot of freeboard, is designed to carry a discharge of 68 cubic feet per

second. The approximate location of the ditch is shown on Drawing No. 11357A. The exact location of the ditch will depend on the location and depth of borrow areas.

The ditches will be lined with riprap in the area of the dam abutments and the hillslopes leading to the natural channel below the dam. The riprap specifications required to withstand erosion resulting from the 100-year runoff were developed by Grant, Schreiber, and Associates and included in a letter from Hecla to UDOGM dated March 17, 1993. The specifications are:

- Impoundment ditches: Mean diameter of at least 0.6 inches and a layer thickness of at least 12 inches.
- North abutment hillslope: Mean diameter of 2.25 feet and a layer thickness of 3.375 feet.
- South abutment hillslope: Mean diameter of 2 feet and a layer thickness of 3 feet.

If any of the subsoil borrow areas are located where the current basin interceptor trench lies, a new basin interceptor trench will be re-established on grade after the borrowing process is complete.

7.0 STRUCTURES AND EQUIPMENT

Hecla proposes to temporarily dismantle some fencing around the impoundment to facilitate construction of the impoundment cover. Because future uncontrolled livestock grazing could damage revegetation efforts, the existing fence will be modified after implementation of revegetation measures to restrict grazing. The fence will be modified to allow safe passage for wildlife, while restricting usage by livestock.

Hecla will abandon and close the ground-water monitoring wells when monitoring is no longer required, in accordance with the State of Utah well closure rules in effect at the time of closure.

8.0 SEDIMENT CONTROL

Sediment caused by erosion from stormwater runoff will be controlled by revegetating the tailings cap, revegetating all borrow areas, and placing water bars in the access and haulage roads to the tailings facility. The revegetation mixture is presented in Section 9.1. The Checkett topsoil used on the tailings cap will provide a naturally gravelly surface condition and will provide an adequate erosional armorment for stormwater runoff.

9.0 RECLAMATION/REVEGETATION

The reclamation/revegetation activities for this project are divided into four different reclamation prescriptions for the four different types of disturbances.

9.1 Tailing Impoundment Reclamation

The reclamation objectives for the 65-acre tailings impoundment are three-fold. First, a capillary barrier will be constructed to impede the upward migration of moisture and minimize any upward translocation of available salts or metals. Second, a self-sustaining vegetative cover must be established to protect against wind and water erosion. Third, infiltration of water into the tailings is prevented through runoff control and evapotranspiration. After reclamation has been completed the tailings underdrain will be capped and sealed.

Generally, the reclamation prescription proposed to meet these objectives consists of compacting the existing tailings surface as is possible, placing a 10-inch capillary barrier of waste rock, 18 inches of subsoil, 6 inches of topsoil, application of hay, seedbed preparation, seeding, vegetation establishment, and maintenance. The total depth of material placed on the tailings will be a minimum of 34 inches.

The tailings surface will first be compacted with at least three passes with a padded foot, or other appropriate compaction equipment, as approved by UDOGM in a December 1, 1993 letter to Hecla. This will should aid in the reduction of permeability of the surface layer and provide a more stable working surface.

The 6 inches of topsoil and 18 inches of subsoil will provide a minimum rooting medium of 24 inches over the impoundment. As an additional measure to assure establishment of vegetation, DOGM suggested the addition of hay to the subsoil and to the topsoil layer above the subsoil at a rate of two to three thousand pounds per acre. It is proposed to add the hay at this rate in order to increase nitrogen, increase moisture holding capacity, minimize any re-seeding or maintenance activities, and to decrease the number of years needed to carry reclamation bonds.

The six inches of topsoil will be placed on top of the subsoil and drill seeded after the hay has been applied. Hecla proposes to seed the area with shallow rooted grasses and forbs. Shrubs will not be seeded on the impoundment cover because they are deep rooting plants. Hecla proposes to use the seed mix recommended for the tailings impoundment by DOGM in a letter to Hecla dated April 29, 1991, with the exception that alfalfa will be omitted from the suggested mixture because it is a deep rooting plant. In general, the following seed mix will be used on the impoundment cover. Hecla reserves the right to adjust the quantity of each type of seed, depending upon seed availability and concurrence with DOGM:

+ BLM

Species	lb/acre PLS*
Grasses	
Bottlebrush squirrel tail	0.5
Needle and thread	0.5
Crested wheatgrass	1.0
Riparian wheatgrass	2.0
Western wheatgrass	2.0
Indian ricegrass	2.0
Russian wildrye	1.0
Forbs	
Lewis flax	0.5
Palmer penstemon	1.0
Yellow sweetclover	2.0
Gooseberry & or Goldenmallow	1.0
Small burnet	1.0
Total	14.5

* Based upon drill seeding only. The rates will be increased ~~of~~ if seeds are broadcast.

Expectations are that shallow-rooted grasses will establish and dominate. Because of the difficulty of rangeland seeding in Checkett soils, follow-up grass seedings will be conducted as needed.

9.2 Subsoil Borrow Area Reclamation

The two subsoil borrow areas are located adjacent to the tailing impoundment, as shown on Drawing No. 11357A. The combined source area totals approximately 31 acres. Approximately 25% of the subsoil required will come from the impoundment diversion ditch construction with the remainder from the outlined area.

A typical subsoil extraction procedure would be as follows:

1. Push the topsoil off the subsoil layer with the use of a dozer.
2. Excavate and transport the material to the tailings impoundment.
3. Replace the topsoil over the borrow area.
4. Reseed the disturbed borrow area.

Some borrow sources that have deep deposits will result in deeper excavations. In those cases, the cut slopes will be graded back to at least a two to one or flatter slope that will blend in with the natural topography. The topsoil removed from the borrow areas to expose the subsoil material will be replaced. As requested by DOGM, hay will be incorporated into the topsoil at a rate of approximately 2,000 to 3,000 pounds per acre.

For borrow areas on BLM land the seed mixture recommended in BLM's letter dated December 16, 1991, approving the Plan of Operations, will be used for seeding of disturbed areas. Hecla reserves the right to adjust quantities depending on seed availability and pre-approval of changes by the authorized BLM officer. This seed mixture is as follows:

SPECIES	lb/acre PLS	Method
Bottlebrush squirreltail*	2.0	Drill
Needle-and-thread*	2.0	Drill
Crested wheatgrass	1.5	Drill
(Nordan, Fairway, Ephraim, Hycrest)		
Pubescent wheatgrass (Luna)	2.0	Drill
Yellow sweetclover	1.0	Broadcast
Alfalfa	1.0	Broadcast
(Ladak, Nomad, Spreader II)		
Common globemallow*	0.5	Drill
Small burnet	1.0	Drill
Wyoming big sagebrush*	0.5	Drill
Black sagebrush*	0.5	Drill
Fourwing saltbush*	1.0	Drill
Forage kochia	0.5	Broadcast
Curlygrass (Galleta)	3.0	Drill
Palmer penstemon	1.0	Broadcast
Total	17.5	

As requested by the BLM, broadcast seeding will be completed before drilling to provide a minimal soil cover over the broadcast seed. Seeding will be completed in the fall immediately following the reclamation to decrease the encroachment of introduced annual weed species into the area. Hecla will install and maintain fences around the reclaimed areas to prevent damage to the seedings from wild horses and livestock grazing. The fences will be removed after Hecla and the BLM agree that the areas are stable enough for the resumption of grazing. The fences will consist of 4 wires and will not exceed 40 inches in height. The top three wires will be barbed and the bottom wire will be smooth. The wire spacing from the ground to the top will be 16 inches, 6 inches, 6 inches, and 12 inches respectively.

To ensure vegetative recovery at least 8 to 10 inches of topsoil/subsoil, as is available, will be left covering the white, high-pH soil material that underlies the subsoil material. The base material will be ripped before replacing the topsoil.

For disturbed areas on Hecla-owned land, the Utah Department of Wildlife's suggested seed mixture will be used dependent on seed availability and other agency agreement. That seed mix is described below:

SPECIES	lb/acre PLS
Bottlebrush squirreltail*	0.5
Needle-and-thread*	0.5
Crested wheatgrass	1.5
(Nordan, Fairway, Ephraim, Hycrest)	
Pubescent wheatgrass (Luna)	1.0
Russian wildrye	1.0
Lewis flax	0.5
Palmer penstemon	0.5
Yellow sweetclover	1.0
Alfalfa	1.0
(Ladak, Nomad, Spreader II)	
Common globemallow*	0.5
Small burnet	1.0
Winterfat	1.0
Wyoming big sagebrush*	0.5
Black sagebrush*	0.5
Green and white rubber rabbitbrush	1.0
Low rabbitbrush	0.5
Fourwing saltbush*	1.0
Forage kochia	0.5
Total	14.0

Seeding on Hecla-owned land will be completed during the late fall or early winter months. Grasses, forbs, and some shrubs will be drill seeded. Other shrubs will have to be hand seeded after ripping the soil. Grasses will be seeded in rows different from the shrub and forb seed to prevent over competition of the grasses.

9.3 Topsoil Storage Area Reclamation

The topsoil storage area will be reclaimed in the same manner as the subsoil borrow sources on BLM land. Some topsoil from the stockpile may be allocated for use in this area.

9.4 Access Road Reclamation

A new access road will need to be established to haul topsoil materials to the tailings site. The amount of new road establishment disturbance is expected to total less than 1 acre. Efforts will be made to place the road where little or no cut and fill is necessary. After reclamation is complete, the newly established road will be ripped, water-barred, topsoiled, and seeded. The seed mix and methods for the road will be similar to the prescription described for the subsoil borrow areas.

As approved in the Plan of Operations submitted to the BLM, the existing access roads (mill to tailings impoundment) will be reduced to a one-lane road. Disturbed areas adjacent to the one-

lane road will also be ripped and seeded with the mixture described in Section 10.2. This road will be needed for periodic tailings reclamation inspections and general land management use. Hecla will leave this road in a condition suitable for continued use, complete with existing drainage structures.

10.0 CLOSURE SCHEDULE

If weather permits and required approvals are received, earth moving activity would start in March 1994. The following tentative schedule outlines the reclamation process:

ACTIVITY	ANTICIPATED DATE
Begin Earth Moving	3/1/94
Complete Earth Moving	8/1/94
Seed	10/1/94
Cap and Grout Underdrain	11/1/94
Bond Release	2/1/95

Revision 1

Reclamation Plan

Escalante Unit Mill Tailings Facility

Date Received
1/6/92
HWS

Enterprise, Utah

Prepared For:

Hecla Mining Company
Coeur d'Alene, Idaho

Prepared By:

Grant, Schreiber and Associates
Coeur d'Alene, Idaho

January 2, 1992

Project No. 610449

Grant, Schreiber and Associates
Engineering • Hydrology • Management
Coeur d'Alene • Denver • Little Rock

Revision 1

Reclamation Plan

Escalante Unit
Mill Tailings Facility

Enterprise, Utah

Prepared For:

Hecla Mining Company
Coeur d'Alene, Idaho

Prepared By:

Grant, Schreiber and Associates
Coeur d'Alene, Idaho

January 2, 1992

Project No. 610449

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Grant, Schreiber and Associates
Engineering • Hydrology • Management
Coeur d'Alene • Denver • Little Rock

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1. INTRODUCTION

Hecla Mining Company (Hecla) and its predecessor, Ranchers Exploration and Development Company (Ranchers), have committed to reclamation requirements through the permitting, development, and production phases of the Escalante Silver Mine. The Utah Division of Oil, Gas and Mining (DOGM) has authority over all lands disturbed by mining and milling. This authority is given to the Division under the Utah State Reclamation Act effective May 14, 1975 and the Amended and New Rules Minerals Reclamation Program of December 1, 1988.

Since the majority of the tailings impoundment reclamation requirements are described in Rule M-10 of the Utah State Reclamation Act, the proposal will follow that format and outline plans for complying with the Act.

In August 1989, the State of Utah adopted regulations for ground-water protection. The Utah Bureau of Water Pollution Control (BWPC) has authority under Rule R448-6-6.1B over facilities that discharge or would probably result in a discharge of pollutants directly or indirectly into ground water. The data, analyses, and drawings provided in this report demonstrate that the reclaimed tailings facility will have a de-minimus actual or potential effect on ground-water quality.

2. LAND USE

The tailings impoundment is located on land administered by the U.S. Bureau of Land Management (BLM). Adjacent parcels of land are administered by the BLM, as well as Hecla. The pre-operational use of this land included occasional grazing, mining and exploration activities, and wildlife habitat. The probable land uses during the post Escalante mining stage will be occasional grazing, minerals exploration and mining activities, and wildlife habitat. There should be no difficulty in returning the disturbed area to a condition capable of supporting these types of land uses.

3. PUBLIC SAFETY AND WELFARE

To effectively reclaim the tailings pond, some of the existing fences may need to be dismantled temporarily. However, there will be sufficient signs to warn the public during the earth moving stage. Because future uncontrolled livestock grazing could damage revegetation efforts, the existing fence will be modified, after implementation of revegetation measures, to prevent grazing by domestic stock. The fence will be modified to allow safe passage for wildlife, while restricting usage by livestock.

4. IMPOUNDMENTS

The tailings area will be re-contoured in a manner that will not impound water. The gentle slope (approximately 0.25 % to 0.5 %) of the tailings cap will direct storm-water runoff away from the embankment to a newly constructed impoundment runoff ditch. This ditch will be constructed to divert runoff from the cap and adjacent slopes around the tailings area into the natural channel below the dam. Details are provided in Section 8.0, Drainages, and Section 15.0, Drawings.

The existing underdrain system that collected leachate from the bottom of the tailings during mill operation will be left operable for an interim period until the tailings are drained. Leachate collected in the interim period will be routed to the evaporation tanks at the mill, where it will be evaporated. After the tailings are drained, the reclaim pipe will be sealed off, so that no leachate will leave the impoundment.

5. SLOPES

The downstream slope of the embankment containing the tailings is stable at its present 2 horizontal to 1 vertical slope ratio. Revegetation results from past seeding (1980) on the embankment are successful. This revegetation will suffice in preventing wind erosion. Water erosion will be controlled by preventing surface water flow from crossing the embankment.

As briefly mentioned in Section 4.0, the tailings cap will be sloped gently (0.25% to 0.5%) away from the tailings embankment. This shallow slope will

result in a low runoff velocity without causing ponding, which will reduce the likelihood of erosion of the cover material.

The new impoundment runoff ditch that was discussed briefly in Section 4.0, will also be sloped gently (about 0.2%) in the longitudinal direction to preclude erosion. The side slopes of the ditch will also be constructed to prevent erosion. After construction, the impoundment runoff ditches will be seeded with the mix for borrow areas specified by the BLM for borrow areas (see Section 11.2). Mulch will be applied to stabilize the bottom and sides of the ditch until vegetation becomes established. NEW

Details regarding the cap and impoundment runoff ditch are included in Sections 8.0 and 15.0.

6. TOXIC MATERIALS

Hecla will comply with the toxic materials provision of the Reclamation Act by leaving the mill tailings in an encapsulated, isolated condition. This will assure that adverse environmental effects will be eliminated or controlled. Further discussion on this subject is included in Sections 6.1 and 6.2, as well as the rest of this report.

6.1 Ground-Water Protection

In August 1989, the State of Utah adopted regulations for ground-water protection. The BWPC has authority under Rule R-448-6-6.1 over facilities that discharge or would probably result in a discharge of pollutants directly or indirectly into ground water. In 1980, the Executive Secretary of the Utah Department of Health granted approval for Ranchers to deposit the tailings in the lined impoundment in their current state.

Ground-water protection will be demonstrated in this section by presenting 1) results of modeling the reclaimed tailings using weather data from nearby (Cedar City, Utah), 2) a discussion of the feasibility of treating the tailings, 3) an evaluation of the ground-water monitoring system, and 4) an analysis of cyanide concentrations in the tailings.

6.1.1 Cap Modeling Results

As part of the tailings impoundment cover design, a modeling study was performed to evaluate the potential for leaching of water into, through, and out of the tailings impoundment. The Hydrologic Evaluation of Landfill Performance (HELP) model (Schroeder et al., 1983 and Schroeder, 1988) was used to simulate the performance of the cover on a daily basis for a period of 5 years after closure. This time period was chosen because of the availability of the climatologic data and because the data appeared to be representative from a long-term average standpoint.

The HELP model was developed by the U.S. Army Engineer Waterways Experiment Station for the U.S. Environmental Protection Agency (EPA). The model is widely used by designers and regulatory reviewers for evaluating the performance of landfill and impoundment designs during operation and post-closure.

The HELP model simulates precipitation, surface storage, surface runoff, infiltration, percolation, evapotranspiration, soil moisture storage, and lateral drainage, based on actual climatologic, vegetative, design, and soil data. Climatologic data collected at Cedar City, Utah from 1974 through 1978 were used as the basis for the simulation. This particular set of data was available with the HELP model. It is a representative set of data in that it includes high, as well as low, precipitation data, and the overall average precipitation is near the long-term average for the area. The climatologic data required by the model include:

- daily precipitation,
- mean monthly temperature,
- mean monthly isolation (solar radiation), and
- leaf area indices.

The vegetative cover used in the model was a poor stand of grass. This type of cover results in a leaf area index of 1. The U.S. Soil Conservation Service runoff curve number associated with this type of vegetative cover in arid and semiarid areas is 93 (SCS, 1986). These assumptions provide conservatism in the modeling results.

The tailings impoundment was modeled as seven different layers, as shown in Table 6-1 and Drawing No. 11359 in Section 15.0. The top three layers represent the impoundment cover, which consists of a topsoil layer, a subsoil layer, and a low-permeability clay cap. The fourth layer represents the tailings layer. The fifth and sixth layers represent the underdrain and low-permeability clay liner. The seventh layer represents the foundation material (native soil layer). According to Fox (1980), the ground-water table is located approximately 300-350 feet below the surface of the foundation material, which is below the tailings. These depths were confirmed by recent ground-water level measurements, which are listed in Table 6-2. The soil parameters used to model the various layers in the impoundment are shown in Table 6-1. The values for these parameters were selected based upon soil tests performed by Fox (1980 and 1984).

The results of the modeling are shown in Table 6-3. The annual precipitation during this 5-year period ranged from 6.38 inches to 13.93 inches, with an average of 9.76 inches. Because of the arid climate, an average of 92.6 percent of the precipitation is dissipated through evapotranspiration. Another 4.5 percent is lost through surface runoff, leaving less than 3 percent. The remaining 3 percent is accounted for by an increase in soil moisture in the upper layers. This increase in soil moisture will help sustain the vegetation on the cover during dry periods. Most importantly, the model results show **no** discharge from the tailings impoundment and only a minute amount of water (an average of 0.003 inches per year) percolating through the cap and into the tailings. To alleviate concerns that this discharge may create a "bath tub effect" and saturate the impoundment, the time required to completely fill the impoundment was calculated. Based on a tailings volume of 60 million cubic feet (Wright, 1980), a tailings porosity of 0.49, a surface area of 58 acres, and a discharge to the tailings of 0.003 inches per year, the time required to completely fill the impoundment is approximately 46,500 years, assuming that the tailings were initially dry. If a tailings moisture content of 30 percent, as observed during operation, is assumed (Fox, 1984), the time required to completely saturate the tailings is approximately 7,600 years. Since the underdrain system will be operational until the tailings are drained, the water content will be less than during operation, which would require a longer time to achieve complete

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saturation of the tailings. Thus, the quantity of water percolating through the cover and into the tailings is negligible, with none of this reaching ground water.

Encapsulation, such as proposed here, is an appropriate closure plan for this tailings facility. Similar closure plans are used for new solid waste landfills under RCRA Subtitle D, hazardous waste landfills, and low-level radioactive waste disposal facilities.

6.1.2 Evaluation of Tailings Treatment

This issue has been discussed between Hecla, DOGM, BWPC, and the BLM on several occasions -- the last being a joint meeting at DOGM's Salt Lake City office on August 30, 1990. The following discussion points out why tailings treatment is neither desirable nor economically feasible.

The pH levels in the tailings are high, currently ranging from about 9.5 to 9.8. Concentrations of heavy metals in the impoundment are loosely complexed and would become more mobile if pH levels were lowered (neutralized) by washing the tailings. This could cause heavy metals to move downward and concentrate at higher levels.

Washing of the tailings would require several years of effort. Adding large quantities of water to the tailings would require keeping the underdrain system functioning for a number of years. Thus, the mill/pumping areas could not be completely dismantled and reclaimed for several years.

Washing solutions placed on the impoundment would pond on the surface prior to infiltrating, since the hydraulic conductivity of the tailings is relatively low (10^{-5} cm/sec). There are two disadvantages to a ponding situation that a wash would create. One disadvantage is that evaporation will diminish the amount of solution available to actually wash the tailings. The other disadvantage is that ponded water on the tailings is undesirable for migratory waterfowl, as demonstrated by past difficulties in hazing waterfowl.

Removal of the tailings and treating is not economically feasible. It took 10 years for Hecla to deposit over two million tons of tailings in the impoundment at an hourly rate of about 30 tons/hr. A like amount of time or more would be

expected to remove and treat the tailings. This would require keeping the mill complex operating; thus, it could not be dismantled and reclaimed until treatment was finished.

Another area would have to be permitted to place the treated tailings, while removing the existing tailings. Furthermore, removing the existing tailings would risk damage to the liner and underdrain system, which have worked admirably to date.

For a heap leach mining process (which Escalante is not), washing and detoxification can readily be done at the end of the mine heap life. With most leaching processes, the rock material being leached ranges in size from 0.5 to 2 inches. The Escalante milling operation ground the rock material to 200-mesh size material with a rather low hydraulic conductivity. Thus, washing the Escalante tailings is not as amenable as heap leach rock material.

Ranchers was originally permitted in 1980 by DOGM and the Department of Health to deposit the cyanide and metal bearing tailings in the impoundment that was designed to hold these types of materials. The original feasibility studies did not consider the extremely high cost of cyanide treatment, because the agencies were satisfied with the technical design of the tailings facility clay liner to contain mine waste. To require treatment of tailings after all of the material has left the milling circuit is unreasonable. In this instance, the company should not be penalized because regulator opinions changed prior to reclamation, especially since ground water has been protected and modeling shows that ground water will be protected in the future.

In summary, it is not practical nor feasible to treat the tailings. Several years and a great deal of expense would be required. For these reasons, encapsulation of the tailings is the preferred reclamation alternative and will provide adequate protection of the environment.

6.1.3 Ground-Water Monitoring System

The ground-water monitoring system is comprised of three wells (TMW-1, TMW-2, TMW-3) as shown on Drawing No. 11360 in Section 15. Two of these wells, TMW-1 and TMW-3 are upslope and west of the tailings area. The other

well, TMW-2, is downslope of the tailings dam, to the east of the tailings area. Based upon the ground-water elevation contours shown on Drawing No. 11360, TMW-2 is downgradient of the tailings area, while the other two wells are upgradient.

Ground-water levels in the three monitoring wells were measured in August, September, and October of 1990 and are listed in Table 6-2. These elevations, as shown on Drawing No. 11360, indicate that the monitoring wells are located in the same aquifer as the other wells in the valley. The ground-water gradient is towards the northeast at about 2 ft/1000 ft in the vicinity of the tailings monitoring wells.

Water quality data for the three monitoring wells are shown in Tables 6-4 through 6-6. In addition, water quality data for pumping well P-1 near the mine are shown in Table 6-7. In general for the last three years, none of the parameters exceeded acceptable standards. Furthermore, cyanide has never been detected in any of the four wells.

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As noted in Section 6.1.1, it is highly unlikely that any leachate will seep from the tailings through the liner and existing soils to the groundwater. In the improbable event that any solution originating from the tailings leachate did ever reach the groundwater table, which is about 300 ft below the tailings, a time period of about 4,750 years would be required for this solution to move downgradient 1,000 feet in the ground water. The time was determined by dividing the downgradient distance by the ground-water velocity. The 1,000-ft distance is measured from approximately the upstream base of the impoundment dam to monitoring well TMW-2. The ground-water velocity was determined by dividing the Darcy velocity (from Darcy's Law) by the effective porosity of the aquifer. This travel time does not account for any attenuation of leachate parameters, such as cyanide or metals, on the solid matrix of the aquifer, nor does it account for vertical travel time from the bottom of the tailings impoundment to the ground-water table.

Based upon the ground-water contours on Drawing No. 11360, the unlikelihood of seepage through the impoundment liner and 300 feet of foundation soil, and the lengthy groundwater travel times, which allow for constituent attenuation and degradation, it is our opinion that the existing

ground-water monitoring system is sufficient. Furthermore, ground-water monitoring well TMW-2 is immediately downgradient of the base of the tailings impoundment dam, and it is located approximately in the middle of the region that would be expected to contain any constituents.

Hecla will continue to conduct water quality sampling, on a quarterly basis, at the existing monitoring wells for a period of four years after the impoundment is fully reclaimed. The constituents to be monitored are:

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- free cyanide,
- total dissolved solids, and
- dissolved metals (arsenic, cadmium, chromium, lead, mercury, and selenium).

6.1.4 Cyanide Concentrations in Tailings

Cyanide is a relatively simple chemical compound, and it is a fundamental building block of many organic compounds. The occurrence of cyanide in nature is widespread. Many types of living organisms, including bacteria, fungi, higher plants, and insects, can synthesize cyanide.

Cyanide occurs in different forms in solution, and it can be analyzed by different techniques. Hydrogen cyanide is one form in which cyanide may occur. It also may occur in its ionic form and in complexes with metals and organic compounds.

Cyanide is commonly referred to in its various forms as free or complexed cyanide, total cyanide, weak acid-dissociable cyanide, or reactive cyanide. Free cyanide is defined as the sum of hydrogen cyanide (HCN) and ionic cyanide (CN^-). Total cyanide is the sum of both free and complexed cyanides. Weak acid-dissociable cyanides are those, both free and metallo-cyanide complexes, that are capable of converting to HCN gas in a slightly acidified medium. Reactive cyanide is that cyanide that is available for chemical reaction -- primarily weak-acid dissociable cyanide.

Relatively little research has been directed towards the mobility of various forms of cyanide through the soil to surface water or ground water. The research

that has been done indicates that cyanide complexes of most cations are soluble to some degree, but may migrate only a short distance through soil before being converted to nitrates under aerobic biological conditions (Stanton et al., 1986). In an anaerobic environment, cyanides tend to de-nitrify to form gaseous nitrogen compounds that are released to the atmosphere (Towill et al., 1978). Because of complexing with trace metals and biological metabolism, Towill et al. (1978) conclude that cyanide movement in soil is generally quite limited. The Bureau of Mines reported no success in finding any mobile forms of cyanide in tailings samples analyzed from around inactive mines (EPA, 1976). This report indicated that the cyanides were complexed with organic matter and rendered non-toxic.

Cyanide is a very reactive and relatively short-lived constituent. Thus, it is considered to be a transient pollutant. Several natural processes have been identified as potentially significant in the natural degradation or depletion of cyanide in effluents from mining and milling operations. These natural processes are volatilization, oxidation, biodegradation, photo decomposition, and cyanide-thiocyanate reactions. Polymerization and hydrolysis may also be important for solutions of high concentrations (Stanton et al., 1986).

In an effort to determine the levels of cyanide in the tailings at Escalante, several laboratory analyses have been conducted over the past year and a half. These data are summarized in Table 6-8.

The June 1989 and August 1990 tailings samples listed in Table 6-8 were taken from various locations on the impoundment surface (the top two feet). The October 1990 tailings samples were taken from the vertical faces of two test pits dug in the impoundment with a backhoe. The purpose of analyzing the August 1990 samples was to evaluate different methods for analyzing cyanide (total, weak acid-dissociable, free, and amenable). The purpose of the October 1990 samples was to evaluate variation of cyanide with depth at two locations on the impoundment. As can be noted, there is no apparent correlation between reactive cyanide concentrations and depth. Underdrain effluent samples were also obtained during the October sampling event.

Based upon the above discussions from the existing literature and upon the laboratory analyses of cyanide concentrations in the tailings, it is concluded

that, even if cyanide were to leach from the encapsulated tailings and enter the underlying soil system, the cyanide concentrations would rapidly diminish though natural degradation. Furthermore, and as discussed in Section 6.1.3, the ground-water velocity is extremely slow. In the improbable event that a constituent did reach the ground-water table 300 feet below the tailings, 4,750 years would be required for the constituent to move downgradient 1,000 feet, assuming that the constituent moves freely with the ground water and is not adsorbed to the soil matrix of the aquifer.

6.2 Air Quality

In order to ensure that the surface of the tailings facility is protected from wind erosion and resulting air quality degradation, Hecla proposes to seed and revegetate the surface of the impoundment. This revegetation activity can begin after the cap is in place and prepared for seeding. To the extent practicle, the earth work will be conducted during the spring and early winter months. Earth work during this time should reduce the amount of air particulates generated.

Table 6-1. Soil profile for the reclaimed tailings impoundment.

Layer	Material	Thickness (inches)	Layer Type	Porosity	Hydraulic Conductivity (cm/sec)	Initial Water Content
1	Topsoil	4	Vertical Percolation	0.398	1.2E-04	5.0%
2	Subsoil	14	Lateral Drainage	0.417	1E-05	5.0%
3	Clay Cap	6	Barrier	0.43	1E-07	10.0%
4	Tailings	300	Vertical Percolation	0.49	1.9E-05	30.0%
5	Underdrain	12	Lateral Drainage	0.41	1E-04	13.2%
6	Clay Liner	18	Barrier	0.41	5.67E-07	15.1%
7	Foundation Soil	3600	Vertical Percolation	0.31	2.44E-05	5.7%

Table 6-2. Ground-water levels in tailings monitoring wells.

Well No.	Well Elevation	Measured Depth, feet				Ground-water Elevation, feet			
		08-24-90	09-28-90	10-12-90	03-25-91	08-24-90	09-28-90	10-12-90	03-25-91
TMW-1	5409	306	307.1	306.9	307.6	5103	5101.9	5102.1	5101.4
TMW-2	5331	233	232.8	231.6	232.1	5098	5098.2	5099.4	5098.9
TMW-3	5416	318*	312.5	313	312.4	5098*	5103.5	5103.0	5103.6

*Believed to be in error

Table 6-3. Average annual totals from the HELP model.

Component	Depth (inches)	Percent
Precipitation	9.76	100
Runoff	0.435	4.46
Evapotranspiration	9.036	92.62
Lateral Drainage from Layer 2	0	0
Percolation from Layer 3	0.003	0.03
Lateral Drainage from Layer 5	0	0
Percolation from Layer 6	0	0
Percolation from Layer 7	0	0
Change in Soil Moisture	0.286	2.89

UPSLOPE OF TAILINGS

Table 6-4. Ground-water quality data for monitoring well TMW-1.

Hecla Mining Company – Escalante Mine
Well: TMW-1 All units in mg/l

Date	Type	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Selenium	Zinc	Cyanide	TSS
08-21-81	U	<0.001	0.01	<0.001	<0.001	0.002	0.28	<0.001	<0.0002	<0.001		<0.001	
05-02-83	U	<0.002	0.094	<0.002	0.005	0.011	14	<0.025		<0.002		<0.1	
01-15-85	T	0.004	0.06	<0.006	0.007	<0.006	23	<0.025		<0.002		<0.01	56
07-01-85	U	0.069	0.16	<0.004	0.057	0.26	65	0.15	<0.0002	<0.008	1.7	<0.01	1605
10-16-85	U	0.012	0.084	<0.004	<0.005	<0.002	1.1	<0.025	<0.0001	<0.004	0.076	<0.01	2440
01-21-86	U	0.012	0.1	<0.004	<0.005	0.023	2.6	<0.025	0.0002	<0.02	0.027	<0.01	1280
04-25-86	U	0.06	0.029	0.006	0.027	0.29	53	0.11	<0.0001	<0.002	0.43	<0.01	2490
10-21-86	T	0.042	0.074	<0.004	0.02	0.13	34	0.12	<0.0001	<0.02	0.25	<0.01	1730
02-19-87	T	0.034	0.15	<0.005	0.02	0.11	24	0.03	<0.0001	<0.02	0.18	<0.01	702
05-18-87	T	0.046	0.08	<0.005	0.01	0.18	27	0.07	0.0002	<0.04	0.21	<0.01	2380
10-08-87	T	0.023	0.07	<0.005	<0.01	0.15	6.6	<0.05	<0.0001	<0.01	0.13	<0.01	628
03-30-88	T	0.014	0.08	<0.005	0.01	0.074	6	<0.05	<0.0001	<0.002	0.51	<0.01	365
07-29-88	T	0.023	0.12	<0.005	0.08	0.11	12	<0.05	<0.0001	<0.004	2.7	<0.01	525
06-29-89	D	<0.005	0.06	<0.005	<0.01	0.02	<0.1	<0.05	<0.0002	<0.005	0.02	<0.01	1030
10-10-89	D	<0.005	0.07	<0.005	<0.01	<0.01	<0.1	<0.05	<0.0002	<0.005	0.02	<0.01	1650
01-29-90	D	<.005	0.063	<0.005	0.012	<0.01	<0.1	<0.05	<0.0002	<0.005	0.012	<0.01	2300
06-18-90	D	0.0059	<0.1	<0.005	0.023	<0.02	<0.1	<0.05	<0.0002	<0.005	0.032	<0.01	557
12-18-90	D	0.0062	<0.10	<0.005	<0.01	0.033	<0.1	<0.05	<0.0002	<0.02	0.072	<0.01	301
03-25-91	D	<0.005	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.05	<0.02	<0.01	357
06-18-91	D	<0.005	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.01	<0.02	<0.01	197
09-30-91	D	<0.005	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.01	<0.02	<0.01	94.4
Standards		0.05*	0.75**	0.01*	0.05*	1*	0.3**	0.05*	0.002*	0.01*	5*	0.2**	

*State of Utah (1989)
**EPA (1986)
U=Unknown, assumed to be total metals
T=Total metals
D=Dissolved metals

DOWN GRADIENT OF TAILINGS

Table 6-5. Ground-water quality data for monitoring well TMW-2.

Hecla Mining Company - Escalante Mine
Well: TMW-2 All units in mg/l

Date	Type	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Selenium	Zinc	Cyanide	TSS
08-21-81	U	<0.001	0.009	<0.001	<0.001	0.003	0.265	<0.001	<0.0002	<0.001		<0.001	
05-02-83	U	<0.002	0.059	<0.002	0.005	0.004	4.5	<0.025		<0.002		<0.1	
01-15-85	T	0.005	0.05	<0.006	0.006	0.025	3.3	<0.025		<0.002		<0.01	6
07-01-85	U	0.007	0.06	<0.004	<0.007	0.007	10	0.032	<0.0002	<0.002	0.024	<0.01	16
10-16-85	U	<0.02	0.069	<0.004	0.005	0.016	4.6	<0.025	<0.0001	<0.004	0.024	<0.01	5
01-30-86	U	0.006	0.051	<0.004	0.086	0.012	2.8	<0.025	<0.0001	<0.002	0.017	<0.01	8
04-25-86	U	0.007	0.042	<0.004	0.008	0.004	1.5	<0.02	<0.0001	<0.002	0.015	<0.01	3
10-21-86	T	0.009	0.06	<0.004	<0.005	0.013	11	<0.02	<0.0001	<0.002	0.034	<0.01	15
05-18-87	T	0.32	0.04	<0.005	0.03	0.2	58	0.24	0.0003	<0.04	0.47	<0.01	4150
10-08-87	T	0.55	0.07	<0.005	<0.01	0.19	7.9	0.11	0.0006	<0.04	0.2	<0.01	14800
03-30-88	T	0.6	0.07	<0.005	0.04	0.11	26	0.17	0.0007	<0.004	1.8	<0.01	4240
07-29-88	T	0.6	0.1	<0.005	0.1	0.16	64	0.27	0.0004	<0.02	4	<0.01	2360
06-29-89	D	0.008	0.05	<0.005	<0.01	<0.01	<0.1	<0.05	<0.0002	<0.005	0.02	<0.01	4600
10-10-89	D	0.008	0.05	<0.005	<0.01	<0.01	<0.1	<0.05	<0.0002	<0.005	<0.01	<0.01	5810
01-29-90	D	0.0079	0.048	<0.005	<0.01	<0.01	<0.1	<0.05	<0.0002	<0.005	0.013	<0.01	2640
06-18-90	D	0.0079	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.005	<0.02	<0.01	1550
12-18-90	D	0.0068	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.01	<0.02	<0.01	1510
03-25-91	D	0.0091	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.02	<0.02	<0.01	2030
06-18-91	D	0.007	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.01	<0.02	<0.01	1340
09-30-91	D	0.0087	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	0.0094	<0.02	<0.01	461
Standards		0.05*	0.75**	0.01*	0.05*	1*	0.3**	0.05*	0.002*	0.01*	5*	0.2**	

*State of Utah (1989)
**EPA (1986)
U=Unknown, assumed to be total metals
T=Total metals
D=Dissolved metals

UPSLOPE OF TAILINGS

Table 6-6. Ground-water quality data for monitoring well TMW-3.

Hecla Mining Company - Escalante Mine
Well: TMW-3 All units in mg/l

Date	Type	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Selenium	Zinc	Cyanide	TSS
08-21-81	U	<0.001	0.008	<0.001	<0.001	<0.001	0.198	<0.001	<0.0002	<0.001		<0.001	
05-02-83	U	0.033	0.066	<0.002	0.007	0.079	4.8	0.068		<0.002		<0.1	
01-15-85	T	0.028	0.05	<0.006	0.01	0.11	6.8	0.04		<0.002		<0.01	389
07-01-85	U	0.072	0.3	<0.004	0.016	0.21	21	0.22	<0.0002	<0.002	0.3	<0.01	324
10-16-85	U	0.018	0.057	<0.004	0.005	0.041	2.6	<0.025	<0.0001	<0.004	0.048	<0.01	166
01-21-86	U	0.028	0.053	<0.004	<0.005	0.091	2.9	0.05	<0.0001	<0.002	0.14	<0.01	604
04-25-86	U	0.035	0.046	<0.004	0.008	0.077	7.2	0.04	<0.0001	<0.002	0.12	<0.01	426
10-21-86	T	0.023	0.073	<0.004	<0.005	0.047	4.5	0.03	<0.0001	<0.002	0.08	<0.01	614
02-19-87	T	0.046	0.09	<0.005	<0.01	0.054	8	0.031	<0.0001	<0.02	0.08	<0.01	385
05-18-87	T	0.042	0.04	<0.005	<0.01	0.058	6.1	<0.05	0.0001	<0.02	0.1	<0.01	354
10-08-87	T	0.032	0.06	<0.005	<0.01	0.047	2	<0.05	<0.0001	<0.01	0.05	<0.01	231
03-30-88	T	0.066	0.06	<0.005	0.02	0.076	15	0.08	0.0001	<0.002	0.76	<0.01	938
07-29-88	T	0.052	0.08	<0.005	0.06	0.074	13	0.05	0.0001	<0.004	2.5	<0.01	623
06-29-89	D	0.01	0.04	<0.005	<0.01	0.01	<0.1	<0.05	<0.0002	<0.005	0.05	<0.01	3200
10-10-89	D	0.016	0.05	<0.005	<0.01	<0.01	<0.1	<0.05	<0.0002	<0.005	0.09	<0.01	2150
01-29-90	D	0.016	0.042	<0.005	<0.01	<0.01	<0.1	<0.05	<0.0002	<0.005	0.042	<0.01	1770
06-18-90	D	0.016	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.005	<0.02	<0.01	632
12-18-90	D	0.018	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.02	0.04	<0.01	1550
03-25-91	D	0.018	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.02	0.032	<0.01	1460
06-18-91	D	0.014	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.01	0.05	<0.01	120
09-30-91	D	0.018	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	0.018	<0.02	<0.01	972
Standards		0.05*	0.75**	0.01*	0.05*	1*	0.3**	0.05*	0.002*	0.01*	5*	0.2**	

*State of Utah (1989)
**EPA (1986)
U=Unknown, assumed to be total metals
T=Total metals
D=Dissolved metals

—WHAT HAPPEND AFTER 7-29-88 TO CHANGE THE OCCURRENCE OF IRON?
DISSOLVED METALS TESTING?

Table 6-7. Ground-water quality data for pumping well P-1.

Hecla Mining Company - Escalante Mine
Well: P-1 All units in mg/l

Date	Type	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Selenium	Zinc	Cyanide	TSS
05-23-83	U	0.027	0.06	<0.002	<0.005	<0.002	<0.05	<0.025		<0.002		<0.1	
01-15-85	T	0.026	0.06	<0.006	<0.005	<0.006	<0.05	<0.025		<0.002		<0.01	<2
10-16-85	U	<0.028	0.1	<0.004	<0.005	0.006	<0.05	<0.025	<0.0001	<0.004	0.028	<0.01	<2
01-30-86	U	0.03	0.066	<0.004	0.054	<0.002	0.2	<0.025	<0.0001	<0.002	0.012	<0.01	<2
04-25-86	U	0.033	0.06	<0.004	<0.005	<0.003	<0.05	<0.02	<0.0001	<0.002	0.009	<0.01	<10
10-21-86	T	0.003	0.061	<0.004	<0.005	<0.003	<0.05	<0.02	<0.0001	<0.04	0.011	<0.01	<2
02-19-87	T	0.03	0.08	<0.005	<0.01	0.011	<0.05	0.032	<0.0001	<0.02	0.04	<0.01	<2
10-08-87	T	0.03	0.08	<0.005	<0.01	0.018	<0.05	<0.05	<0.0001	<0.004	0.02	<0.01	<5
03-30-88	T	0.037	0.07	<0.005	<0.01	0.013	0.05	<0.05	<0.0001	<0.002	0.005	<0.01	2
07-29-88	T	0.026	0.11	<0.005	<0.01	0.007	0.06	<0.05	<0.0001	<0.002	0.05	<0.01	<2
Standards		0.05*	0.75**	0.01*	0.05*	1*	0.3**	0.05*	0.002*	0.01*	5*	0.2**	

*State of Utah (1989)
**EPA (1986)
U=Unknown, assumed to be total metals
T=Total metals
D=Dissolved metals

TABLE 6-8. CYANIDE CONCENTRATIONS IN TAILINGS IMPOUNDMENT

Sample No.	Date	Depth/ft	Analysis	Conc.	Units	Laboratory
1-11345	06/15/89	1-2	Total	36.2	mg/kg	A&L Mid West
2-11346	06/15/89	1-2	Total	116.9	mg/kg	A&L Mid West
3-11347	06/15/89	1-2	Total	83.9	mg/kg	A&L Mid West
TS-11348	06/15/89	0-1	Total	<0.2	mg/kg	A&L Mid West
WP-11349	06/15/89	0-1	Total	<0.2	mg/kg	A&L Mid West
T-1	08/20/90	1-2	Total	14.8	mg/kg	Silver Valley
T-2	08/20/90	1-2	Total	33.0	mg/kg	Silver Valley
T-3	08/20/90	1-2	Total	41.6	mg/kg	Silver Valley
T-4	08/20/90	1-2	Total	47.2	mg/kg	Silver Valley
T-5	08/20/90	1-2	Total	18.2	mg/kg	Silver Valley
T-6	08/16/90	0-1	Total	66.6	mg/kg	Silver Valley
T-1	08/20/90	1-2	WAD	11.4	mg/kg	Silver Valley
T-2	08/20/90	1-2	WAD	31.4	mg/kg	Silver Valley
T-3	08/20/90	1-2	WAD	26.4	mg/kg	Silver Valley
T-4	08/20/90	1-2	WAD	36.6	mg/kg	Silver Valley
T-5	08/20/90	1-2	WAD	7.6	mg/kg	Silver Valley
T-6	08/16/90	0-1	WAD	33.0	mg/kg	Silver Valley
T-3	08/20/90	0-1	Free	12.0	mg/kg	Silver Valley
T-6	08/16/90	0-1	Free	16.6	mg/kg	Silver Valley
T-3	08/20/90	0-1	Amenable	10.0	mg/kg	Silver Valley
T-6	08/16/90	1	Amenable	32.2	mg/kg	Silver Valley
TP1-1	10/04/90	1	Reactive	0.2	mg/kg	Silver Valley
TP1-2	10/04/90	2	Reactive	0.1	mg/kg	Silver Valley
TP1-3	10/04/90	3	Reactive	0.4	mg/kg	Silver Valley
TP1-4	10/04/90	4	Reactive	0.1	mg/kg	Silver Valley
TP1-5	10/04/90	5	Reactive	0.4	mg/kg	Silver Valley
TP1-6	10/04/90	6	Reactive	0.6	mg/kg	Silver Valley
TP2-1	10/04/90	1	Reactive	0.4	mg/kg	Silver Valley
TP2-2	10/04/90	2	Reactive	0.8	mg/kg	Silver Valley
TP2-3	10/04/90	3	Reactive	0.4	mg/kg	Silver Valley
TP2-4	10/04/90	4	Reactive	0.1	mg/kg	Silver Valley
TP2-5	10/04/90	5	Reactive	0.2	mg/kg	Silver Valley
TP2-6	10/04/90	6	Reactive	0.2	mg/kg	Silver Valley
U-1	10/04/90	--	WAD	186.0	mg/l	Silver Valley
U-2	10/04/90	--	WAD	191.0	mg/l	Silver Valley

TAKEN FROM IMPOUNDMENT SURFACE

CAN'T COMPARE TOTAL & WAD WITH REACTIVE (?)

TAKEN FROM BACKHOE PIT

Notes:

TS = Top Soil Accumulated for Use on Tailings Impoundment Cap.
WP = Waste Soil Pile for Possible Use on Tailings Impoundment Cap.
T = Tailings
WAD = Weak Acid-Dissociable
TP1 = Tailings Pit No. 1
TP2 = Tailings Pit No. 2
U = Underdrain Effluent Sample

7. ROADS, PADS, AND BORROW AREAS

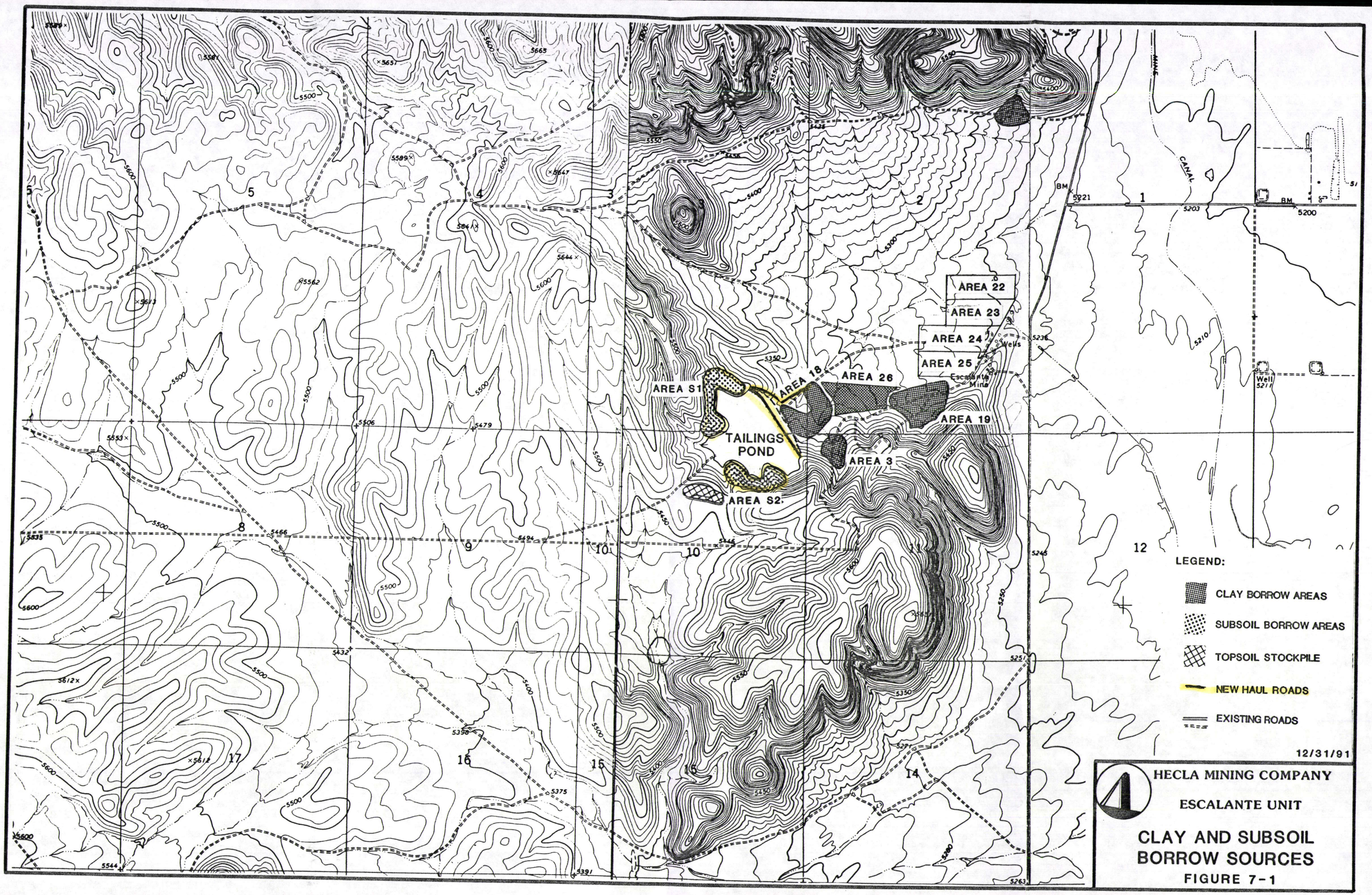
A Plan of Operations, describing the proposed borrow areas and access roads, was submitted to the BLM on October 16, 1991. An environmental assessment report for the removal of clayey and subsoil material from public lands was subsequently completed by the BLM. The Plan of Operations was approved by BLM on December 16, 1991. NEW

As stated in the approved Plan of Operations, the road to the tailings area will be reduced to a one-lane road. Disturbed areas adjacent to this one-vehicle-width road will be ripped and seeded with the appropriate seed mixture described in Section 11.2. This road will be needed for periodic reclamation inspections and general land management use. Hecla will leave this road in a condition suitable for continued use, complete with the existing drainage structures.

Some road construction will be needed to access the clay and subsoil borrow areas. The map on Figure 7-1 shows the locations of roads and borrow areas. The borrow areas outlined in the figure are areas where the specific source material is located. Detailed information on the borrow areas is presented in Section 11.1. NEW ROADS

ACREAGES? DIMENSIONS?

Haulage roads from borrow areas to the tailings facility will be only temporary during the construction phase. Following reclamation, these haulage roads will not be needed and will be ripped, water-barred, and seeded with the appropriate seed mixture. The specific revegetation prescriptions for the borrow areas and roads are described in Sections 11.2 and 11.4, respectively.


AREA 22
AREA 23
AREA 24
AREA 25
AREA 26
AREA 18
AREA 19
AREA 3
AREA S1
AREA S2
TAILINGS POND
Escalante Mine
Wells
Well
CANAL
BM
LEGEND:
CLAY BORROW AREAS
SUBSOIL BORROW AREAS
TOPSOIL STOCKPILE
NEW HAUL ROADS
EXISTING ROADS
12/31/91
HECLA MINING COMPANY
ESCALANTE UNIT
CLAY AND SUBSOIL BORROW SOURCES
FIGURE 7-1

8. DRAINAGES

As stated above, the tailings will remain in place. Hecla will recontour the tailings area with the use of subsoil and topsoil to assure the area is left in a stable condition. The recontouring will involve completely filling the tailings pond area such that no water will be impounded on the site. Stormwater runoff will be directed around the site and into the natural channel below the tailings dam without affecting the face of the original containment structure. Storm events or runoff occurring in the basin above the tailings containment area will be diverted via the existing basin interceptor trench and newly constructed impoundment runoff ditch constructed around both sides of the impoundment. This will assure that surface water flow is not channeled across the reclaimed surface and the face of the impoundment structure. Any storm events or runoff originating on the tailings cap will be diverted off the cap to the new impoundment runoff ditch. The runoff conveyances are designed for the 100-yr, 6-hr flood event. These structures will channel storm water to the natural water course below the tailings. Considering the size of this small arid basin (with no visible gullies or watercourses), the basin will be left in a stable condition that will avoid future damage to the hydrologic system.

RIP RAP?

As described in Sections 4 and 5, the surface of the tailings cap will be contoured to direct stormwater runoff to an impoundment runoff ditch. The longitudinal slope of the tailings cap will range from approximately 0.25% to 0.5%. Based upon a 100-yr, 6-hr design storm, the new impoundment runoff ditch will have a longitudinal slope of approximately 0.2% (0.002 ft/ft), a trapezoidal cross-section with side slopes of 4 to 1, and a bottom width of 8 ft, as shown in Section 15, Drawing No. 11358. The 2.5-foot deep ditch, which includes 1-foot of freeboard, is designed to carry a discharge of 68 cubic feet per second. The approximate location of the ditch is shown on Drawing No. 11357. The exact location of the ditch will depend on the location and depth of borrow areas.

Some of the subsoil borrow areas are located where the current basin interceptor trench lies. In these areas, a new basin interceptor trench will be re-established ongrade after the borrowing process is complete.

9. STRUCTURES AND EQUIPMENT

All structures and equipment will be removed from the surface prior to regrading and reclamation. Two exceptions will be the ground-water monitoring wells and the fence around the tailings perimeter. Hecla proposes to temporarily dismantle some fencing around the impoundment to facilitate construction of the impoundment cover. Because future uncontrolled livestock grazing could damage revegetation efforts, the existing fence will be modified, after implementation of revegetation measures, to restrict grazing. The fence will be modified to allow safe passage for wildlife, while restricting usage by livestock.

CHANGED

Hecla plans to correctly seal and abandon the ground-water monitoring wells when monitoring is no longer needed. If no ground-water monitoring anomalies occur through the dewatering, regrading, and reseeding phases, and after a time period of four years has passed, then the wells will be properly abandoned.

HAS BEEN INCREASED FROM TWO YEARS

10. SEDIMENT CONTROL

Sediment caused by erosion from stormwater runoff will be controlled by revegetating the tailings cap, once it is in place, revegetating the topsoil storage area, and placing water bars in the access and haulage roads to the tailings facility. The Checkett topsoil used on the tailings cap will provide a naturally gravelly surface condition and should be an adequate erosional armorment for stormwater runoff. For more information on sediment control protection measures, please see Section 8.0, which discusses drainages.

11. RECLAMATION/REVEGETATION

The reclamation/revegetation activities for this project are divided into four different reclamation prescriptions for the four different types of disturbances. The first area discussed will be the tailings impoundment area. As a result of the nature of the tailings material, this area will have uniquely different reclamation objectives than the other two areas. The second areas to be reclaimed are the clay and subsoil borrow areas surrounding the tailing impoundment. The third area to be reclaimed is the topsoil stockpile area. When this stored topsoil is

placed upon the tailing impoundment, the remaining disturbed area will need to be reclaimed. The last areas to be reclaimed are the haul and access roads.

11.1 Tailing Impoundment Reclamation

The reclamation objectives for the 65-acre tailings impoundment are three-fold. A capillary barrier is proposed to impede the downward migration of moisture. The capillary barrier will also minimize any upward translocation of available salts or metals. The last objective is to establish a self-sustaining vegetative cover to protect against wind and water erosion, as well as forage for animals.

Generally, the reclamation prescription proposed to meet these objectives consists of a 6-inch clay barrier installation, 14 inches of subsoil placement, 4 inches of topsoil placement, application of hay, seedbed preparation, seeding, vegetation establishment, and maintenance. The total depth of material placed on the tailings will be two feet.

More specifically, the clay cap material will be obtained from soils in the vicinity of the tailings impoundment. Four separate investigations have been conducted in the vicinity of the tailings impoundment to identify sources of clayey soil materials, suitable for use in the impoundment liner and cover layers. These investigations were conducted by Fox (1981, 1983a, 1983b) and GSA (1991). The criteria used in these investigations to delineate suitable borrow areas for clay cap and liner material included particle size gradation, Atterberg limits, soil classification, and permeability tests. These investigations identified the potential borrow areas shown on Figure 11-1. The estimated quantities of suitable clay cap soils in these areas are shown in Table 11-1.

NEW

$(6\ \text{INCH})\left(\frac{1\ \text{FT}}{12\ \text{INCH}}\right)(65\ \text{ACRE})\left(\frac{43{,}560\ \text{FT}^2}{\text{ACRE}}\right)\left(\frac{1\ \text{YD}^3}{27\ \text{FT}^3}\right) \Rightarrow 52{,}453\ \text{YD}^3$ OF CLAY NEEDED

$\left(\frac{14}{12}\right)(65)\left(\frac{43{,}560}{27}\right) \Rightarrow 122{,}344\ \text{YD}^3$ OF SUBSOIL Total = 209,753 yd^3

$\left(\frac{4}{12}\right)(65)\left(\frac{43{,}560}{27}\right) \Rightarrow 34{,}956\ \text{YD}^3$ OF TOPSOIL

ALL NEW INFO

Table 11-1. Estimated quantities of clay cap material.

Area*	Surface Disturbance (acres)			Estimated Quantity (yd^3)
	Hecla	BLM	Total	
1. 18	12.9	5.4	18.3	1 18,000
2. 26	23.9	0	23.9	2 12,800
3 19	23.3	0.0	23.3	3 4,000
4. 3	0.0	8.4	8.4	4 5,000
12	4.3	3.0	7.3	5 3,000
8. 22	22.0	0.0	22.0	6 130,000
7. 23	20.7	0.0	20.7	7 60,000
6. 24	24.1	0.0	24.1	8 40,000
5 25	16.6	0.0	16.6	1 40,000

3.66 ft depth

CAN MEET ~53,000 CY HERE SOMEWHERE

*See Figure 11-1 for Area locations.

T = 312,800.00 yd^3

As stated in the Plan of Operations approved by BLM and as supplemented by subsequent information (GSA, 1991), excavation of clay cap material is expected to proceed in following the order until a sufficient quantity of suitable material is obtained:

1. Area 18 — 18.3 — 18,000
2. Area 26 (identified in the Plan of Operations as between Areas 18 and 19) — 23.9 — 12,800 TABLE 1
3. Area 19 — 23.3 — 4,000
4. Area 3 — 8.4 — 5,000
5. Area 25 — 16.6 — 40,000 — CAN MEET ~53,000 CY IN HERE
6. Area 24 — 90.5 ACRE — 79,800
7. Area 23
8. Area 22

NEW AREAS NOT DESIGNATED IN BLM'S POO

It is anticipated that Areas 22, 23, and 24 will not be disturbed, depending on the quantity of suitable material found during excavation of the Areas 18, 26, 19, 3, and 25.

The criteria for selection of clay cap material selection will be as follows:

- a minimum of 25 percent (by weight) of the material finer than a standard No. 200 sieve, and
- the material passing through a standard No. 200 sieve must classify above the "A-line" according to the Unified Soil Classification system.

The clay cap material is generally found in deposits of varying depth. Typical deposits are found beneath 6 to 12 inches of topsoil, and are from 0.5 to 4.5 feet deep. Because of the variable nature of the clay cap material, it will be sorted during borrow material excavation. The clay cap borrow material will be visually classified and sorted in the field by a Field Engineer or Geologist, with periodic laboratory testing of particle size gradation and Atterberg limits to verify compliance with the material specifications. Soils not meeting the specifications for clay cap material will be stockpiled and used in the subsoil layer.

PLACING CAP IS THEORETICAL

The tailings are expected to provide a stable base for placement and compaction of the clay cap layer; however, this has not been confirmed by field investigations. Until this has been investigated, suitable specifications for compaction of the clay cap layer cannot be developed. Hecla will be conducting field investigations to determine the most feasible method for placing and compacting the clay cap layer. Upon completion of these field investigations, Hecla will develop appropriate methods and specifications for placement and compaction of the impoundment cover materials. Hecla will inform DOGM of the results of the investigations.

NEW

Past site experience has shown that the compacted clay to clayey sand soils work well for alleviating downward fluid movement when compacted with normal earthworking traffic. The soils should also work equally well in alleviating upward capillary action. prevention of upward migration of salts?

The subsoil material will be obtained in a manner that minimizes surface disturbance, while also considering haulage cost. Material removed from borrow areas that does not meet the clay cap specifications will be sorted and stockpiled for use in the subsoil layer. The subsoil deposits generally occur below the clay or topsoil layer and appear to be plentiful. The 14-inch subsoil layer should be more than adequate in duplicating the subsoil layers in adjacent areas. According to information from the USDA Soil Conservation Service (SCS), the soils in the vicinity of the impoundment are from the Checkett series. The typical thickness of the Checkett soil profile is 19 inches, with bedrock ranging from 10 to 20 inches below the ground surface. The 14-inch subsoil layer, along with the 4-inch topsoil layer, provides a minimum rooting medium of 18 inches, which is similar to the natural soil conditions. In addition, the topsoil and subsoil layers will provide moisture storage for establishment of vegetation. As an additional

~NEW

ESTIMATE OF ACREAGE DISTURBED FOR SUBSOIL? SAME AS CLAY?

only in depth of topsoil/subsoil

measure to assure vegetation establishment, DOGM suggested the addition of hay to the subsoil and to the topsoil layer above the subsoil. The BLM has observed these types of soil amendments in the past and believes that hay tilled into the subsoil and topsoil layers at a rate of two to three thousand pounds per acre is adequate to assure vegetation establishment. It is proposed to add the hay at this rate in order to increase nitrogen, increase moisture holding capacity, to minimize any re-seeding or maintenance activities, and to decrease the number of years needed to carry reclamation bonds. ~NEW

During construction of the impoundment, topsoil was removed from the impoundment area and stockpiled southwest of the impoundment (see Figure 7-1). A four-inch layer of stockpiled topsoil will be placed over the subsoil layer. Since the topsoil will come from the revegetated stockpile established ten years ago, some established vegetation such as Russian wildrye and crested wheatgrass are expected to persist. This topsoil layer will provide water holding capacity during the dormant season and a fertile root medium. The naturally gravely surface condition of the Checkett topsoil should provide adequate erosional armorment for any surface flow. TOPSOIL AMOUNT?

After applying hay to the top two layers, the topsoil will be drill seeded. In order to further remove the potential of downward water migration and constituent uptake from the tailings area, Hecla proposes to seed the area with shallow-rooted grasses and forbs. Shrubs will not be seeded on the impoundment cover because they are deep rooting plants and could penetrate the clay cap layer, which would increase the quantity of water infiltrating into the tailings. Hecla will utilize the seed mix recommended for the impoundment area by DOGM in a letter to Hecla dated April 29, 1991, with the exception that alfalfa will be excluded because it is a deep rooting plant. In general, the following seed mix will be used on the impoundment cover; however, Hecla reserves the right to adjust the quantity of each amount of seed, depending upon seed availability and concurrence with DOGM: NEW

Species	lb/ac PLS*
Grasses	
Bottlebrush squirrel tail	0.5
Needle-and-thread	0.5
Crested wheatgrass	1.0
Riparian wheatgrass	2.0
Western wheatgrass	2.0
Indian ricegrass	2.0
Russian wildrye	1.0
Forbs	
Lewis flax	0.5
Palmer penstemon	1.0
Yellow sweetclover	2.0
Gooseberryleaf and/or goldenmallow	1.0
Small burnet	1.0
	14.5

* Based upon drill seeding only. The rates will be increased if seeds are broadcast.

Expectations are that shallow-rooted grasses will establish and dominate. Because of the difficulty of rangeland seeding in Checkett soils, follow-up grass seedings may be needed. A diversity of grasses should establish roots down to the top of the compacted clay layer. These species will more quickly take up excess moisture than the forb species.

Because of the sodic nature of the tailings two feet below the surface, we must accept that ultimately a physical and/or chemical climax community of grasses may dominate. Hopefully, any pioneering deep-rooted shrub or forb species that takes root, only temporarily establishes in a less vigorous, edaphic controlled state.

In the long-term management of this area, it would be best to treat these soils as if the soils were sodic. Sodic or natric soil horizons exist in southwestern Utah. These soils are managed to minimize the uptake of salts. The two mechanisms that Hecla intends to use on the tailing reclamation to minimize the uptake of salts are the barrier and control mechanisms. The barrier mechanism will be the compacted clay cap. Initial species will stabilize the soil to maintain this barrier. The control mechanism would assure long-term federal land management for the appropriate uses and to assure the site is never irrigated. Since irrigation may enable excess salts or metals to translocate upwards to the root zone, as has been demonstrated on irrigated natric soils, irrigation should

be avoided. These same management strategies should also maintain the desired high pH values of the isolated tailings.

11.2 Clay and Subsoil Borrow Area Reclamation

100 ACREAGE BREAKDOWN SEE TABLE 11-1

The clay and subsoil borrow areas are located adjacent to the tailing impoundment, as shown on Figure 7-1. The clay generally occurs below the topsoil and is found anywhere from 0.5 to 4.5 feet in depth. The subsoil deposits generally occur below the clay or topsoil layer and appear to be plentiful. Initially, clay will be borrowed from the source areas closest to the impoundment. The out-lying clay source areas will be disturbed only if there is an unexpected clay shortfall. To keep the borrow area disturbance to a minimum, subsoil will be extracted, whenever possible, from beneath the clay deposits. A typical clay or subsoil extraction procedure will be as follows:

1. Confirm a plentiful clay source by trenching with a backhoe.
2. Push the topsoil off the clay layer with the use of a dozer or grader.
3. Excavate and transport the material to the tailings impoundment.
4. Replace the topsoil over the borrow area.
5. Reseed the disturbed borrow area.

2:1 OR LESS

Some borrow sources that have deep deposits result in deeper excavations. In those cases, the cut slopes will be graded back to a two to one or flatter slope that will blend in with the natural topography. The topsoil removed from the borrow areas to expose the clay and subsoil material will be replaced. As requested by DOGM, hay will be incorporated into the topsoil at a rate of approximately 3,000 pounds per acre.

BLM Land

For borrow areas on BLM land, the seed mixture, which was recommended in BLM's letter dated December 16, 1991, approving the Plan of Operations, will be used for seeding of disturbed areas, depending on seed availability and pre-approval of changes by the authorized BLM officer. This seed mixture is as follows:

Species		lb/ac PLS		Method
Bottlebrush squirrel tail	26	2.0	52	Drill
Needle-and-thread	32	2.0	64	Drill
Crested wheatgrass (Ephriam & Hycrest	0.90	1.5	1.35	Drill
Pubescent Wheatgrass (Luna)	?	2.0	—	Drill
Yellow sweetclover	0.5	1.0	0.5	Broadcast
Alfalfa (Ladak, Nomad, Spreader II)	?	1.0	—	Broadcast
Common Globemallow	35	0.5	17.50	Drill
Small Burnet	?	1.0	—	Drill
Wyoming Big Sagebrush	28	0.5	14	Drill
Black Sagebrush	~23?	0.5	11.5	Drill
Fourwing Saltbrush	5.5	1.0	5.5	Drill
Forage Kochia	?	0.5	—	Broadcast
Curlygrass (Galleta)	?	3.0	—	Drill
Palmer penstemon	18	1.0	18	Broadcast
Total		17.5	91.66 /ACRE — WITHOUT EVERYTHING	

As requested by the BLM, broadcast seeding will be done before drilling to provide a minimal soil cover over the broadcast seed. Seeding will be completed in the fall immediately following the reclamation to decrease the encroachment of introduced annual weed species into the area. Hecla will install and maintain fences around the reclaimed areas to prevent damage to the seedings from wild horses and livestock grazing. The fences will be removed after Hecla and the BLM agree that the areas are stable enough for the resumption of grazing. The fences will consist of 4 wires and will not exceed 40 inches in height. The top three wires will be barbed, and the bottom wire will be smooth. The wire spacing from the ground to the top will be 16 inches, 6 inches, 6 inches, and 12 inches, respectively. To ensure vegetative recovery, at least 8 to 10 inches of topsoil/subsoil will be left covering the white, high-pH soil material that underlies the subsoil material. The base material will be ripped before replacing the topsoil.

FENCES REMOVED WHEN BLM & HECLA AGREE

NEW

Hecla Land

For disturbed areas on Hecla-owned land, the Utah Department of Wildlife's suggested seed mixture will be used dependant on seed availability and other agency agreement. That seed mix is as described below:

	SPECIES		lb/acre PLS	
BLM-	Bottlebrush squirreltail*	26	0.5	1.3
BLM-	Needle-and-thread*	32	0.5	16
BLM-	Crested wheatgrass (Nordan, Fairway, Ephraim, Hycrest)	0.9	1.5	1.3
BLM-	Pubescent wheatgrass (Luna)		1.0	
	Russian wildrye (Boizoisky)	1.0	1.0	1
	Lewis flax*	~9	0.5	4.5
BLM-	Palmer penstemon*	18	0.5	9
BLM-	Yellow sweetclover	0.5	1.0	0.5
BLM-	Alfalfa (Ladak, Nomad, Spreader II)		1.0	
BLM-	Gooseberryleaf and/or common globemallow*	35	0.5	17.5
	Small burnet		1.0	
	Winterfat*	16	1.0	16
BLM-	Wyoming big sagebrush*	28	0.5	14
BLM-	Black sagebrush*	~23	0.5	11.5
	Green and white rubber rabbitbrush*	33	1.0	33
	Low rabbitbrush*		0.5	
BLM-	Fourwing saltbush*	5.5	1.0	5.5
BLM-	Forage kochia		0.5	
			PLS lbs per acre = 14.0	~$143

*native to southern Utah

Seeding on Hecla-owned land will be completed during the late fall or early winter months. Grasses, forbs, and some shrubs will be drill seeded. Other shrubs will have to be hand seeded after ripping the soil. Grasses will be seeded in rows different from the shrub and forb seed to prevent over competition of the grasses.

~~No fencing?~~

11.3 Topsoil Storage Area Reclamation

The topsoil storage area will be reclaimed after the stockpiled topsoil has been removed. This area will be reclaimed in the same manner as other disturbed areas on BLM land (see Section 11.2). Some topsoil from the stockpile may be allocated for use in this area.

11.4 Access Road Reclamation

During reclamation, there will be two types of roads used. The existing and the new access roads will both receive reclamation attention. New access roads will need to be established to haul clay, subsoil, and topsoil materials to the tailings site. Efforts will be made to place roads where little or no cut and fill

NO ESTIMATE OF AREA FOR NEW ROAD

is necessary. The general locations of the roads are shown on Figure 7-1. After reclamation is complete, the newly established roads will be ripped, water-barred, and seeded. The seed mix and methods for these roads will be similar to the prescription described for the clay and subsoil borrow areas (see Section 11.2).

As approved in the Plan of Operations submitted to the BLM, the existing access roads (mill to tailings impoundment) will be reduced to a one-lane road. Disturbed areas adjacent to the one-vehicle-width-road will also be ripped and seeded as described above. This road will be needed for periodic tailings reclamation inspections and general land management use. Hecla will leave this road in a condition suitable for continued use, complete with existing drainage structures.

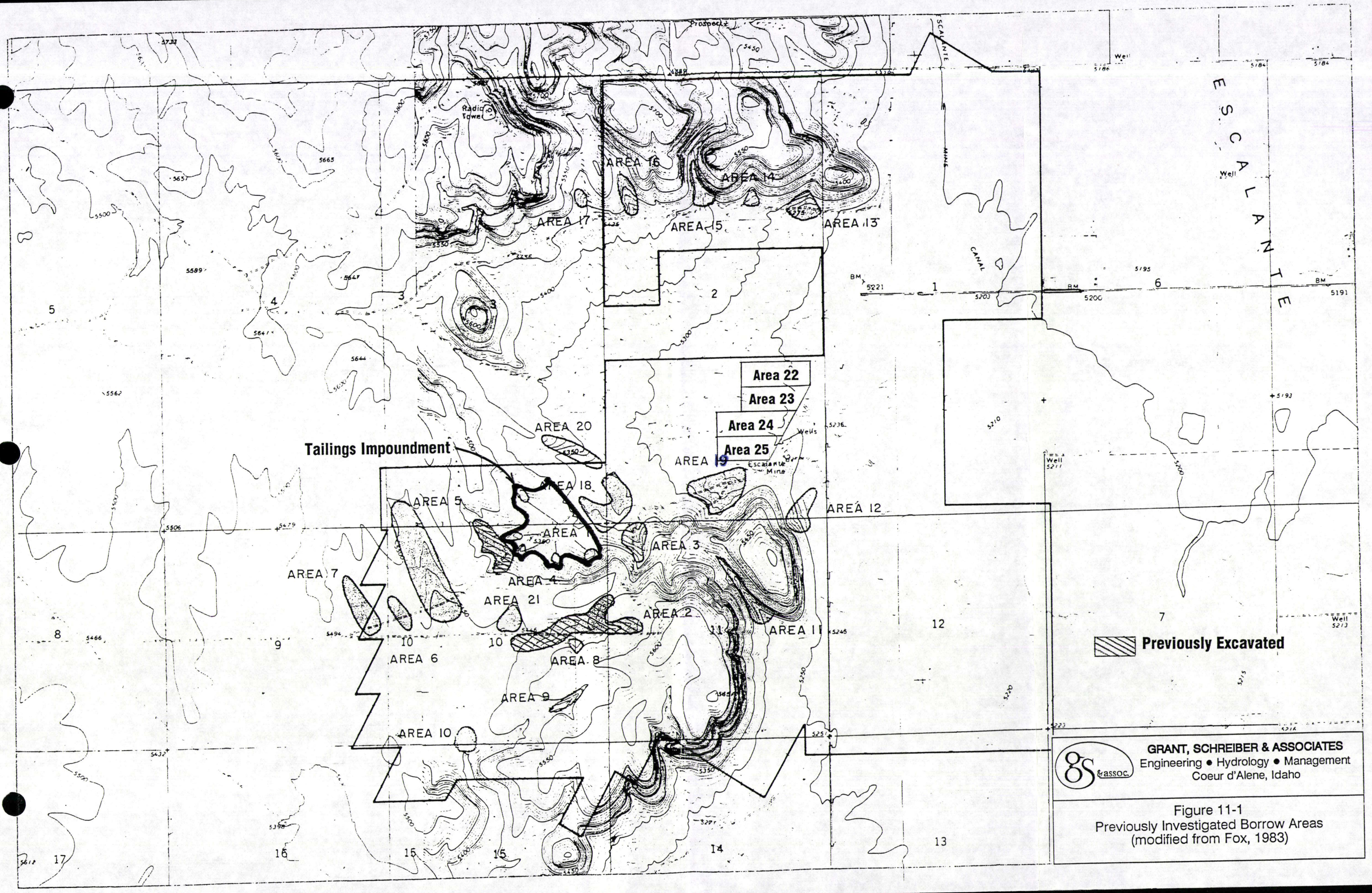


Figure 11-1
Previously Investigated Borrow Areas
(modified from Fox, 1983)

12. DAMS

As described in Section 6, the tailings dam will not impound water on the surface of the tailings, although the dam was designed for hydraulic conditions, assuming the tailings would be completely saturated. The dam will impound tailings, but will be mechanically stable, protected from erosion, and protected from constituent mobility. – How?

As described in Sections 4 and 5, the tailings cap will be sloped away from the embankment of the dam to ensure that the embankment will not be subject to erosional forces of stormwater runoff.

13. SOILS

The topsoil, subsoil, and tailings materials have been sampled and analyzed for nutrients, metals, and other soil indicators. Since there will be a 6-inch clay layer and 14-inch layer (buffer material) of subsoil between the tailings and the topsoil, vegetative toxicity, resulting from metals uptake is not a concern, as previously discussed in Section 11.

14. CLOSURE SCHEDULE

If weather permits and required approvals are received, earth moving activity should begin as soon as practicable in the Summer of 1992. The following tentative schedule outlines the reclamation process:

ACTIVITY	ANTICIPATED DATE
Escalante Mill Shutdown	August 1990
Residual Tailings Solution Capture and Evaporation	August 1990 until the tailings are drained
Conduct Earth Moving	Summer/Fall/Early Winter 1992
Seed	Late Fall/Early Winter 1992
Cap and Grout Underdrain	Winter 1992
Reclamation of Wells	Fall 1996
Bond Release	December 1996

15. DRAWINGS

The enclosed drawings show plan views (Drawing No. 11357), an east-west cross-section (Drawing Nos. 11358 and 11359), a north-south cross-section (Drawing Nos. 11358 and 11359), and various details of the reclaimed tailings facility. The cross-sections show the relative locations of the ground-water table, the native soil above the ground-water table, original ground surface, the clay liner, the underdrain system and its protective cover, the tailings, the clay cap, the subsoil, and the topsoil (which includes vegetation). Drawing No. 11360 presents a map of ground-water elevation contours as of September 1990 for the tailings area, as well as the downgradient valley.

16. RECLAMATION SURETY

Hecla has agreed to sample ground-water on a quarterly basis at the existing monitoring wells for a period of four years after the impoundment has been fully reclaimed. Hecla proposes to fulfill the surety instrument requirements by obtaining a reclamation surety bond. However, Hecla believes that incremental bond release is appropriate. After the earth materials (clay, subsoil, and topsoil) have been placed on the impoundment and the hay has been disced into the topsoil and subsoil, Hecla proposes that the bond be reduced by the cost of these activities. Hecla presumes that DOGM will be inspecting the reclamation activities and will be able to verify by observation that these activities have been completed. In addition, Hecla also proposes that the bond amount be reduced by 75 percent of the cost for ripping, ditch construction, and reseeding when those activities as a whole have been completed.

REFERENCES

Fox, F.M. and Associates, Inc., *Geotechnical Investigation for the Proposed Mill and Tailings Disposal Areas - Escalante Project - Iron County, Utah*, prepared for Ranchers Exploration and Development Corporation, Fox Job No. 1-2762-3106, May 14, 1980.

F.M. Fox & Associates, Inc., *Subsoil Investigation for Borrow Material, Stage 1 Tailings Dam for Escalante Silver Mine - Iron County, Utah,* prepared for Ranchers Exploration and Development Corporation, April 21, 1981.

F.M. Fox & Associates, Inc., *Geotechnical Investigation for Liner Borrow Material - Escalante silver Mine/Tailings Dam, Iron County, Utah,* prepared for Ranchers Exploration and Development Corporation, May 5, 1983.

Fox Consultants, Inc., *Inspection of 1983 Construction Stages 2 and 3 - Tailings Dam and Pond Liner at the Escalante Silver Mine,* prepared for Ranchers Exploration and Development Corporation, November 30, 1983.

Fox Consultants, Inc., *Liner and Seepage Investigation - Escalante Silver Mine Tailings Pond*, prepared for REDCO Silver, Inc., Fox Project No. 11278.0, August 22, 1984.

Grant, Schreiber and Associates, *Borrow Investigation for Impoundment Cap Borrow Material - Escalante Mine Tailings Impoundment, Enterprise, Utah,* prepared for Hecla Mining Company, November 12, 1991.

Schroeder, P.R., J.M. Morgan, T.M. Walski, and A.C. Gibson, *The Hydrologic Evaluation of Landfill Performance (HELP) Model Volume 1 - User's Guide for Version 1*, prepared by U.S. Army Engineer Waterways Experiment Station for the U.S. Environmental Protection Agency Office of Solid Waste, Washington, D.C., August 1983.

Schroeder, P.R., *User's Guide for HELP Version 2*, prepared by U.S. Army Engineer Waterways Experiment Station for the U.S. Environmental Protection Agency Office of Solid Waste, Washington, D.C., February 1988.

Stanton, M.D., T.A. Colbert, and R.B. Trenholme, *Environmental Handbook for Cyanide Leaching Projects*, prepared by Intermountain Soils, Inc. for The National Park Service, June 1986.

State of Utah, *State of Utah Ground Water Quality Protection Regulations*, August 1989.

Towill, L.F., J.J. Drury, B.L. Whitfield, E.B. Lewis, E.L. Galyan, and A.J. Hammers, *Reviews of the Environmental Effects of Pollutants: V. Cyanide*, Interagency Report, Oak Ridge National Laboratory Report No. ORNL/EIS-81 and EPA Report No. EPA-600/1-78-027, U.S. Environmental Protection Agency, Washington, D.C., 1978.

U.S. EPA, Quality Criteria for Water, Washington, D.C., 1976.

U.S. EPA, Quality Criteria for Water, Washington, D.C., 1986.

U.S. Soil Conservation Service, *Urban Hydrology for Small Watersheds*, Technical Release 55, Second Edition, June 1986.

Wright Engineers Limited, *Escalante Silver Mine Tailing Disposal System*, Project No. 1045, June 17, 1980.

Final Report

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DIVISION OF
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RECLAMATION PLAN
ESCALANTE UNIT
MILL TAILINGS FACILITY

Prepared For:

HECLA MINING COMPANY
Coeur d'Alene, Idaho

Prepared By:

GRANT, SCHREIBER & ASSOCIATES
Coeur d'Alene, Idaho

November 19, 1990

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Engineering • Hydrology • Management
Coeur d'Alene • Denver • Hot Springs
Salt Lake City • Columbus

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MILL TAILINGS FACILITY

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November 19, 1990

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1.0 INTRODUCTION

Hecla Mining Company and its predecessor, Rancher's Exploration and Development Company, have committed to reclamation requirements through the permitting, development, and production phases of the Escalante Silver Mine. The Utah Division of Oil, Gas and Mining (DOGM) has authority over all lands disturbed by mining and milling. This authority is given to the Division under the Utah State Reclamation Act effective May 14, 1975 and the Amended and New Rules Minerals Reclamation Program of December 1, 1988.

Since the majority of the tailings impoundment reclamation requirements are described in Rule M-10 of the Utah State Reclamation Act, the proposal will follow that format and outline plans for complying with the Act. ?

found under General Rules & Regulations (pre-1988)

In August 1989, the State of Utah adopted regulations for ground-water protection. The Utah Bureau of Water Pollution Control (BWPC) has authority under Rule R448-6-6.1B over facilities that could discharge pollutants directly or indirectly into ground water. It is the intent, through the data, analyses, and drawings provided in this report, to demonstrate that the reclaimed tailings facility will have a de-minimus actual or potential effect on ground-water quality. Thus, a ground-water discharge permit will not be required, as per Rule R448-6-6.2A21.

2.0 LAND USE

The tailings impoundment is located on U.S. Bureau of Land Management (BLM) land. Adjacent parcels of land are owned by the BLM, as well as Hecla. The pre-operational use of this land included occasional grazing, mining and exploration activities, and wildlife habitat. The probable land uses during the post Escalante mining stage will be occasional grazing, minerals exploration and mining activities, and wildlife habitat. There should be no difficulty in returning the disturbed area to a condition capable of supporting these types of land uses.

3.0 PUBLIC SAFETY AND WELFARE

To effectively reclaim the tailings pond, some fences may need to be dismantled temporarily. However, there will be sufficient signs to warn the public during the earth moving stage. The current fence and warning signs will be maintained until DOGM and Hecla agree that revegetation is complete and the

—MAINTENANCE OF FENCE BY ?

tailings are immobilized. At that time, the fence and signs will be removed from the property to support post-mining land use as described above.

4.0 IMPOUNDMENTS

The tailings area will be re-contoured in a manner that will not impound water. The gentle slope (approximately 0.25 % to 0.5 %) of the tailings cap will direct storm-water runoff away from the embankment to a newly constructed impoundment runoff ditch. This ditch will be constructed to divert runoff from the cap and adjacent slopes around the tailings area into the natural channel below the dam. Details are provided in Section 8.0, Drainages, and Section 15.0, Drawings. ~1° OR LESS

The existing underdrain system that collected leachate from the bottom of the tailings during mill operation will be left operable for an interim period of time until the tailings are completely drained. Leachate collected in the interim period will be routed to the evaporation tanks at the mill, where it will be evaporated. After the tailings are drained, the reclaim pipe will be sealed off, so that no leachate will leave the impoundment.

5.0 SLOPES

IN OTHER WORDS, THE DAM?

The downstream slope of the embankment containing the tailings is stable at its present 2 horizontal to 1 vertical slope ratio. Revegetation results from past seeding (1980) on the embankment are successful. This revegetation will suffice in preventing wind erosion. Water erosion will be controlled by preventing surface water flow from crossing the embankment.

As briefly mentioned in Section 4.0, the tailings cap will be sloped gently (0.25% to 0.5%) away from the tailings embankment. This shallow slope will result in a low runoff velocity without causing ponding, which will reduce the likelihood of erosion of the cover material.

The new impoundment runoff ditch that was discussed briefly in Section 4.0, will also be sloped gently (about 0.2%) in the longitudinal direction to preclude erosion. The side slopes of the ditch will also be constructed to prevent erosion.

Details regarding the cap and impoundment runoff ditch are included in Sections 8.0 and 15.0.

6.0 TOXIC MATERIALS

Hecla will comply with the toxic materials provision of the Reclamation Act and the ground-water protection regulations by leaving the mill tailings in an encapsulated, isolated condition. This will assure that adverse environmental effects will be eliminated or controlled. Further discussion on this subject is included in Sections 6.1 and 6.2, as well as the rest of this report.

6.1 Ground-Water Protection

In August 1989, the State of Utah adopted regulations for ground-water protection. The BWPC has authority under Rule R-448-6-6.1 over facilities that could discharge pollutants directly or indirectly into ground water. However, Hecla received an approval letter from the Executive Secretary of the Utah Department of Health in 1980 to deposit the tailings in the lined impoundment in a non-detoxified state.

Ground-Water protection will be demonstrated in this section by presenting 1) results of modeling the reclaimed tailings using weather data from nearby (Cedar City, Utah), 2) a discussion of the feasibility of detoxifying or neutralizing the tailings, 3) an evaluation of the ground-water monitoring system, and 4) an analysis of cyanide concentrations in the tailings.

6.1.1 Cap Modeling Results

As part of the tailings impoundment cover design, a modeling study was performed to evaluate the potential for leaching of water into, through, and out of the tailings impoundment. The Hydrologic Evaluation of Landfill Performance (HELP) model (Schroeder et al., 1983 and Schroeder, 1988) was used to simulate the performance of the cover on a daily basis for a period of 5 years after closure. This time period was chosen because of the availability of the climatologic data and because the data appeared to be representative from a long-term average standpoint.

The HELP model was developed by the U.S. Army Engineer Waterways Experiment Station for the U.S. Environmental Protection Agency (EPA). The model is widely used by designers and regulatory reviewers for evaluating the performance of landfill and impoundment designs during operation and post-closure.

The HELP model simulates precipitation, surface storage, surface runoff, infiltration, percolation, evapotranspiration, soil moisture storage, and lateral drainage, based on actual climatologic, vegetative, design, and soil data. Climatologic data collected at Cedar City, Utah from 1974 through 1978 were used as the basis for the simulation. This particular set of data was available with the HELP model. It is a representative set of data in that it includes high, as well as low, precipitation data, and the overall average precipitation is near the long-term average for the area. The climatologic data required by the model include:

- daily precipitation,
- mean monthly temperature,
- mean monthly isolation (solar radiation), and
- leaf area indices.

The vegetative cover used in the model was a poor stand of grass. This type of cover results in a leaf area index of 1. The U.S. Soil Conservation Service runoff curve number associated with this type of vegetative cover in arid and semiarid areas is 93 (SCS, 1986).

The tailings impoundment was modeled as seven different layers, as shown in Table 6-1 and Drawing No. 11359 in Section 15.0. The top three layers represent the impoundment cover, which consists of a topsoil layer, a subsoil layer, and a low-permeability clay cap. The fourth layer represents the tailings layer. The fifth and sixth layers represent the underdrain and low-permeability clay liner. The seventh layer represents the foundation material (native soil layer). According to Fox (1980), the ground-water table is located approximately 300-350 feet below the surface of the foundation material, which is below the tailings. These depths were confirmed by recent ground-water level measurements, which are listed in Table 6-2. The soil parameters used to model the various layers in the impoundment are shown in Table 6-1. The values for these

TABLE 6-2
231'-318'
BELOW GROUND ELEVATION

IS THERE ANY CONCERN OVER PARTIAL FILLING OF THE TAILINGS w/WATER? →

631.62 ft^3 H_2O /year at rate of .003" infiltration/yr

parameters were selected based upon soil tests performed by Fox (1980 and 1984).

The results of the modeling are shown in Table 6-3. The annual precipitation during this 5-year period ranged from 6.38 inches to 13.93 inches, with an average of 9.76 inches. Because of the arid climate, an average of 92.6 percent of the precipitation is dissipated through evapotranspiration. Another 4.5 percent is lost through surface runoff, leaving less than 3 percent. The remaining 3 percent is accounted for by an increase in soil moisture in the upper layers. This increase in soil moisture will help sustain the vegetation on the cover during dry periods. Most importantly, the model results show no discharge from the tailings impoundment and only a minute amount of water (an average of 0.003 inches per year) percolating through the cap and into the tailings. To alleviate concerns that this discharge may create a "bath tub effect" and saturate the impoundment, the time required to completely fill the impoundment was calculated. Based on a tailings volume of 60 million cubic feet (Wright, 1980), a tailings porosity of 0.49, a surface area of 58 acres, and a discharge to the tailings of 0.003 inches per year, the time required to completely fill the impoundment is approximately 46,500 years, assuming that the tailings were initially dry. If a tailings moisture content of 30 percent, as observed during operation, is assumed (Fox, 1984), the time required to completely saturate the tailings is approximately 7,600 years. Since the underdrain system will be operational until the tailings are drained, the water content will be less than during operation, which will require a longer time to achieve complete saturation of the tailings. Thus, the quantity of water percolating through the cover and into the tailings is negligible, with none of this reaching ground water.

How was this # determined? what assumptions used?

30 PERCENT?

Encapsulation, such as proposed here, is an appropriate closure plan for this tailings facility. Similar closure plans are used for new solid waste landfills under the proposed RCRA Subtitle D, hazardous waste landfills, and low-level radioactive waste disposal facilities.

?

I'm sure the cap is significantly thicker

6.1.2 Detoxification/Neutralization

This issue has been discussed between Hecla, DOGM, BWPC, and the BLM on several occasions -- the last being a joint meeting at DOGM's Salt Lake City office on August 30, 1990. The following discussion points out why detoxification/neutralization is neither desirable nor economically feasible.

The pH levels in the tailings are high, currently ranging from about 9.5 to 9.8. Concentrations of heavy metals in the impoundment are loosely complexed and would become more mobile if pH levels were lowered (neutralized) by washing the tailings. This could cause heavy metals to move downward and concentrate at higher levels.

BY WHOM, HOW?

Washing is estimated to only penetrate about 9 ft/yr. Thus, several years would be required to advance the wash to the underdrain system. This would allow excess moisture to build up in the tailings, and would require keeping the underdrain system functioning for a number of years. Thus, the mill/pumping areas could not be completely dismantled and reclaimed for several years.

WHAT NUMBER?

NUMBER = ?

Washing solutions placed on the impoundment would pond on the surface prior to infiltrating, since the hydraulic conductivity of the tailings is relatively low (10^{-5} cm/sec). There are two disadvantages to a ponding situation that a wash would create. One disadvantage is that evaporation will diminish the amount of solution available to actually wash the tailings. The other disadvantage is that ponded water on the tailings is undesirable for migratory waterfowl, as demonstrated by past difficulties in hazing waterfowl.

Detoxification of the tailings by removing and treating is not economically feasible. It took 10 years for Hecla to deposit over two million tons of tailings in the impoundment at an hourly rate of about 30 tons/hr. A like amount of time or more would be expected to remove and treat the tailings. This would require keeping the mill complex operating; thus, it could not be dismantled and reclaimed until treatment was finished.

Another area would have to be permitted to place the treated tailings, while removing the existing tailings. Furthermore, removing the existing tailings would risk damage to the liner and underdrain system, which have worked admirably to date.

For a heap leach mining process (which Escalante is not), washing and detoxification can readily be done at the end of the mine heap life. With most leaching processes, the rock material being leached ranges in size from 0.5 to 2 inches. The Escalante milling operation ground the rock material to 200-mesh size material with a rather low hydraulic conductivity. Thus, washing the Escalante tailings is not as amenable as heap leach rock material. <.1mm?

Hecla was originally permitted in 1980 by DOGM and the Department of Health to deposit the cyanide and metal bearing tailings in the impoundment that was designed to hold these types of materials. The original feasibility studies did not consider the extremely high cost of cyanide treatment, because the agencies were satisfied with the technical design of the tailings facility clay liner to contain mine waste. To require treatment or detoxification of tailings after all of the material has left the milling circuit is unreasonable. In this instance, the company should not be penalized because the regulations changed prior to reclamation, especially since ground water has been protected and modeling shows that ground water will be protected in the future.

In summary, it is not practical nor feasible to wash or detoxify the tailings. Several years and a great deal of expense would be required. For these reasons, encapsulation of the tailings is the preferred reclamation alternative and will provide adequate protection of the environment.

6.1.3 Ground-Water Monitoring System

The ground-water monitoring system is comprised of three wells (TMW-1, TMW-2, TMW-3) as shown on Drawing No. 11360 in Section 15. Two of these wells, TMW-1 and TMW-3 are upslope and west of the tailings area. The other well, TMW-2, is downslope of the tailings dam, to the east of the tailings area. Based upon the ground-water elevation contours shown on Drawing No. 11360, TMW-2 is downgradient of the tailings area, while the other two wells are upgradient.

Ground-water levels in the three monitoring wells were measured in August, September, and October 1990 and are listed in Table 6-2. These elevations, as shown on Drawing No. 11360, indicate that the monitoring wells are located in the same aquifer as the other wells in the valley. The ground-water

gradient is towards the northeast at about 2 ft/1000 ft in the vicinity of the tailings monitoring wells.

Water quality data for the three monitoring wells are shown in Tables 6-4 through 6-6. In addition, water quality data for pumping well P-1 near the mine are shown in Table 6-7. In general for the last two years, none of the parameters exceeded acceptable standards. Furthermore, detectable cyanide concentrations were never observed in any of the four wells.

As noted in Section 6.1.1, it appears very unlikely that any leachate will seep from the tailings through the liner and existing soils to the groundwater. In the event that any solution originating from the tailings leachate did ever reach the groundwater table, which is about 300 ft below the tailings, a time period of about 4,750 years would be required for this solution to move downgradient 1,000 feet in the ground water. The time was determined by dividing the downgradient distance by the ground-water velocity. The 1,000-ft distance is measured from approximately the upstream base of the impoundment dam to monitoring well TMW-2. The ground-water velocity was determined by dividing the Darcy velocity (from Darcy's Law) by the effective porosity of the aquifer. This travel time does not account for any attenuation of leachate parameters, such as cyanide or metals, on the solid matrix of the aquifer, nor does it account for vertical travel time from the bottom of the tailings impoundment to the ground-water table.

Based upon the ground-water contours on Drawing No. 11360, the unlikelihood of seepage through the impoundment liner, and the lengthy groundwater travel times, which allow for contaminant attenuation and degradation, it is our opinion that the existing ground-water monitoring system is sufficient. Furthermore, ground-water monitoring well TMW-2 is immediately downgradient of the base of the tailings impoundment dam, and it is located approximately in the middle of the region that would be expected to contain any contaminant plume. AND SO...?

6.1.4 Cyanide Concentrations in Tailings

Cyanide is a relatively simple chemical compound, and it is a fundamental building block of many organic compounds. The occurrence of cyanide in

nature is widespread. Many types of living organisms, including bacteria, fungi, higher plants, and insects, can synthesize cyanide.

Cyanide occurs in different forms in solution, and it can be analyzed by different techniques. Hydrogen cyanide is one form in which cyanide may occur. It also may occur in its ionic form and in complexes with metals and organic compounds.

Cyanide is commonly referred to in its various forms as free or complexed cyanide, total cyanide, weak acid-dissociable cyanide, or reactive cyanide. Free cyanide is defined as the sum of hydrogen cyanide (HCN) and ionic cyanide (CN^-). Total cyanide is the sum of both free and complexed cyanides. Weak acid-dissociable cyanides are those, both free and metallo-cyanide complexes, that are capable of converting to HCN gas in a slightly acidified medium. Reactive cyanide is that cyanide that is available for chemical reaction -- primarily weak-acid dissociable cyanide.

Relatively little research has been directed towards the mobility of various forms of cyanide through the soil to surface water or ground water. The research that has been done indicates that cyanide complexes of most cations are soluble to some degree, but may migrate only a short distance through soil before being converted to nitrates under aerobic biological conditions (Stanton et al., 1986). In an anaerobic environment, cyanides tend to de-nitrify to form gaseous nitrogen compounds that are released to the atmosphere (Towill et al., 1978). Because of complexing with trace metals and biological metabolism, Towill et al. (1978) conclude that cyanide movement in soil is generally quite limited. The Bureau of Mines reported no success in finding any mobile forms of cyanide in tailings samples analyzed from around inactive mines (EPA, 1976). This report indicated that the cyanides were complexed with organic matter and rendered non-toxic. INACTIVE FOR HOW LONG?

Cyanide is a very reactive and relatively short-lived contaminant. Thus, it is considered to be a transient pollutant. Several natural processes have been identified as potentially significant in the natural degradation or depletion of cyanide in effluents from mining and milling operations. These natural processes are volatilization, oxidation, biodegradation, photo decomposition, and cyanide-

thiocyanate reactions. Polymerization and hydrolysis may also be important for solutions of high concentrations (Stanton et al., 1986).

In an effort to determine the levels of cyanide in the tailings at Escalante, several laboratory analyses have been conducted over the past year and a half. These data are summarized in Table 6-8.

The June 1989 and August 1990 tailings samples listed in Table 6-8 were taken from various locations on the impoundment surface (the top two feet). The October 1990 tailings samples were taken from the vertical faces of two test pits dug in the impoundment with a backhoe. The purpose of analyzing the August 1990 samples was to evaluate different methods for analyzing cyanide (total, weak acid-dissociable, free, and amenable). The purpose of the October 1990 samples was to evaluate variation of cyanide with depth at two locations on the impoundment. As can be noted, there is no apparent correlation between reactive cyanide concentrations and depth. Underdrain effluent samples were also obtained during the October sampling event.

MAP SHOWING LOCATION OF SAMPLING?

Based upon the above discussions from the existing literature and upon the laboratory analyses of cyanide concentrations in the tailings, it is concluded that, even if cyanide were to leach from the encapsulated tailings and enter the underlying soil system, the cyanide concentrations would rapidly diminish though natural degradation. Furthermore, and as discussed in Section 6.1.3, the ground-water velocity is extremely slow. If a contaminant did reach the ground-water table 300 feet below the tailings, 4,750 years would be required for the contaminant to move downgradient 1,000 feet, assuming that the contaminant moves freely with the ground water and is not adsorbed to the soil matrix of the aquifer.

6.2 Air Quality

In order to ensure that the surface of the tailings facility is protected from wind erosion and resulting air quality degradation, Hecla proposes to seed and revegetate the surface of the impoundment. This revegetation activity can begin after the cap is in place and prepared for seeding. Most of the earth work should occur during the spring and early winter months. Earth work during this time should reduce the amount of air particulates generated.

Table 6–1. Soil profile for the reclaimed tailings impoundment.

Layer	Material	Thickness (inches)	Layer Type	Porosity	Hydraulic Conductivity (cm/sec)	Initial Water Content
1	Topsoil	4	Vertical Percolation	0.398	1.2E–04	5.0%
2	Subsoil	14	Lateral Drainage	0.417	1E–05	5.0%
3	Clay Cap	6	Barrier	0.43	1E–07	10.0% * 1.54 in/yr
4	Tailings	300	Vertical Percolation	0.49	1.9E–05	30.0%
5	Underdrain	12	Lateral Drainage	0.41	1E–04	13.2%
6	Clay Liner	24	Barrier	0.41	5.67E–07	15.1%
7	Foundation Soil	3600	Vertical Percolation	0.31	2.44E–05	5.7%

Table 6–2. Ground–water levels in tailings monitoring wells.

Well No.	Well Elevation	Measured Depth, feet			Ground–water Elevation, feet		
		08–24–90	09–28–90	10–12–90	08–24–90	09–28–90	10–12–90
TMW–1	5409	306	307.1	306.9	5103	5101.9	5102.1
TMW–2	5331	233	232.8	231.6	5098	5098.2	5099.4
TMW–3	5416	318*	312.5	313	5098*	5103.5	5103.0

*Believed to be in error

avg over 5 year period

Table 6–3. Average annual totals from the HELP model.

Component	Depth (inches)	Percent
Precipitation	+ 9.76	100
Runoff	– 0.435	4.46
Evapotranspiration	– 9.036	92.62
Lateral Drainage from Layer 2	0	0
Percolation from Layer 3	– 0.003	0.03
Lateral Drainage from Layer 5	0	0
Percolation from Layer 6	0	0
Percolation from Layer 7	0	0
Change in Soil Moisture	+ 0.286	2.89

default values which are used
Help model done on daily basis
empirical model

→ daily total?

→ 1.54"/yr ?

/ based on 1x10⁻⁷ cm/sec

• .003 in/dy or 1.54 in/yr

• clay layer only

upper layers only

over period

average yr over 5 period

Table 6-4. Ground-water quality data for monitoring well TMW-1.

Hecla Mining Company - Escalante Mine
Well: TMW-1 All units in mg/l

Date	Type	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Selenium	Zinc	Cyanide	TSS
08-21-81	U	<0.001	0.01	<0.001	<0.001	0.002	0.28	<0.001	<0.0002	<0.001		<0.001	
05-02-83	U	<0.002	0.094	<0.002	0.005	0.011	14	<0.025		<0.002		<0.1	
01-15-85	T	0.004	0.06	<0.006	0.007	<0.006	23	<0.025		<0.002		<0.01	56
07-01-85	U	0.069	0.16	<0.004	0.057	0.26	65	0.15	<0.0002	<0.008	1.7	<0.01	1605
10-16-85	U	0.012	0.084	<0.004	<0.005	<0.002	1.1	<0.025	<0.0001	<0.004	0.076	<0.01	2440
01-21-86	U	0.012	0.1	<0.004	<0.005	0.023	2.6	<0.025	0.0002	<0.02	0.027	<0.01	1280
04-25-86	U	0.06	0.029	0.006	0.027	0.29	53	0.11	<0.0001	<0.002	0.43	<0.01	2490
10-21-86	T	0.042	0.074	<0.004	0.02	0.13	34	0.12	<0.0001	<0.02	0.25	<0.01	1730
02-19-87	T	0.034	0.15	<0.005	0.02	0.11	24	0.03	<0.0001	<0.02	0.18	<0.01	702
05-18-87	T	0.046	0.08	<0.005	0.01	0.18	27	0.07	0.0002	<0.04	0.21	<0.01	2380
10-08-87	T	0.023	0.07	<0.005	<0.01	0.15	6.6	<0.05	<0.0001	<0.01	0.13	<0.01	628
03-30-88	T	0.014	0.08	<0.005	0.01	0.074	6	<0.05	<0.0001	<0.002	0.51	<0.01	365
07-29-88	T	0.023	0.12	<0.005	0.08	0.11	12	<0.05	<0.0001	<0.004	2.7	<0.01	525
06-29-89	D	<0.005	0.06	<0.005	<0.01	0.02	<0.1	<0.05	<0.0002	<0.005	0.02	<0.01	1030
10-10-90	D	<0.005	0.07	<0.005	<0.01	<0.01	<0.1	<0.05	<0.0002	<0.005	0.02	<0.01	1650
01-29-90	D	<.005	0.063	<0.005	0.012	<0.01	<0.1	<0.05	<0.0002	<0.005	0.012	<0.01	2300
06-18-90	D	0.0059	<0.1	<0.005	0.023	<0.02	<0.1	<0.05	<0.0002	<0.005	0.032	<0.01	557
Standards		0.05*	0.75**	0.01*	0.05*	1*	0.3**	0.05*	0.002*	0.01*	5*	0.2**	

*State of Utah (1989)
**EPA (1986)
U=Unknown, assumed to be total metals
T=Total metals
D=Dissolved metals

Table 6-5. Ground-water quality data for monitoring well TMW-2.

Hecla Mining Company - Escalante Mine
Well: TMW-2 All units in mg/l

Date	Type	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Selenium	Zinc	Cyanide	TSS
08-21-81	U	<0.001	0.009	<0.001	<0.001	0.003	0.265	<0.001	<0.0002	<0.001		<0.001	
05-02-83	U	<0.002	0.059	<0.002	0.005	0.004	4.5	<0.025		<0.002		<0.1	
01-15-85	T	0.005	0.05	<0.006	0.006	0.025	3.3	<0.025		<0.002		<0.01	6
07-01-85	U	0.007	0.06	<0.004	<0.007	0.007	10	0.032	<0.0002	<0.002	0.024	<0.01	16
10-16-85	U	<0.02	0.069	<0.004	0.005	0.016	4.6	<0.025	<0.0001	<0.004	0.024	<0.01	5
01-30-86	U	0.006	0.051	<0.004	0.086	0.012	2.8	<0.025	<0.0001	<0.002	0.017	<0.01	8
04-25-86	U	0.007	0.042	<0.004	0.008	0.004	1.5	<0.02	<0.0001	<0.002	0.015	<0.01	3
10-21-86	T	0.009	0.06	<0.004	<0.005	0.013	11	<0.02	<0.0001	<0.002	0.034	<0.01	15
05-18-87	T	0.32	0.04	<0.005	0.03	0.2	58	0.24	0.0003	<0.04	0.47	<0.01	4150
10-08-87	T	0.55	0.07	<0.005	<0.01	0.19	7.9	0.11	0.0006	<0.04	0.2	<0.01	14800
03-30-88	T	0.6	0.07	<0.005	0.04	0.11	26	0.17	0.0007	<0.004	1.8	<0.01	4240
07-29-88	T	0.6	0.1	<0.005	0.1	0.16	64	0.27	0.0004	<0.02	4	<0.01	2360
06-29-89	D	0.008	0.05	<0.005	<0.01	<0.01	<0.1	<0.05	<0.0002	<0.005	0.02	<0.01	4600
10-10-89	D	0.008	0.05	<0.005	<0.01	<0.01	<0.1	<0.05	<0.0002	<0.005	<0.01	<0.01	5810
01-29-90	D	0.0079	0.048	<0.005	<0.01	<0.01	<0.1	<0.05	<0.0002	<0.005	0.013	<0.01	2640
06-18-90	D	0.0079	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.005	<0.02	<0.01	1550
Standards		0.05*	0.75**	0.01*	0.05*	1*	0.3**	0.05*	0.002*	0.01*	5*	0.2**	

*State of Utah (1989)
**EPA (1986)
U=Unknown, assumed to be total metals
T=Total metals
D=Dissolved metals

Table 6-6. Ground-water quality data for monitoring well TMW-3.

Hecla Mining Company - Escalante Mine
Well: TMW-3 All units in mg/l

Date	Type	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Selenium	Zinc	Cyanide	TSS
08-21-81	U	<0.001	0.008	<0.001	<0.001	<0.001	0.198	<0.001	<0.0002	<0.001		<0.001	
05-02-83	U	0.033	0.066	<0.002	0.007	0.079	4.8	0.068		<0.002		<0.1	
01-15-85	T	0.028	0.05	<0.006	0.01	0.11	6.8	0.04		<0.002		<0.01	389
07-01-85	U	0.072	0.3	<0.004	0.016	0.21	21	0.22	<0.0002	<0.002	0.3	<0.01	324
10-16-85	U	0.018	0.057	<0.004	0.005	0.041	2.6	<0.025	<0.0001	<0.004	0.048	<0.01	166
01-21-86	U	0.028	0.053	<0.004	<0.005	0.091	2.9	0.05	<0.0001	<0.002	0.14	<0.01	604
04-25-86	U	0.035	0.046	<0.004	0.008	0.077	7.2	0.04	<0.0001	<0.002	0.12	<0.01	426
10-21-86	T	0.023	0.073	<0.004	<0.005	0.047	4.5	0.03	<0.0001	<0.002	0.08	<0.01	614
02-19-87	T	0.046	0.09	<0.005	<0.01	0.054	8	0.031	<0.0001	<0.02	0.08	<0.01	385
05-18-87	T	0.042	0.04	<0.005	<0.01	0.058	6.1	<0.05	0.0001	<0.02	0.1	<0.01	354
10-08-87	T	0.032	0.06	<0.005	<0.01	0.047	2	<0.05	<0.0001	<0.01	0.05	<0.01	231
03-30-88	T	0.066	0.06	<0.005	0.02	0.076	15	0.08	0.0001	<0.002	0.76	<0.01	938
07-29-88	T	0.052	0.08	<0.005	0.06	0.074	13	0.05	0.0001	<0.004	2.5	<0.01	623
06-29-89	D	0.01	0.04	<0.005	<0.01	0.01	<0.1	<0.05	<0.0002	<0.005	0.05	<0.01	3200
10-10-89	D	0.016	0.05	<0.005	<0.01	<0.01	<0.1	<0.05	<0.0002	<0.005	0.09	<0.01	2150
01-29-90	D	0.016	0.042	<0.005	<0.01	<0.01	<0.1	<0.05	<0.0002	<0.005	0.042	<0.01	1770
06-18-90	D	0.016	<0.1	<0.005	<0.01	<0.02	<0.1	<0.05	<0.0002	<0.005	<0.02	<0.01	632
Standards		0.05*	0.75**	0.01*	0.05*	1*	0.3**	0.05*	0.002*	0.01*	5*	0.2**	

*State of Utah (1989)
**EPA (1986)
U=Unknown, assumed to be total metals
T=Total metals
D=Dissolved metals

Table 6-7. Ground-water quality data for pumping well P-1.

Hecla Mining Company - Escalante Mine
Well: P-1 All units in mg/l

Date	Type	Arsenic	Boron	Cadmium	Chromium	Copper	Iron	Lead	Mercury	Selenium	Zinc	Cyanide	TSS
05-23-83	U	0.027	0.06	<0.002	<0.005	<0.002	<0.05	<0.025		<0.002		<0.1	
01-15-85	T	0.026	0.06	<0.006	<0.005	<0.006	<0.05	<0.025		<0.002		<0.01	<2
10-16-85	U	<0.028	0.1	<0.004	<0.005	0.006	<0.05	<0.025	<0.0001	<0.004	0.028	<0.01	<2
01-30-86	U	0.03	0.066	<0.004	0.054	<0.002	0.2	<0.025	<0.0001	<0.002	0.012	<0.01	<2
04-25-86	U	0.033	0.06	<0.004	<0.005	<0.003	<0.05	<0.02	<0.0001	<0.002	0.009	<0.01	<10
10-21-86	T	0.003	0.061	<0.004	<0.005	<0.003	<0.05	<0.02	<0.0001	<0.04	0.011	<0.01	<2
02-19-87	T	0.03	0.08	<0.005	<0.01	0.011	<0.05	0.032	<0.0001	<0.02	0.04	<0.01	<2
10-08-87	T	0.03	0.08	<0.005	<0.01	0.018	<0.05	<0.05	<0.0001	<0.004	0.02	<0.01	<5
03-30-88	T	0.037	0.07	<0.005	<0.01	0.013	0.05	<0.05	<0.0001	<0.002	0.005	<0.01	2
07-29-88	T	0.026	0.11	<0.005	<0.01	0.007	0.06	<0.05	<0.0001	<0.002	0.05	<0.01	<2
Standards		0.05*	0.75**	0.01*	0.05*	1*	0.3**	0.05*	0.002*	0.01*	5*	0.2**	

*State of Utah (1989)
**EPA (1986)
U=Unknown, assumed to be total metals
T=Total metals
D=Dissolved metals

TABLE 6-8. CYANIDE CONCENTRATIONS IN TAILINGS IMPOUNDMENT

Sample No.	Date	Depth/ft	Analysis	Conc.	Units	Laboratory
1-11345	06/15/89	1-2	Total	36.2	mg/kg	A&L Mid West
2-11346	06/15/89	1-2	Total	116.9	mg/kg	A&L Mid West
3-11347	06/15/89	1-2	Total	83.9	mg/kg	A&L Mid West
TS-11348	06/15/89	0-1	Total	<0.2	mg/kg	A&L Mid West
WP-11349	06/15/89	0-1	Total	<0.2	mg/kg	A&L Mid West
T-1	08/20/90	1-2	Total	14.8	mg/kg	Silver Valley
T-2	08/20/90	1-2	Total	33.0	mg/kg	Silver Valley
T-3	08/20/90	1-2	Total	41.6	mg/kg	Silver Valley
T-4	08/20/90	1-2	Total	47.2	mg/kg	Silver Valley
T-5	08/20/90	1-2	Total	18.2	mg/kg	Silver Valley
T-6	08/16/90	0-1	Total	66.6	mg/kg	Silver Valley
T-1	08/20/90	1-2	WAD	11.4	mg/kg	Silver Valley
T-2	08/20/90	1-2	WAD	31.4	mg/kg	Silver Valley
T-3	08/20/90	1-2	WAD	26.4	mg/kg	Silver Valley
T-4	08/20/90	1-2	WAD	36.6	mg/kg	Silver Valley
T-5	08/20/90	1-2	WAD	7.6	mg/kg	Silver Valley
T-6	08/16/90	0-1	WAD	33.0	mg/kg	Silver Valley
T-3	08/20/90	0-1	Free	12.0	mg/kg	Silver Valley
T-6	08/16/90	0-1	Free	16.6	mg/kg	Silver Valley
T-3	08/20/90	0-1	Amenable	10.0	mg/kg	Silver Valley
T-6	08/16/90	1	Amenable	32.2	mg/kg	Silver Valley
TP1-1	10/04/90	1	Reactive	0.2	mg/kg	Silver Valley
TP1-2	10/04/90	2	Reactive	0.1	mg/kg	Silver Valley
TP1-3	10/04/90	3	Reactive	0.4	mg/kg	Silver Valley
TP1-4	10/04/90	4	Reactive	0.1	mg/kg	Silver Valley
TP1-5	10/04/90	5	Reactive	0.4	mg/kg	Silver Valley
TP1-6	10/04/90	6	Reactive	0.6	mg/kg	Silver Valley
TP2-1	10/04/90	1	Reactive	0.4	mg/kg	Silver Valley
TP2-2	10/04/90	2	Reactive	0.8	mg/kg	Silver Valley
TP2-3	10/04/90	3	Reactive	0.4	mg/kg	Silver Valley
TP2-4	10/04/90	4	Reactive	0.1	mg/kg	Silver Valley
TP2-5	10/04/90	5	Reactive	0.2	mg/kg	Silver Valley
TP2-6	10/04/90	6	Reactive	0.2	mg/kg	Silver Valley
U-1	10/04/90	--	WAD	186.0	mg/l	Silver Valley
U-2	10/04/90	--	WAD	191.0	mg/l	Silver Valley

TOP 2FT OF IMPOUNDMENT SURFACE TAILINGS

TAKEN FROM VERTICAL FACES IN TEST PITS DUG IN THE IMPOUNDMENT

Notes:

TS = Top Soil Accumulated for Use on Tailings Impoundment Cap.
WP = Waste Soil Pile for Possible Use on Tailings Impoundment Cap.
T = Tailings
WAD = Weak Acid-Dissociable
TP1 = Tailings Pit No. 1
TP2 = Tailings Pit No. 2
U = Underdrain Effluent Sample

7.0 ROADS, PADS, AND BORROW AREAS

The road to the tailings area will be reduced to a one-lane road. Disturbed areas adjacent to this one-vehicle-width road will be ripped and seeded with the seed mixture described in Section 11.0. This road will be needed for periodic reclamation inspections and general land management use. Hecla will leave this road in a condition suitable for continued use, complete with the existing drainage structures.

Some road construction will be needed to access the clay and subsoil borrow areas. The map on Figure 7-1 shows the roads and borrow areas. The borrow areas outlined in the figure are areas where the specific source material is located. If sufficient quantities of materials are found closer to the tailings impoundment, the borrow areas located further away would not be used. Also, because of the varied depths of the clay sources, it is likely that only half of the borrow areas will be disturbed.

Haulage roads from borrow areas to the tailings facility will be only temporary during the construction phase. Following reclamation, these haulage roads will not be needed and will be ripped, water-barred, and seeded with the appropriate seed mixture. The specific revegetation prescriptions for the roads and borrow areas are described in Section 11.