

Considered: _____

WATER PERMIT NO. 1439-1

HAP No. same 584-2010

Name of Applicant Golden Reward Mining Company

Post Office Address PO Box 888, Lead SD 57754

Amount of Water Claimed 0.33 cfs Total Acres NA

Source of Water Supply ground water 1 well

Water to be used for industrial & domestic use County Lawrence

about 1 1/2 miles SW of Lead.

PROOF OF PUBLICATION: Received _____ Not Received _____

APPLICATION: Approved _____ Subject to _____

F. & C.L. Adopted _____ Not Approved _____ Deferred _____

PRIORITY _____ Date Received Apr. 11, 1988 Fee 225⁰⁰ Remarks _____

Corrected Application Received _____ Period of Annual Use Jan 1 - Dec 31

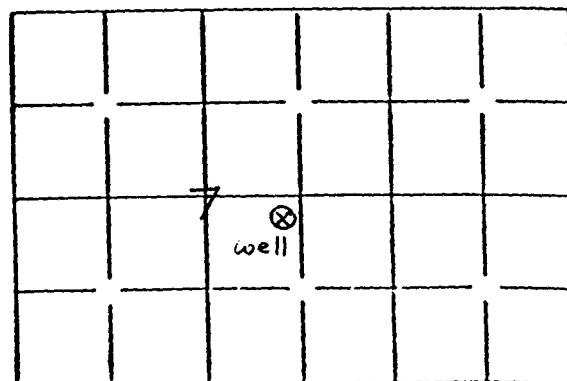
WATER QUALITY APPROVAL RECEIVED NA APPROVED/CONDITIONAL (Circle one)

1-1 Description same as Application YES NO REMARKS _____

Diversion Point well: NW 1/4 SE 1/4 section 7 -

T4N-R3E

Land to be Irrigated NA



Well Log: Driller B & B drilling Licensed YES ☒ NO ☐

Depth of Well 300 feet REMARKS _____

Type of Map plat PREPARED BY John M. Arleth Reviewed and the Number

assigned on April 21, 1988 By Ron Duwall

Mail to: Water Rights Div.
DWNR, Foss Bldg.
Pierre, SD 57501
(605) 773-3352

No. 1439-1 Hydrologic Unit 10120202
Map No. same Basin Belle Fourche R
Newspaper Lead Daily Call, Box 876

Application For Permit To Appropriate Water Within The State Of South Dakota

Check use of water: Industrial ☒ Commercial ☐ Municipal ☐ Other Common Distribution System ☐
Rural Water System ☐ Suburban Housing ☐ Geothermal Heat ☐ Institutional ☐ Recreational ☐
Domestic ☒ (above 18gpm) Other ☐

Type of Application: Check one or more of the following

New ☒ Vested Right ☐ Future Use ☐ Change Use ☐

☐ Amend Permit No. _____ with old priority date retained

Change diversion point(s) ☐ Add diversion point(s) ☐ Other ☐ _____

☐ Application to: Change diversion point(s) ☐ Add diversion point(s) ☐ on Permit No. _____

☐ Construction to use water reserved by Future Use Permit No. _____



1. Name of Applicant Golden Reward Mining Company Phone No. (605) 584-2010

Post Office Address P.O. Box 888, Lead State SD 57754
(Street, RR or Box) Zip Code

2. Amount of water claimed (c.f.s.) 0.33 CFS

3. Source of water supply Deadwood Formation 1 well

4. Location of point of diversion NW 1/4 of SE 1/4 of Sect. 7, T4N, R3E, BHM
3500 ft. S 28 deg. 47 min 48 sec W of NE corner section 7, T4N, R3E, BHM
Golden Reward Ref. Nos. PW-1, Ex. 616 County Lawrence

5. Counties where water will be used Lawrence

6. Annual period during which water is to be used year round January 1 - December 31

7. Give a brief description of proposed project. When available include any preliminary engineering report or other reports or information that will help explain the project. (Attach sheet if more space is needed)

The water is required for the Golden Reward Heap Leach Project. Gold will be extracted from Auriferous Crushed Ore utilizing a weak cyanide solution. The water will be used for: Leach Solution, Spent Ore Washing, Dust Control, Vehicle Washdown and for potable water.

Attachments: Attach Form 2A if diversion from a well or dugout, or if storage of water, is proposed. Attach map (see instruction)

STATE OF SOUTH DAKOTA)
County of _____)

I, Peter Erickson, General Manager the applicant, certify that I have read the foregoing application, have examined the attached map and that the matters therein stated are true and that I intend, and am able to complete the necessary construction.

Signed by [Signature] General Manager
Golden Reward Mining Company

Subscribed and sworn to before me this 11th day of April 1988

[Signature] Comm exp 08.24.95
Notary Public (or other qualified officer)

WATER PERMIT APPROVAL SHEET COULD
NOT BE FOUND AT TIME OF SCANNING

QUALIFICATIONS FOR WATER PERMIT APPLICATION NO. 1439-1

1. Although the Board believes there is reasonable probability that there is unappropriated water available for the proposed use, since only limited flow data are available for Stewart Gulch and the impacts of proposed groundwater withdrawals on spring flows and stream flows under Permit Nos. 1438-1, 1439-1, and 1440-1 are uncertain, the Water Management Board is retaining jurisdiction of these Permits, which will be exercised prior to licensing. The Board may quantify and/or determine if minimum amounts of water must be present in Stewart Gulch, Whitetail Creek and Whitewood Creek to protect these streams as cold water permanent fish life propagation waters and to determine any impacts of Golden Reward Mining Company withdrawals on these streams.

This retained jurisdiction will be exercised pursuant to the public trust duties of the State and the Water Management Board as the Board vested with the authority of the State, to supervise the appropriation and distribution of water resources of the State.

2. That Golden Reward Mining Company install and operate a continuous recording flow gaging station on Stewart Gulch at a site below the Bertha Mine Workings outflow and above the confluence with Whitetail Creek.
3. The casing of the well to be constructed under Permit No. 1438-1 shall be pressure grouted with cement (bottom to top) from the producing formation to the surface, constructed by a licensed well driller and the well constructed in compliance with Water Management Board Well Construction Rules, Chapter 74:02:04.
4. The well approved under this Permit will be located near domestic wells and other wells which may obtain water from the same aquifer. The well owner under this Permit shall control his withdrawals so there is not a reduction of needed water supplies in adequate domestic wells or in adequate wells having prior water rights.
5. Approval of Permit No. 1438-1 is subject to compliance with the following then existing and applicable Water Management Board rules:
 - a. Chapter 74:03:15 Ground Water Quality Standards,
 - b. Chapter 74:03:16 Ground Water Discharge Permit,
 - c. Chapter 74:03:02 Surface Water Quality Standards,
 - d. Chapter 74:03:04 Uses Assigned to Streams,
 - e. Chapter 74:03:17 Surface Water Discharge Permit - General Provisions,
 - f. Chapter 74:03:18 Surface Water Discharge Permit Application Requirements,
 - g. Chapter 74:03:19 Surface Water Discharge Permit Conditions,
 - h. Chapter 74:03:20 Transfer Modification, Revocation and Reissuance and Termination of Surface Water Discharge Permits,
 - i. Chapter 74:03:21 Procedure For Permit Processing,
 - j. Chapter 74:03:22 Secondary Treatment Standards,
 - k. Chapter 74:03:23 Criteria and Standards for Surface Water Discharge Permit,
 - l. Chapter 74:03:24 Toxic Pollutant Effluent Standards for Surface Water Discharge Permits,
 - m. Chapter 74:03:25 Effluent Guidelines and Standards for Surface Water Discharge Permits, and
 - n. Chapter 74:03:26 Pretreatment Regulations for Surface Water Discharge Permits.

1. RECOMMENDATIONS FOR FURTHER RESEARCH

Supplemental Information

(type or print in ink)

1. Well Information - Proposed construction

- a) Drill Hole Diameter 8 3/4 in. Depth 300'
- b) Casing Type PVC Sched 40 Diameter 6 in. Thickness 0.280 in.
- c) Screen Type Perforated Pipe Diameter 6 in. Thickness 0.280 in.
- d) Gravel Pack Thickness _____ Length of Gravel Pack 67 ft.
- e) Depth to Top of Water Bearing Material 210 ft.
- f) Depth of Water (ground surface to water level) 210 ft.
- g) Distance to nearest existing domestic well:
 On applicants property 1,975 ft. (PW2) On property owned by others 3,000 ft.

2. Dugout Information Estimates

- a) Surface Dimensions _____ Depth _____
- b) Depth to water (ground surface to water level) _____

3. Water Storage Dams

If the proposed water use system contains one or more storage dams, please furnish the information requested below. The locations of each dam should be shown on the map submitted with the application.

- a) If a private engineering firm or government agency was involved in the design of this dam please give their name and address

b) Freeboard _____

c) Crest Width _____

Crest Length _____

d) Height _____

e) Outlet Dimensions:
 Pipe diameter _____

Spillway width _____

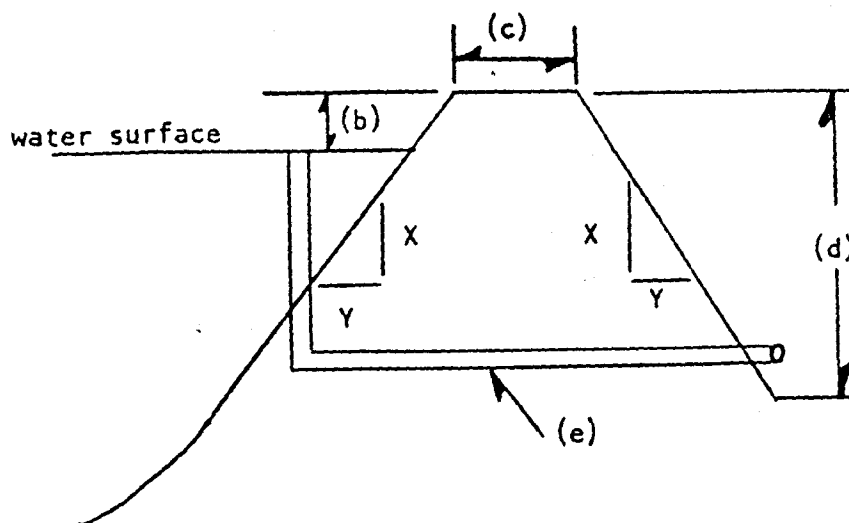
f) X & Y Slope
 Upstream _____

Downstream _____

Surface Area of Impoundment _____

Storage _____ acre feet

Drainage area above dam _____



Signature of Applicant _____

1439-1

PW-01

SOUTH DAKOTA WATER WELL COMPLETION REPORT

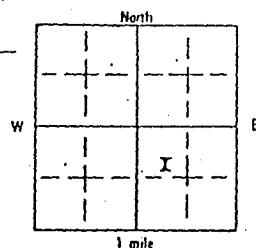
10-85

Location NE 1/4 SE 1/4 Sec 7 Twp 4N Rg 3E

County

Lawrence

Please mark well location with an "X"

Well Completion Date 6-15-87

PROPOSED USE:

☐ Domestic ☐ Municipal ☒ Test Holes
☐ Irrigation ☐ Industrial ☐ Stock

Method of Drilling:

rotary air hammer

CASING DATA:

☐ Steel ☒ Plastic ☐ Other

If other describe _____

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SCH 40 LB/FT	10 IN	0 FT	20 FT	12 1/2 IN
sch 40 LB/FT	6 IN	0 FT	300 FT	8 3/4 IN
_____ LB/FT	_____ IN	_____ FT	_____ FT	_____ IN
_____ LB/FT	_____ IN	_____ FT	_____ FT	_____ IN

GROUT:

Was the well grouted? ☒ YES ☐ NOTo what depth? 20 FEETWhat is grouting material? cementIf cement, number of sacks? 11Describe grouting procedure 5 gal per 1 sackWhat was grout weight? 15.6 LB/GALSCREEN: ☒ Perforated pipe ☐ ManufacturedDiameter 6 IN Length 40 FEETMaterial PVC Sch. 40Slot Size 8.15/0.01 Set From 238 Feet To 278 Feet

Slot Size _____ Set From _____ Feet To _____ Feet

Slot Size _____ Set From _____ Feet To _____ Feet

Other information _____

Was a packer or seal used? ☒ YES ☐ NOIf so, what material? Bentonite pelletsDescribe packer(s) and location? 20-27Was well disinfected upon completion? ☐ YES ☒ NO

Explain _____

Bacteriological analysis ☐ YES ☒ NO

Laboratory sent to _____

Well Owner:

Name Golden Reward Mining CompanyAddress 310 1/2 Main, Lead, SD 57754Well Log: MW-87-616p

Depth

Formation (pw-1)

	From	To
Fill-shale and limestone	0	5
limestone	5	15
Tertiary porphyry	15	24.5
Quartzite-ss	24.5	290
Precambrian schist	290	300

STATIC WATER LEVEL 210 * Feet

If flowing: closed in pressure _____ PSI

GPM flow _____ through _____ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

If other, specify _____

Can well be completely shut in? _____

WELL TEST DATA:

☐ Pumped☐ Bailed

Describe: _____

☐ Other

Pumping Level Below Land Surface

_____ ft. After _____ hrs. pumped _____ GPM

_____ ft. After _____ hrs. pumped _____ GPM

_____ ft. After _____ hrs. pumped _____ GPM

REMARKS:

*From top of PVC casing

This well was drilled under license # 542

And this report is true and accurate.

Drilling firm B & B Drilling Co., Inc.

Signature of License Representative:

Signature of Well Owner:

Date 6-30-87

RECEIPT

Division of Water Rights

South Dakota Department of Water and Natural Resources

411211

Pierre, _____ April 22, 1988

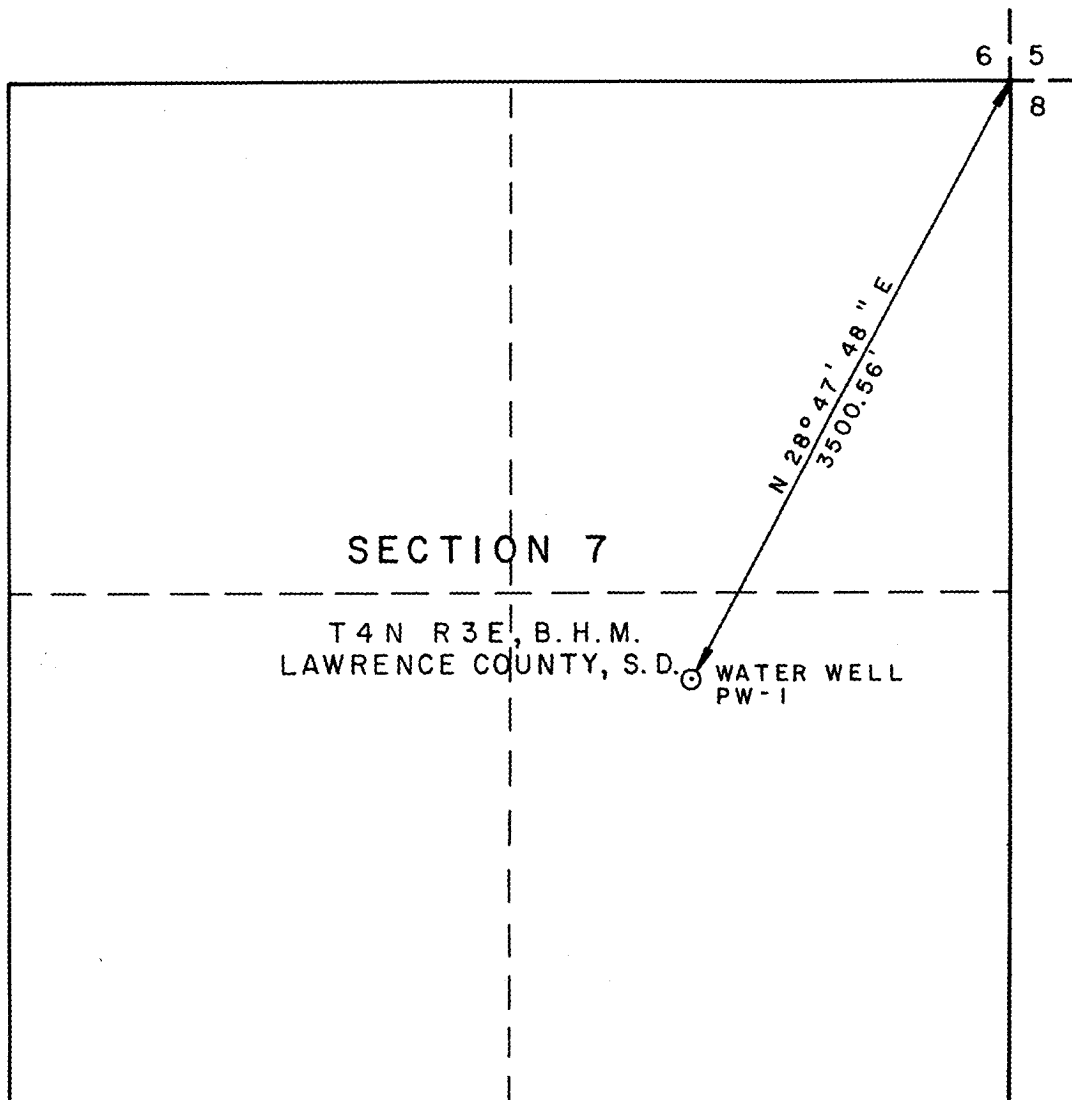
RECEIVED OF Golden Reward Mining Co., PO Box 225, Lead, SD 57744

the following amount in fees for services rendered as provided for by law:

Fee for Application for Permit No. _____ to Appropriate Water, to construct works and to put water to beneficial use _____	225	00
Fee for Application for Permit No. _____ to Appropriate Water for Future Use _____		
Fee to retain Future Use Permit No. _____ after period of seven years.		
Fee for Inspecting Constructed Works, confirming beneficial use and issuing Water License No. _____		
Fee for Filing Transfer Form _____		
Fee for Filing Extension Request _____		
Fee for Certified Copy of _____		
Fee for Print Copy of Map _____		
Fee for Certifying _____		
Fee for _____		
(Any Other Work Provided by Law)	Total	225 00

By John Hatch

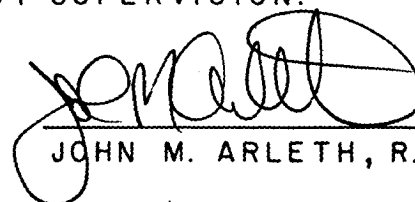
WELL LOCATION MAP

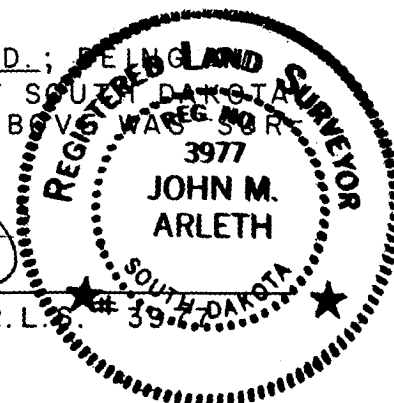


SCALE: 1" = 1000'

I, JOHN M. ARLETH, P.O. BOX 39, DEADWOOD, S.D.; BEING
REGISTERED LAND SURVEYOR IN THE STATE OF SOUTH DAKOTA
DO HEREBY CERTIFY THAT THE WELL SHOWN ABOVE WAS SUR-
VEYED UNDER MY DIRECT SUPERVISION.

3/30/08
DATE


JOHN M. ARLETH, R.L.S.



Appl. No 1439-1

DRILL HOLE # HAN-86-616

PRELIMINARY
ECH A
AZIMUTH
ANGLE -90
N 119375.2524
E 118035.9424
ELEV. 5770.6790
TD 305 FEET
DD-10/23/86

PW-01

DEPTH FROM-TO	RC	SAMPLE	ASSAY GOLD/OPT	LITHOLOGIC LOG
0-5	11	21988	(	Ls, brn. v.f.g. to f.g. sandy, sub. sh, lt. grn-gray soft str. Feox str., hem.)lim. sample very clayey.
5-10	11	21989	((	As above.
10-15	35?	21990	(	Ls as above sub. qtz? lt. gray f.g. sub. rd., wk. to mod. sil., wk. to mod. Feox str., lim.)hem. fractrs., & grain boundaries filled w/CAC03.
20	35	21991	(	As above locally py., sub. ltp lt. grnish-gray matrix w/grn. (amph) & clear gray-milky (feld) phenos mod. sil., locally py.
20-25	30	21992	(	As above mod. to well sil.
25-30	30	21993	(	As above.
30-35	30	21994	(	As above.
35-40	30	21995	((	As above.
40-45	30	21996	(	As above.
45-50	30	21997	(	As above.
50-55	30	21998	(	As above.
55-60	30	21999	(	As above locally py.
60-65	30	22000	(	As above, no apparent py.

BOOTAGE FROM-TO	RC	SAMPLE	ASSAY GOLD/OPT	LITHOLOGIC LOG
70	30	22001	(	As above tr. py.
70-75	30	22002	((	As above w/20% Ttp lt. gray w/gray-milky-salmon (feld) phenos, mod. to well sil., diss. py.
75-80	30	22003	(	As above.
80-85	30	22004	(	As above.
85-90	30	22005	(	Ttp, lt-dk grnish-gray matrix w/grn. amph. (minor weathering) & gray-milky-salmon (feld) phenos wk. to mod. sil., sub. lt. gray Ttp w/gray-milky (feld) phenos. mod. sil., diss. py.
90-95	30	22006		As above.
95-100	30	22007		As above.
100-105	30	22008		As above.
105-110	30	22009		Ttp, lt. gray grnish-gray w/grn. (amph) phenos & clear gray-milky-salmon (feld) phenos, local to wk./mod. sil., locally py.
110-115	30	22010		As above.
115-120	30	22011		As above.
120-125	30	22012		As above.
125-130	30	22013		As above.
130-135	30	22014		As above.
135-140	30	22015		As above.
140-145	30	22016		As above.

FOOTAGE FROM-TO	RC	SAMPLE	ASSAY GOLD/OPT	LITHOLOGIC LOG
.50	30	22017		As above.
50-155	30	22018		As above.
155-160	30	22019		Ttp, lt. gray matrix w/clear gray-milky & salmon (feld) phenos & grn. amph. phenos, wk. sil., diss. py. thruout.
160-165	30	22020		As above.
165-170	30	22021		As above.
170-175	30	22022		As above locally sil. to wk. sil.
175-180	30	22023		As above.
180-185	30	22024		As above.
185-190	30	22025		As above.
190-195	30	22026		Ttp, lt-dk gray matrix w/clear gray-milky feld. phenos, mod. sil., diss. py. thruout & frags py., slight Feox str.
195-200	30	22027		As above.
200-205	30	22028		As above w/Ttp lt-dk gray grnish-gray-salmon w/grn. amph. phenos, & gray-milky-salmon phenos wk. sil.
205-210	30	22029		As above.
210-215	30	22030		Ttp, lt-dk gray, w/clear gray-milky feld. phenos, mod. sil., diss. py. thruout.
215-220	30	22031		As above.
220-225	30	22032		As above.

FOOTAGE FROM-TO	RC	SAMPLE	ASSAY GOLD/OPT	LITHOLOGIC LOG
220-230	30	22033		As above.
230-235	30	22034		As above w/wk. local Feox str.
235-240	30	22035		Ttp, lt-dk gray w/gray-milky phenos well sil., crs. diss. py. thruout, mod. Feox str., lim.=hem.? sil. sh, dk. gray to black.
240-245	50	22036		As above.
245-250	30	22037		Ttp & qtzt, lt. gray f.g. mod. sil., diss. py., str. Feox str., hem., sub. Ttp as above.
250-255	35	22038		As above mod. sil., locally py.
255-260	35	22039		As above w/local wk. Feox str., lim.>hem. diss. py.
260-265	35	22040		Qtzt, lt-dk gray, f.g. mod. sil., diss. py thruout, mod. Feox str., hem.=lim.
265-270	35	22041		As above w/str. Feox str., hem. slight liminitic tr. py.
270-275	35	22042		As above wk. sil., frags of py. very little diss.
275-280	35	22043		As above strly. py., 25% str. Feox str., hem.>lim.
280-285	35	22044		Qtzt, py. hematitic, wk. Feox str., bull qtzt., 25% frags black qtzt loaded w/py.
285-290	7	22045		Qtzt, ss white f.g. to v.f.g. white matrix cement, schistose hematitic character.
290-295	8	22046		pC schist red, brn., sericitic & hematitic luster.

FOOTAGE FROM-TO	RC	SAMPLE	ASSAY GOLD/OPT	LITHOLOGIC LOG
300	8	22047		As above.
300-305	8	22048		Combine with sample 295-300.

GOLDEN REWARD MINING PROJECT
MINING PERMIT APPLICATION
CONTENTS

RECEIVED
DEC 2 1987
EXPLORATION AND
MINING PROGRAM

* * * VOLUME 1 * * *

	<u>Page</u>
LIST OF APPENDICES	x
LIST OF TABLES	xi
LIST OF FIGURES	xiii
LIST OF EXHIBITS	xiv
1.0 INTRODUCTION	
1.1 COMPLIANCE WITH COUNTY PERMITS	1-4
1.2 PERMIT APPLICATION COMPLETENESS	1-5
2.0 APPLICATION FOR PERMIT	2-1
2.1 MAP AND DESCRIPTION OF AFFECTED LAND	2-1
2.1.1 TYPE AND DISTRIBUTION OF SOIL	2-5
2.1.2 IDENTIFICATION OF AFFECTED LAND	2-6
2.1.3 ADJOINING SURFACE OWNERS OF RECORD	2-6
2.1.4 IDENTIFICATION OF GEOGRAPHIC FEATURES	2-7
2.1.5 AREA INVOLVED IN THE OPERATION	2-8
2.1.6 IDENTIFICATION OF PREVIOUSLY MINED LAND	2-11
2.2 SURFACE OWNERSHIP OF AFFECTED LAND	2-11
2.3 MINERAL OWNERSHIP OF AFFECTED LAND	2-12
2.4 APPLICANT'S RIGHT TO ENTER AND INITIATE MINING	2-12
2.5 APPLICANT'S RIGHT TO DISPOSE OF WASTE ROCK AND SPENT ORE	2-13
2.6 DESCRIPTION OF APPLICANT	2-13
2.7 MINERALS TO BE EXTRACTED	2-14
2.8 DESCRIPTION OF MINING TECHNIQUE	2-14

2.8.1	CONTOUR BASIS FOR THE MINING OPERATION	2-15
2.8.2	DEPTH AND DIRECTION OF MINING	2-17
2.8.3	DISPOSAL OF OVERBURDEN AND SPENT ORE	2-17
2.8.4	METHOD OF BLASTING AND BLASTING CONTROL	2-21
2.8.5	DESCRIPTION AND LOCATION OF FACILITIES	2-22
2.8.6	HAUL AND ACCESS ROADS	2-24
2.9	DESCRIPTION OF HEAP LEACHING TECHNIQUE	2-29
2.9.1	ORE PROCESSING AND TREATMENT SYSTEM	2-29
2.9.2	LEACH PADS	2-31
2.9.3	PROCESS PONDS	2-32
2.9.4	CONTROL OF RUNOFF	2-33
2.9.5	LEACH SYSTEM OPERATION	2-34
2.9.6	CHARACTERIZATION OF ORE, OVERBURDEN, SPENT ORE AND PROCESS SOLUTION	2-35
2.9.7	ORE TREATMENT/SPENT ORE DISPOSAL	2-37
2.9.8	PATHWAY AND FATE OF CONTAMINANTS	2-39
2.9.9	PROCESS WATER BALANCE	2-48
2.9.10	LAND APPLICATION AREA	2-50
2.9.11	STORAGE AND HANDLING OF PROCESS AND TREATMENT REAGENTS	2-53
2.10	SIZE OF AREA TO BE WORKED AT ANY ONE TIME	2-54
2.11	TIMETABLE FOR PROPOSED DURATION OF MINING OPERATION	2-55
2.12	CONSENT FOR ACCESS TO AREA UNDER APPLICATION	2-57
2.13	DISPOSAL OF REFUSE	2-57
3.0	RECLAMATION PLAN	3-1
3.1	HISTORIC AND EXISTING LAND USES	3-1

3.2	DEFINITION OF RECLAMATION	3-1
3.3	GRMC RECLAMATION GOALS AND GENERAL COMMITMENT	3-2
3.4	DEFINITION OF WILDLIFE HABITAT/SPECIFIC COMMITMENT	3-3
3.5	DISTURBED ACREAGES	3-4
3.6	SOIL SALVAGE AND REDISTRIBUTION	3-7
3.7	REVEGETATION	3-10
3.7.1	FORBS	3-12
3.7.2	SHRUBS	3-12
3.7.3	TREES	3-13
3.7.4	FERTILIZATION	3-14
3.7.5	SEEDBED PREPARATION, MULCHING, PLANTING TIMES	3-14
3.8	GRADING	3-15
3.9	STRUCTURE DISMANTLE	3-16
3.10	SITE SPECIFIC RECLAMATION SUMMARIES	3-16
3.10.1	PITS AND HIGHWALLS	3-16
3.10.2	SPENT ORE/OVERBURDEN DEPOSITORIES	3-21
3.10.3	PAD/POND/PLANT SITE	3-22
3.10.4	LAND APPLICATION AREA	3-23
3.10.5	CORRIDORS	3-23
3.11	RECLAMATION COSTS	3-24
3.11.1	GENERAL RECLAMATION COSTS	3-25
3.11.2	SITE SPECIFIC RECLAMATION COSTS	3-27
3.11.3	TOTAL RECLAMATION COST	3-29
3.12	MINIMIZING DISTURBANCE TO THE HYDROLOGIC BALANCE	3-30
3.12.1	GROUNDWATER	3-31

3.12.2	SURFACE WATER	3-32
3.12.3	WATER QUALITY	3-34
4.0	AFFECTED AREA MAP	4-1
4.1	AREA THAT CORRESPONDS WITH APPLICATION	4-1
4.2	ADJOINING SURFACE OWNERS OF RECORD	4-1
4.3	TOTAL AREA INVOLVED IN THE OPERATION	4-2
4.4	SOIL THICKNESS AND DISTRIBUTION	4-2
5.0	BASELINE STUDIES AND PROJECT INVESTIGATIONS	5-1
5.1	INTRODUCTION	5-1
5.2	SOIL SURVEY	5-1
5.2.1	METHODS	5-1
5.2.2	RESULTS AND DISCUSSION	5-2
5.2.3	MAP UNIT DESCRIPTIONS	5-3
5.2.4	TOPSOIL SUITABILITY AND SALVAGE	5-7
5.3	VEGETATION SURVEY	5-8
5.3.1	METHODS	5-8
5.3.2	RESULTS AND DISCUSSION	5-10
5.3.3	RARE PLANT INVENTORY	5-16
5.4	WILDLIFE SURVEY	5-16
5.4.1	WILDLIFE HABITAT TYPE DESCRIPTION	5-17
5.4.2	BREEDING BIRD SURVEYS	5-17
5.4.3	SMALL MAMMAL SURVEYS	5-18
5.4.4	BIG GAME PELLET GROUP SURVEY	5-19
5.5	AQUATIC BIOLOGY AND HABITAT SURVEY	5-19
5.5.1	METHODS	5-20
5.5.2	FISH SURVEY	5-20

5.5.3	AQUATIC MACROINVERTEBRATES AND PERIPHYTON	5-21
5.5.4	STREAM HABITAT SURVEY	5-21
5.6	CULTURAL RESOURCES SURVEY	5-22
5.6.1	DESCRIPTION OF SURVEYED AREA	5-24
5.6.2	SURVEY RESULTS	5-24
5.6.3	MANAGEMENT OPTIONS AND RECOMMENDATIONS	5-25
5.6.4	MITIGATION OF PROJECT IMPACTS	5-26
5.7	GEOLOGICAL SURVEY	5-30
5.7.1	REGIONAL GEOLOGY	5-30
5.7.2	LOCAL GEOLOGICAL SETTING	5-31
5.7.3	ORE DEPOSIT CHARACTERISTICS	5-39
5.8	SOCIOECONOMIC EVALUATION	5-41
5.8.1	GENERAL SOCIOECONOMIC IMPACTS	5-41
5.8.2	POPULATION	5-42
5.8.3	HOUSING	5-43
5.8.4	EMPLOYMENT	5-43
5.8.5	PERSONAL INCOME	5-44
5.8.6	COMMUNITY SERVICES AND INFRASTRUCTURE	5-44
5.8.7	LAND USE	5-45
5.8.8	FISCAL CONDITIONS	5-46
5.8.9	PROJECT IMPACTS	5-47
5.9	GROUNDWATER RESOURCES	5-57
5.9.1	BASELINE GROUNDWATER MONITORING PROGRAM	5-58
5.9.2	IDENTIFICATION OF AQUIFERS	5-62
5.9.3	GROUNDWATER FLOW	5-66

5.9.4	BASELINE WATER QUALITY	5-68
5.10	SURFACE WATER RESOURCES	5-70
5.10.1	REGIONAL HYDROLOGY	5-70
5.10.2	SITE DRAINAGE CHARACTERISTICS	5-70
5.10.3	BASELINE SURFACE WATER MONITORING PROGRAM	5-72
5.10.4	SURFACE WATER QUALITY AND FLOW	5-77
5.10.5	SITE DRAINAGE PLAN	5-79
5.11	GEOTECHNICAL ANALYSIS	5-86
5.11.1	GENERAL SITE DESCRIPTION	5-86
5.11.2	HEAP LEACH PAD	5-88
5.11.3	PROCESS POND DESIGN	5-92
5.11.4	SPENT ORE/WASTE ROCK DISPOSAL	5-94
5.11.5	PROCESS PLANT FOUNDATIONS	5-95
5.11.6	PIT SCOPE DESIGN	5-95
5.12	VISUAL RESOURCE ANALYSIS	5-97
5.12.1.	VISUAL RESOURCE INVENTORY	5-97
5.12.2	VISUAL QUALITY CONSIDERATIONS	5-98
5.12.3	VISUAL IMPACTS	5-100
5.12.4	MITIGATION OF VISUAL IMPACTS	5-106
5.13	NOISE ASSESSMENT	5-107
5.13.1	SITE AMBIENT NOISE	5-107
5.13.2	PROJECT NOISE	5-108
5.13.3	NOISE IMPACTS	5-109
5.13.4	NOISE MITIGATION	5-111
5.14	AIR QUALITY AND CLIMATOLOGY	5-112
5.14.1	AIR QUALITY	5-112

5.14.2 CLIMATOLOGY	5-114
6.0 OPERATIONAL MONITORING PROGRAM	6-1
6.1 WATER RESOURCES	6-1
6.1.1 SURFACE WATER	6-1
6.1.2 GROUNDWATER	6-2
6.1.3 SOIL MOISTURE	6-3
6.1.4 SAMPLING PROGRAM	6-7
6.1.5 QUALITY ASSURANCE AND QUALITY CONTROL	6-12
6.2 METEOROLOGICAL AND AIR QUALITY MONITORING	6-20
6.2.1 METEOROLOGICAL MONITORING	6-20
6.2.2 AIR QUALITY MONITORING	6-20
7.0 SPILL CONTINGENCY PLAN	7-1
7.1 CYANIDE	7-1
7.1.1 EMERGENCY RESPONSE	7-1
7.1.2 CONTAINMENT, NEUTRALIZATION, CLEAN-UP AND MONITORING	7-7
7.1.3 DOCUMENTATION AND REPORTING	7-10
7.1.4 CYANIDE ANTIDOTE LOCATION AND ADMINISTRATION PROCEDURES	7-11
7.2 FUEL SPILLS	7-14
7.3 CHEMICALS AND REAGENTS	7-17
7.4 EMERGENCY CONTACT LIST	7-19
8.0 REFERENCES AND CONTRIBUTORS	8-1
8.1 REFERENCES	8-1
8.2 CONTRIBUTORS	8-7

APPENDICES

TEXT APPENDICES

APPENDIX 1.1	NAMES OF SURFACE AND MINERAL OWNERS WITHIN THE PERMIT AREA
APPENDIX 1.2	BLM LETTER/STATUS OF GRMC LAND PURCHASE
APPENDIX 1.3	MINING LEASE (NOT FOR PUBLIC REVIEW)
APPENDIX 2	NAMES OF SURFACE OWNERS WITHIN 500 FEET OF THE PERMIT AREA
APPENDIX 3	OWNERS OR LOCATIONS OF DOMESTIC AND COMMERCIAL WATER WELLS WITHIN ONE MILE OF THE PERMIT AREA

BASELINE REPORT APPENDICES

APPENDIX A	SOIL SURVEY
APPENDIX B	VEGETATION SURVEY
APPENDIX C	WILDLIFE SURVEY
APPENDIX D	AQUATIC BIOLOGY AND HABITAT SURVEY
APPENDIX E	CULTURAL RESOURCES SURVEY
APPENDIX F	SOCIOECONOMIC EVALUATION
APPENDIX G	GROUNDWATER, SURFACE WATER AND MINE WATER OUTFLOW
APPENDIX H	GEOTECHNICAL ANALYSIS
APPENDIX I	VISUAL RESOURCES SURVEY
APPENDIX J	NOISE INVESTIGATION
APPENDIX K	AIR QUALITY AND CLIMATOLOGY

RECEIVED
DEC 2 1987
EXPLORATION AND
MINING PROGRAM

LIST OF TABLES

RECEIVED
DEC 2 1987
EXPLORATION AND
MINING PROGRAM
Page 1-7

TABLE 1.2-1	COMPLETENESS OF APPLICATION FOR PERMIT	
TABLE 2.1-1	DESCRIPTION AND ACREAGES OF AFFECTED LAND	2-2
TABLE 2.1-2	INVENTORY OF AREAS INVOLVED IN THE OPERATION	2-9
TABLE 2.8-1	OPERATIONAL MINING EQUIPMENT	2-16
TABLE 2.8-2	SPENT ORE AND OVERBURDEN ALLOCATION	2-20
TABLE 2.8-3	ALLOWABLE GROUND VIBRATION FROM BLASTING	2-21
TABLE 2.8-4	ALLOWABLE AIR OVERPRESSURE FROM BLASTING	2-21
TABLE 2.9-1	CHEMICAL ANALYSES OF GOLDEN REWARD ORE SAMPLES	2-35A
TABLE 2.9-2	EMISSION SPECTROSCOPY ANALYSES OF GOLDEN REWARD ORE SAMPLES	2-35B
TABLE 2.9-3	CHEMICAL ANALYSES OF EIGHTH DAY DETOXIFICATION SOLUTIONS	2-36A
TABLE 2.9-4	EPA TOXICITY TESTS OF DETOXIFIED SPENT ORE	2-37A
TABLE 2.9-5	CHEMICAL ANALYSIS OF PREGNANT SOLUTION	2-37B
TABLE 2.9-6	SUMMARY OF AQUATIC FATE OF CYANIDE	2-44
TABLE 2.9-7	PROCESS WATER BALANCE	2-49A
TABLE 2.9-8	PARAMETERS TO BE ANALYZED IN LAND APPLICATION SOLUTION	2-52
TABLE 2.10-1	EXPECTED DISTURBANCE SCHEDULE	2-55
TABLE 3.5-1	TIMETABLE OF DISTURBANCE AND RECLAMATION	3-6
TABLE 3.5-2	EXTENT OF BACKFILLING IN PITS	3-8
TABLE 3.6-1	SALVAGEABLE TOPSOIL BY PROJECT COMPONENT	3-9
TABLE 3.7-1	GOLDEN REWARD RECLAMATION SEED MIX	3-11
TABLE 5.8-1	BASELINE AND PROJECT RELATED SOCIOECONOMIC CHARACTERISTICS IN LAWRENCE COUNTY, 1985-1993	5-49
TABLE 5.8-2	SUMMARY OF SOCIOECONOMIC IMPACTS	5-56

TABLE 5.9-1	BASELINE GROUNDWATER MONITORING WELLS	5-60
TABLE 5.9-2	SUMMARY OF AQUIFER TESTING DATA	5-64
TABLE 5.10-1	WATERSHED AREA SUMMARY	5-74
TABLE 5.10-2	SUMMARY OF PEAK FLOW CALCULATIONS	5-75
TABLE 5.10-3	SURFACE WATER MONITORING STATIONS	5-76
TABLE 5.10-4	PEAK FLOW CALCULATIONS FOR SITE DRAINAGE PLAN	5-83
TABLE 5.10-5	SEDIMENT CONTROL DITCH CHARACTERISTICS	5-86
TABLE 5.13-1	AVERAGE SOUND LEVELS FOR EQUIPMENT AND MINE OPERATIONS	5-109
TABLE 5.14-1	MAXIMUM, MINIMUM AND AVERAGE MONTHLY TEMPERATURES, DEADWOOD, SOUTH DAKOTA	5-116
TABLE 5.14-2	PRECIPITATION TOTALS AT VARIOUS SITES IN THE AREA OF DEADWOOD, SOUTH DAKOTA	5-116
TABLE 5.14-3	AVERAGE MONTHLY AND ANNUAL SNOWFALL, DEADWOOD, SOUTH DAKOTA	5-117
TABLE 6.1-1	PARAMETERS TO BE TESTED IN WATER SAMPLES	6-9
TABLE 6.1-2	PARAMETERS TO BE TESTED IN SOIL MOISTURE SAMPLES	6-10
TABLE 6.1-3	OPERATIONAL MONITORING PROGRAM SAMPLING SCHEDULE	6-11

LIST OF FIGURES

RECEIVED
DEC 2 1987
EXPLOSION AND
MINING PROJECT
Page 1-2

FIGURE 1.0-1	GRMC PROJECT LOCATION MAP	
FIGURE 2.8-1	TYPICAL PIT SLOPE	2-15A
FIGURE 2.8-2	TYPICAL ROAD SECTION - ROCK MATERIAL	2-27
FIGURE 2.8-3	TYPICAL ROAD SECTION - UNCONSOLIDATED MATERIAL	2-28
FIGURE 2.9-1	GENERAL PROCESS AREA LAYOUT	2-29A
FIGURE 2.9-2	GENERAL PROCESS FLOW SHEET	2-29B
FIGURE 2.9-3	CROSS-SECTION OF PROPOSED PAD LINER AND LEAK DETECTION RECOVERY DRAIN	2-31A
✓ FIGURE 2.9-4	PROCESS WATER BALANCE	2-49B
FIGURE 2.11-1	ESTIMATED MINE SCHEDULE	2-58
FIGURE 5.7-1	REGIONAL GEOLOGIC MAP	5-32
FIGURE 5.7-2	STRATIGRAPHIC SEQUENCE OF THE BLACK HILLS/ BADLANDS REGION	5-34A
FIGURE 5.7-3	SIMPLIFIED GEOLOGIC MAP OF GOLDEN REWARD PROPERTY	5-36
FIGURE 5.7-4	GENERALIZED GEOLOGIC CROSS-SECTION OF GOLDEN REWARD PROPERTY	5-38
✓ FIGURE 5.10-1	DRAINAGE DITCH CROSS-SECTIONS	5-85
FIGURE 5.12-1	VISUAL VIEWPOINT LOCATIONS	5-99
FIGURE 5.12-2	COMPUTER GENERATED PERSPECTIVE FROM VIEWPOINT 3	5-103
FIGURE 5.12-3	COMPUTER GENERATED PERSPECTIVE FROM VIEWPOINT 5	5-104
FIGURE 5.12-4	COMPUTER GENERATED PERSPECTIVE FROM VIEWPOINT 7	5-105
FIGURE 6.1-1	TYPICAL DIAGRAM OF OPERATIONAL MONITORING WELL IN BEDROCK	6-4
FIGURE 6.1-2	TYPICAL LYSIMETER INSTALLATION	6-6

LIST OF EXHIBITS

RECEIVED
DEC 2 1987
EXPLORATION AND
MINING PROGRAM

- EXHIBIT 2-1 PLAN MAP OF AFFECTED AREA SHOWING PROJECT FEATURES
- EXHIBIT 2-2 PLAN MAP SHOWING SURFACE AND MINERAL OWNERSHIP OF PERMIT AND ADJACENT AREA
- EXHIBIT 2-3 DOMESTIC AND COMMERCIAL WATER WELLS WITHIN ONE MILE OF THE PERMIT AREA
- EXHIBIT 2-4 PLAN MAP SHOWING CONTOUR BASIS FOR MINING
- EXHIBIT 2-5 PRE-MINING AND POST-MINING CROSS-SECTIONS OF AFFECTED AREA
- EXHIBIT 2-6 PLAN MAP SHOWING DEPTH OF MINING IN PROPOSED PITS
- EXHIBIT 2-7 RECLAMATION/AFFECTED LANDS MAP
- EXHIBIT 5-1 HYDROLOGICAL MONITORING STATIONS
- EXHIBIT 5-2 POTENTIOMETRIC SURFACE OF BEDROCK AQUIFER
- EXHIBIT 5-3 DELINEATION OF DRAINAGE BASINS
- EXHIBIT 5-4 SITE DRAINAGE PLAN

into operational cells. These cells will enable the leach solution to be segregated from the detoxification wash solution. Drain pipe will be laid along the up-slope side (cell side) of the curbs to collect and direct the solutions to the central collection launder and pipe system.

The operational cells will be arranged so that at any time during the process cycle, the solutions percolating downward from the ore heap to a specific cell are exclusively of one solution type or the other.

The outer edges of the pad will be approximately 15 to 20 feet wide to accommodate the placement of the conveyer and stacker/reclaimer support structures. These edges, which will be part of the asphalt pad, will be at least 2 to 3 feet above the pad center line. A low curb will be incorporated into the outer limit of the edge to insure that all materials and solutions are contained within the pad area.

2.9.3 Process Ponds

The solution ponds associated with the on-off heap leach system will be the pregnant solution pond and the detoxification solution pond. In addition, a PMP (Probable Maximum Precipitation) pond will be located down-grade of the leach pad and process ponds.

The design of the ponds includes a liner system as described in Section 5.11.3.

The required volume of the two process ponds was established by the

total drain-down volumes of the respective process solutions from the active heap areas. Both of these ponds will have a minimum of three feet of free board which is not included in the operating volumes.

Under normal operating conditions, the two process ponds will be kept at an operating level of less than 20 percent of the maximum in order to minimize the circulating solution inventory and to provide for the drain down volume containment in case of an extended power outage.

The PMP pond is sized to contain the total volume of precipitation falling on the entire containment area for a PMP event. The total volume of the three ponds provides for the complete containment of both the 6 hour PMP plus the total drain down of the active heap areas, including all process solution inventories.

2.9.4 Control of Runoff

All of the process solutions will be recycled and contained totally within the Process Containment Area. This containment area includes the agglomeration area, the process plant area, the heap leach pad, and all conveyer systems that carry the ore to and from the pad.

The Process Containment Area as defined in Section 2.9 will be isolated from precipitation runoff by use of diversion ditches and the natural topography. The containment area will be located on a low ridge with natural drainage away from the plant, pad and pond areas. Ditches and berms will divert surface water drainage from the undisturbed area west of the containment area.

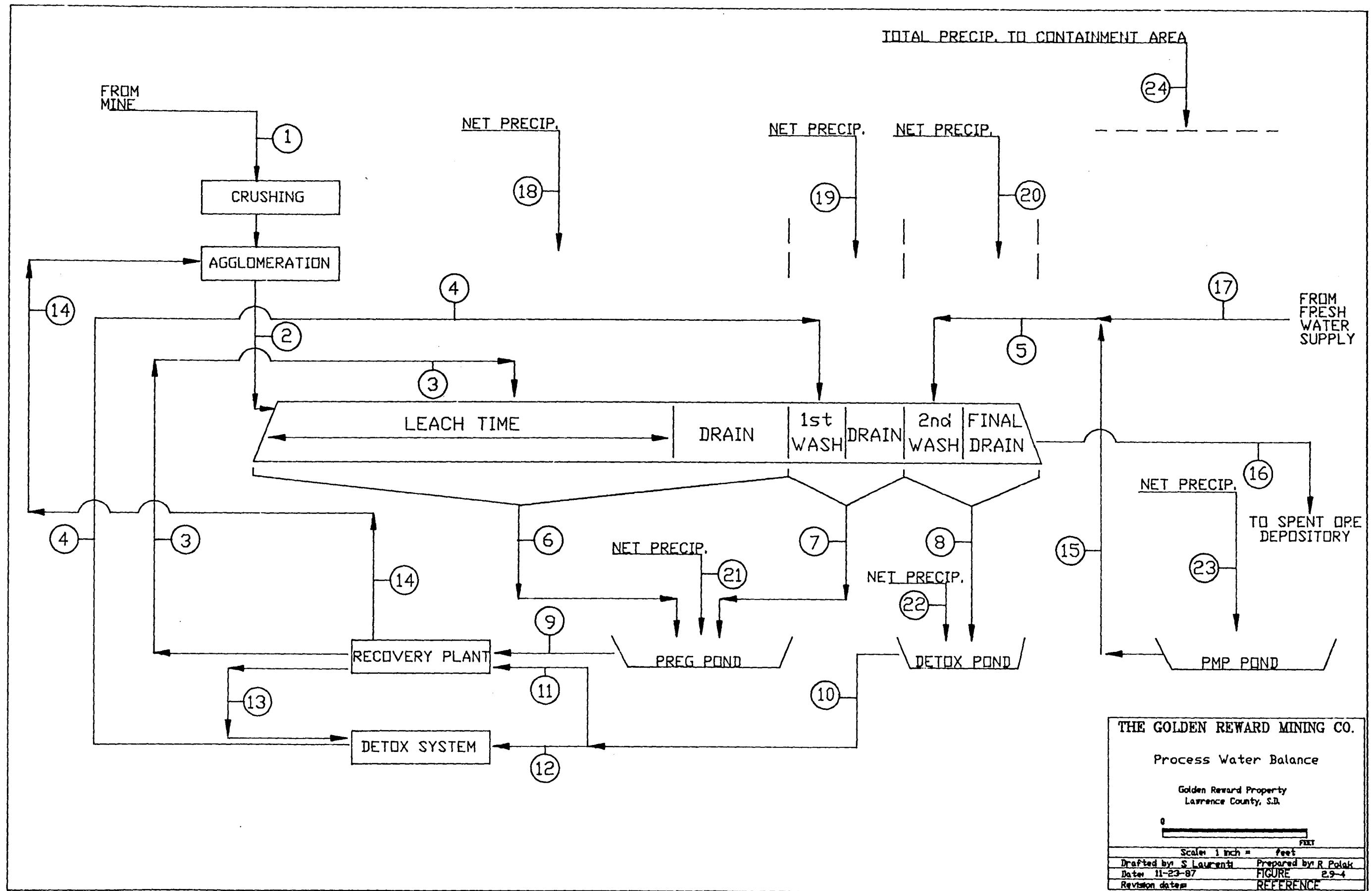
contaminant transport modeling procedure is widely used to assess potential impacts on water resource systems.

2.9.9 Process Water Balance

By far the major use of water at the GRMC project will be in the ore processing operation. Ore processing includes water use in agglomeration, leaching and washing of spent ore. A schematic diagram of the process water balance is in Figure 2.9-4, and a tabulation of elements of the water balance is in Table 2.9-7. The water balance is based on an average water year with 25.4 inches (average Lead precipitation 1909 through 1968) and 29.1 inches of pan evaporation (Pactola Lake station 1955-1979). Assuming a pan factor of 0.7, the net annual evaporation would be 20.3 inches, resulting in a net gain of about 5.1 inches of water per year for the project area.

Use of a pan factor of 0.7 may not be appropriate for wetted crushed ore with a large surface area. It can be assumed that the average evaporation from the heap leach operation will approximately be equal to average precipitation. The process water balance is not sensitive to variations in evaporation and precipitation.

The leach pad and pond area is relatively small, and the net precipitation gain is small (8.5 gpm) compared to the moisture contained in the drained spent ore (164 gpm). This means that variations in weather - that is, wet years and dry years - will not significantly affect the amount of make-up water required (about 119



gpm). It is estimated that process make-up water will range from 110 to 130 gpm.

Other project water requirements are potable water for shops, offices and change rooms (estimated to be 5 gpm), dust suppression (30-40 gpm) and washdown of equipment (5 gpm). The total make-up water demand is estimated to range from approximately 145 to 175 gpm.

Process water as well as water for other project purposes will be obtained from wells. As shown on Exhibit 5-1, wells PW-1; PW-2; PW-3 and PW-4 will be designated for water supply. Well PW-1 which is near the Hannibal pit, is 300 feet deep and yields approximately 80 gpm. Well PW-2, which is near the mouth of Stewart Gulch, is 65 feet deep and yields about 20 gpm. Well PW-3 will be drilled about 250 to 350 feet deep in Fantail Gulch and is expected to yield about 75 gpm. The remaining water supply well is PW-4, is located in Stewart Gulch, will be 50 to 100 feet deep and is expected to yield about 75 gpm.

The total water yield from wells is expected to be approximately 225 gpm. This will easily furnish the 145 to 175 gpm project make-up water demand and provides extra system capacity to allow for maintenance.

An application for permit to appropriate water will be completed for each proposed water supply source in accordance with the appropriation procedures of the Water Rights Division of DWNR. There will be no impact on the quality of groundwater due to appropriation of water supply for the GRMC project. There will be a withdrawal of 145 to 175 gpm from the groundwater system during the operating season. No

TABLE 2.9-7 PROCESS WATER BALANCE

GOLDEN REWARD MINING PROCESS WATER BALANCE	AVERAGE LEACH SOL'N FLOW RATE			.005 Gal/Min/Sq. Ft.		
	AVERAGE WASH SOL'N FLOW RATE			.01 Gal/Min/Sq. Ft.		
	LEACH & WASH TIME FACTOR			33.3 x		
	AVERAGE ANNUAL NET PRECIP (EVAP)			5.1 In./Yr.		
STREAM NO. & DESCRIPTION	SOLIDS			LIQUIDS		
	TONS/YR	TPD (Ave)	% SOLIDS	TONS/YR	TPD (Ave)	GPM (Ave) % SOL'N
1 ORE FROM MINE	2,000,000	7,407.4	97.0	60,000	222.2	37.0 5.0
2 AGGLOMERATED ORE TO PAD	2,000,000	7,407.4	92.0	160,000	592.6	98.8 8.0
3 LEACH SOL'N TO HEAP LEACH				1,179,105	4,367.1	727.8 100.0
4 DETOX SOL'N TO 1st WASH				708,171	2,622.9	437.1 100.0
5 SOLUTION TO 2nd WASH				195,337	723.5	120.6 100.0
6 PREG SOL'N TO PREG POND				1,080,362	4,001.3	666.9 100.0
7 1st WASH SOL'N TO PREG POND				709,130	2,626.4	437.7 100.0
8 2nd WASH SOL'N TO DETOX POND				196,706	728.5	121.4 100.0
9 PREG SOL'N TO RECOVERY PLANT				1,790,032	6,629.7	1,105.0 100.0
10 DETOX SOL'N FROM DETOX POND				197,245	730.5	121.8 100.0
11 DETOX SOL'N TO RECOVERY PLANT				0	.0	.0 100.0
12 DETOX SOL'N TO DETOX SYSTEM				197,245	730.5	121.8 100.0
13 BARREN SOL'N TO DETOX SYSTEM				510,926	1,892.3	315.4 100.0
14 BARREN SOL'N TO AGGLOMERATION				100,000	370.4	61.7 100.0
15 PMP POND WATER TO 2nd WASH				3,044	11.3	1.9 100.0
16 SPENT ORE TO DEPOSITORY	2,000,000	7,407.4	86.7	266,000	985.2	164.2 15.3
17 FRESH WATER TO PROCESS *****				192,292	712.2	118.7 100.0
18 NET PRECIP TO (FROM) LEACH HEAP				7,257	26.9	4.3 100.0
19 NET PRECIP TO (FROM) 1st WASH				958	3.5	.6 100.0
20 NET PRECIP TO (FROM) 2nd WASH				1,369	5.1	.8 100.0
21 NET PRECIP TO (FROM) PREG POND				539	2.0	.3 100.0
22 NET PRECIP TO (FROM) DETOX POND				539	2.0	.3 100.0
23 NET PRECIP TO (FROM) PMP POND				3,044	11.3	1.9 100.0
24 TOTAL NET PRECIP				13,708	50.8	8.5 100.0

3.12 MINIMIZING DISTURBANCE TO THE HYDROLOGIC BALANCE

The GRMC plan for development of the ore reserve is designed to minimize disturbance to the hydrologic balance. Major features of the operation design are:

- 1) Minimum area for heap leaching by using a load/unload type pad.
- 2) Grouping all ore processing facilities into a compact area.
- 3) A plan to sequentially backfill pits with waste rock as the pit areas are mined.
- 4) Well designed and constructed ore processing facilities to avoid any accidental loss of process solutions into groundwater or surface water systems.
- 5) Water management, drainage and erosion control measures to handle all runoff from disturbed areas and to minimize impacts on streams.
- 6) Design and construction of a large storage pond to handle severe precipitation events and eliminate any potential for release of process solutions into the environment (PMP pond).
- 7) Complete treatment of spent ore to avoid future adverse impacts on water quality due to movement of precipitation through spent ore.
- 8) Location, design and construction of spent ore and waste rock depositories to avoid impacts on surface water and groundwater.
- 9) A comprehensive post-mining reclamation plan that will return disturbed lands to a condition that minimizes long-term disturbance to the hydrological balance.

Elements of the hydrological balance are precipitation, evaporation, surface water runoff, groundwater and soil moisture. This project will have no influence on precipitation, negligible influence on evaporation and soil moisture, and minimal influence on groundwater, surface water runoff and water quality. The groundwater and surface water components of the hydrological balance are discussed as well as water quality.

3.12.1 Groundwater

Groundwater is deep in the proposed mining areas and will be encountered in only the northern section of the Liberty Pit; in a small alluvial/colluvial section at the south end of the Liberty Pit and the Isadorah pit will encounter a small section of shallow alluvium in Unnamed Gulch near monitoring well (SM-4). As described in the Mining Hydrology Report (Appendix G), the only groundwater inflow of any significance will be in the Liberty pit. In this pit, only the northern end of the pit will encounter the upper portion of the saturated zone. A maximum hypothetical inflow to the pit of 43.7 gpm is calculated. However, actual pit inflow will be considerably less because the rate of excavation of the pit is slow as compared to the assumed instantaneous removal of material in the inflow estimate. This groundwater inflow will only occur until water levels in the pit rise after mining and the inflow will then cease.

Mining on the edge of the shallow, alluvial/colluvial aquifer in the upper reach of Fannie Creek may slightly reduce the flow in this

aquifer downgradient of the Liberty pit. Groundwater flow in this shallow aquifer is small and the impact will not be significant.

There is a potential that the proposed mining operation in the Hannibal open pit will impact flow and water quality to spring SP-2. The spring is located east of the proposed pit and probably is receiving water from a perched aquifer. Water quality of the spring does not indicate deep circulation along a fault present in the spring area.

All process ponds and the leach pad are designed for total containment so no impact on groundwater is expected from these facilities.

The Terry Peak Ski Area well is located approximately 4,000 feet from the northern portion of the Liberty pit. This well is producing water from flooded underground workings. Because of the distance and difference in elevation between this well and the Liberty pit, no impacts on this well by mining activities are anticipated.

The nearest operating gold mine is located approximately three miles from the Golden Reward project site. Because of this distance and the calculated zone of influence in the bedrock aquifer at the Liberty pit, no cumulative impact on the local groundwater regime is anticipated.

3.12.2 Surface Water

The only disturbance to surface water systems will be due to placement of overburden and spent ore (Sundance Depository) in the upper end of

Unnamed Gulch and in the North Fork of Stewart Creek (Steward Depository). A drainage diversion channel will be constructed to divert runoff around the Stewart overburden depository. This will allow drainage from the 138 acres of undisturbed land upstream of this overburden storage area to be diverted around the stored overburden. The broad, shallow basin on the upper end of Unnamed Gulch will be used as a depository for spent ore and overburden. This drainage is ephemeral and only flows in response to spring snowmelt or to intense precipitation events. There will be a reduction in flows from this small drainage basin as a result of overburden and spent ore storage.

In addition to placement of spent ore and overburden in Unnamed Gulch (the Sundance Depository), this gulch also is intersected by proposed pits. As shown on Exhibit 2-1, the Isadorah and Sundance pits become part of the spent ore and overburden depository and the Fannie pit is downstream of these pits. This will intercept water from this ephemeral drainage and reduce downstream flows. After mining, flows in this small, ephemeral drainage will continue to be affected with flow entering the pits and the water will either seep downward into the underlying bedrock or will fill the pits and the overflow will continue downstream to Whitetail Creek.

Fantail Creek will be channelized between the Liberty and Harmony pits to allow water from undisturbed areas to drain naturally past the pits and into the existing channel below the mining area.

All surface waters will be diverted from the ore processing area except that precipitation which falls directly on the heaps and ponds. This will slightly reduce runoff from this topographic ridge during spring snowmelt and after intense rainfall events.

3.12.3 Water Quality

Disturbance to the quality of both surface water and groundwater will be minimized by this project. As described in Section 5.10.5, the drainage management program will reduce or eliminate erosion and sedimentation. This plan involves interception and containment of water from disturbed areas and conveyance of runoff water from undisturbed areas around the disturbances.

Concurrent reclamation during mining and a sediment on-site control program will minimize sedimentation. Runoff from road surfaces and parking areas will be handled by use of sediment retention facilities such as small ponds, by rip-rap of culvert outlets, and use of geotextile covers on erosion-prone areas, and use of silt fences, revegetation and straw-bale barriers where required.

The design and installation of the ore processing facilities (plant, heap leach and ponds) is directed at prevention of any loss of process water. No impacts on water quality will occur from the ore processing operation or facilities.

The spent ore will be neutralized and washed to meet or exceed state

leachate quality requirements. This will prevent any degradation of surface water or groundwater due to percolation of rainwater through the stored spent ore.

Overburden testing has shown a positive acid-base balance and the overburden does not create a contaminated leachate due to percolating waters. The overburden depositories will not be a source of contamination during mining. Reclamation consisting of sub-soil, topsoil and revegetation will prevent any long-term impacts on water quality.

Overall, the project design and proposed operational water management programs will eliminate or minimize adverse impacts on water quality.

backed voles, and 9 were least chipmunks. During the 1986 trapping, dwarf shrews and red squirrels were also caught.

It is typical of most western states' small-mammal studies that deer mice predominate. The other species caught were not unusual. The total number of species caught during the two years of study is typical for this type of study in the Black Hills.

5.4.4 Big Game Pellet Group Surveys

Deer pellet group transects were established in all plots and habitats on and off the mine site to determine relative use of habitats and provide numbers of pellet groups by habitat for trend information. Twenty-nine ten-meter by two-meter transects were established and permanently staked for future recounting.

All pellet groups within the transect were counted and classified as old, new, or fresh on the basis of softness, color, and the degree of weathering to help determine the time of year deer utilize the habitats.

Pellet group transect data suggest that deer utilize the heavier cover and/or food opportunities provided by the aspen-birch habitats on and around the proposed Golden Reward Mine site on a year-round basis.

5.5 AQUATIC BIOLOGY AND HABITAT SURVEY

Field investigations of the aquatic biology and stream habitat

characteristics of four streams draining the proposed Golden Reward Mine were conducted during the summers of 1986 and 1987. The four streams studied were Nevada Gulch, Fantail Creek, Stewart Gulch and Whitetail Creek. The purpose of these studies was to determine the baseline condition of aquatic biota in the streams. A comprehensive report describing aquatic studies is in Appendix D.

5.5.1 Methods

The field studies involved collecting, weighing and measuring fish, and collecting and identifying aquatic macroinvertebrates (insects) and periphyton (attached algae) that inhabit the streams. A number of stream habitat variables including water depth and width, amount of pool and riffle, substrate (stream bottom) composition and quality were measured to determine the quality of the habitat for fish, insects and algae.

5.5.2 Fish Survey

Fish were collected, weighed and measured to determine the species present in each stream and their relative health. Fish were returned live to the stream after they were weighed and measured. Brook trout were collected from Stewart Gulch and Whitetail Creek. No fish was captured in Nevada Gulch or Fantail Creek. Stewart Gulch had a much higher density of fish (54.6 fish per 100 meters² of water surface area) than Whitetail Creek (4.76 fish per 100 meters² of water surface area). The health of the fish captured was very similar to that of brook trout collected from other streams in the area.

5.5.3 Aquatic Macroinvertebrates and Periphyton

Aquatic insect and periphyton collections are useful in determining the quality of water. If a large variety of species is found in a given water-course, it generally indicates a high-quality environment. In addition, certain species are known to be less tolerant of poor water quality than others. If the less-tolerant species are found, it is further evidence that water quality is good.

Results of the aquatic insect and periphyton investigations indicate that all of these streams contain water of a quality suitable for fish in general and trout in particular. Fantail Creek contained fewer species than the other streams but still showed good diversity as well as the presence of several "pollution intolerant" species.

5.5.4 Stream Habitat Survey

The stream habitat measurements reveal that Stewart Gulch contained the best habitat for trout of the streams studied. Sedimentation is low in this stream, water temperature is good, there are numerous pools, and cover for hiding is abundant.

Whitetail Creek also has good water temperature and little sedimentation. There are very few pools and virtually no cover for hiding. The few fish collected from this stream were found in two or three small pools located downstream of boulders.

TABLE 5.9-1 BASELINE GROUNDWATER MONITORING WELLS

<u>Well No.</u>	<u>Installation Date</u>	<u>Drilling Total Depth (Feet)</u>	<u>Monitored Strata</u>	<u>Screened Interval (Feet)</u>	<u>Total Depth Casing (Feet)</u>	<u>(8/87) Water Level Elevation (ft above msl)</u>
SM-1	11/01/86	32.0	Weathered Bedrock	15.3-30.3	30.3	5840.21
SM-2	11/01/86	85.0	Colluvium	61.7-71.7	71.7	5775.55
SM-3	04/08/87	23.5	Alluvium/Colluvium	1.3-21.3	21.3	5650.68
SM-4	10/31/86	22.0	Colluvium	12.0-22.0	22.0	5715.49
SM-5	11/01/86	45.0	Colluvium/ Top of Bedrock	32.2-42.2	42.2	5814.52
SM-6	04/08/87	45.0	Alluvium/Colluvium	22.5-42.5	42.5	5573.09
SM-7a (Aband.)	04/08/87	25.0	Fill/Colluvium	3.1-14.1	14.1	-
SM-7	06/10/87	65.0	Deadwood Formation	40.0-60.0	60.0	5782.86
SM-8	12/87 (proposed)	Approx. 30.0	Alluvium/Colluvium	Approx. 20-30	Approx. 30.0	-
DM-1	05/23/86	275.0	Tertiary porphyry	216.0-275.0	275.0	5567.71
DM-2	05/28/86	310.0	Deadwood Form. & Precamb. schist	245.0-310.0	310.0	5584.38
DM-3	05/30/86	185.0	Deadwood Formation	100.0-185.0	185.0	5771.56
PZ-4	Existing Well	-	Bedrock	-	-	5579.56
PZ-5	Existing Well	-	Bedrock	-	-	5645.22
PZ-6	Existing Well	-	Bedrock	-	-	5750.03
DM-7	04/12/87	280.0	Precambrian schist	225.7-265.7	265.7	5572.49
DM-8	04/13/87	215.0	Deadwood Formation	191.0-210.0	210.0	5777.36
PZ-9	06/05/87	350.0	Deadwood Formation	210.0-220.0	220.0	5707.15
PZ-10	06/13/87	350.0	Precambrian schist	340.0-350.0	350.0	5699.97

TABLE 5.9-1 BASELINE GROUNDWATER MONITORING WELLS (Continued)

Well No.	Installation Date	Drilling Total Depth (Feet)	Monitored Strata	Screened Interval (Feet)	Total Depth Casing (Feet)	(8/87) Water Level Elevation (ft above msl)
DM-11	12/87 (prop.)	270.0	Deadwood Formation	230.0-270.0	270.0	-
DM-12	12/87 (prop.)	305.0	Deadwood Formation	275.0-305.0	305.0	-
DM-13	12/87 (prop.)	370.0	Deadwood Formation	330.0-370.0	370.0	-
DM-14	12/87 (prop.)	320.0	Deadwood Formation	280.0-320.0	320.0	-
DM-15	12/87 (prop.)	390.0	Deadwood Formation	350.0-390.0	390.0	-
DM-16	12/87 (prop.)	260.0	Deadwood Formation	220.0-260.0	260.0	-
DM-17	12/87 (prop.)	170.0	Deadwood Formation	130.0-170.0	170.0	-
DM-18	12/87 (prop.)	270.0	Deadwood Formation	130.0-270.0	270.0	-
MM-1	04/09/87	215.0	Mine Workings	188.0-198.0	198.0	5561.57
MM-2	10/30/86	265.0	Mine Workings	251.5-261.5	261.5	5659.39 (6/87)
MM-3	04/08/87	75.0	Mine Workings	52.3-62.3	62.3	5572.18
MM-4	10/31/86	365.0	Mine Workings	315.2-325.2	325.2	5589.30
PW-1	06/15/87	300.0	Tertiary porphyry and quartzite	238.0-278.0	300.0	5564.11
PW-2	06/16/87	200.0	Precambrian schist	138.0-158.0	200.0	5537.96
PW-3	12/87 (prop.)	200.0	Deadwood Formation	160.0-200.0	200.0	-
PW-4	12/87 (prop.)	50.0	Deadwood Formation	30.0-50.0	50.0	-

NOTE: (prop.) = proposed

Reward's acquisition of the property, and are monitored monthly for water levels only. PZ-9 and PZ-10 were installed as part of the geotechnical investigation and are also monitored for water levels only. DM-11 through DM-18 were installed in December 1987 specifically to monitor the bedrock aquifer which may potentially be affected by leakage from the proposed heap leach pad and process ponds.

Four wells, including MM-1 through MM-4, provide data pertaining to open underground mine workings. Finally, two springs, SP-1 and SP-2 are sampled for groundwater quality.

5.9.2 Identification of Aquifers

Shallow Aquifer. The local stream drainages are underlain by unconsolidated sediment, mostly of colluvial origin. The sediments consist of layers and mixtures of clays, silts, boulders, and some sand and gravel. These sediments are present in the lower portions of drainages and are relatively shallow and localized in extent. Although these sediments are water bearing, they cannot be considered good aquifers. Low permeability, limited thickness and small areal extent result in low yield from wells installed in this shallow water-bearing unit.

Three aquifer pumping tests and four slug injection tests were performed using seven wells in the shallow aquifer. Results of these tests are summarized in Table 5.9-2. Based on these tests, transmissivity (T) of the colluvial/alluvial sediments ranges from 0.47

ft²/day (SM-4) to 444 ft²/day (SM-3) and hydraulic conductivity (K) ranges from 0.079 ft/day to 18.13 ft/day. Typically, the higher permeability was measured in the lower reaches of the local drainages. Based on geologic characteristics, the storage coefficient of the colluvial/alluvial aquifer was estimated as 0.2.

The shallow aquifer is typically unconfined. However, local partially confined conditions may exist where more permeable strata are covered by clay layers.

Bedrock Aquifers. Groundwater in bedrock strata is present in the fracture systems of the Cambrian Deadwood Formation (predominantly limestone, dolomite, quartzite), Tertiary porphyry, and Precambrian schist and quartzite. The most permeable water yielding sections of the bedrock are in Deadwood Formation dolomite, quartzite, and basal conglomerate.

Hydrologic characteristics of the bedrock aquifer were tested in five monitoring wells (Table 5.9-2). Pumping tests in wells DM-1, DM-2, and DM-3 and PW-2 indicated low values of hydraulic conductivity and transmissivity. The highest values of permeability were obtained during drawdown and recovery tests in well PW-1, where T (transmissivity) of the severely fractured Precambrian schist is 4160 ft²/day and K (hydraulic conductivity) is 104 ft/day. The values of K and T in the other tested wells are substantially lower, with transmissivity ranging from 1.5 to 6.0 ft²/day and hydraulic

Table 5.9-2 Summary of Aquifer Testing Data

WELL NUMBER	TESTED AQUIFER	AQUIFER THICKNESS (feet)	TESTING PROCEDURE	TYPE OF TEST	METHOD OF EVALUATION	TRANSMISSIVITY			HYDRAULIC CONDUCTIVITY			STORAGE COEFFICIENT dimensionless ⁽²⁾
							Avg. Value			Avg. Value		
						ft ² /day	m ² /day	ft ² /day	ft/day	m/day	ft/day	
SM-1	Weathered Bedrock	15.00	Field Permeability Test	Falling Head	Hvorslev	10.83	1.01	10.83	0.72	0.22	0.72	0.2
SM-2	Colluvium	20.00	Field Permeability Test	Falling Head	Hvorslev	62.40	5.79	62.40	3.12	0.95	3.12	0.2
SM-3	Alluvium/ Colluvium	14.70	Submersible Pump	Pumping	Cpr/Jcb ⁽¹⁾ Unconf.	444.00	41.25	444.00	30.20	9.21	30.20	0.2
SM-4	Colluvium	6.00	Field Permeability Test	Falling Head	Hvorslev	0.47	0.04	0.47	0.079	0.024	0.079	0.2
SM-5	Colluvium/ weathered bedrock	29.30	Field Permeability Test	Falling Head	Hvorslev	1.93	0.17	1.93	0.082	0.019	0.082	0.2
SM-6	Alluvium/ Colluvium	20.0	Submersible Pump	Pumping	Cpr/Jcb ⁽¹⁾ Conf	130.00	12.08	130.00	8.50	1.99	8.50	0.2
SM-7	Fall/ Colluvium	9.35	Submersible Pump	Pumping	Cpr/Jcb ⁽¹⁾ Conf	144.00	13.36	144.00	17.20	5.25	17.20	0.2
DM-1	Deadwood FM	34.00	Submersible Pump	Pumping	Cpr/Jcb ⁽¹⁾ Conf	4.00	0.37	6.00	0.16	0.03	0.15	3.4 x 10 ⁻³
				Recovery		8.00	0.74		0.20	0.06		
DM-2	Deadwood FM	47.00	Submersible Pump	Pumping	Cpr/Jcb ⁽¹⁾ Conf	2.00	0.19	2.50	0.04	0.01	0.07	4.7 x 10 ⁻³
				Recovery		3.00	0.28		0.10	0.03		
DM-3	Deadwood FM	65.00	Submersible Pump	Pumping	Cpr/Jcb ⁽¹⁾ Conf	2.00	0.19	1.50	0.02	0.006	0.015	3.5 x 10 ⁻³
				Recovery		1.00	0.09		0.01	0.003		

Table 5.9-2 Summary of Aquifer Testing Data
(Continued)

WELL NUMBER	TESTED AQUIFER	AQUIFER THICKNESS (feet)	TESTING PROCEDURE	TYPE OF TEST	METHOD OF EVALUATION	TRANSMISSIVITY			HYDRAULIC CONDUCTIVITY			STORAGE COEFFICIENT
						ft ² /day	m ² /day	Avg. Value ft ² /day	ft/day	m/day	Avg. Value ft/day	
PW-1	Tertiary Porphyry and Quartzite	40.00	Submersible Pump	Pumping	Cpr/ Jcb ⁽¹⁾	3,973.00	369.09	4,159.00	99.30	30.29	104.15	4.0 x 10 ⁻³
				Recovery		4,345.00	403.65		109.00	33.25		
PW-2	Precambrian Schist	20.00	Submersible Pump	Pumping	Cpr/Jcb ⁽¹⁾	5.00	0.46	6.00	0.30	0.092	0.35	2.0 x 10 ⁻³
				Recovery		7.00	0.65		0.40	0.122		

Note: ⁽¹⁾Cooper/Jacob as found in Irriaco (1936)

⁽²⁾Estimated using method published by Brown et al (1972)

conductivity ranging from 0.015 to 0.35 ft/day. The permeability of the bedrock aquifer is highly dependent on the presence and interconnection of local fracture systems.

The aquifer in the Deadwood Formation is semi-confined by Tertiary porphyry in most of the study area.

5.9.3 Groundwater Flow

Shallow Aquifer. Water levels have been monitored approximately monthly since November, 1986 in seven wells constructed in the shallow aquifer. The depth to groundwater beneath the ground surface ranges from several feet to about 37 feet. The aquifer is hydraulically connected to the streams and, therefore, the depth to groundwater fluctuates depending on flow in the stream. The largest fluctuation measured was 16 feet between April and August, 1987, in monitoring well SM-3.

A surface water inventory, performed in October 1986 (Appendix G), indicated most local streams were losing water into the shallow aquifer. Recharge to the surficial aquifer also occurs as precipitation in the form of rainfall and snowmelt. Lateral groundwater flow follows the local topography, which typically drains from west to east. Based on hydraulic conductivity (Table 5.9-2) and water levels for spring and summer 1987 (Appendix G), groundwater is estimated to move at a velocity of about 370 ft/yr in sediments in Fantail Gulch and 78 ft/yr along N. Stewart Gulch. Discharge from the

shallow aquifer occurs in the lower portions of the drainages in the form of seeps. A portion of the groundwater in the shallow aquifer discharges downward into underlying bedrock strata.

Bedrock Aquifers. Water levels have been measured approximately monthly since November, 1986 in nine bedrock wells and five wells installed in underground mine workings. The depth to groundwater in the bedrock units depends on local topography. Wells located near the stream drainages can have a water level within 50 feet of the surface (well DM-5, 34 feet) and wells located topographically higher have a water table more than 200 feet beneath the ground surface. Water level fluctuations in these wells range from 2.5 ft (DM-1) to 44.5 ft (DM-8) as a result of spring recharge.

The groundwater flow direction in the bedrock aquifer is generally eastward. However, the flow direction is locally affected by faults which act as flow barriers. In the Astoria area, monitoring well DM-3 is located approximately 2,700 feet from well DM-2, and the difference between the potentiometric surface elevations of the two wells is over 200 feet. This difference in elevation, substantially greater than the general groundwater hydraulic gradient, is probably caused by a fault separating these two wells. The hydraulic gradient between wells DM-1 and DM-2, both located northeast of the fault, is only about 0.0055 ft/ft. The groundwater flow rate between these two wells is about 0.22 ft/year. The map of the groundwater potentiometric surface in the bedrock aquifer is on Exhibit 5-2.

Some groundwater recharge to the bedrock aquifer occurs in the project area. Recharge occurs primarily as leakage from the shallow alluvial/colluvial aquifer, with recharge rates being highest during spring runoff. Discharge from shallow, perched water zones in the Deadwood Formation occurs as springs and seeps such as monitoring stations SP-1 and SP-2. Deep groundwater in the project area contributes to regional groundwater flow and does not discharge within the site boundaries.

Open underground mine workings affect the groundwater flow system on a local scale. Although situated below the regional potentiometric surface, mine workings encountered by monitoring wells MM-1 through MM-4 are not flooded; therefore, these open workings may act as local groundwater sinks.

5.9.4 Baseline Water Quality

Groundwater samples have been collected and analyzed for seven bedrock wells, one mine monitoring well, two springs, and five shallow wells approximately quarterly since June, 1986. Results of all water analyses are listed in Appendix G.

Shallow Aquifer. Groundwater in the shallow aquifer is hard to very hard and is a calcium-bicarbonate type. The content of total dissolved solids ranged from 178 to 264 mg/l and the pH ranged from 6.5 to 7.5 from April to August, 1987. Federal Primary Drinking Water Standards

were not exceeded at any site monitored. Groundwater from monitoring wells SM-1 and SM-6 exceeded Secondary Drinking Water Standards for iron.

Bedrock Aquifers. Groundwater in the bedrock aquifers is extremely hard and is a calcium-bicarbonate or calcium-sulfate/bicarbonate (monitoring well DM-2 only) type. The content of total dissolved solids ranged from 134 to 662 mg/l and the pH ranged from 6.2 to 7.5 units from June 1986 to August 1987.

Groundwater quality varies in individual wells with time and also varies between wells. For example, monitoring wells DM-1 and DM-2 are both installed in the Deadwood Formation and are only 900 feet apart. The sulfate content in these two wells was consistently different throughout a year of monitoring, possibly as a result of fault-controlled groundwater flow. The sulfate concentration in wells DM-1 and DM-3 ranged between 12 and 39 mg/l and well DM-2 had a range of sulfate concentrations from 77 to 414 mg/l. Fluoride content in well DM-3 was usually more than twice the content in wells DM-1 and DM-2.

Springs. Water quality in the monitored springs is hard to very hard and is a calcium-bicarbonate (SP-2) or a calcium-sulfate/bicarbonate (SP-1) type. The content of total dissolved solids ranged from 136 to 284 mg/l and pH ranged from 7.2 to 8.0 between May 1986 and August 1987. The type of water found in the two springs indicates shallow bedrock circulation and probably no contact with the deeper ore body or mine workings.

5.10 SURFACE WATER RESOURCES

5.10.1 Regional Hydrology

The Golden Reward project site is located near the headwaters of several small drainages which flow easterly into Whitetail Creek. Whitetail Creek is tributary to Whitewood Creek which supports a limited fishery and is used for irrigation and mining. Whitewood Creek and its tributaries flow into the Belle Fourche River and the Belle Fourche River flows easterly into the Cheyenne River which discharges into a reservoir on the Missouri River. The complete baseline surface water resources report is in Appendix G.

Water quality in Whitewood Creek has exceeded EPA Standards for some heavy metals and cyanide because of past mining activities. However, water quality has been improving recently (U.S. Environmental Protection Agency, 1986). Four U.S. Geological Survey surface water discharge gaging stations have been installed on Whitewood Creek since 1981. Two of these stations collect water quality data.

5.10.2 Site Drainage Characteristics

The Golden Reward property lies near the headwaters of five watersheds: Nevada Gulch, Fantail Creek, Unnamed Gulch, Stewart Gulch, and Whitetail Creek. Headwaters of these drainages are located at Terry Peak and Deer Mountain. Elevations range from 7,064 feet at Terry Peak to 5,560 feet at surface water monitoring station SS-1 on Stewart Gulch.

Nevada Gulch is a perennial stream originating at Terry Peak. It flows in an easterly direction to its confluence with Whitetail Creek downstream of the property boundary.

The Fantail Creek watershed lies immediately south of the Nevada Gulch watershed. Fantail Creek is an intermittent stream flowing in a northeasterly direction to its confluence with Nevada Gulch, approximately 1,125 feet upstream of the confluence of Nevada Gulch and Whitetail Creek. Fantail Creek is classified by the DWNR (South Dakota Department of Water and Natural Resources) as a cold water permanent fish life propagation water 0.6 miles downstream of the property boundary.

Unnamed Gulch is an ephemeral stream south of Fantail Gulch which flows in an easterly direction to its confluence with Whitetail Creek.

Stewart Gulch is located south of Unnamed Gulch and Fantail Creek. Its headwaters are at Deer Mountain. The North Fork of Stewart Gulch is an intermittent stream that flows in an easterly direction in its upper reaches. The lower reach of the North Fork of Stewart Gulch is perennial and also flows in an easterly direction. The South Fork of Stewart Gulch is an ephemeral stream which flows northeasterly to its confluence with the North Fork of Stewart Gulch approximately 3300 feet upstream from its confluence with Whitetail Creek.

Whitetail Creek is a perennial stream flowing in a northerly direction from its headwaters at Deer Mountain to Whitewood Creek, Nevada. Stewart, and Unnamed Gulches and Fantail Creek are tributaries to Whitetail Creek.

Watershed delineations are shown on Exhibit 5-3. Table 5.10-1 lists the hydrologic design points used for delineating each watershed in addition to hydraulic length, area, and average gradient of each drainage. The hydrologic design points are typically located at the Golden Reward property boundaries and at locations where a hydraulic structure such as a bridge, culvert, diversion ditch, or pond is planned.

Predicted peak flows were calculated for each of the delineated watersheds (Table 5.10-2). The Rational Method (Haan and Barfield, 1978) was used for watershed areas under 100 acres and the SCS method (U.S. Soil Conservation Service, 1980) was used for peak runoff from watershed areas over 100 acres. Details of the calculations are discussed in Appendix G.

5.10.3 Baseline Surface Water Monitoring Program

The surface water monitoring program consists of eighteen monitoring stations located within, upstream and downstream of the project area. The monitoring system was established such that the baseline hydrologic

characteristics of the site and potential disturbance caused by the proposed mining activities could be monitored. Locations of surface water monitoring stations are shown on Exhibit 5-1 and listed in Table 5.10-3.

Station locations were selected to monitor all drainages on the property, including at least one upgradient and one downgradient station on each flowing stream.

SS-17 will replace SS-11, and SS-18 will replace SS-8 after at least three sampling periods during which all four stations will be monitored. SS-8 is expected to be covered with spent ore and overburden in the proposed disposal area and SS-11 is expected to be displaced by Isadorah pit during operational monitoring.

Streamflow is measured at each station monthly. Continuity of measurements has been limited by the ephemeral character of some streams and by winter conditions. Surface water quality samples have been collected at twelve sites approximately quarterly from May 1986 to August 1987. Monthly sampling commenced in September 1986 and will continue until operational monitoring begins. New surface water stations SS-17 and SS-18 will be sampled for at least six months prior to operational monitoring.

TABLE 5.10-1 WATERSHED AREA SUMMARY - GOLDEN REWARD MINING COMPANY

<u>Design Point</u>	<u>Description</u>	<u>Area (mi²)</u>	<u>Area (acres)</u>	<u>Hydraulic Length (feet)</u>	<u>Average Watershed Slope (ft/ft)</u>
N-1	Nevada Gulch at SS-5 (exiting property)	1.08	691	11,200	0.16
N-2	Nevada Gulch at road crossing (exiting property, west of N1)	0.92	589	10,500	0.16
N-3	Nevada Gulch at entrance to property (300 feet upstream of SS-4)	0.74	474	7,100	0.17
F-1	Fantail Creek at SS-2 (exiting property)	0.49	314	8,200	0.27
F-2	Fantail Creek upstream of Liberty and Harmony Pits	0.21	134	4,900	0.29
U-1	Unnamed Gulch at SS-11 (exiting to property)	0.33	211	6,850	0.16
U-2	Unnamed Gulch upstream of disposal	0.02	13	1,650	0.20
U-3	Unnamed Gulch upstream of leach pad site	.004	2.4	550	0.05
S-1	Stewart Gulch at SS-1	0.83	531	8,625	0.24
S-2	Stewart Gulch at SS-12 (below confluence of North & South forks)	0.56	358	6,125	0.25
W-1	Whitetail Creek at SS-3	1.28	819	9,200	0.18
W-2	Whitetail Creek exiting property near campground (300 feet SW of DM-8)	0.85	544	6,825	0.30

TABLE 5.10-2. SUMMARY OF PEAK FLOW CALCULATIONS
GOLDEN REWARD MINING COMPANY

<u>Water- Shed</u>	<u>Area (acres)</u>	<u>Discharge (cfs)</u> <u>Recurrence Interval</u>			
		<u>10-Yr</u>	<u>25-Yr</u>	<u>50-Yr</u>	<u>100-Yr</u>
N-1	691	125	226	335	453
N-2	589	107	194	288	389
N-3	474	91	165	245	331
F-1	314	65	118	175	235
F-2	134	29	53	78	105
U-1	211	39	71	105	142
U-2	13	14	16	18	21
U-3	2.4	2	2	2	3
S-1	531	109	197	292	394
S-2	358	76	138	204	275
W-1	819	152	275	408	551
W-2	544	106	192	284	384

TABLE 5.10-3. SURFACE WATER MONITORING STATIONS
GOLDEN REWARD MINING COMPANY

<u>Station Number</u>	<u>Drainage</u>	<u>Method of Flow Measurement</u>	<u>Sediment Sampler</u>	<u>Water Quality Samples</u>	<u>Date First Monitored</u>
SS-1	Lower Stewart Gulch	Weir and CSG	Yes	Yes	5/86
SS-2	Middle Fantail Creek	Weir and CSG	Yes	Yes	11/86
SS-3	Upper Whitetail Creek	Culvert	No	Yes	8/86
SS-4	Middle Nevada Gulch	Current Meter	No	Yes	5/86
SS-5	Lower Nevada Gulch	Current Meter	No	No	7/87
SS-6	Lower Fantail Creek	Culvert	No	No	5/86
SS-7	Upper Fantail Creek	CSG	Yes	Yes	4/87
SS-8	Upper Stewart Gulch	CSG	Yes	Yes	11/86
SS-9	Middle Whitetail Creek	Current meter	No	No	7/87
SS-10	Lower Whitetail Creek	Current meter	No	Yes	11/86
SS-11	Unnamed Drainage	CSG	Yes	Yes	4/87
SS-12	Middle Stewart Gulch	Culvert	No	Yes	5/86
SS-13	Upper Nevada Gulch	Culvert	No	Yes	6/86
SS-14	Middle Fantail Creek	Portable Flume	No	Yes	4/87
SS-15	Unnamed Drainage (East of Hwy. 85)	Portable Flume	No	No	4/87
SS-16	Spring	Portable Flume	No	Yes	8/87
SS-17	Unnamed Drainage (will replace SS-11)	CSG	Yes	Yes	12/87 (proposed)
SS-18	Upper Stewart Gulch (will replace SS-8)	CSG	Yes	Yes	12/87 (proposed)

NOTE: See Exhibit 5-1, Hydrological Monitoring Stations, for station locations.

5.10.4 Surface Water Quality and Flow

A range of monthly discharge measurements taken to date, is listed below:

<u>Watershed</u>	<u>Maximum (gpm)</u>	<u>Minimum (gpm)</u>
Nevada Gulch	92.04	0.00
Fantail Creek	361.65	0.00
Unnamed Gulch	0.00	0.00
Stewart Gulch	699.35	0.00
Whitetail Creek	419.20	9.04

A complete listing of surface water monthly discharge measurements is included in Appendix G.

The available surface water quality data indicate that water in streams within and near the Golden Reward project area is a bicarbonate-calcium/sulfate type. The total dissolved solids content averaged about 150-200 mg/l and ranged to 426 mg/l, and pH ranged from 6.48 to 8.14. Water in streams is generally better, or has lower content of dissolved solids, in the upper reaches of the streams than in the lower sections. The exception is Nevada Gulch. The most upstream monitoring station on Nevada Gulch, SS-13, located within the Terry Peak Ski Area, has higher total dissolved solids content than downstream stations. This is probably due to impacts of previous mining activities.

The concentration of bicarbonate tends to fluctuate more than other major anions and cations. At SS-1, for example, bicarbonate concentration ranged from 56 mg/l in April 1987 to 275 mg/l in May 1986. Typically, the lower concentration corresponds to a high flow rate.

The concentration of most metals in surface waters is typically low and, in many cases, below the laboratory detection limit (chromium, cadmium, copper, gold, selenium, silver). Most metals increased in concentration during periods of high flow due to the increased load of suspended solids.

Comparison of the chemical analyses of surface water samples with the U.S. Environmental Protection Agency (EPA) National Interim Primary and Secondary Drinking Water Regulations - Maximum Contaminant Levels indicates that Primary and Secondary contaminant levels of at least one trace metal are exceeded in most of the samples. Standards for maximum levels of iron and manganese are exceeded in six sampling locations, levels for arsenic and mercury are exceeded in two sampling stations, and maximum levels for cadmium are exceeded in one sampling station. The maximum concentration of mercury content listed in the Maximum Acceptable Concentrations for Inorganics for livestock use is exceeded in three locations. Therefore, water in surface streams is not suitable for drinking purposes at most monitoring stations. Results of all analyses are listed in Appendix G.

In addition to routine monitoring, a detailed inventory of streams and springs was conducted in October, 1986. During this inventory, the stream and spring flows, and field water quality parameters (temperature, pH and electrical conductivity) were measured along the streams at regular intervals. The geometric characteristics of hydraulic structures such as culverts, bridges, and significant flow restrictions were measured and photographed.

Observations of the stream profiles at the time of the inventory indicate that Nevada Gulch, Fantail Creek, Stewart Gulch, and Astoria Gulch originate from springs. Most reaches of these streams were discharging water to the groundwater system. The base flows increased in areas where faults apparently cross the stream beds (central part of Fantail Creek and lower section of Stewart Gulch) and in areas where shallow underground workings are located underneath the stream beds (lower Stewart Gulch).

The stream inventory also showed that within the project area there are no significant springs discharging polluted water from existing underground workings.

5.10.5 Site Drainage Plan

General Description

During the operational phase of the Golden Reward project, surface water drainage will be controlled to minimize impacts of erosion and sedimentation. The drainage and diversion plan to control runoff is

designed so that it can easily be integrated into the final mine reclamation plan. Areas of primary concern are the Sundance, Stewart and Hannibal overburden depositories; four topsoil stockpiles; and haul roads.

Elements of the drainage and diversion plan are as follows:

1. Diversion of runoff waters from undisturbed areas away from or around the permit area.
2. A complete drainage and diversion system downstream of disturbed areas to contain runoff and prevent offsite sedimentation.

The general plan for surface water drainage and diversion is shown on Exhibit 5-4. A description of specific design criteria and engineering characteristics of each component of the site drainage plan follows the general drainage description.

Waters from undisturbed drainages will be transported around or away from the permit area. As shown on Exhibit 5-4, the Stewart Gulch diversion ditch will divert natural runoff water from the offsite undisturbed drainage above the Stewart overburden depository from the North Fork of Stewart Gulch to the South Fork of Stewart Gulch. Runoff from the offsite undisturbed drainage above the Liberty/Harmony pit will flow between these two pits along Fantail Ditch. This ditch will

follow the existing stream channel. After leaving the pit area, runoff will continue to flow in the natural Fantail Stream Channel.

Runoff water from disturbed areas will be diverted to open mine pits or to sediment control traps. Drainage from the Hannibal overburden depository will be diverted into a small sediment control trap.

Drainage from the Stewart overburden depository will be diverted by ditch into the Isadorah pit. Runoff from the Sundance spent ore and overburden depository will flow naturally into the Sundance pit.

Runoff from the plant and main office area will either drain through the Sundance spent ore and overburden depository into Sundance pit, or through the Stewart Overburden Depository into Isadorah pit via the Stewart Overburden Diversion Ditch.

Sediment derived from topsoil stockpile runoff will be controlled by diversion ditches around the stockpiles which will direct runoff into drainage stabilization structures. Typical structures include stormwater dispersion terraces, silt fences, Gabion sediment traps, grass filter waterways or sediment strawbale barriers. These structures will be maintained by periodically removing accumulated sediment deposits. Erosion from topsoil stockpiles will be minimized by seeding the soil soon after stockpiling, using the seed mixture listed in Table 3.7-1.

Project roads will be designed and constructed to provide for proper drainage. Culverts for the access road, haul roads, and project service roads will be placed according to road grades and length of grades, road swales, watershed area draining to road surface, and road curves. Where culverts are installed to provide drainage for an existing channel, the culvert alignment and slope will maintain the existing characteristics of the channel.

Diversions will not be needed in the open-pit or the leach pad areas. Drainage into the mine pit areas will be allowed to flow directly into the pits. Since the majority of the pits are unsaturated, it is anticipated that this water will then percolate through the fractured rock of the mine pit. Runoff from the leach pad will be contained within the process water system by berms. Runoff control facilities will be constructed as required during the mining operation. The ditches and traps will be maintained throughout the life of the mine and will be modified as necessary as the mine expands. All drainage and diversion structures will be constructed to avoid the accumulation of stagnant water. Upon completion of the mining operation, the diversion and drainage system will be integrated into a post-mine diversion and drainage system as described in Section 3.8. The major natural drainages in the area will be maintained, both during and after mining.

Engineering Designs

Peak runoff in the area results from snowmelt or intense spring or

early summer rainfall events. Peak discharge events in both disturbed and undisturbed drainages were estimated using the U.S. Soil Conservation Service method (SCS, 1977) as summarized in Table 5.10-4. Computer printouts of calculations used to determine peak discharge rates and volumes are in Appendix G. Locations of the design points and their associated drainage basins are on Exhibit 5-4. Runoff control structures are designed to transport the 25-year, 24-hour runoff event.

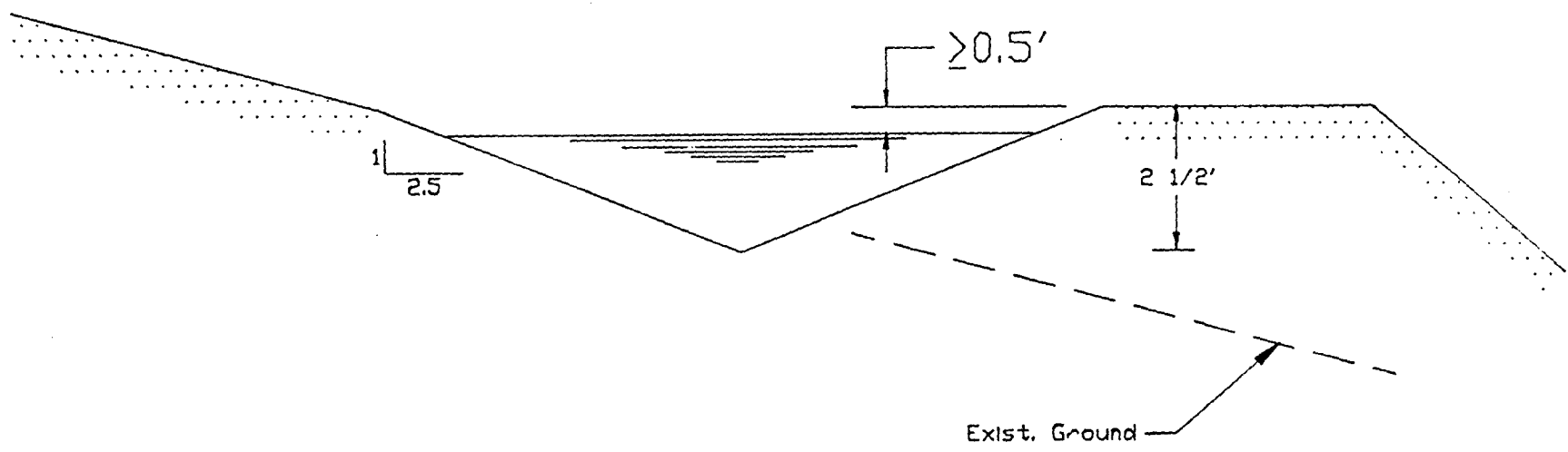
TABLE 5.10-4. PEAK FLOW CALCULATIONS
FOR SITE DRAINAGE PLAN

Design Point	Area of Drainage (acres)	Discharge (cfs)				Runoff Control
		Recurrence Interval				
		10-yr	25-yr	50-yr	100-yr	
1	138	22.2	40.1	59.4	81.4	Stewart Gulch Diversion Ditch.
2	48.5	48.2	64.1	78.8	93.8	Sundance pit
3	48.9	19.0	28.6	38.0	48.2	(1) Stewart Overburden Ditch (2) Isadorah pit
4	11.3	6.3	9.2	12.2	15.3	Sediment trap for Hannibal Overburden Depository.
5	192	42	75	112	151	(1) Berm along SW edge of Liberty pit. (2) Fantail Ditch

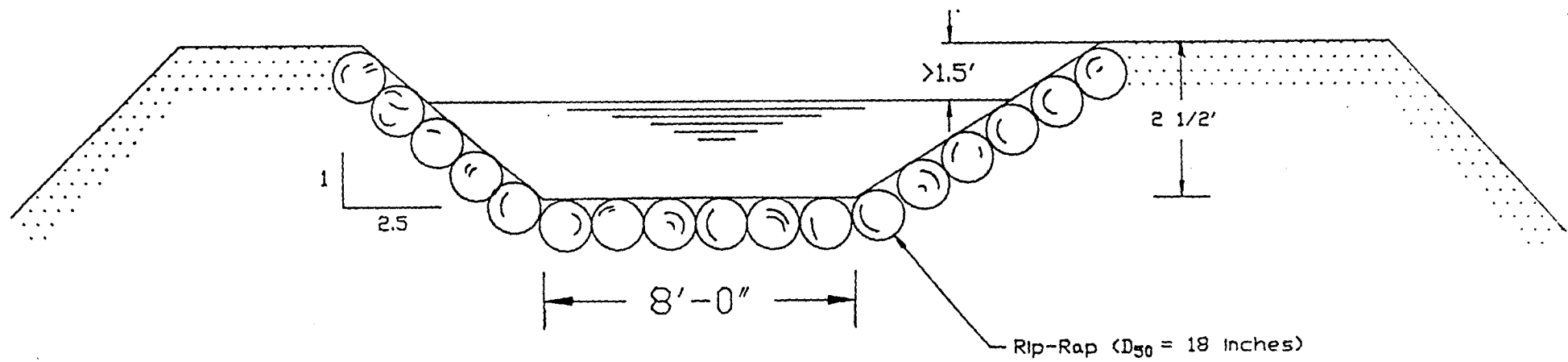
Source: U.S. Soil Conservation Service (1977) method.

The Mannings equation for calculating open channel flow was used to determine engineering characteristics of the three sediment control ditches (Table 5.10-5). All ditches were sized using a Mannings "n" equal to 0.035. Stewart Gulch Diversion Ditch and Stewart Overburden Ditch will be V-ditches with maximum channel slopes of 1.0%, side slopes of 2.5(h):1(v), and depths of 2 1/2 feet. Fantail Ditch will be a trapezoidal ditch with a maximum slope of 7.77% (present topographic slope), side slopes of 2.5(h):1(v), bottom width of eight feet, and depth of 2 1/2 feet. Fantail Ditch will be rip-rapped with 18 inch d_{50} rip-rap (EPA, 1976, Figures I-18 and I-19) to prevent erosion. Typical cross sections of these drainage and diversion ditches are shown in Figure 5.10-1. Computer printouts of Mannings calculations are included in Appendix G.

The sediment control trap below the Hannibal overburden depository will be designed to totally contain the 10-year, 24-hour storm runoff volume of 1 acre-ft (SCS, 1977). Its approximate dimensions will be 75 by 100 feet by 2 feet deep.



Typical V-Ditch

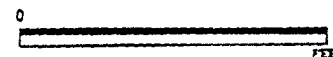


Typical Fantail Ditch

THE GOLDEN REWARD MINING CO.

Drainage Ditch Cross Sections

Golden Reward Property
Lawrence County, S.D.



Scale: 1 inch = 10 feet

Drafted by: S. Laurenti

Prepared by: J. Gould

Date: 11-30-87

FIGURE 530-1

Revision dates:

REFERENCE: 11-30-87

along the upslope side of each curb. The combined effects of the curbs, drain rock and solution-recovery pipes will be to minimize the hydraulic head on the asphalt pad and to direct solutions to the central launder and pipe system for transport to the pregnant solution or detoxification ponds. Each solution-recovery pipe will have plumbing necessary to allow flow to go to the pregnant solution or detoxification rinse sumps, as appropriate.

Preparation of the pad subgrade will entail clearing of surface vegetation, stripping to remove topsoil and site grading to establish the required pad geometry. In the event that some in-situ clays prove adequate for lining materials, then they would also be stripped and stockpiled temporarily until site grading was done. All fill material expected to provide foundation support for the leach pad will be placed as engineered fills; that is, the material, consisting of native mineral soils supplemented by waste rock, will be emplaced in layers and compacted. Following site grading but prior to placement of the clay liner, vadose zone monitoring installations will be emplaced as outlined in Section 6-1.3. Pad grading plans and specifications are being prepared as part of the detailed engineering plans and specifications.

5.11.3 Process Pond Design

Three process ponds will be located at the east end of the leach pad. One pond will collect pregnant solution draining by gravity from the drainage system above the leach pad liner. The second pond will

receive detoxification rinse solutions draining from the spent ore treatment process. A large overflow pond (PMP Pond) will be located adjacent to the two operating ponds and will receive overflow solution during storm precipitation. The combined storage in all three ponds is designed to hold the complete heap draindown plus a 6 hour probable maximum precipitation (PMP) storm on the heap and pond catchments.

Under normal operating conditions, the ponds will remain less than one-third full. A sump will be utilized in each of the operating ponds with flows from the heap directed into the sumps. A pump in each sump will return the solution either to the plant or directly to the appropriate section of the heap. Only under precipitation or surge conditions will the sumps overflow into the ponds. When normal conditions are resumed and the excess solutions evaporated off, the ponds will drain through one way valves back into the sumps. Under severe precipitation events, draindown, pump failure or power outage conditions, all solutions in excess of process pond storage will drain by gravity to the PMP pond.

All three ponds will be lined to provide a closed circuit and prevent loss of solution. From the top down, the pond liner system will consist of the following:

- Layer 1 - 80 mil geosynthetic membrane liner
- Layer 2 - leak detection system
- Layer 3 - 60 mil geosynthetic membrane liner
- Layer 4 - 24 inch clay layer - compacted in lifts

Cuts and fills will be required to achieve the geometry of the ponds. Fills will consist of select fill material placed in lifts and compacted to ensure stability and minimize settlement.

Surface diversions will be constructed as necessary to keep surface runoff water from entering the ponds; these diversions will be sized to handle PMP conditions to be consistent with pond hydraulic design standards. Detailed engineering drawings and specifications will be prepared and submitted to the department prior to construction.

5.11.4 Spent Ore/Waste Rock Disposal

After being detoxified on the leach pad, spent ore will be removed and placed in the Sundance spent ore and overburden depository immediately adjacent to and south of the leach pad (Exhibit 2-1). Waste rock will also be placed in this depository. Any waste rock disposal requirements in excess of the spent ore/waste rock dump capacity will be accommodated within the Stewart overburden depository located south of the Sundance depository.

Site preparation of waste dumps will entail clearing of surface vegetation and stripping of topsoil. The spent ore/waste rock will be placed in stages, generally starting at the lower end, then progressing back up toward the head of the basin. Completed dump slopes will be re-graded and reclaimed as discussed in Section 3.8.3. Results of ongoing stability analyses will be incorporated into the detailed

6.0 OPERATIONAL MONITORING SYSTEM

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MINING SOCIETY

Monitoring systems have been developed for water resources, air quality, and meteorology.

6.1 WATER RESOURCES

The operational hydrology monitoring program for the GRMC project consists of a network of surface water, groundwater and vadose zone monitoring sites. The program is designed to detect leakage from the heap leach pad, process ponds and spent ore depositories before such leakage is allowed to leave GRMC property and before it can adversely affect water resources. The baseline monitoring program (see Appendix G) provided background data to which operational monitoring data can be compared to detect changes. Locations of all monitoring stations are on Exhibit 5-1.

6.1.1 Surface Water

Surface water monitoring will consist of flow measurements at sixteen sites and water quality analyses at twelve of these sites. The stations are the same as those included in baseline monitoring and listed in Table 5.10-3, except for stations SS-8 and SS-11 which will be replaced by SS-18 displaced and SS-17, respectively. The original stations will be displaced by the active mining area. The sixteen stations were located to optimize monitoring of all drainages on the property, including at least one upgradient and one downgradient station on each drainage.

Surface water monitoring stations consist of a weir (trapezoidal or V-notch), crest stage gage (CSG) and sediment sampler, portable flume, culvert, or current meter as described in GRMC's Operational Monitoring Procedures Manual (OMPM) for the Golden Reward Mining Company (1987).

6.1.2 Groundwater

Groundwater monitoring will consist of water level measurements at twenty-six monitoring wells and water quality sampling at twenty-one of these sites. The stations are the same as those included in baseline monitoring and as listed in Table 5.9-1 except for two wells: SM-4 will be grouted and replaced by SM-8 after the original station is removed by Isadorah pit, and SM-7a was replaced by SM-7 shortly after installation in order to better monitor the surficial aquifer. Installation and construction of existing wells are discussed and illustrated in Appendix G.

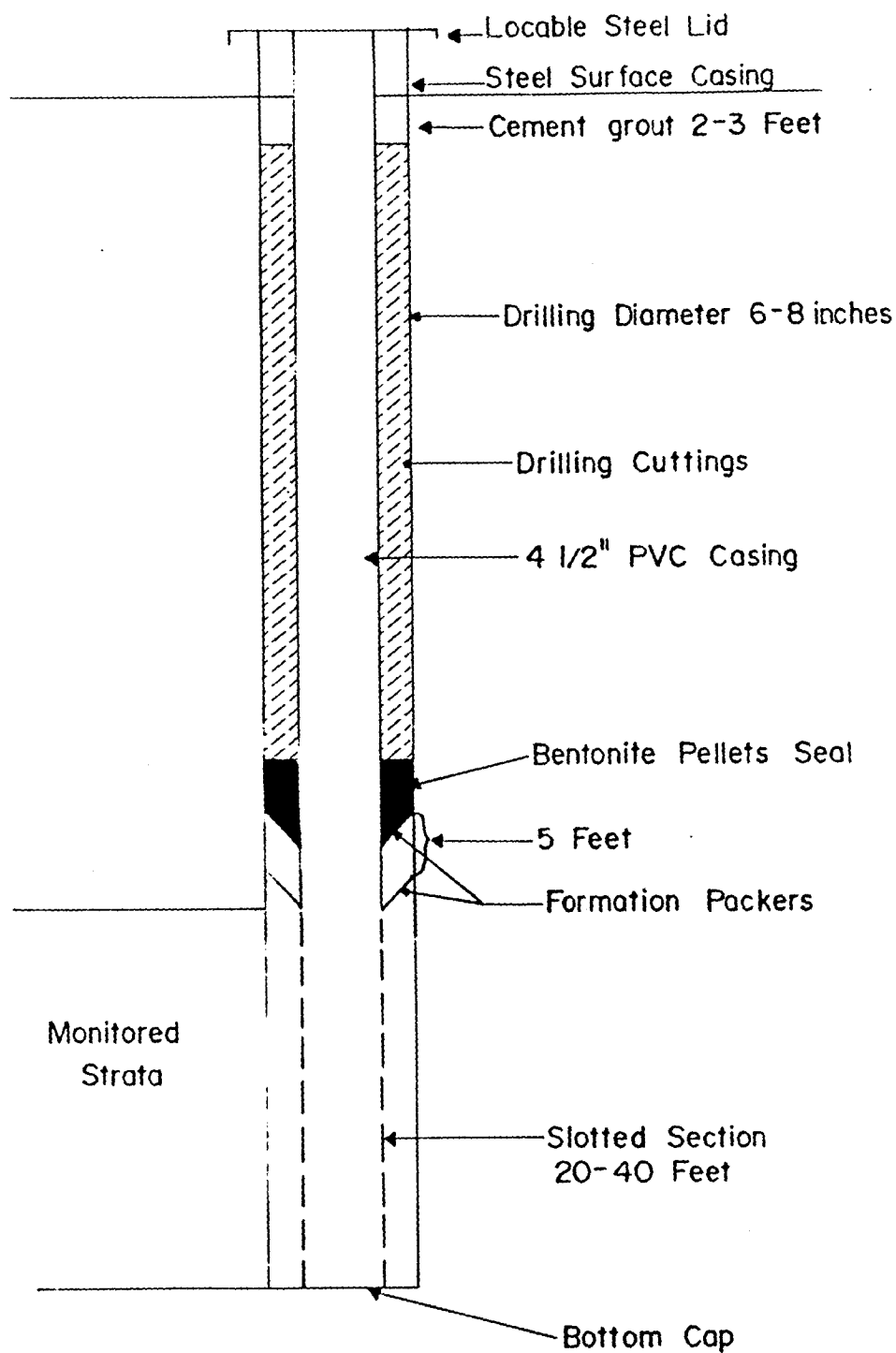
Monitoring wells DM-11 through DM-18 (8 stations) will be installed in November and December 1987 specifically to monitor ore processing facilities that overlie the Deadwood Formation aquifer. These monitor wells were requested by Nick Bugosh of the SDDWNR (South Dakota Department of Water and Natural Resources). Well DM-11 is upgradient of the heap leach pad and wells DM-11, DM-13 and DM-15 are upgradient of the process ponds. The other five new wells will monitor the bedrock aquifer downgradient from the ore processing and spent ore storage facilities. These wells will be constructed in the manner

as reviewed by Nick Bugosh (pers. comm., November 13, 1987), and as shown in Figure 6.1-1. A reverse circulation, air hammer drilling rig with air and water injection will be used for installation. The twenty- to forty-foot long screened sections will be placed at such depths that the top of the water table can always be monitored and enough water will flow into the wells to allow efficient sampling. A GRMC geologist will be present during drilling and will log the drill holes. After well completion, casing elevations and locations will be surveyed to an accuracy of 0.01 foot by a licensed land surveyor, and measuring points and well identification will be clearly and permanently marked on the casings. In addition, casing elevations will be resurveyed annually to determine if the ground surface elevation has changed.

6.1.3 Soil Moisture

A leak detection system will be installed beneath the heap leach pad to detect potential leakage through the underlying impermeable membrane liner. In order to detect leakage through the clay layer which underlies the membrane, soil moisture in the vadose zone will be sampled from beneath processing facilities using pressure-vacuum lysimeters. These instruments are reported to be reliable as early warning leakage detection devices at mining facilities and tailing waste sites (Bond and Rouse, undated) and are used and recommended by the EPA.

TYPICAL DIAGRAM OF OPERATIONAL MONITORING WELL IN BEDROCK
(WELLS DM-II THROUGH DM-18)



GOLDEN REWARD WATER REQUIREMENTS

Golden Reward will be requiring 90 gpm of make up water during the non-operating months (winter months) and 495 gpm during the operating months for an annual average usage of 402 gpm (Table 1).

Although water needs are estimated at 402 gpm, the aggregate appropriation is for 675 gpm for several reasons. If we should have periods of dry weather, our water needs will be above average. If precipitation is low, the water wells will have to make up more, so the wells themselves are permitted such as to provide the total requirements. An extended operating season could increase the needs over and above the average, also.

Golden Reward proposes using the runoff from the depositories, precipitation collected within the pits and wells to supply this water.

Golden Reward proposes using three wells to partially supply this water. The first primary water well source is Well PW-5. This well is located at the southern end of the property and draws water from the historic Astoria underground mine some 300 feet below the surface. This well is being permitted for 300 gpm with an annual usage of 252 gpm.

The second primary well source is Well PW-1 located some 1,400 feet north of PW-5 and east of the Golden Reward Hannibal pit. This well is being permitted for 150 gpm, and average annual usage is anticipated to be 96 gpm.

The secondary well source is PW-4 which is located in the lower end of Stewart Gulch and draws water from the historic Bertha underground workings. PW-4 will supplement PW-1 and PW-5, supplying short term water needs over and above average requirements and will provide a short term back-up should there be a pump failure in PW-1 or PW-5. This well would be able to supply extra water if it were needed for fire fighting. This well is being permitted for 100 gpm, and average annual usage is anticipated at 54 gpm.

Since the drainage from the Bertha mine is a major contributor to the stream flow in Lower Stewart Gulch, Golden Reward proposes to limit its usage such that when the flow is equal to or less than 150% of the previously recorded minimum flows, Golden Reward will not utilize PW-4. The low flow rates in Stewart Gulch occur during Golden Reward's non-

operating period when Golden Reward's water requirements are low.

The minimum recorded flow rate in Stewart Gulch is 37 gpm, and 150% of that is 56 gpm. The average flow in Stewart Gulch during the non-operating season is 186.5 gpm, so even if Golden Reward pumped the proposed appropriation, the average winter flow would be 86 gpm, some 30 gpm above Golden Reward's proposed minimum flow.

In addition to the wells, GRMC will be utilizing two other water sources. These sources are an integral part of the site drainage and stream sedimentation control plan.

Golden Reward plans to retain runoff from the waste depositories and the pits, store the water in a completed pit and use this water for processing and road dust control.

The first collection area on the north fork of Stewart Gulch is normally a dry draw. Runoff from the depository located in the draw will be transferred via a channel to a pit in the Eastern Mining Area.

The second collection area is the runoff from the Sundance depository which will be stored in the same pit in the Eastern depository.

The third collection area is precipitation waters collected within the pits and stored at the pit at the Eastern Mine Area. The aggregate of the surface waters is expected to average 125 gpm and is being permitted for 125 gpm.

The normal priority of water usage would be:

1. Pit and Depository Runoff
2. PW-5
3. PW-1
4. PW-4

This water management scheme is designed to provide adequate water for GRMC's operation while conserving and using efficiently this resource.

Table 1

Golden Reward Water Requirements

	<u>Operating Season</u>	<u>Non-Operating Season</u>	<u>Annual Average</u>
Time (Weeks)	40	12	52
Process Water (gpm)	330	-	254
Pit (gpm)	150	75	133
<u>Miscellaneous (gpm)</u>	<u>15</u>	<u>15</u>	<u>15</u>
Total	495	90	402

Golden Reward Average Water Supply Sources

Pit Sumps	varies	varies	125
PW-1 (gpm)	125	-	96
PW-4 (gpm)	70	-	54
<u>PW-5 (gpm)</u>	<u>300</u>	<u>90</u>	<u>252</u>
	495	90	527

Golden Reward Average Available Water Supply (Permitted)

Pit Sumps	varies	varies	125
PW-1 (gpm)	150	150	150
PW-4 (gpm)	100	100	100
<u>PW-5 (gpm)</u>	<u>300</u>	<u>300</u>	<u>300</u>
	550	550	675

THE
GOLDEN REWARD
MINING COMPANY

April 11, 1988

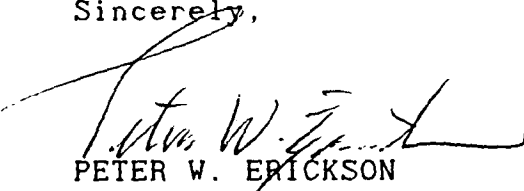
Mr. Ron Duvall
Water Rights Division
Joe Foss Building
Pierre, SD 57501

Dear Mr. Duvall:

Please find enclosed four Applications to Appropriate Water within the State of South Dakota, along with the appropriate application fees.

I trust that the information included with the applications is complete, but if you should have further questions or need more information, please contact our engineer, Mr. John Gould.

Sincerely,


PETER W. ERICKSON
General Manager

PWE:co
Enc.



Department of Water & Natural Resources

Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

April 13, 1988

John Gould
Golden Reward Mining Co.
PO Box 888
Lead SD 57754

Dear Mr. Gould:

This letter is in response to the four water permit applications for Golden Reward submitted on April 11, 1988.

A separate application does not need to be submitted for each proposed diversion point. I can combine the information to make one application if Golden Reward is willing to proceed with one application instead of four applications. The application fee for one application with the combined diversion rates of 1.50 cfs is \$400.00 instead of the \$1050.00 (correct amount should be \$975.00) submitted for the four applications. Therefore, I will combine the applications with your written permission and enclosed are the checks totaling \$1050.00. Please remit a check for \$400.00 if you wish to combine the applications or return checks for \$225.00 (0.28 cfs), \$300.00 (0.67 cfs), \$225.00 (0.33 cfs) and \$225.00 (0.22 cfs) for the four applications totalling \$975.00.

The following additional information is also needed for review of the permit application:

- 1) The proposed operating capacity and maximum capacity of the solution ponds (including the PMP pond). Plans and specifications showing the proposed construction and size of the ponds.
- 2) The same information as requested in No.1 is also needed for the sediment control traps plus the location of the traps (also see No. 4).
- 3) A copy of Exhibits 2-1, 2-3, 5-1, 5-3, 5-4; Appendix G, Figure 7, Figure 1,5, and Figure 2.
- 4) The written description accompanying the applications made reference to runoff being collected from the waste depositories and from the pits. The references to the Sundance Depository, Eastern Depository, pits and so on are difficult to visualize without a map. The map submitted with this application locates the point of diversion as being in the NW 1/4 NE 1/4 section 7-T4N-R3E; however, no reference is made as to what this point locates. Please locate and name all the pits from which runoff is to be pumped and the proposed pumping locations from the waste depositories. Then locate the pit to which this water is to be pumped and specify the size of the pit. Enclosed is a copy of the map submitted with the application and a copy of the written description with the material in question highlighted in red.

April 13, 1988
John Gould
Page 2

The permit application can not be processed for consideration by the Water Management Board until the application is complete. The above information is needed for completion of the report and recommendation. Completion of the report may also require obtaining additional information at a later date.

Please contact me if you have any questions.

Sincerely,

A handwritten signature in cursive script, appearing to read "Ron Duvall".

Ron Duvall
Natural Resources Engineer
605 773-3352

enc.

THE
GOLDEN REWARD
MINING COMPANY



April 19, 1988

Mr. Ron Duvall
Water Rights Division
Joe Foss Building
Pierre, SD 57501

Dear Mr. Duvall:

Thank you for your timely response to our water permit application.

After due consideration, we prefer to have separate applications and appropriations for each of the diversions. I have enclosed the appropriate checks.

We would expect to handle all of the appropriations at a single hearing, which we are requesting as soon as possible but no later than July, 1988.

The enclosed attachment should provide the supplemental information you have requested. At this time, much of the information is conceptual. When the construction plans and specifications are available, we can provide your office with copies of them.

If you need further information, do not hesitate to call us.

Sincerely,

JOHN C. GOULD
Chief Engineer

JCG:co
Enc.

Golden Reward Mining Company
Application to Appropriate Water
Supplemental Information

RE: Mr. Ron Duvall's letter dated April 18, 1988

Q "1) The proposed operating capacity and maximum capacity of the solution ponds (including the PMP pond). Plans and specifications showing the proposed construction and size of the ponds."

A The pertinent information for the operating ponds is shown on Table 1.

TABLE 1 PRELIMINARY POND STATISTICS

	<u>Surge</u>	<u>Detox</u>	<u>PMP</u>
Length (ft.)	260	180	600
Width (ft.)	130	130	190
Depth (ft.)	25	25	25
Max. Water Surface* (acres)	0.8	0.5	2.6
Operating Freeboard	20	12	20

Pond Capacity (millions of gallons)	<u>Cont.</u>	<u>Avail.</u>	<u>Cont.</u>	<u>Avail.</u>	<u>Cont.</u>	<u>Avail.</u>
Freeboard-0 ft.	3.6	0	2.4	0	14.9	0
Freeboard-1 ft.	3.3	0.3	2.2	0.2	14.0	0.9
Freeboard-3 ft.	2.8	0.8	1.8	0.6	12.3	2.6
Normal Oper.	0.3	3.3	0.6	1.8	1.9	13.0

* Surface Area with 0 ft. of Freeboard

The proposed lining for the ponds is as follows from the top down:

60 Mill HDPE
GeoNet
60 Mill HDPE
Gravel Drain Layer
Compacted Clay

The gravel drain layer and clay layers will run up the 2:1 (H:V) pond slopes as high as can be practically placed and compacted.

Q "2) The same information as requested in No. 1 is also needed for the sediment control traps plus the location of the traps (also see No. 4)."

A The sediment control traps locations are shown on Exhibit 5-4. The traps will be designed for the 10 year, 24 hour precipitation event. The Hannibal trap will be 75 feet by 100 feet by 2 feet deep.

Q "3) A copy of Exhibits 2-1, 2-3, 5-1, 5-3, 5-4; Appendix G, Figure 7, Figure 1,5, and Figure 2."

The following are attached:

- Exhibit 2-1
- Exhibit 2-3
- Exhibit 5-1
- Exhibit 5-4
- Appendix G Figure 7
- Appendix G Figure 2

Appendix G, Figure 1, 5 is a duplicate of Exhibit 2-3, and I did not include it.

Q "4) The written description accompanying the applications made reference to runoff being collected from the waste depositories and from the pits. The references to the Sundance Depository, Eastern Depository, pits and so on are difficult to visualize without a map. The map submitted with this application locates the point of diversion as being in the NW 1/4 NE 1/4 section 7-T4N-R3E; however, no reference is made as to what this point locates. Please locate and name all the pits from which runoff is to be pumped and the proposed pumping locations from the waste depositories. Then locate the pit to which this water is to be pumped and specify the size of the pit. Enclosed is a copy of the map submitted with the application and a copy of the written description with the material in question highlighted in red."

The map enclosed with the permit applications depicted the location of the primary pit water storage area.

The attached pit map (Exhibit 2-6), along with Exhibits 2-1 and 3-4 should clarify the nomenclature. The overall site drainage plan follows.

Site Drainage Plan - General Description

During the operational phase of the Golden Reward project, surface water drainage will be controlled to minimize impacts

of erosion and sedimentation. The drainage and diversion plan to control runoff is designed so that it can easily be integrated into the final mine reclamation plan. Areas of primary concern are the Sundance, Stewart and Hannibal overburden depositories; four topsoil stockpiles; and haul roads.

Elements of the drainage and diversion plan are as follows:

1. Diversion of runoff waters from undisturbed areas away from or around the permit area.
2. A complete drainage and diversion system downstream of disturbed areas to contain runoff and prevent offsite sedimentation.

The general plan for surface water drainage and diversion is shown on Exhibit 5-4. A description of specific design criteria and engineering characteristics of each component of the site drainage plan follows the general drainage description.

Waters from undisturbed drainages will be transported around or away from the permit area. As shown on Exhibit 5-4, the Stewart Gulch diversion ditch will divert natural runoff water from the offsite undisturbed drainage above the Stewart overburden depository from the North Fork of Stewart Gulch to the South Fork of Stewart Gulch. Runoff from the offsite undisturbed drainage above the Liberty/Harmony pit will flow between these two pits along Fantail Ditch. This ditch will follow the existing stream channel. After leaving the pit area, runoff will continue to flow in the natural Fantail Stream Channel.

Runoff water from disturbed areas will be diverted to open mine pits or to sediment control traps. Drainage from the Hannibal overburden depository will be diverted into a small sediment control trap.

Drainage from the Stewart overburden depository will be diverted by ditch into the Isadorah pit. Runoff from the Sundance spent ore and overburden depository will flow naturally into the Sundance pit.

Runoff from the plant and main office area will either drain through the Sundance spent ore and overburden depository into Sundance pit, or through the Stewart Overburden Depository into Isadorah pit via the Stewart Overburden Diversion Ditch.

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Typical structures include stormwater dispersion terraces, silt fences, Gabion sediment traps, grass filter waterways or sediment strawbale barriers. These structures will be maintained by periodically removing accumulated sediment deposits. Erosion from topsoil stockpiles will be minimized by seeding the soil soon after stockpiling.

Project roads will be designed and constructed to provide for proper drainage. Culverts for the access road, haul roads, and project service roads will be placed according to road grades and length of grades, road swales, watershed area draining to road surface, and road curves. Where culverts are installed to provide drainage for an existing channel, the culvert alignment and slope will maintain the existing characteristics of the channel.

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Engineering Designs

Peak runoff in the area results from snowmelt or intense spring or early summer rainfall events. Peak discharge events in both disturbed and undisturbed drainages were estimated using the U.S. Soil Conservation Service method (SCS, 1977) as summarized in Table 2. Locations of the design points and their associated drainage basins are on Exhibit 5-4. Runoff control structures are designed to transport the 25-year, 24-hour runoff event.

TABLE 2 PEAK FLOW CALCULATIONS
FOR SITE DRAINAGE PLAN

Design Point	Area of Drainage (acres)	Discharge (cfs)				Runoff Control
		Recurrence Interval				
		10-yr	25-yr	50-yr	100-yr	
1	138	22.2	40.1	59.4	81.4	Stewart Gulch Diversion Ditch.
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3	48.9	19.0	28.6	38.0	48.2	(1) Stewart Overburden Ditch (2) Isadorah pit
4	11.3	6.3	9.2	12.2	15.3	Sediment trap for Hannibal Overburden Depository.
5	192	42	75	112	151	(1) Berm along SW edge of Liberty pit. (2) Fantail Ditch

Source: U.S. Soil Conservation Service (1977) method.

The Mannings equation for calculating open channel flow was used to determine engineering characteristics of the three sediment control ditches (Table 3). All ditches were sized using a Mannings "n" equal to 0.035. Stewart Gulch Diversion Ditch and Stewart Overburden Ditch will be V-ditches with maximum channel slopes of 1.0%, side slopes of 2.5(h):1(v), and depths of 2 1/2 feet. Fantail Ditch will be a trapezoidal ditch with a maximum slope of 7.77% (present topographic slope), side slopes of 2.5(h):1(v), bottom width of eight feet, and depth of 2 1/2 feet. Fantail Ditch will be rip-rapped with 18 inch d_{50} rip-rap (EPA, 1976, Figures I-18 and I-19) to prevent erosion.

TABLE 3 SEDIMENT CONTROL DITCH CHARACTERISTICS

<u>Ditch Name</u>	<u>Type of Ditch</u>	<u>Length (feet)</u>	<u>Depth of Flow¹ (ft)</u>	<u>Top Width of Flow (ft)</u>	<u>Maximum Channel Slope</u>	<u>Velo-city (ft/s)</u>	<u>Dis-charge² (cfs)</u>	<u>Flow Type</u>
Stewart Gulch Diversion	V	950	1.99	9.97	.01	4	40.1	Sub-critical
Stewart Overburden	V	1950	1.76	8.78	.01	3.7	28.6	Sub-critical
Fantail	Trap ³	1350	0.83	12.14	.077	9	75	Super-critical

- NOTES:
- 1 Channel will be constructed with minimum of .5 feet of freeboard.
 - 2 Design discharge is the 25-year, 24-hour event (SCS, 1977).
 - 3 Trapezoidal ditch bottom width is 8 feet wide.

The capacities of pit storage ponds are shown on Table 4 and are illustrated in Figure 1.

TABLE 4 PIT WATER STORAGE

Site	Depth Ft.	CF 1,000's	Volume Gal. Millions	Acre Ft.	Surf. Area Acre
Isadorah 1	40	824	6.2	18.9	1.0
Isadorah 2	15	408	3.1	9.4	0.6
Isadorah 3	30	852	6.4	19.6	0.9
Sundance	<u>30</u>	<u>540</u>	<u>4.0</u>	<u>12.4</u>	<u>0.7</u>
Total		2,624	19.7	60.3	3.2

THE
GOLDEN REWARD
MINING COMPANY

Mr. Ron Duvall
Water Rights Division
Joe Foss Building
Pierre, SD 57501



Dear Mr. Duvall:

Enclosed are the checks and Exhibit 2-1 which I omitted in the supplemental package which I mailed to you earlier in the week.

I apologize for any inconvenience which this omission may have caused you.

Sincerely,

JOHN C. GOULD
Chief Engineer

JCG:co
Enc.

RECOMMENDATION OF CHIEF ENGINEER FOR WATER PERMIT
APPLICATION NO. 1439-1, Golden Reward Mining Company

Pursuant to SDCL 46-2A-2, the following is the recommendation of the Chief Engineer, Water Rights Division, Department of Water and Natural Resources concerning Water Permit Application No. 1439-1, Golden Reward Mining Company, PO Box 888, Lead SD.

The Chief Engineer is recommending APPROVAL of Application No. 1439-1 because 1) there is reasonable probability that there is unappropriated water available for the applicant's proposed use, 2) the proposed diversion can be developed without unlawful impairment of existing rights, 3) the proposed use is a beneficial use and 4) in the public interest with the following qualifications:

1. Although the Board believes there is reasonable probability that there is unappropriated water available for the proposed use, since only limited flow data are available for Stewart Gulch and the impacts of proposed groundwater withdrawals on spring flows and stream flows under Permit Nos. 1438-1, 1439-1, 1440-1 and ~~1441-1~~ are uncertain, the Water Management Board is retaining jurisdiction of these Permits, which will be exercised prior to licensing. The Board may quantify and/or determine if minimum amounts of water must be present in Stewart Gulch, Whitetail Creek and Whitewood Creek to protect these streams as cold water permanent fish life propagation waters and to determine any impacts of Golden Reward Mining Company withdrawals on these streams.

*1441-1 denied
by Board
7-27-88
JH*

This retained jurisdiction will be exercised pursuant to the public trust duties of the State and the Water Management Board as the Board vested with the authority of the State, to supervise the appropriation and distribution of water resources of the State.

2. That Golden Reward Mining Company install and operate a continuous recording flow gaging station on Stewart Gulch at a site below the Bertha Mine Workings outflow and above the confluence with Whitetail Creek.
3. The casing of the well to be constructed under Permit No. 1439-1 shall be pressure grouted with cement (bottom to top) from the producing formation to the surface, constructed by a licensed well driller and the well constructed in compliance with Water Management Board Well Construction Rules, Chapter 74:02:04.

4. The well approved under this Permit will be located near domestic wells and other wells which may obtain water from the same aquifer. The well owner under this Permit shall control his withdrawals so there is not a reduction of needed water supplies in adequate domestic wells or in adequate wells having prior water rights.
5. Approval of Permit No. 1439-1 is subject to compliance with the following then existing and applicable Water Management Board rules:
 - a. Chapter 74:03:15 Ground Water Quality Standards,
 - b. Chapter 74:03:16 Ground Water Discharge Permit,
 - c. Chapter 74:03:30 Heap Leach Design and Construction,
 - d. Chapter 74:03:02 Surface Water Quality Standards,
 - e. Chapter 74:03:04 Uses Assigned to Streams,
 - f. Chapter 74:03:17 Surface Water Discharge Permit - General Provisions,
 - g. Chapter 74:03:18 Surface Water Discharge Permit Application Requirements,
 - h. Chapter 74:03:19 Surface Water Discharge Permit Conditions,
 - i. Chapter 74:03:20 Transfer Modification, Revocation and Reissuance and Termination of Surface Water Discharge Permits,
 - j. Chapter 74:03:21 Procedure For Permit Processing,
 - k. Chapter 74:03:22 Secondary Treatment Standards,
 - l. Chapter 74:03:23 Criteria and Standards for Surface Water Discharge Permit,
 - m. Chapter 74:03:24 Toxic Pollutant Effluent Standards for Surface Water Discharge Permits,
 - n. Chapter 74:03:25 Effluent Guidelines and Standards for Surface Water Discharge Permits, and
 - o. Chapter 74:03:26 Pretreatment Regulations for Surface Water Discharge Permits.

*not enacted
by Board*

See the attached report for additional information.



JOHN HATCH, Chief Engineer
June 7, 1988

REPORT ON PERMIT APPLICATION Nos. 1438-1, 1439-1 and 1441-1
GOLDEN REWARD MINING COMPANY
JUNE 6, 1988

Permit application No. 1438-1 proposes to appropriate 0.67 cubic feet of water per second (300 gpm) from one well 355 feet deep located in the SW⁴SE⁴ Sec. 7, T4N-R3E. The well that is to supply water for Permit application No. 1438-1 will penetrate the flooded underground workings of the Astoria Mine. The average annual usage under Application No. 1438-1 is estimated to be 252 gpm.

Permit application No. 1439-1 proposes to appropriate 0.33 cubic feet of water per second (150 gpm) from one well 300 feet deep located in the NW⁴SE⁴ Sec. 7, T4N-R3E. The average annual usage under No. 1439-1 is estimated to be 96 gpm.

Permit application No. 1441-1 proposes to appropriate 0.22 cubic feet of water per second (100 gpm) from one well approximately 100 feet deep to be located in the NW⁴NE⁴ Sec. 7, T4N-R3E. The well that is to supply water for Permit application No. 1441-1 will penetrate the flooded underground workings of the Bertha Mine. The Bertha Mine workings contribute directly to the base flow in Stewart Gulch. Application No. 1441-1 proposes that no water will be diverted from the well when the flow in Stewart Gulch is equal to or less than 150% of the recorded minimum flow. The previously recorded minimum flow is 37 gallons per minute (gpm); therefore, a flow greater than 56 gpm would be necessary before the well would be operated. This well would be used to supplement the wells specified on Application No.'s 1438-1, and 1439-1 to meet short term water demands that exceed average requirements and will be a back-up well in event of a pump failure in the other two wells. The average annual usage under Application No. 1441-1 is estimated to be 54 gpm.

Water is to be used for industrial and domestic purposes in a heap leach ore-processing facility operated by Golden Reward Mining Company in portions of Sec. 6 and Sec. 7, T4N-R3E; and Sec. 1 and Sec. 12, T4N-R2E. Golden Reward Mining Co. is proposing to develop a heap leach ore-processing facility approximately two miles southwest of Lead in Lawrence County. The planned operation will require an annual average water use of 402 gpm with maximum short term usage of up to 675 gpm, over the 6 to 7 year life of the mine. The normal priority of operation for water usage proposes to first use runoff water and groundwater accumulated in the pits, then when needed use water from the three wells. In terms of Water Permits; 1st use - No. 1440-1, 2nd use - No. 1438-1, 3rd use - No. 1439-1, 4th use - No. 1441-1.

Aquifer: Pre-Cambrian Rock, Deadwood Formation, and Tertiary Intrusives

Geology and Aquifer Characteristics:

A review of the areal geology (Darton, 1925), and the logs from test wells and monitor wells submitted with this application and the applicant's mining permit application indicate ground water in the area is encountered in Pre-Cambrian Rock, the Deadwood Formation, Tertiary aged intrusives, and colluvium/alluvium which is restricted to the area stream beds. Because the extent of the "shallow aquifer" consisting of colluvium and alluvium is very limited it cannot be considered a viable aquifer. The Pre-Cambrian rock of this area consists primarily of mica schist, although metasediments and phyllites are also present. Schist is a strongly foliated rock formed by dynamic metamorphism. The total porosity of the rock is assumed to be 3% and the effective porosity containing the recoverable water in storage is estimated to be 1% (Rahn, 1979). Permeability of the Pre-Cambrian rock is low and water is transmitted through fractures, joints and bedding planes. In this area, the Deadwood formation consists of dolomite, quartzite, and a basal conglomerate. The total porosity of the Deadwood is estimated to be 10% and the effective porosity is estimated to be 50% of the total porosity. The Deadwood has moderately low permeability and has been described as the "Relatively, impermeable Deadwood. . .aquitard" (Rahn, 1979). Intrusives in the area are predominately Phonolite Porphyry sills. Porphyries typically have very low porosity and permeability and except where fractured, are generally considered to be a confining unit. The geologic formations representing the "Bed rock" aquifer, the Pre-Cambrian, the Deadwood, and the Tertiary intrusives are not generally considered significant aquifers. However, the intrusion and/or intrusives have altered the constitution of the Pre-Cambrian rock and the Deadwood Formation. Redden (1975) states that contact metamorphism was very limited during emplacement of the intrusives, that assimilation of country rock was extremely limited and that the intrusions were forcibly injected. Stress on the country rock as a result of the intrusion have undoubtedly increased the density of joints, fractures and faults in the Pre-Cambrian and the Deadwood.

The three rock types present in this area; sedimentary-Deadwood Formation, metamorphic- Pre-Cambrian, and igneous- intrusives, are probably hydrologically connected and represent a single hydrologic unit basically under unconfined condition. Locally confining conditions do exist where less permeable material overlies more permeable strata, and perched aquifers are present where a more permeable material overlies a less permeable strata. The groundwater flow system is dominated by fracture flow. Pump

tests conducted by the applicant indicate the transmissivity of the aquifer ranges from 5 ft²/d in a Porphyry to a high of 4159 ft²/d in highly fractured Pre-Cambrian schist. The potentiometric surface of this "Bed rock aquifer" generally follows the topography, groundwater flows away from topographic highs toward topographic lows. The general trend of the water table is from west to east, however, locally the groundwater flow is obstructed by faults and underground mine workings. Discharge from the "bedrock aquifer" within the project area may occur in the form of springs and seeps. The "spring inventory" included with the Golden Reward Mining Co.'s mining permit application identifies several springs, seeps and boggy areas within the project area. Most of these are at elevations above the elevation of the potentiometric surface of nearby "Deep Monitor" wells. For example, spring SP-2 is located approximately 250 feet from the proposed diversion point for Application No. 1439-1, and two seeps or boggy areas (L11 and L12) within approximately 500 feet of the well site for application No. 1439-1. The water levels of the spring and the seeps are approximately 180 to 200 feet higher than the water level of the test well drilled for Application No. 1439-1, and it can be assumed the spring and seeps are the result of dewatering of a perched aquifer in the area.

Underground mine workings are extensive in this area (see figure 1). Maps provided by the applicant are inconclusive in determining the extent of interconnection between the various workings, to what degree the workings are flooded, and where the underground workings dewater and contribute to the area streamflow. The Golden Reward mining permit application indicates the deeper levels of the workings opened via the Astoria, Union and Lucille shafts are probably fully flooded. Correspondence with the Golden Reward Mining Co. indicates the Bertha workings are also probably flooded. The proposed diversion point for Application No. 1438-1 is a well which penetrates the underground workings of the Astoria Mine. The volume of water in storage in the Astoria mine can be estimated using the past production from the mine (26,000 oz. of gold), and the average ore grade for the Astoria of 0.3 oz./ton (Allsman 1940). Assuming a volume of 15 ft³/ton, and assuming the mine is completely flooded, and there are no dams within the mine caused by cave-ins, etc., the volume of water in storage in the Astoria Mine alone is approximately 29.54 ac-ft, or sufficient water to pump continuously for 22 days at 0.67 cfs to dewater the mine assuming no recharge. It is not known if the Astoria Mine directly discharges via adits to contribute to the local streamflow in the area. The Astoria may be interconnected with the Union Workings. Evidence suggests that the Union Workings discharge water to Whitetail Creek via the Union Drainage Tunnel (see Appendix 1). The proposed diversion point for Application No. 1439-1 is a well which does not appear

to penetrate underground workings. The proposed diversion point for Application No. 1441-1 is a well which is completed into the underground workings of the Bertha Mine. The volume of water in storage in the Bertha mine can also be estimated using the past production from the mine (41,000 oz. of gold). Using the same assumptions as were used above, the volume of water in storage in the Bertha Mine alone is approximately 47 ac-ft, or sufficient water to pump continuously for approximately 108 days at 0.22 cfs to dewater the mine assuming no recharge. The Bertha Mine dewaterers to Stewart Gulch, and contributes significantly to the base flow in the gulch.

This project area is located near the headwaters of several small drainages which flow into Whitetail Creek and ultimately into Whitewood Creek. The drainages include: Nevada Gulch, Fantail Creek, Unnamed Gulch, Stewart Gulch, and Whitetail/Astoria Gulch. Fantail Creek and Stewart Gulch have been classified by the Water Management Board as "cold water permanent fish life propagation waters" and "limited contact recreation waters", Whitetail Creek has been classified as "cold water permanent fish life propagation waters", "limited contact recreation waters", and "immersion recreation waters". Nevada, Fantail, Stewart and Whitetail streams originate from springs. The source of these springs may be perched aquifers or discharge from the "Bedrock Aquifer". For example, the springs in the center of Fantail Gulch are located on faults and may be discharging from the "bedrock aquifer". Base flows to the area streams are increased where underground workings discharge directly to the streams and are probably increased in areas of faults crossing stream beds and in areas where shallow underground workings are located underneath stream beds.

The DWNR-Office of Water Quality has prepared a report reviewing the interconnection between flows from the Bertha workings and flows in Stewart Gulch and ultimately Whitewood Creek (see Appendix 2). The limited period of record (May 14, 1987 to November 17, 1987) indicate that 26 to 48 % of the flow in Whitetail Creek can be attributed to water from Stewart Gulch. A large percentage of the flow in Stewart Gulch is derived from the Bertha workings. Although the report specifically deals with dewatering of the Bertha workings, it may have been appropriate to discuss the groundwater-surface water interaction in general over the entire project area. The Office of Water Quality has recommended denial of the Golden Reward Mining Co. Application to appropriate water from the Bertha workings (Application No. 1441-1) because of possible detrimental impacts to the fisheries in Stewart Gulch, Whitetail Creek and Whitewood Creek; and possible economic impact to BHP&L and Homestake Mining Co. due to non compliance with their NPDES permits and Surface Water Quality Standards. It is not possible to quantify any potential impact to area springs, seeps and ultimately the area stream flow.

The hydrologic properties of a fracture flow dominated system make the potential as a water source very difficult to assess, highly variable, and quite site-specific. Few wells in this type of geohydrologic setting are capable of a sustained yield of 0.22 cubic feet per second or greater because of the limited porosity and permeability. It is possible this proposed wells may not produce the amount of water requested by each application. Although, Terry Peak Ski Area, which is located approximately 4000 feet from the Golden Reward Mining Co.'s project area has a well which penetrates the Ben Hur Mine, that is capable of producing 960 gpm. The 1987 usage from the well was 58.5 acre-feet. The underground workings of the Ben Hur Mine do not appear to be directly connected to the underground workings in the Golden Reward Mining Co. project area. The well proposed to supply application No. 1438-1 will penetrate the flooded underground workings of the Astoria Mine, and the well proposed to supply Application No. 1441-1 will penetrate the flooded underground workings of the Bertha Mine. The storage of the mine workings will have a significant impact on the productivity of these wells. However, long term pumping would be necessary to confirm the production potential at these well sites, as is always the case when dealing with fracture flow, because of the properties inherent to the system.

Recharge to the bedrock aquifer in this area occurs through infiltration of precipitation, runoff over the surface of the aquifer, and recharge from local streams through the shallow alluvium/colluvium aquifer where it is hydrologically connected to the bedrock aquifer. The Golden Reward project area is located on a recharge area for the bedrock aquifer.

The Division of Water Rights does not monitor any observation wells in this area and there is no historic data (water level records) available for this aquifer.

Review of Existing Water Rights:

The Division of Water Rights has record of several domestic wells completed into the bedrock aquifer in this area. Existing Water Permits in the area include: (see enclosed map for locations)

Permit No.	Owner	Source
301-1	Black Hills Chairlift Co.	groundwater
301A-1	Black Hills Chairlift Co.	groundwater
1335-1	Whitetail Court	groundwater
1168-1	Milton Morris	groundwater
1202-1	Roy M. Dungey	Sue Spring
1346-1	Wharf Resources	groundwater
1173-1	Warbonnet Inc.	Ross Spring

1288-1	Wharf Resources	groundwater
1278-1	Wharf Resources	groundwater
1247-1	Warbonnet Inc.	groundwater
1406-1	Wharf Resources	Spearfish Creek
1174-1	Warbonnet Inc.	Ross Spring
1365-1	Wharf Resources	groundwater
565-1	Black Hills Power and Light	groundwater
1322-1	Strawberry Hill Mining Co.	groundwater
1372-1	St. Joe Mining Co.	groundwater
0425-1	Golden Reward Mining Co	Whitetail Creek
	(different Golden Reward Mining Co.)	
0431-1	Henry R. Locke	Whitewood Creek
912-1	W. Gilbert Alan	Whitewood Creek
921-1	Wendelyn Richter	Whitewood Creek
928-1	Charles Wennberg	Whitewood Creek
1285-1	Tom Lein-Sand & Gravel	Whitewood Creek

The nearest groundwater permit is Permit No. 1335-1. The point of diversion is located approximately 1 mile northeast of this project area. Permit No. 301A-1 diverts water from underground mine workings located approximately 4000 feet from the Golden Reward Mining Co. project area. The nearest surface water permit to the Golden Reward Mining Co. project area is located nearly 15 miles downstream along Whitewood Creek. The diversion point for Water Right Filing No. 0425-1 is located on Golden Reward Mining Co. project area. The filing claims all of the flow in Whitetail creek. The diversion point for Water Right Filing No. 0431 is located just down stream of the confluence of Whitetail Creek and Whitewood Creek. The filing claims 10.00 cfs. These filings have not been validated and it is likely they can both be cancelled due to forfeiture.

Conclusions:

1. Permit application No. 1438-1 proposes to appropriate 0.67 cubic feet of water per second from one 355 feet deep well completed into the "Bedrock Aquifer". The "Bedrock Aquifer" consists of Pre-Cambrian Rock, the Deadwood Formation, and Tertiary aged intrusives. The proposed well is to penetrate the flooded underground workings of the Astoria Mine.
2. Permit application No. 1439-1 proposes to appropriate 0.33 cubic feet of water per second from one well 300 feet deep completed into the "Bedrock Aquifer".
3. Permit application No. 1441-1 proposes to appropriate 0.22 cubic feet of water per second from one well approximately 100 feet deep, completed into the "Bedrock Aquifer". The proposed well is to penetrate the flooded underground workings of the Bertha Mine. No water is to be diverted from the well when the flow in Stewart Gulch is equal to or less than 150 % of the previously recorded minimum flow.

4. The bedrock aquifer is basically under water-table conditions, although confined conditions and perched conditions exist. Primary (intergranular) porosity and permeability of this aquifer are low. Most of the water in storage in the aquifer is contained in the secondary porosity (i.e. bedding planes, faults, joints and fractures). Flooded underground workings do increase the recoverable water in storage in the aquifer.
5. The bedrock aquifer is a viable aquifer in this area, and there is a reasonable probability unappropriated water is available in this area.
6. Well interference should not be a problem between this proposed well and other adequate wells in the area.
7. The proposed diversion points for these applications are located near the headwaters of several small drainages which flow into Whitetail Creek, and ultimately into Whitewood Creek. Nevada, Fantail, Stewart and Whitewood Creek originate as springs which may originate from the bedrock aquifer.
8. Groundwater withdrawals in this area may affect spring flow in this area. It is not possible to quantify the potential impact, if any, on streamflow in the area.
9. There are no existing water rights along Nevada Gulch, Fantail creek, Stewart Gulch, or Whitetail Creek.
10. The nearest downstream water right from this diversion point is nearly 15 miles downstream, along Whitewood Creek.
11. Decrease in stream flow in area streams may result in noncompliance with Black Hills Power & Light (BHP&L), and Homestake Mining Co.'s NPDES permits and the Surface Water Quality Standards. Streamflow used for dilution water by BHP&L and Homestake has not been appropriated.

Kent Buhler /ks

KENT BUHLER
Natural Resources Engineer

References:

Allsman, T.P., 1940, Reconnaissance of Gold-Mining Districts in the Black Hills, S. Dak., United States Government Printing Office, Washington DC

Darton, N.H., Paige, S., 1925, Geologic Atlas of the United States, Central Black Hills Folio, South Dakota, USGS, Folio No. 219,

DWNR - Division of Water Rights, "Domestic Well Log Files, Water Permit Files, DWNR, Joe Foss Building, Pierre SD

Rahn, P.H., 1979, Groundwater Resources of Western South Dakota, US Army Corps of Engineers, Draft-Final Report

Redden, J.A., 1975, "Precambrian Geology of The Black Hills", Mineral and Water Resources of South Dakota, USGS, US Government Printing Office, Washington DC



Department of Water & Natural Resources

Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

June 23, 1988

Lead Daily Call
Box 876
Lead SD 57754

Dear Sir:

Enclosed is a Notice of Hearing on Application Nos. 1438-1, 1439-1, 1440-1 and 1441-1 to be published twice. Please publish the first notice on or before June 30, 1988 with the second publication 7 days later.

The APPLICANT MUST VERIFY TO YOU THAT THE NOTICE IS TO BE PUBLISHED, before you make the first publication. Please BILL the APPLICANT for the cost of publication. The APPLICANT is Golden Reward Mining Company, PO Box 888, Lead SD 57754.

A copy of BOTH publications must be SENT to the WATER RIGHTS DIVISION. IMMEDIATELY return the FIRST publication with the FIRST Transmittal form on the bottom of this page. The first copy is needed to check the publication for errors so any corrections can be made in the second publication. Publication errors can invalidate the public notice and cause the applicant costly delays.

Please be sure the SECOND publication is returned IMMEDIATELY with the enclosed Proof of Publication form. DO NOT WAIT until the end of the month or the billing cycle. The permit application cannot be considered by the Water Management Board until proof of publication has been received.

Sincerely,

Ron Duvall
Natural Resources Engineer
605 773-3352

enclosures

-----CUT HERE-----

FIRST TRANSMITTAL NOTICE
No. _____

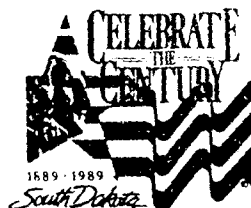
TO: Water Rights Division
Joe Foss Building
Pierre SD 57501-3181

Date _____

We are in receipt of your letter of _____ enclosing Notice of Hearing to
Appropriate Water by Application No. _____ which was first published in our issue
of _____. ENCLOSED IS A COPY OF THIS FIRST PUBLICATION.

Name

Newspaper





Department of Water & Natural Resources

Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

June 23, 1988

NOTE: TO BE SURE OF PUBLICATION ON
THE CORRECT DATES, CONTACT
THE NEWSPAPER RIGHT AWAY.

Peter Erickson, General Manager
Golden Reward Mining Company
PO Box 888
Lead SD 57754

Dear Mr. Erickson:

Your Application Nos. 1438-1 1439-1, 1440-1 and 1441-1 for permits to appropriate water for industrial and domestic use have been examined and found to comply with the South Dakota Water Laws and applicable rules. Notice of your intent to appropriate water has been sent to the Publisher of the Lead Daily Call printed at Lead SD. For your information, a copy of the notice is enclosed. Copies of the recommendation of the Chief Engineer and a report on the applications will be sent later. Please review the notice prior to publication and notify this office, if you have any corrections or questions.

Be sure to contact the above newspaper to authorize publication of your Notice of Intent to Appropriate Water and to arrange for payment. Early contact with the paper can eliminate delays. The publisher has been instructed to publish your notice once each week for two consecutive weeks with the last publication to occur twenty days before the board meeting. We must receive Proof of Publication before the application can be considered by the Water Management Board.

Sincerely,

Ron Duvall
Natural Resources Engineer
605 773-3352

enclosures



Instruction to Newspaper - Publish first Notice on or before June 30, 1988 with 2nd publication 7 days later. The applicant is responsible for payment.

NOTICE OF HEARINGS on Application Nos. 1438-1, 1439-1, 1440-1 and 1441-1
to Appropriate Water

Notice is given that Golden Reward Mining Company, PO Box 888, Lead SD 57754 has filed Application No. 1438-1 for a water permit to appropriate 0.67 cubic feet of water per second from one well 355 feet deep to be located in the SW 1/4 SE 1/4 Section 7-T4N-R3E. The well is to be completed into the old flooded underground workings of the Astoria Mine. Water is to be used for industrial and domestic purposes in a heap leach ore-processing facility operated by Golden Reward Mining Company in portions of Sections 6, 7-T4N-R3E; Sections 1, 12-T4N-R2E.

Application No. 1439-1 is to appropriate 0.33 cubic feet of water per second from one well 300 feet deep to be located in the NW 1/4 SE 1/4 Section 7-T4N-R3E. Water is to be used for industrial and domestic purposes in a heap leach ore-processing facility operated by Golden Reward Mining Company in portions of Section 6, 7-T4N-R3E; Sections 1, 12-T4N-R2E.

Application No. 1440-1 is to appropriate 0.28 cubic feet of water per second of impounded ground water from the dewatering of mine pits and impounded runoff water from precipitation falling on a proposed mine site in sections 6, 7-T4N-R3E; sections 1, 12-T4N-R2E. Runoff water from areas disturbed by mining operations is to be impounded by sediment control traps (each capable of impounding a 10 year, 24 hour precipitation event) and by the primary pit water storage area in the NW 1/4 NE 1/4, NE 1/4 NW 1/4 section 7; SE 1/4 SW 1/4 section 6; all in T4N-R3E. Sediment control traps are to be located within the proposed mine site as needed to control sedimentation. Ground water seeping into mine pits located within the proposed mine site is also to be diverted to the primary pit storage area. The primary pit storage area is to consist of 4 pits including Isadorah 1 (18.9 acre-feet storage capacity), Isadorah 2 (9.4 acre-feet storage capacity), Isadorah 3 (19.6 acre-feet storage capacity) and Sundance (12.4 acre-feet storage capacity) for a total storage capacity of 60.3 acre-feet. The impounded surface and ground water is to be used for industrial purposes, including dust control, in a heap leach ore-processing facility operated by Golden Reward Mining Company.

Runoff water from areas undisturbed by mining operations is to be diverted via ditch to avoid areas disturbed by mining operations. Runoff water from an undisturbed area on the North Fork of Stewart Gulch is to be diverted via ditch to the South Fork of Stewart Gulch at a point in the NE 1/4 NE 1/4 section 12-T4N-R2E. A portion of the Fantail Creek drainage area that is undisturbed by mining is also to be diverted via ditch between two mining pits in the SE 1/4 section 1-T4N-R2E. The ditch is to follow the existing creek channel and water will then flow in the natural Fantail Creek channel below the pit sites.

Application No. 1441-1 is to appropriate 0.22 cubic feet of water per second from one well approximately 100 feet deep to be located in the NW 1/4 NE 1/4 Section 7-T4N-R3E. The well is to be completed into the old Bertha mine workings which contribute to the water flow in Stewart Gulch. The application proposes that no water will be diverted from the well when the flow in Stewart Gulch is equal to or less than 150% of the previously recorded minimum flow. The previously recorded minimum flow is 37 gallons per minute (gpm); therefore, the flow in Stewart Gulch would be greater than 56 gpm before the well would be operated. The well is to supplement the wells specified on Application Nos. 1438-1 and 1439-1 to meet short term water demands that exceed average requirements and will be a back-up well in event of pump failure in the other two wells. Water is to be used for industrial and domestic purposes in a heap leach ore-processing facility operated by Golden Reward Mining Company in portions of Sections 6, 7-T4N-R3E; Sections 1, 12-T4N-R2E.

The total water appropriation requested by Application Nos. 1438-1, 1439-1, 1440-1 and 1441-1 is 1.50 cubic feet of water per second. The normal priority for water use from the sources specified on the four applications is: 1) Application No. 1440-1, 2) Application No. 1438-1, 3) Application No. 1439-1 and 4) Application No. 1441-1. Water is also to be used for fire protection purposes in addition to industrial and domestic uses.

Pursuant to SDCL 46-2A-2, the Chief Engineer of the Water Rights Division recommends APPROVAL of Application Nos. 1438-1, 1439-1, 1440-1, and 1441-1 with qualifications because 1) unappropriated water is available, 2) existing rights will not be unlawfully impaired, 3) it is a beneficial use of water and 4) it is in the public interest. These applications will be considered by the Water Management Board in Room 216, Joe Foss Building, 523 E Capitol, Pierre SD on July 27, 1988 at 10:00 am. The Chief Engineer's recommendation is not final or binding upon the Board. The Board is authorized to 1) approve, 2) approve with qualifications, 3) defer or 4) deny these applications based on the facts presented at the public hearing.

Any interested person that intends to participate in the hearings before the Board by presenting evidence or cross-examining witnesses according to SDCL 1-26, must file a written petition with BOTH the applicant and Chief Engineer by July 15, 1988. The Chief Engineer's address is "Water Rights Division, Foss Building, 523 E Capitol, Pierre SD 57501 (605 773-3352)". The petition may be informal, but must include a statement describing the petitioner's interest in an application, the petitioner's reasons for opposing or supporting an application and the signature and mailing address of the petitioner or legal counsel if legal counsel is obtained. The applicant need not file a petition. Contact the Water Rights Division to request information on these applications or to assure access to the hearing by the handicapped.

These hearings are adversary proceedings. Any person filing a petition and/or the applicant have the right to be represented by a lawyer. These and other due process rights will be forfeited if not exercised. Decisions of the Board may be appealed to the Circuit Court and State Supreme Court as provided by law. The time of the hearings will also be automatically delayed for at least twenty days upon written request to the Chief Engineer from the applicant or a petitioner. The request for a delay must be received by July 15, 1988.

These applications are made pursuant to SDCL 46-1-1 thru 46-1-9, 46-1-12 thru 46-1-15; 46-2-3.1, 46-2-9, 46-2-11, 46-2-13, 46-2-17; 46-2A-1 thru 46-2A-10, 46-2A-12, 46-2A-14, 46-2A-15; 46-5-1 thru 46-5-11, 46-5-13 thru 46-5-15, 46-5-24, 46-5-25, 46-5-30.2, 46-5-30.4, 46-5-31; 46-6-3, 46-6-3.1, 46-6-6.1, 46-6-10, 46-6-13, 46-6-14; and Board Rules ARSD 74:02:01:01 thru 74:02:01:15.

Affidavit of Publication

STATE OF SOUTH DAKOTA }
COUNTY OF LAWRENCE } SS.

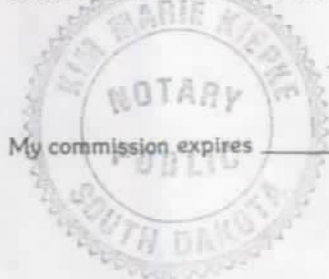


Bill T. Masterson, Jr. of said County and State being first duly sworn, on his oath says: That The QUEEN CITY MAIL is a legal daily newspaper of general circulation, printed and published in the City of Spearfish, in said County and State by Bill Kunerth, and has been such a newspaper during the times hereinafter mentioned; and that said newspaper has a bonafide circulation of at least 200 copies weekly, and has been published within said County in the English language for at least one year prior to the first publication of the notice herein mentioned, and is printed in whole or in part in an office maintained at the place of publication; and That I Bill T. Masterson, Jr., the undersigned, am the Publisher of said newspaper and have personal knowledge of all the facts stated in this affidavit; and that the advertisement headed:

Notice of Hearings

a printed copy of which is hereto attached, was printed and published in said newspaper for Two (2) successive and consecutive weeks, the first publication being made on the 30th day of June, 1988, and the last publication on the 7th day of July, 1988, that the full amount of fees charged for publishing same, to-wit: The sum of \$ 93.67, inures solely to the benefit of the publisher of the QUEEN CITY MAIL, that no agreement or understanding for a division thereof has been made with any person and that no part thereof has been agreed to be paid to any other person whomsoever.

Subscribed and sworn to before me this 7th day of July, 19 88



Kim Marie Kiepe
NOTARY PUBLIC, LAWRENCE COUNTY, SOUTH DAKOTA
My Commission
Expires 3-24-96

My commission expires

NOTICE OF HEARINGS on Application Nos. 1438-1, 1439-1, 1440-1 and 1441-1 to Appropriate Water

Notice is given that Golden Reward Mining Company, PO Box 888, Lead SD 57754 has filed Application No. 1438-1 for a water permit to appropriate 0.67 cubic feet of water per second from one well 355 feet deep to be located in the SW 1/4 SE 1/4 Section 7-T4N-R3E. The well is to be completed into the old flooded underground workings of the Astoria Mine. Water is to be used for industrial and domestic purposes in a heap leach ore-processing facility operated by Golden Reward Mining Company in portions of Sections 6, 7-T4N-R3E; Sections 1, 12-T4N-R2E.

Application No. 1439-1 is to appropriate 0.33 cubic feet of water per second from one well 300 feet deep to be located in the NW 1/4 SE 1/4 Section 7-T4N-R3E. Water is to be used for industrial and domestic purposes in a heap leach ore-processing facility operated by Golden Reward Mining Company in portions of Section 6, 7-T4N-R3E; Sections 1, 12-T4N-R2E.

Application No. 1440-1 is to appropriate 0.28 cubic feet of water per second of impounded ground water from the dewatering of mine pits and impounded runoff water from precipitation falling on a proposed mine site in sections 6, 7-T4N-R3E; sections 1, 12-T4N-R2E. Runoff water from areas disturbed by mining operations is to be impounded by sediment control traps (each capable of impounding a 10 year, 24 hour precipitation event) and by the primary pit water storage area in the NW1/4 NE1/4, NE1/4 NW1/4 section 7; SE1/4 SW1/4 section 6; all in T4N-R3E. Sediment control traps are to be located within the proposed mine site as needed to control sedimentation. Ground water seeping into mine pits located within the proposed mine site is also to be diverted to the primary pit storage area. The primary pit storage area is to consist of 4 pits including Isadorah 1 (18.9 acre-feet storage capacity), Isadorah 2 (9.4 acre-feet storage capacity), Isadorah 3 (19.6 acre-feet storage capacity) and Sundance (12.4 acre-feet storage capacity) for a total storage capacity of 60.3 acre-feet. The impounded

surface and ground water is to be used for industrial purposes, including dust control, in a heap leach ore-processing facility operated by Golden Reward Mining Company.

Runoff water from areas undisturbed by mining operations is to be diverted via ditch to avoid areas disturbed by mining operations. Runoff water from an undisturbed area on the North Fork of Stewart Gulch is to be diverted via ditch to the South Fork of Stewart Gulch at a point in the NE1/4 NE1/4 section 12-T4N-R2E. A portion of the Fantail Creek drainage area that is undisturbed by mining is also to be diverted via ditch between two mining pits in the SE1/4 section 1-T4N-R2E. The ditch is to follow the existing creek channel and water will then flow in the natural Fantail Creek channel below the pit sites.

Application No. 1441-1 is to appropriate 0.22 cubic feet of water per second from one well approximately 100 feet deep to be located in the NW 1/4 NE 1/4 Section 7-T4N-R3E. The well is to be completed into the old Bertha mine workings which contribute to the water flow in Stewart Gulch. The application proposes that no water will be diverted from the well when the flow in Stewart Gulch is equal to or less than 150 of the previously recorded minimum flow. The previously recorded minimum flow is 37 gallons per minute (gpm); therefore, the flow in Stewart Gulch would be greater than 56 gpm before the well would be operated. The well is to supplement the wells specified on Application Nos. 1438-1 and 1439-1 to meet short term water demands that exceed average requirements and will be a back-up well in event of pump failure in the other two wells. Water is to be used for industrial and

domestic purposes in a heap leach ore-processing facility operated by Golden Reward Mining Company in portions of Sections 6, 7-T4N-R3E; Sections 1, 12-T4N-R2E.

The total water appropriation requested by Application Nos. 1438-1, 1439-1, 1440-1 and 1441-1 is 1.50 cubic feet of water per second. The normal priority for water use from the sources specified on the four applications is: 1) Application No. 1440-1, 2) Application No. 1438-1, 3) Application No. 1439-1 and 4) Application No. 1441-1. Water is also to be used for fire protection purposes in addition to industrial and domestic uses.

Pursuant to SDCL 46-2A-2, the Chief Engineer of the Water Rights Division recommends APPROVAL of Application Nos. 1438-1, 1439-1, 1440-1, and 1441-1 with qualifications because 1) unappropriated water is available, 2) existing rights will not be unlawfully impaired, 3) it is a beneficial use of water and 4) it is in the public interest. These applications will be considered by the Water Management Board in Room 216, Joe Foss Building, 523 E Capitol, Pierre SD on July 27, 1988 at 10:00 am. The Chief Engineer's recommendation is not final or binding upon the Board. The Board is authorized to 1) approve, 2) approve with qualifications, 3) defer or 4) deny these applications based on the facts presented at the public hearing.

Any interested person that intends to participate in the hearings before the Board by presenting evidence or cross-examining witnesses according to SDCL 1-28, must file a written petition with BOTH the applicant and Chief Engineer by July 15, 1988. The Chief Engineer's address is "Water Rights Division, Foss Building, 523 E

Capitol, Pierre SD 57501 (605 773-3352)". The petition may be informal, but must include a statement describing the petitioner's interest in an application, the petitioner's reasons for opposing or supporting an application and the signature and mailing address of the petitioner or legal counsel if legal counsel is obtained. The applicant need not file a petition. Contact the Water Rights Division to request information on these applications or to assure access to the hearing by the handicapped.

These hearings are adversary proceedings. Any person filing a petition and/or the applicant have the right to be represented by a lawyer. These and other due process rights will be forfeited if not exercised. Decisions of the Board may be appealed to the Circuit Court and State Supreme Court as provided by law. The time of the hearings will also be automatically delayed for at least twenty days upon written request to the Chief Engineer from the applicant or a petitioner. The request for a delay must be received by July 15, 1988.

These applications are made pursuant to SDCL 46-1-1 thru 46-1-9, 46-1-12 thru 46-1-15; 46-2-3.1, 46-2-9, 46-2-11, 46-2-13, 46-2-17; 46-2A-1 thru 46-2A-10, 46-2A-12, 46-2A-14, 46-2A-15; 46-5-1 thru 46-5-11, 46-5-13 thru 46-5-15, 46-5-24, 46-5-25, 46-5-30.2, 46-5-30.4, 46-5-31; 46-6-3, 46-6-3.1, 46-6-6.1, 46-6-10, 46-6-13, 46-6-14; and Board Rules ARSD 74:02:01:01 thru 74:02:01:15.

B-142

June 30

July 7

July 19, 1988
(date)

page 1

Parties of Record before Water Management Board regarding Water Permit
Application No. 1439-1, Golden Reward Mining Company

For:

Peter Erickson, Manager
Golden Reward Mining Company
PO Box 888
Lead SD 57754
represented by:
Max Main, attorney
618 State Street
Belle Fourche SD 57717

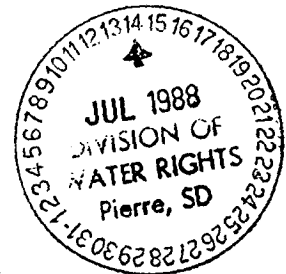
Interested:

Richard Beringson, Secretary
SD Dept. of Game, Fish + Parks
445 East Capitol
Anderson Building
Pierre SD 57501

South Dakota
**Department of
Game, Fish and Parks**

Office of the Secretary
Sigurd Anderson Building
445 East Capitol
Pierre, South Dakota 57501
(605) 773-3387

July 14, 1988



Mr. John Hatch, Chief Engineer
Division of Water Rights
S.D. Department of Water & Natural Resources
Joe Foss Building
Pierre, SD 57501

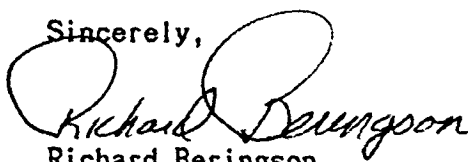
Dear Mr. Hatch:

Pursuant to the notice provided by the Chief Engineer, the South Dakota Department of Game, Fish and Parks intends to be a party to water right claims 1438-1, 1439-1, 1440-1, and 1441-1, Golden Reward Mining Co.

GF&P is an interested and potentially affected party by virtue of statutory authority to manage fish and wildlife resources of the state (SDCL Chapter 41). The pending water right claim could affect the quantity of water available for natural resource management.

Thank you for the opportunity to comment on this pending water right application.

Sincerely,


Richard Beringson
Secretary

RB/RK/ld

cc: Golden Reward Mining Co.

 **Department of
Water & Natural Resources**

Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

August 23, 1988

1438-1
1439-1

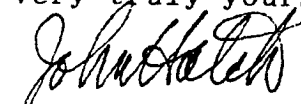
John C. Gould
Chief Mine Engineer
Golden Reward Mining Company
P.O. Box 888
Lead, SD 57754

Dear Mr. Gould:

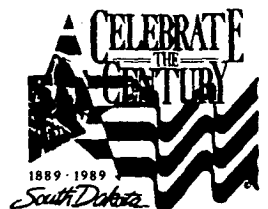
We have reviewed your design for the Parshall Flume, the bypass weir (for measurement of higher flows) and continuous recorder to measure the flows on Stewart Gulch. The design of the structure is acceptable to us. The installation of the structure as designed will meet the flow measurement condition required in the qualifications adopted by the Water Management Board for Water Permit Nos. 1438-1 and 1439-1.

Thank you for providing us with this information.

Very truly yours,



JOHN HATCH, Chief Engineer
Water Rights Division
605 773-3352





Department of Water & Natural Resources

Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501

Water Rights Division
605 773-3352

NOV 23 1988

Golden Reward Mining Company
PO Box 888
Lead, South Dakota 57754

Dear Sir:

Enclosed herewith is your Water Permit No. 1439-1 as approved by the Water Management Board authorizing you to construct your water diversion system and the water to beneficial use, not exceeding the limits as specified in said Water Permit No. 1439-1.

Also enclosed is Form 10, Notice of Completion of Works and Application of Water to Beneficial Use, which you are to complete and submit to the Chief Engineer when you have completed the system and/or have put the water to beneficial use. An inspection can then be scheduled so that your Water License may be issued to you, thus completing your acquisition of a Water Right.

Very truly yours,

A handwritten signature in black ink, appearing to read "John Hatch". The signature is written in a cursive, flowing style.

JOHN HATCH, Chief Engineer
Water Rights Division

JH:ms

enclosure

PLEASE NOTE: Certain changes can be made in your permit within the five year construction period, usually without affecting the priority date provided an application to amend your permit is made within the five year period-i.e. changes in location or number of diversion points (wells) or location of land to be irrigated. Well locations for wells into the same aquifer can be moved up to 660 feet without application.

Applications to amend a permit after the five year construction period will be assigned a new priority date. Applications to change water sources, to add lands or increase original diversion rates, if approved will usually receive the date of the new application as a priority date regardless of the five year construction period.

WNR-809-5/83

THE
GOLDEN REWARD
MINING COMPANY



September 8, 1989

Mr. John Hatch
DWR - Water Rights Division
Joe Foss Building
523 East Capitol
Pierre, SD 57501-3181

RE: Water Permit No. 1438-1 and 1439-1

Dear John:

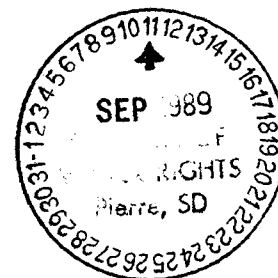
Enclosed is the completed Form 10, Notice of Completion of Works and Application of Water to Beneficial Use for Water Permit No. 1438-1 (well PW-5) and Water Permit No. 1439-1 (well PW-1). Please call me at 584-2010 to schedule an inspection so that a Water License may be issued to complete GRMC's acquisition of a Water Right for wells PW-5 and PW-1.

Sincerely,


CAROL KOERNER
Public Affairs Manager

Enc.

XC: Bob Polak



NOTICE OF COMPLETION OF WORKS AND
APPLICATION OF WATER TO BENEFICIAL USE

Date September 7, 1989

TO: Water Rights Division, DWNH
Joe Foss Building
Pierre SD 57501-3181

FROM: The Golden Reward Mining Co. P.O. Box 888 Lead, SD 57754
name address city

I have completed the construction of the water diversion system and I have put the water to beneficial use to the maximum extent it is going to be used.* I have not exceeded the amounts specified in Water Permit No. 1439-1.

Water Permit No. 1439-1 states that the diversion system is to be constructed by July 27, 1993, and that the water it put to beneficial use by July 27, 1997.

The diversion system was completed on August 8, 1989.
Applying the water to beneficial use was completed on August 8, 1989.

You may schedule an inspection so that the Water License may be issued.

R. J. Polch
signature

* The well has been put to beneficial use; however, it is not at maximum extent.

FOR YOUR INFORMATION:

Golden Reward has changed their address. We are not moving, we are just having our mail delivered to the mine site rather than the post office. Our stationary will not change at this time.

Please replace 'P.O. Box 888' with the following:

Golden Reward
HC 37 Box 1020
Lead, SD 57754

Our physical address will remain the same:

Fantail Creek Road #41
Lead, SD 57754

Thank you for your attention to this adjustment.

BENNETT & MAIN

A PROFESSIONAL CORPORATION
ATTORNEYS AT LAW

DONN BENNETT
MAX MAIN
JOHN R. FREDERICKSON



618 STATE STREET
BELLE FOURCHE, SOUTH DAKOTA 57717-1489
TELEPHONE (605) 892-2011
FAX (605) 892-4084

July 28, 1992

Chief Engineer
Water Rights Division, DENR
523 East Capitol
Pierre, SD 57501-3181

RE: Water Permits 1438-1, 1439-1, 1440-1, and 1447-1.

Dear Chief Engineer:

Enclosed are NOTICES OF TRANSFER OF OWNERSHIP for each of the above-referenced Water Permits. Also enclosed is a check in the amount of \$10 as payment of the \$2.50 filing fee for each of the four notices.

The Water Permits are being transferred from The Golden Reward Mining Company to The Golden Reward Mining Company, L.P. However, please note, as stated in the Exhibit A attached to each Notice, that the transfer shall only be effective upon completion of Closing of the purchase and sale transaction between MinVen Gold Corporation/Matrix Financial Inc. and Wharf Resources Ltd. You will receive joint written confirmation of that Closing.

Should you have any questions, please do not hesitate to contact me.

Sincerely yours,

BENNETT & MAIN, P.C.

Max Main
Max Main

MM/ra

Encs.

pc w/encs.: Carol Koerner
Richard F. Mauro, Esq.
James S. Nelson, Esq.
John A. Lawson

RECEIPT

413356

Division of Water Rights
South Dakota Department of Environment and Natural Resources

Pierre, _____ July 29, 19 92

RECEIVED OF The Golden Reward Mining Company, Box 888, Lead, SD 57754-0888

the following amount in fees for services rendered as provided by law:

Fee for Application for Permit No. _____ to Appropriate Water, to construct
and to put water to beneficial use _____

Fee for Application for Permit No. _____ to Appropriate Water, for Future
Use _____

Fee to retain Future Use Permit No. _____ after period of _____ years.

Fee for Inspecting Constructed Works, confirming beneficial use and issuing Water
License No. _____

Fee for Filing Transfer Form Permit No. 1440-1

Fee for Filing Extension Request _____

Fee for _____

(Any Other Work Provided by Law)

Total

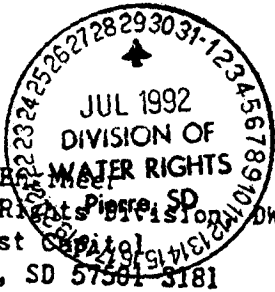
2 50

By

Chief Engineer

JOHN HATCH

gm



NOTICE OF TRANSFER OF OWNERSHIP

No. _____

TO: Chief Executive Officer
Water Rights Division
523 East Capitol
Pierre, SD 57501-3181

Date: July 13, 1992

I, We request that Water Permit/Right No. 1439-1

formerly owned by: The Golden Reward Mining Company

be transferred to: (name & address) The Golden Reward Mining Company, L.P.

P.O. Box 888, Lead, South Dakota 57754 (telephone No.) (605) 584-2010

Title to the following described land(s)/property has been transferred as described above:

SEE ATTACHED EXHIBIT A: Transferor's property located in NW 1/4 SE 1/4 Section 7,

T4N, R3E, BHM

I/We understand that the validity of Water Permit/Right No. 1439-1 has not been determined by this transfer action. If I/We have any questions on validity, I/We understand that only the Water Management Board has the authority to determine if a water permit/right is valid (see note).

You are requested to file this "Notice of Transfer" in the appropriate file at the Division of Water Rights, as evidence of the change of ownership.

A fee of Two Dollars and Fifty Cents (\$2.50) is attached to cover the filing fees as required under SDCL 46-2-13.

CANADA
Province of Ontario
Judicial District of York
City of Toronto

} ss.

I/We Rolando Francisco being first duly sworn on my oath depose and say that my relation to the above described undertaking is that of Owner, that I have read the above foregoing statement, and that I know of my own personal knowledge that the information herein stated is true.

[Signature]
(Signed)

Subscribed and sworn to before me this 21st day of July, 19 92.

[Signature]
(Notary Public)

In and for the Province of Ontario
My Commission does not expire

NOTE: Water permits may be cancelled for nonconstruction within the five year construction period. Once a water permit is developed and the water used, the permit becomes a water right. A water right may be lost for three reasons:

1. Abandonment - no intent to use water and use is abandoned.
2. Forfeiture - no use of water for three year period without legal excuse.
3. For a third violation of a condition of a water permit/right.

EXHIBIT A



This transfer is to be effective upon the completion of closing of the purchase and sale transaction between MinVen Gold Corporation/Matrix Financial Incorporated and Wharf Resources Limited, at which time, the new owner will be The Golden Reward Mining Company, L.P., P.O. Box 888, Lead, South Dakota 57754. Upon the completion of said closing, the parties shall provide joint written confirmation of the closing.

BENNETT & MAIN
A PROFESSIONAL CORPORATION
ATTORNEYS AT LAW

DONN BENNETT
MAX MAIN
JOHN R. FREDERICKSON



618 STATE STREET
BELLE FOURCHE, SOUTH DAKOTA 57717-1489
TELEPHONE (605) 892-2011
FAX (605) 892-4084

September 11, 1992

Chief Engineer
Water Rights Division
Department of Environment and Natural Resources
Joe Foss Bldg., 523 East Capitol
Pierre, SD 57501-3181

RE: Transfer of Water Permits 1438-1, 1439-1, 1440-1,
and 1447-1; Our Schedule 2, Items 8 and 9; The
Golden Reward Mining Company to Golden Reward Mining
Company Limited Partnership; Our File 2011.128092.

Dear Sir:

In the July 13, 1992 notice of transfer that was forwarded to you with my cover letter dated July 28, 1992, we indicated that the transfer to the Golden Reward Mining Company Limited Partnership would become effective only upon completion of the Closing of the purchase and sale transaction between MinVen Gold Corporation/Matrix Financial Inc. and Wharf Resources, Ltd.

This letter serves as an update that the Closing is now scheduled to be completed in October. As part of our final preparations for the Closing, would you please confirm to me in writing that you did receive my July 28 cover letter with enclosed July 13 notice of transfer, and that everything is in order for the transfer to occur upon completion of the Closing?

As previously advised, we will provide joint written confirmation of the Closing, at which time we will request your written acknowledgment of receipt of the confirmation and your further acknowledgment that the above permits have then been transferred to Golden Reward Mining Company Limited Partnership.

Thank you for your cooperation in this matter.

Sincerely yours,

BENNETT & MAIN, P.C.

Max Main
Max Main

MM/ea
pc: Carol Koerner
James S. Nelson, Esq.

John A. Lawson
Roxanne Giedd



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE SOUTH DAKOTA 57501-3181

September 15, 1992

Max Main
BENNETT & MAIN, P.C.
Attorneys At Law
618 State Street
Belle Fourche, SD 57717-1489

RE: Transfer of Ownership on Water Permit Nos. 1438-1, 1439-1,
1440-1 and 1447-1

Dear Mr. Main:

The transfer of ownership forms for the above named permits were received July 29, 1992.

The transfer of ownership forms were completed properly and the permits can now be transferred. As your letter stated, the transfers will not be finalized until closing of the purchase and sale transaction between MinVen Gold Corporation/Matrix Financial Inc. and Wharf Resources, Ltd. Upon joint written confirmation, the transfers will be processed.

If you have any questions, please contact me.

Sincerely,

Genny McMath
Natural Resources Analyst
(605) 773-3352

BENNETT & MAIN
A PROFESSIONAL CORPORATION
ATTORNEYS AT LAW

DONN BENNETT
MAX MAIN
JOHN R. FREDERICKSON



618 STATE STREET
BELLE FOURCHE, SOUTH DAKOTA 57717-1489
TELEPHONE (605) 892-2011
FAX (605) 892-4084

October 8, 1992

Genny McMath, Natural Resources Analyst
c/o Office of the Chief Engineer
Water Rights Division
Department of Environment and Natural Resources
Joe Foss Bldg., 523 East Capitol
Pierre, SD 57501-3181

RE: Notice of Closing; Our File 2011.128092.

Dear Ms. McMath:

Please be advised that the Closing of the purchase and sale transaction between MinVen Gold Corporation/Matrix Financial Inc. and Wharf Resources Ltd. was completed October 8, 1992.

Pursuant to our prior communications, would you please acknowledge receipt of this notice and advise that Water Permits 1438-1, 1439-1, 1440-1, and 1447-1 are now transferred from GOLDEN REWARD MINING COMPANY to GOLDEN REWARD MINING COMPANY LIMITED PARTNERSHIP on the appropriate records of your Department.

In order to expedite matters, we are sending a duplicate copy of this letter to you for your acknowledgment, and we ask you to date and sign it and return to the undersigned in the enclosed self-addressed stamped envelope.

Sincerely yours,

BENNETT & MAIN, P.C.
Attorneys for Golden Reward Mining Company

Max Main

Max Main

GUNDERSON, PALMER, GOODSSELL & NELSON
Attorneys for Golden Reward Mining Company
Limited Partnership

James S. Nelson
James S. Nelson

RECEIPT

Receipt of the above Notice of Closing is hereby acknowledged, and Water Permits 1438-1, 1439-1, 1440-1, and 1447-1 are now transferred from GOLDEN REWARD MINING COMPANY to GOLDEN REWARD MINING COMPANY LIMITED PARTNERSHIP on the appropriate records of the Department of Environment and Natural Resources.

Dated this 9th day of October, 1992.

MMcra
Encs. (2)

cc: Carol Koerner

John A. Lawson

James S. Nelson

Roxanne Giedd

Genny McMath
GENNY McMATH, Natural Resources Analyst



**DEPARTMENT of ENVIRONMENT
and NATURAL RESOURCES**

JOE FOSS BUILDING
523 EAST CAPITOL
PIERRE, SOUTH DAKOTA 57501-3181
www.state.sd.us/denr

SEP 23 1998

1666-1

Golden Reward Mining Company, L.P.
%Tim Thomure
HC 37, Box 1020
Lead, SD 57754

Dear Mr. Thomure:

Enclosed is Water License No. 1666-1. This is the final water right document completing your process of obtaining a Water Right. Enclosed is Receipt No. 415861 in the amount of \$50.00 which you paid for the investigation and issuance of the Water License.

For your information SDCL 46-6-27 requires that if the owner of an existing well, such as the well authorized by Water Right No. 1666-1, constructs a replacement well and does not plan to use the old well, the old well is considered abandoned and must be plugged. Also, any well that is being used or is not considered abandoned must be valved and controlled, if flowing, or sealed and capped so that no leaking occurs either underground or at the surface.

As long as you use the water beneficially, as stated in the Water License, the State Water Laws provide that you have a continuing right to use the water. If you have any questions, please contact our office.

Very truly yours,

JOHN HATCH, Chief Engineer
Water Rights Program
(605) 773-3352

ks
enclosures

NOTE: The applicable portions of No. 1440-1, 1439-1 and 1438-1 have been incorporated into this Water License No. 1666-1.