# Beaver Creek Coal Company
# Mining and Reclamation Plan
# Gordon Creek No. 2
# and No. 7 Mines
# Volume 2

# *CHAPTER 4*

## *LAND STATUS, LAND-USE*
## *AND*
## *POST-MINING LAND -USE*

## TABLE OF CONTENTS

# CHAPTER 4
# LAND STATUS, LAND-USE AND POST-MINING LAND-USE

## 4.1 Scope

This section details surface and mineral ownership as well as lease holders or easement holders, or other pending options or interests in lands which are contiguous to or within the area covered by the permit.

The existing regional and site specific land use as well as the possible impacts which may occur during and after mining to the land-use and socio-economy are considered.

## *4.2 Methodology*

*All information documenting land status has been acquired from information on file with the ARCO Coal Company Land Department, contacts with various governmental agencies, and also through independent land checks complete by consulting land brokers.*

## *4.3 Land Status*

### *4.3.1 Surface Land Status*

*Tables 4-1, 4-1a, 4-2 and 4-2a (numerically cross referenced) identify the current ownership, rights-of-way, easements, leases, special use permits, water rights, and surface managing authorities for all property in and contiguous to the permit area. Figure 4-1 shows the location of the subject tracts.*

### *4.3.2 Mineral Status*

*Tables 4-1, 4-1a, 4-2 and 4-2a also identify coal, oil and gas, and other mineral leases and ownership for the mine area. Figure 4-2 shows the locations of the subject tracts.*

### *4.3.3 Pending Interests*

*Mountain Coal Company does not own any lands or interests in lands contiguous to the area to be covered by the permit. Mountain Coal Company does not hold any options or pending bids on lands or interests in lands contiguous to the area to be covered by the permit.*

Table 4-1 Surface and Mineral Land Status

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Margaret Peirce Grant (19)<br>Catherine Peirce Jewkes (27)<br>Movell A. Jewkes (28) | ALL<br>United States of America (55) | COAL<br>Beaver Creek Coal Company (2)<br>OIL & GAS<br>Hawthorn Oil Company (21) | United States of America (56) | MORTGAGE<br>Peggy Ann Peirce(44)<br>RIGHT-OF-WAY<br>Mt. States Telephone & Telegraph Company (35)<br>WATER<br>Margaret P. Grant(19)<br>Peggy Ann Peirce(44)<br>Catherine Jewkes(27) |

GRID CO-ORD.
Sec. 7 T 13S R 8E
Descr. S½SW¼, NW¼SW¼
Within permit area

Table 4-1 Surface and Mineral Land Status (continued)

Gordon Creek

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Helper Associates (22) | COAL<br>United States of America (55)<br><br>MINERALS OTHER THAN COAL<br>State of Utah (54) | COAL<br>Beaver Creek Coal Company (2)<br><br>OIL & GAS<br>Husky Oil Company (23) | United States of America (56)<br><br>State of Utah (54)<br><br>ORR - OIL & GAS<br>Energetics, Inc. (14)<br><br>Alfred Ching (9) | WATER<br>Helper Associates (22) |

GRID CO-ORD.
Sec. 12 T 13S R 7E.
Descr. S½NE¼, NE¼SE¼, S½SE¼, SE¼NW¼, SE¼SW¼.
Within permit area

Table 4-1 Surface and Mineral Land Status (continued)

Gordon Creek #2

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Helper Associates (22) | ALL<br>United States of America (55) | COAL<br>Beaver Creek Coal Company (2)<br><br>OIL & GAS<br>Hawthorn Oil Company (21)<br><br>Husky Oil Company (23) | United States of America (56)<br><br>ORR - OIL & GAS<br>Donald Ogilvie (40)<br><br>Estate of John E. Oakason (38)<br><br>Energetics, Inc. (14)<br><br>Alfred Ching (9) | |

GRID CO-ORD.

Sec. 12 T 13S R 7E

Descr. N½NE¼, NW¼SE¼, NE¼SW¼, NE¼NW¼.

Within Permit area

Table 4-1 Surface and Mineral Land Status (continued)

Gordon Creek #2

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Helper Associates (22) | ALL<br>United States of America (55) | COAL<br>Beaver Creek Coal Company (2)<br><br>OIL & GAS<br>Hawthorn Oil Company (21)<br>Husky Oil Company (23) | United States of America (56)<br><br>ORR - OIL & GAS<br>Donald Ogilvie (40)<br>Estate of John E. Oakason (38)<br>Energetics, Inc. (14)<br>Alfred Ching (9) | WATER<br>Helper Associates (22) |

GRID CO-ORD.

Sec. 13 T 13S R 7E

Descr. NE¼NE¼, N½NW¼NE¼, N½S½NW¼NE¼.

Within permit area

Table 4-1

SURFACE AND MINERAL OWNERSHIP

| Surface Owner(s) | Mineral Owner(s) | Leasehold Interest(s) | Royalty Interest(s) | Rights-of-Way Easement(s) & Miscellaneous |
|---|---|---|---|---|
| G. Pete Frandsen (7) | All<br><br>United States of America (21)<br><br>Minerals Other than Coal<br><br>State of Utah (23) | Beaver Creek Coal Company (1) | United States of America (21) | |

Sec.: 13, T13S, R7E
Descr.: SE¼SW¼
Within Permit Area

Table 4-

SURFACE AND MINERAL OWNERSHIP

| Surface Owner(s) | Mineral Owner(s) | Leasehold Interest(s) | Royalty Interest(s) | Rights-of-Way Easement(s) & Miscellaneous |
|---|---|---|---|---|
| G. Pete Frandsen (7) | <u>All</u><br><br>United States of America (21) (22) | <u>Oil & Gas</u><br><br>Lawrence C. Harris (9)<br><br><u>Coal</u><br><br>Beaver Creek Coal Company (1) | United States of America (21) (22) | |

Sec.: 13, T13S, R7E
Descr.: NE¼SW¼
Within Permit Area

Table 4-1

SURFACE AND MINERAL OWNERSHIP

| Surface Owner(s) | Mineral Owner(s) | Leasehold Interest(s) | Royalty Interest(s) | Rights-of-Way Easement(s) & Miscellaneous |
|---|---|---|---|---|
| Helper Associates (11) | <u>Coal</u> | <u>Coal</u> | State of Utah (23) | <u>Water</u> |
| | United States of America (21) | Beaver Creek Coal Company (1) | United States of America (21) | Helper Associates (11) |
| | <u>Minerals Other than Coal</u> | <u>Oil & Gas</u> | <u>ORR - Oil & Gas</u> | |
| | | Husky Oil Company (12) | Energetics, Inc. (5) | |
| | State of Utah (23) | | Alfred Ching (3) | |

Sec.: 13, T13S, R7E

Descr.: E½NW¼
Within Permit Area

Sec.: 13 & 24 T13S, R7E

Descr.: Sec. 13 SE¼, S½NE¼ and S½NW¼NE¼; Sec. 24 N½NE¼ Within Permit Area

Table 4-1

SURFACE AND MINERAL OWNERSHIP

| Surface Owner(s) | Mineral Owner(s) | Leasehold Interest(s) | Royalty Interest(s) | Rights-of-Way Easement(s) & Miscellaneous |
|---|---|---|---|---|
| Helper Associates (11) | All<br><br>United States of America (21) (22) | Coal<br><br>Beaver Creek Coal Company (1)<br><br>Oil & Gas<br><br>Exxon Company, USA (6)<br><br>Lawrence C. Harris (9) | United States of America (21) (22)<br><br>ORR<br><br>Lawrence C. Harris (9) | Mountain Fuel Supply Company (16)<br><br>Utah Natural Gas Company (25) |

Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Carbon County (7) | <u>COAL</u><br>Marilyn C. Halamandaris (20)<br>Carolyn C. Bushman (5)<br>Roselyn Colombo (13)<br>Frank V. Colombo, Jr. (12)<br><br><u>MINERALS OTHER THAN COAL</u><br>Carbon County (7) | <u>COAL</u><br>Beaver Creek Coal Company (2) | <u>COAL</u><br>Marilyn C. Halamandaris (20)<br>Carolyn C. Bushman (5)<br>Roselyn Colombo (13)<br>Frank V. Colombo, Jr. (12) | <u>EASEMENTS</u><br>Weyland U. & Jessie L. Ewing (15)<br><u>WATER</u><br>E. E. Peirce, Jr. (43)<br><u>RIGHT-OF-WAY</u><br>Milton A. & Odell M. Oman (41 & 42) |
| Carbon County Road No. 129 | <u>COAL</u><br>Wasatch Coal Company<br><br><u>MINERALS OTHER THAN COAL</u><br>Carl Nyman | None | None | County Road Right-of-Way |

GRID CO-ORD.
Sec. 17 T 13S R 8E
Descr. SW¼SW¼, Portions of SE¼ SW¼ and NW¼ SW¼ (county road)
Within permit area

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Margaret Peirce Grant (10)<br>Catherine Peirce Jewkes (27)<br>Movell A. Jewkes (28) | COAL<br>United States of America (55)<br>MINERALS OTHER THAN COAL<br>Lucille Tingley (52)<br>Reese Llewellyn (33)<br>Max R. Llewellyn (32)<br>Leslie L. Llewellyn (31)<br>Jack R. Llewellyn (30)<br>Lota Carlson (8)<br>Yvonne Piper (45) | COAL<br>Beaver Creek Coal Company (2) | United States of America (56) | MORTGAGE<br>Peggy Ann Peirce (44)<br>WATER<br>Margaret P. Grant (19)<br>Peggy Ann Peirce (44)<br>Catherine Jewkes (27) |

GRID CO-ORD.
Sec. 18 T 13S R 8E
Descr. Lots 1, 3, 4, NE¼NW¼.
Within permit area

Table 4-1 Surface and Mineral
Land Status (continued)

Gordon Creek #2

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| D. E. Jenkins (26)<br>C. K. Jacob & Sons Partnership(25) | COAL<br>United States of America (55)<br>MINERALS OTHER THAN COAL<br>State of Utah (54) | COAL<br>Beaver Creek Coal Company (2)<br>OIL & GAS<br>Hawthorn Oil Company (21) | United States of America (56)<br>State of Utah (54) | RIGHT-OF-WAY<br>Mountain States Telephone & Telegraph Co. (35) |

GRID CO-ORD.
Sec. 18 T 13S R 8E
Descr. SE¼NE¼
Within Permit Area

Table 4-1 Surface and Mineral Land Status (continued)

Gordon Creek #2

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| C. K. Jacob & Sons Partnership (25) | ALL<br>United States of America (55) | COAL<br>Beaver Creek Coal Company (2)<br><br>OIL & GAS<br>Hawthorn Oil Company (21) | United States of America (56)<br><br>ORR - OIL & GAS<br>R. K. O'Connell (39) | RIGHT-OF-WAY<br>Mt. States Telephone & Telegraph (35)<br><br>WATER<br>Sweet Coal Company (50)<br><br>Helen Marakis (34) |

GRID CO-ORD.
Sec. 18 T 13S R 8E
Descr. Lot 2, SE¼NW¼, W½NE¼, NE¼SW¼.
Within permit area

Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Calvin K. Jacob & Sons Partnership(25) | COAL<br>Marilyn C. Halamandaris (20)<br>Carolyn C. Bushman(5)<br>Roselyn Colombo(13)<br>Frank V. Colombo, Jr.(12)<br><br>MINERALS OTHER THAN COAL<br>United States of America (55) | COAL<br>Beaver Creek Coal Company (2) | COAL<br>Frances Skaggs (48)<br>William Roger Skaggs(49)<br>Marilyn C. Halamandaris (20)<br>Carolyn C. Bushman (5)<br>Roselyn Colombo (13)<br>Frank V. Colombo, Jr. (12) | WATER<br>Helen Marakis(34) |

GRID CO-ORD.
Sec. 18 & 19 T 13S R 8E
Descr. 18: SE¼, SE¼SW¼;
19: NW¼NE¼, NE¼NW¼.
Within Permit Area

Table 4-1

SURFACE AND MINERAL OWNERSHIP

| Surface Owner(s) | Mineral Owner(s) | Leasehold Interest(s) | Royalty Interest(s) | Rights-of-Way Easement(s) & Miscellaneous |
|---|---|---|---|---|
| Calvin K. Jacob & Sons Partnership (13) | All<br><br>United States of America (21)(22) | Oil & Gas<br><br>Hawthorn Oil Company (10) | United States of America (22)<br><br>ORR - Oil & Gas<br><br>R. K. O'Connell (17) | Water<br><br>Helen Marakis (15) |

Sec.: 19, T13S, R8E

Descr.: Lots 1 and 2 SE¼NW¼ Within Permit Area

Table 4-1 Surface and Mineral
Land Status (continued)

Gordon Creek #2

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Carbon County (7) | COAL<br>Marilyn C. Halamandaris (20)<br>Carolyn C. Bushman(5)<br>Roselyn Colombo (13)<br>Frank V. Colombo, Jr. (12)<br><br>MINERALS OTHER THAN COAL<br>Carbon County (7) | COAL<br>Beaver Creek Coal Company (2) | COAL<br>Frances Skaggs (48)<br>William Roger Skaggs(49)<br>Marilyn C. Halamandaris (20)<br>Carolyn C. Bushman (5)<br>Roselyn Colombo(13)<br>Frank V. Colombo, Jr. (12) | EASEMENTS<br>Weyland U. & Jessie L. Ewing (15)<br><br>RIGHT-OF-WAY<br>Milton A. & Odell M. Oman (41 & 42)<br><br>WATER<br>Sweet Coal Company (50)<br>E. E. Peirce, Jr. (43) |

GRID CO-ORD. ______
Sec. 19 T 13S R 8E
Descr. E½NE¼, SW¼NE¼, NW¼SE¼, N½SW¼.
Within permit area

12/15/92

Table 4-1

SURFACE AND MINERAL OWNERSHIP

| Surface Owner(s) | Mineral Owner(s) | Leasehold Interest(s) | Royalty Interest(s) | Rights-of-Way Easement(s) & Miscellaneous |
|---|---|---|---|---|
| G. Pete Frandsen (7) | <u>All</u><br>United States of America (21) (22) | <u>Coal</u><br>Beaver Creek Coal Company (1)<br><u>Oil & Gas</u><br>Lawrence C. Harris (9) | <u>Coal - Oil & Gas</u><br>United States of America (21) (22) | Mountain Fuel Supply Company (16)<br>Utah Natural Gas Company (25) |

Sec.: 24, T13S, R7E
Descr.: NE¼NW¼
Within Permit Area

Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Helper Associates (22) | COAL<br>United States of America (55)<br>MINERALS OTHER THAN COAL<br>State of Utah (54) | COAL<br>Atlantic Richfield Company (Exploration License) (1)<br>OIL & GAS<br>Husky Oil Company (23) | State of Utah (54)<br>ORR - OIL & GAS<br>Energetics, Inc. (14)<br>Alfred Ching (9) | WATER<br>Helper Associates (22) |

GRID CO-ORD.
Secs. 1,12,13 T 13S R 7E
Descr. 1: S½S½;
12: SW¼NW¼, SW¼SW¼;
13: N½NW¼.
Contiguous to permit area

Table 4-1 Surface and Mineral Land Status (continued)

Gordon Creek #2

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Helper Associates (22) | ALL<br>United States of America (55) | COAL<br>Atlantic Richfield Company (Exploration License) (1)<br><br>OIL & GAS<br>Hawthorn Oil Company (21)<br>Husky Oil Company (23) | United States of America (56)<br><br>ORR - OIL & GAS<br>Donald Ogilvie (40)<br>Estate of John E. Oakason (38)<br>Energetics, Inc. (14)<br>Alfred Ching (9) | |

GRID CO-ORD.
Sec. 12 T 13S R 7E
Descr. NW¼NW¼, NW¼SW¼
Contiguous to permit are

Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Helper Associates (22) | ALL<br>United States of America (55) | COAL<br>Atlantic Richfield Company (Exploration License) (1)<br><br>OIL & GAS<br>Husky Oil Company (23) | United States of America (56)<br><br>ORR- OIL & GAS<br>Donald Ogilvie (40)<br>Estate of John E. Oakason (38)<br>Energetics, Inc. (14)<br>Alfred Ching (9) | GRID CO-ORD.<br>Sec. 13 T 13S R 7E<br>Descr. S½S½NW¼NE¼, S½NE¼, E½SE¼.<br>Contiguous to permit are |

Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Helper Associates (22) | COAL<br>United States of America (55)<br>MINERALS OTHER THAN COAL<br>Helper Associates (22) | COAL<br>Atlantic Richfield Company (Exploration License) (1) | | |

GRID CO-ORD.
Sec. 13 T 13S R 7E
Descr. SE¼NW¼
Contiguous to permit area

# Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Helper Associates(22) | ALL<br>United States of America (55) | OIL & GAS<br>Husky Oil Company (23) | United States of America (56)<br>ORR - OIL & GAS<br>Donald Ogilvie(40)<br>John E. Oakason Estate(38)<br>Energetics, Inc.(14)<br>Alfred Ching(9) | WATER<br>Helper Associates (22) |

GRID CO-ORD.
Sec. 24 T 13S R 7E
Descr. E½NE¼.
Contiguous to permit area

Table 4-1 Surfa.. and Mineral Land Status (continued)

Gordon Creek #2

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Margaret Peirce Grant (19)<br>Catherine Peirce Jewkes (27)<br>Movell A. Jewkes (28) | COAL<br>United States of America (55)<br>MINERALS OTHER THAN COAL<br>Lucille Tingley (52)<br>Reese Llewellyn (33)<br>Max R. Llewellyn (32)<br>Leslie L. Llewellyn (31)<br>Jack R. Llewellyn (30)<br>Lota Carlson (8)<br>Yvonne Piper (45) | COAL<br>Wasatch Coal Company (subject to Purchase Contract in favor of Utah Coal & Chemicals Corporation(53) & mining lease to C & W Coal Producers Corp.(6) ) (57) | United States of America (56)<br>Wasatch Coal Company (57) | NET PROFITS INTEREST<br>J. Pierce Gannon, Jr.(18)<br>Leroy Collard(11)<br>Benjamin H. Swig (51)<br>Ralph D. Rooney(47)<br>Bonanza Coal Limited(4)<br>EASEMENT FOR PASSAGEWAY<br>Beaver Creek Coal Company (2)<br>LIENS ON BONANZA'S INTERES<br>Paul S. Rogers & William Jorgensen dba Star Valley Associates (46)<br>LMC Resources, Ltd.(29)<br>Jessie T. Beuhler (3)<br>Richard E. Nilsson (36)<br>Larry E. Clark (10) |

GRID CO-ORD.

Sec. 7 T 13S R 8E

Descr. S½SE¼

Contiguous to permit are

Gordon Creek #2

Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Margaret Peirce Grant (19)<br>Catherine Peirce Jewkes (27)<br>Movell A. Jewkes (28) | ALL<br>United States of America (55) | OIL & GAS<br>Hawthorn Oil Company (21) | United States of America (56)<br>ORR - OIL & GAS<br>R. K. O'Connell (39) | |

GRID CO-ORD.

Sec. 7 T 13S R 8E

Descr. S½NW¼, NE¼SW¼, NW¼SE¼.

Contiguous to permit are

Sec.: 13 & 14, T13S, R7E

Descr.: Sec. 13: W½SW¼
Sec. 14: SE¼SE¼
Contiguous to Permit Area

| Surface Owner(s) | Mineral Owner(s) | Leasehold Interest(s) | Royalty Interest(s) | Rights of Way Easement(s) & Miscellaneous |
|---|---|---|---|---|
| G. Pete Frandsen (7) | All<br><br>United States of America (21) (22) | Coal<br><br>Kanawha & Hocking Coal & Coke Company (14)<br><br>Oil & Gas<br><br>Lawrence C. Harris (9) | United States of America (21) (22) | |

Table 4-1a

SURFACE AND MINERAL OWNERSHIP

| Surface Owner(s) | Mineral Owner(s) | Leasehold Interest(s) | Royalty Interest(s) | Rights-of-Way Easement(s) & Miscellaneous |
|---|---|---|---|---|
| Helper Associates (11) | Coal<br>United States of America (21)<br>Minerals Other than Coal<br>State of Utah (22) | Coal<br>Kanawha & Hocking Coal & Coke Company (14) | United States of America (21) | |

Sec.: 13 & 14, T13S, R7E

Descr.: Sec. 13: W½NW
Sec. 14: E½NE
and NE¼SE¼
Contiguous to Permit Area

Table 4-1 Surface and Mineral Land Status (continued)

Gordon Creek #2

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Eldred E. Peirce, Jr. (43) | COAL<br>United States of America (55)<br><br>MINERALS OTHER THAN COAL<br>State of Utah(54) | COAL<br>Wasatch Coal Company (subject to purchase contract in favor of Utah Coal & (53)Chemicals Corporation and mining lease to C & W Producers Corp.(6))(57)<br><br>OIL & GAS<br>Hawthorn Oil Company(21) | United States of America (56)<br><br>Wasatch Coal Company(57)<br><br>State of Utah(54) | NET PROFITS INTEREST<br>J. Pierce Gannon, Jr.(18)<br>Leroy Collard(11)<br>Benjamin H. Swig(51)<br>Ralph D. Rooney(47)<br>Bonanza Coal Limited(4)<br><br>LIENS ON BONANZA'S INTERES<br>Paul S. Rogers & William Jorgensen dba Star Valley Associates(46)<br>LMC Resources, Ltd.(29)<br>Jessie T. Beuhler (3)<br>Richard E. Nilsson(36)<br>Larry E. Clark (10) |

GRID CO-ORD.

Sec. 17 T 13S R 8E

Descr. NW¼NW¼

Contiguous to Permit area

Table 4-1 Surface and Mineral Land Status (continued)

Gordon Creek #2

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Calvin K. Jacob & Sons Partnership(25) | COAL<br>Wasatch Coal Company (subject to Purchase Contract in favor of Utah Coal & Chemicals Corporation(53))(57)<br><br>MINERALS OTHER THAN COAL<br>State of Utah (54) | COAL<br>C & W Coal Producers Corp.(6)<br><br>OIL & GAS<br>Hawthorn Oil Company(21) | Wasatch Coal Company (57)<br><br>State of Utah (54) | WATER<br>Helen Marakis (34)<br><br>NET PROFITS INTEREST<br>J. Pierce Gannon, Jr.(18)<br>Leroy Collard (11)<br>Benjamin H. Swig (51)<br>Ralph D. Rooney(47)<br>Bonanza Coal Limited (4)<br><br>LIENS ON BONANZA'S INTEREST<br>Paul S. Rogers & William Jorgensen dba Star Valley Associates(46)<br>LMC Resources, Ltd.(29)<br>Jessie T. Beuhler(3)<br>Richard E. Nilsson(36)<br>Larry E. Clark(10) |

GRID CO-ORD.
Sec. 17 T 13S R 8E
Descr. SW¼NW¼
Contiguous to Permit Area

12/15/92

Table 4-1 Surface and Mineral Land Status (continued)

Gordon Creek #2

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Carl Nyman(37) | COAL<br>Wasatch Coal Company (subject to Purchase contract in favor of Utah Coal & Chemicals Corporation(53))(57)<br><br>MINERALS OTHER THAN COAL<br>Carl Nyman(37) | COAL<br>C & W Coal Producers Corp.(6) | Wasatch Coal Company (57) | NET PROFITS INTEREST<br>J. Pierce Gannon, Jr.(18)<br>Leroy Collard (11)<br>Benjamin H. Swig(51)<br>Ralph D. Rooney(47)<br>Bonanza Coal Limited(4)<br><br>RIGHT-OF-WAY<br>Milton A. & Odell M. Oman(41 & 42)<br><br>LIENS ON BONANZA'S INTEREST<br>Paul S. Rogers & William Jorgensen dba Star Valley Associates(46)<br>LMC Resources, Ltd.(29)<br>Jessie T. Beuhler(3)<br>Richard E. Nilsson (36)<br>Larry E. Clark(10) |

GRID CO-ORD.
Sec. 17 T 13S R 8E
Descr. S½SE¼SW¼
Contiguous to Permit area

Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Wasatch Coal Company (subject to Purchase Contract in favor of Utah Coal & Chemicals Corporation(53))(57) | ALL<br>Wasatch Coal Company (subject to Purchase Contract in favor of Utah Coal & Chemicals Corporation(53))(57) | COAL<br>C & W Coal Producers Corp. (6) | Wasatch Coal Company (57) | WATER<br>United States of America (55)<br><br>NET PROFITS INTEREST<br>J. Pierce Gannon, Jr.(18)<br>Leroy Collard(11)<br>Benjamin H. Swig (51)<br>Ralph D. Rooney(47)<br>Bonanza Coal Limited(4)<br><br>LIENS ON BONANZA'S INTEREST<br>Paul S. Rogers & William Jorgensen dba Star Valley Associates (46)<br>LMC Resources, Ltd. (29)<br>Jessie T. Beuhler (3)<br>Richard E. Nilsson (36)<br>Larry E. Clark (10) |

GRID CO-ORD.

Sec. 17 & 20 T 13S R 8E

Descr. 17: N½SW¼, N½SE¼SW¼.

20: NE¼NW¼

Contiguous to Permit Area

Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Calvin K. Jacob & Sons Partnership (25) | COAL<br>United States of America (55)<br><br>MINERALS OTHER THAN COAL<br>State of Utah (54) | COAL<br>Wasatch Coal Company (subject to purchase contract in favor of Utah Coal and Chemicals (53) Corporation and mining lease to C&W Coal Producers Corp. (6) ) (57)<br><br>OIL & GAS<br>Hawthorn Oil Company (21) | United States of America (56)<br><br>Wasatch Coal Company (57)<br><br>State of Utah (54) | WATER<br>Helen Marakis (34)<br><br>NET PROFITS INTEREST<br>J. Pierce Gannon, Jr. (18)<br>Leroy Collard (11)<br>Benjamin H. Swig (51)<br>Ralph D. Rooney (47)<br>Bonanza Coal Limited (4)<br><br>LIENS ON BONANZA'S INTEREST<br>Paul S. Rogers & William Jorgensen dba Star Valley Associates (46)<br>LMC Resources, Ltd (29)<br>Jessie Beuhler (3)<br>Richard E. Nilsson (36)<br>Larry E. Clark (10) |

GRID CO-ORD.
Sec. 18 T 13S R 8E
Descr. NE¼NE¼
Contiguous to Permit are

Gordon Creek #2

Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| United States of America (55) | <u>ALL</u><br>United States of America (55) | <u>OIL & GAS</u><br>Hawthorn Oil Company (21)<br><br><u>GRAZING</u><br>Calvin Jacob (24) | United States of America (56)<br><br><u>ORR - OIL & GAS</u><br>R. K. O'Connell (39) | |

GRID CO-ORD.
Sec. 19 T 13S R 8E
Descr. E½SE¼, SW¼SE¼, SE¼SW¼.
Contiguous to Permit are

12/15/92

Gordon Creek #2

## Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Calvin K. Jacob & Sons Partnership(25) | ALL<br>United States of America(55) | OIL & GAS<br>Hawthorn Oil Company(21) | United States of America (56)<br>ORR - OIL & GAS<br>R. K. O'Connell (39) | WATER<br>Helen Marakis(34) |

GRID CO-ORD. ______
Sec. 19 T 13S R 8E
Descr. Lots 1 & 2, SE¼NW¼.
Contiguous to Permit are

Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Carbon County (7) | COAL<br>Marilyn C. Halamandaris (20)<br>Carolyn C. Bushman (5)<br>Roselyn Colombo (13)<br>Frank V. Colombo, Jr. (12)<br>MINERALS OTHER THAN COAL<br>Carbon County (7) | | | |

GRID CO-ORD.
Sec. 19 T 13S R 8E
Descr. Lot 4
Contiguous to permit are

Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| Calvin K. Jacob & Sons Partnership(25) | ALL<br>United States of America (55) | OIL & GAS<br>Hawthorn Oil Company (21) | United States of America (56)<br><br>ORR - OIL & GAS<br>R. K. O'Connell(39) | |

GRID CO-ORD.
Sec. 20 T 13S R 8E
Descr. SW¼NW¼, NW¼SW¼
Contiguous to Permit Area

Table 4-1 Surface and Mineral Land Status (continued)

| Surface Owner (s) | Mineral Owner (s) | Leasehold Interest | Royalty Interests | ROW-Easement & Miscellaneous |
|---|---|---|---|---|
| G. Pete & Betty Rae Frandsen(16) | COAL<br>United States of America(55)<br><br>MINERALS OTHER THAN COAL<br>State of Utah (54) | OIL & GAS<br>Hawthorn Oil Company(21) | State of Utah(56) | WATER<br>Pete Frandsen(17) |

GRID CO-ORD. ___

Sec. 20 T 13S R 8E

Descr. NW¼NW¼

Contiguous to permit area

Sec.: 23 & 24, T13S, R7E

Descr.: Sec. 23: E½NE¼ NE¼SE¼; Sec. 24: NW¼NW¼ S½NW¼ and N½SW¼ Contiguous to Permit Area

Table 4-1

SURFACE AND MINERAL OWNERSHIP

| Surface Owner(s) | Mineral Owner(s) | Leasehold Interest(s) | Royalty Interest(s) | Rights-of-Way Easement(s) & Miscellaneous |
|---|---|---|---|---|
| G. Pete Frandsen (7) | <u>All</u><br><br>United States of America (21) (22) | <u>Coal</u><br><br>Kanawha & Hocking Coal & Coke Company (14)<br><br><u>Oil & Gas</u><br><br>Lawrence C. Harris (9) | United States of America (21) (22) | Mountain Fuel Supply Company (16)<br><br>Utah Natural Gas Company (25) |

Table 4-1

SURFACE AND MINERAL OWNERSHIP

| Surface Owner(s) | Mineral Owner(s) | Leasehold Interest(s) | Royalty Interest(s) | Rights-of-Way Easement(s) & Miscellaneous |
|---|---|---|---|---|
| Helper Associates (11) | <u>All</u><br><br>United States of America (21) (22) | <u>Oil & Gas</u><br><br>Lawrence C. Harris (9) | United States of America (21) (22) | Mountain Fuel Supply Company (16)<br><br>Utah Natural Gas Company (25) |

Sec.: 24, T13S, R7E
Descr.: S½NE¼ and N½SE¼
Contiguous to Permit Area

### TABLE 4-2
### Names and Address
### Holders of Legal Interests

1. Atlantic Richfield Company
   P.O. Box 5300
   Denver, Colorado 80217

2. Mountain Coal Company
   P.O. Box 591
   Somerset, Colorado 81434

3. Jessie T. Beuhler
   c/o Morgan Scally & Davis
   261 E. 300 South, 2nd Floor
   Salt Lake City, Utah 84111

4. Bonanza Coal Limited
   c/o Moffat, Welling,
   Paulsen & Birmingham
   143 South Main Street
   Salt Lake City, Utah 84111

5. Carolyn C. Bushman
   4220 Greenbriar Avenue
   Long Beach, California 90808

6. C & W Coal Producers Corp.
   Address Unknown

7. Carbon County
   Courthouse Building
   Price, Utah 84501

8. Lota Carlson
   Address Unknown

9. Alfred Ching
   4150 Papu Circle
   Honolulu, Hawaii 96813

10. Larry E. Clark
    c/o Morgan Scally & Davis
    261 E. 300 South, 2nd Floor
    Salt Lake City, Utah 84111

11. Leroy Collard
    Address Unknown

12. Frank V. Colombo, Jr.
    647 26 1/2 Road
    Grand Junction, CO 81501

13. Roselyn Colombo
    414 2nd Street, Apt. 234
    Hermosa Beach, CA 80110

14. Energetics, Inc.
    333 West Hampden Avenue
    Englewood, Colorado 80110

15. Weyland U. & Jessie L. Ewing
    1333 Emigration Circle
    Salt Lake City, Utah 84101

16. G. Pete & Betty Ray Frandsen
    9267 Tortellini Drive
    Sandy, Utah 84070

17. Pete Frandsen
    Tooele, Utah 84074

18. J. Pierce Gannon, Jr.
    3842 Quail Hollow Drive
    Salt Lake City, Utah 84109

19. Margaret Pierce Grant
    c/o Catherine Jewkes
    730 N. 4th East
    Price, Utah 84501

20. Marilyn C. Halamandaris
    10216 Flintridge Drive
    Villa Park, CA 92667

21. Hawthorn Oil Company
    Box 2693
    Casper, Wyoming 82601

22. Helper Associates
    c/o S.V. Litizzette
    178 South Main Street
    Helper, Utah 84526

TABLE 4-2
(continued)

23. Husky Oil Company
600 S. Cherry Street
Denver, Colorado 80222

24. Calvin Jacob
754 S. Cherry Drive
Orem, Utah 84057

25. Calvin K. Jacob & Sons
Partnership
754 S. Cherry Drive
Orem, Utah 84057

26. D.E. Jenkins
Address Unknown

27. Catherine Peirce Jewkes
730 N. 4th East
Price, Utah 84501

28. Movell A. Jewkes
c/o Reese Llewellyn
2588 Elizabeth
Salt Lake City, Utah 84101

29. LMC Resources, Ltd.
Address Unknown

30. Jack R. Llewellyn
c/o Reese Llewellyn
Salt Lake City, Utah 84101

31. Leslie L. Llewellyn
c/o Reese Llewellyn
2588 Elizabeth
Salt Lake City, Utah 84101

32. Max R. Llewellyn
c/o Reese Llewellyn
2588 Elizabeth
Salt Lake City, Utah 84101

33. Reese Llewellyn
2588 Elizabeth
Salt Lake City, Utah 84101

34. Helen Marakis
165 E. First South
Price, Utah 84501

35. Mt. States Telephone
& Telegraph Company
931 14th Street
Denver, Colorado 80202

36. Richard E. Nilsson
c/o Joseph S. Knowlton
455 East 45th Street
Salt Lake City, Utah 84117

37. Carl Nyman
4260 Olympus View Drive
Salt Lake City, Utah 84117

38. John E. Oakason Estate
Box 194
Salt Lake City, Utah 84111

39. R.K. O'Connel
Box 2003
Casper, Wyoming 83601

40. Donald Ogilvie
Box 784
East Liverpool, Ohio 43920

41. Milton A. Oman
717 Continental Bank Bldg.
Salt Lake City, Utah 84100

42. Odell M. Oman
864 So. Grand Avenue
Moses Lake, WA

43. Eldred E. Peirce, Jr.
Rt. 1, Box 143
Price, Utah 84501

*TABLE 7-2*
*(continued)*

45. *Yvonne Piper*
    *Address Unknown*

46. *Paul S. Rogers & Williams*
    *Jorgensen dba Star Valley*
    *Associates*
    *c/o Howard, Lewis & Petersen*
    *P.O. Box 778*
    *Provo, Utah 84601*

47. *Ralph D. Rooney*
    *Executive Office*
    *Fairmont Hotel*
    *San Francisco, California 84101*

48. *Frances Skaggs*
    *P.O. Box 275*
    *Helper, Utah 84526*

49. *William Roger Skaggs*
    *P.O. Box 536*
    *Price, Utah 84501*

50. *Sweet Coal Company*
    *Continental Bank Building*
    *Salt Lake City, Utah 84101*

51. *Benjamin H. Swig*
    *Executive Offices*
    *Fairmont Hotel*
    *San Francisco, California 94101*

52. *Lucille Tingley*
    *Address Unknown*

53. *Utah Coal & Chemicals Corporation*
    *c/o J. Pierce Gannon, Jr.*
    *3842 Quail Hollow Drive*
    *Salt Lake City, Utah 84109*

54. *State of Utah*
    *Division of State Lands*
    *Department of Natural Resources*
    *105 State Capital Building*
    *Salt Lake City, Utah 84114*

55. *Bureau of Land Management*
    *Moab District Office*
    *Price River Resource Area*
    *P.O. Drawer AB*
    *Price, Utah 84501*

56. *United States of America*
    *U.S. Geological Survey*
    *2040 Administration Bldg.*
    *1745 West 1700 South*
    *SLC, Utah 84104*

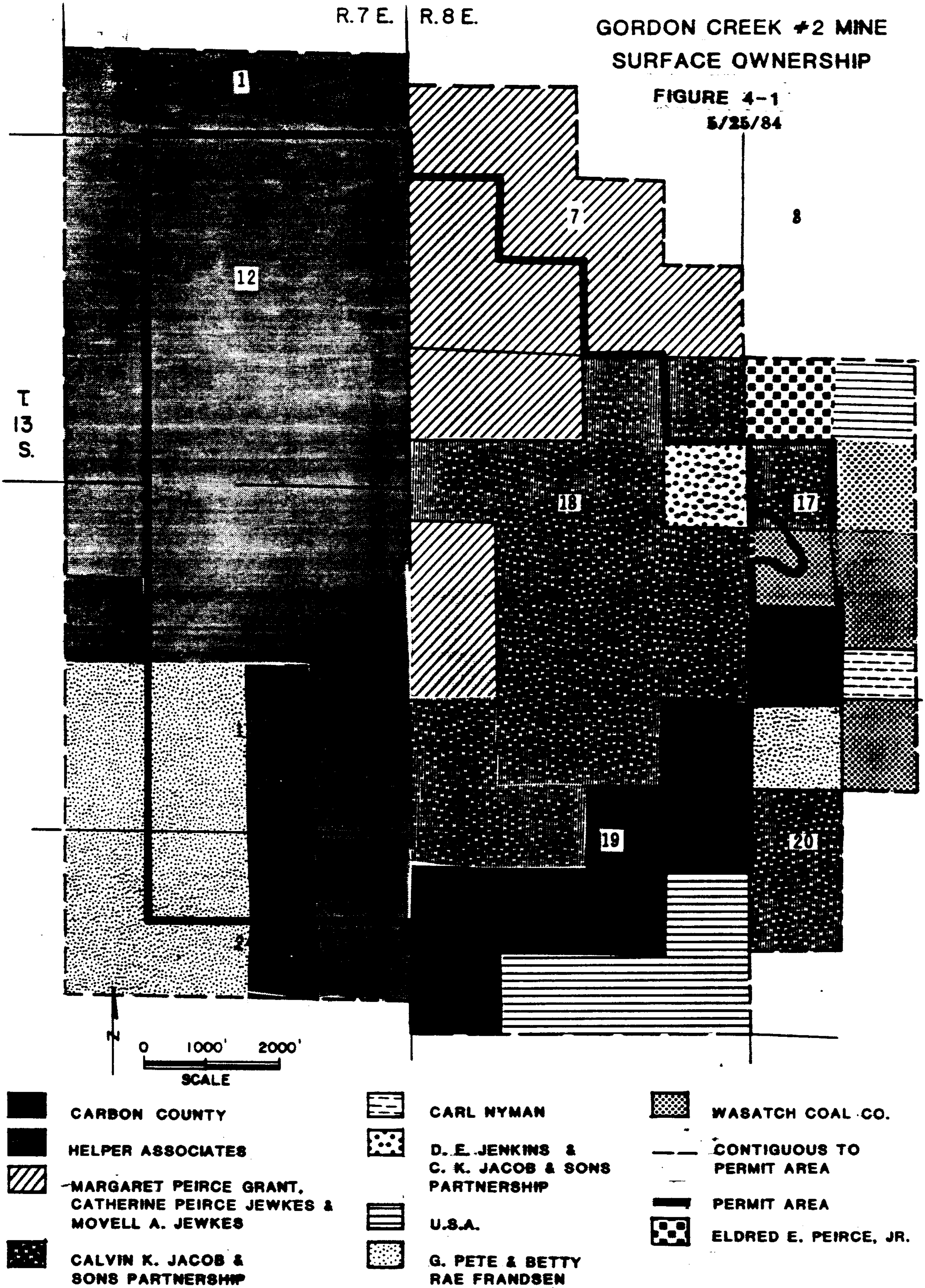
57. *Wasatch Coal Company*
    *c/o George N. Cannan Co.*
    *Mtg. Rep.*
    *1322 Chandler Dr.*
    *SLC, Utah 84103*

TABLE 4-2A
MASTER ADDRESS LIST

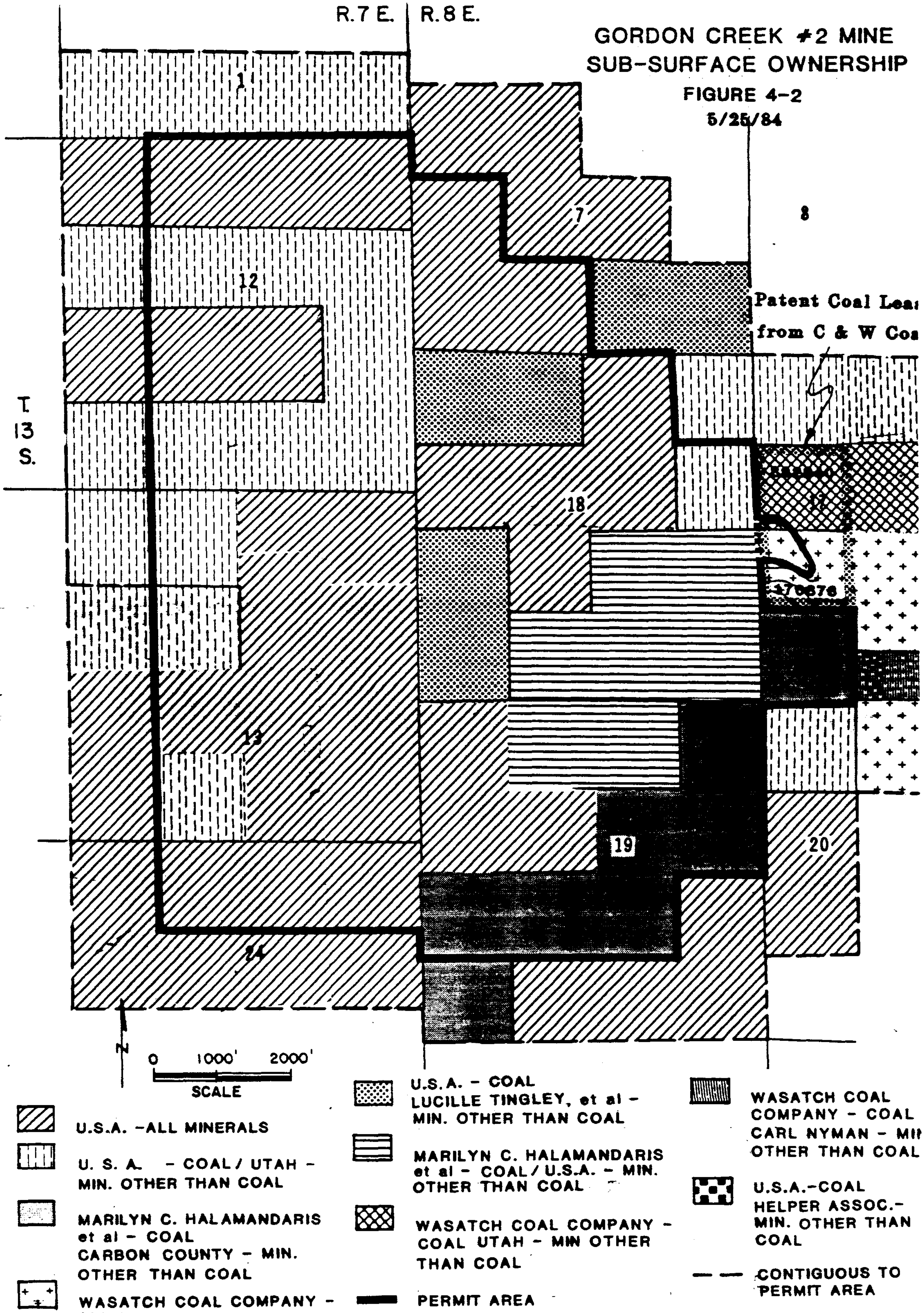
| | |
|---|---|
| 1. Mountain Coal Company<br>555 17th Street<br>Denver, Colorado 80202 | 12. Husky Oil Company<br>600 S. Cherry Street<br>Denver, Colorado 80222 |
| 2. C&W Coal Producers Corp.<br>% Buck Wilkerson<br>American Plaza III, Suite 490<br>47 West Second South<br>Salt Lake City, Utah 84101 | 13. Calvin K. Jacob & Sons Partnership<br>754 S. Cherry Drive<br>Orem, Utah 84057 |
| 3. Alfred Ching<br>4150 Papu Circle<br>Honolulu, Hawaii 96813 | 14. Kanawha & Hocking Coal & Coke Company<br>% Valley Camp of Utah, Inc.<br>Scofield Route<br>Helper, Utah 84526 |
| 4. Leroy Collard<br>3840 Quail Hollow<br>Salt Lake City, Utah 84109 | 15. Helen Marakis<br>165 E. First South<br>Price, Utah 84501 |
| 5. Energetics, Inc.<br>333 W. Hampden Avenue<br>Englewood, California 80110 | 16. Mountain Fuel & Supply Co. |
| 6. Exxon Company, U.S.A.<br>PO Box 120<br>Denver, Colorado 80201 | 17. R.K. O'Connel<br>Box 2003<br>Casper, Wyoming 83601 |
| 7. G. Pete Frandsen<br>9267 Tortellini Drive<br>Sandy, Utah 84070 | 18. Elder E. Pierce, Jr<br>Route 1, Box 143<br>Price, Utah 84501 |
| 8. J. Pierce Gannon, Jr<br>3842 Quail Hollow Drive<br>Salt Lake City, Utah 84109 | 19. Ralph D. Rooney<br>Executive Office<br>Fairmont Hotel<br>San Francisco, CA. 84101 |
| 9. Lawrence C. Harris<br>PO Box 1714<br>Roswell, New Mexico 88201 | 20. Benjamin H. Swig<br>Executive Office<br>Fairmont Hotel<br>San Francisco, CA. 84101 |
| 10. Hawthorn Oil Company<br>Box 2693<br>Casper, Wyoming 82601 | 21. Untied States of America<br>Bureau of Land Management<br>Moab District Office<br>Price River Resource Area<br>PO Box AB<br>Price, Utah 84501 |
| 11. Helper Associates<br>% S.V. Litizzette<br>178 South Main Street<br>Helper, Utah 84526 | |

TABLE 4-2A
(continued)

| | |
|---|---|
| 22. United States of America<br>U.S. Geological Survey<br>2040 Administration Building<br>1745 West 1700 South<br>Salt Lake City, Utah 84104 | |
| 23. State of Utah<br>Division of State Lands<br>Department of Natural Resources<br>105 State Capital Building<br>Salt Lake City, Utah 84114 | |
| 24. Utah Coal & Chemicals Corp.<br>% Gen. Stanley R. Larsen<br>220 Montgomery, Suite 1080<br>San Francisco, CA. 94104 | |
| 25. Utah Natural Gas Company | |
| 26. Wastach Coal Company<br>% George N. Cannon Co.<br>Mtg. Rep.<br>1322 Chandler Drive<br>Salt Lake City, Utah 84103 | |


R.7 E.
R.8 E.
GORDON CREEK #2 MINE
SURFACE OWNERSHIP
FIGURE 4-1
5/25/84
T.
13
S.
1
12
7
8
18
17
19
20
0 1000' 2000'
SCALE
CARBON COUNTY
HELPER ASSOCIATES
MARGARET PEIRCE GRANT, CATHERINE PEIRCE JEWKES & MOVELL A. JEWKES
CALVIN K. JACOB & SONS PARTNERSHIP
CARL NYMAN
D. E. JENKINS & C. K. JACOB & SONS PARTNERSHIP
U.S.A.
G. PETE & BETTY RAE FRANDSEN
WASATCH COAL CO.
CONTIGUOUS TO PERMIT AREA
PERMIT AREA
ELDRED E. PEIRCE, JR.

12-15-92


R.7 E.
R.8 E.
GORDON CREEK #2 MINE
SUB-SURFACE OWNERSHIP
FIGURE 4-2
5/25/84
T.
13
S.
1
7
8
12
18
17
13
19
20
24
Patent Coal Lea
from C & W Coa
170676
0 1000' 2000'
SCALE
N
U.S.A. -ALL MINERALS
U. S. A. - COAL / UTAH - MIN. OTHER THAN COAL
MARILYN C. HALAMANDARIS et al - COAL CARBON COUNTY - MIN. OTHER THAN COAL
WASATCH COAL COMPANY - ALL MINERALS
U.S.A. - COAL LUCILLE TINGLEY, et al - MIN. OTHER THAN COAL
MARILYN C. HALAMANDARIS et al - COAL / U.S.A. - MIN. OTHER THAN COAL
WASATCH COAL COMPANY - COAL UTAH - MIN OTHER THAN COAL
PERMIT AREA
WASATCH COAL COMPANY - COAL CARL NYMAN - MI OTHER THAN COAL
U.S.A.-COAL HELPER ASSOC.- MIN. OTHER THAN COAL
CONTIGUOUS TO PERMIT AREA

12-15-92

### *4.3.4 Legal Right to Enter*

*Figure 4-3 shows the boundaries of land within the proposed permit area upon which the applicant has the legal right to enter and conduct coal mining activities.*

*The documents which give the applicant the legal right to enter and begin mining activities in the permit area are as follows:*

1. *Federal Coal Lease #U-8319, dated March 1, 1970, from the United States of America, lessor and Ura Swisher, lessee, assigned to Swisher Coal Co. (now Mountain Coal Company) approved effective May 1, 1976, as modified April 5, 1976 and March 26, 1980, covering all coal located in the following described lands:*

   *Township 13 South, Range 8 East, SLM*

   *Section 18: Lots 1-4, NW 1/4 NE 1/4, S 1/2 NE 1/4, E 1/2 NW 1/4, NE 1/4 SW 1/4.*

   *Township 13 South, Range 7 East, SLM*

   *Section 12: E 1/2, E 1/2 W 1/2;*

   *Section 13: NE 1/4 NE 1/4, N 1/2 NW 1/4 NE 1/4, N 1/2 S 1/2 NW 1/4 NE 1/4.*

   *Lessee has the right "to use so much of the surface as may reasonably be required in the exercise of the rights and privileges herein granted..."*

2. Permit to mine coal pursuant to a letter from U.S. Department of Interior - Geological Survey, dated November 28, 1972, covering coal in the following described lands:

   Township 13 South, Range 8 East, SLM

   Section 7: W 1/2 SW 1/4, SE 1/4 SW 1/4

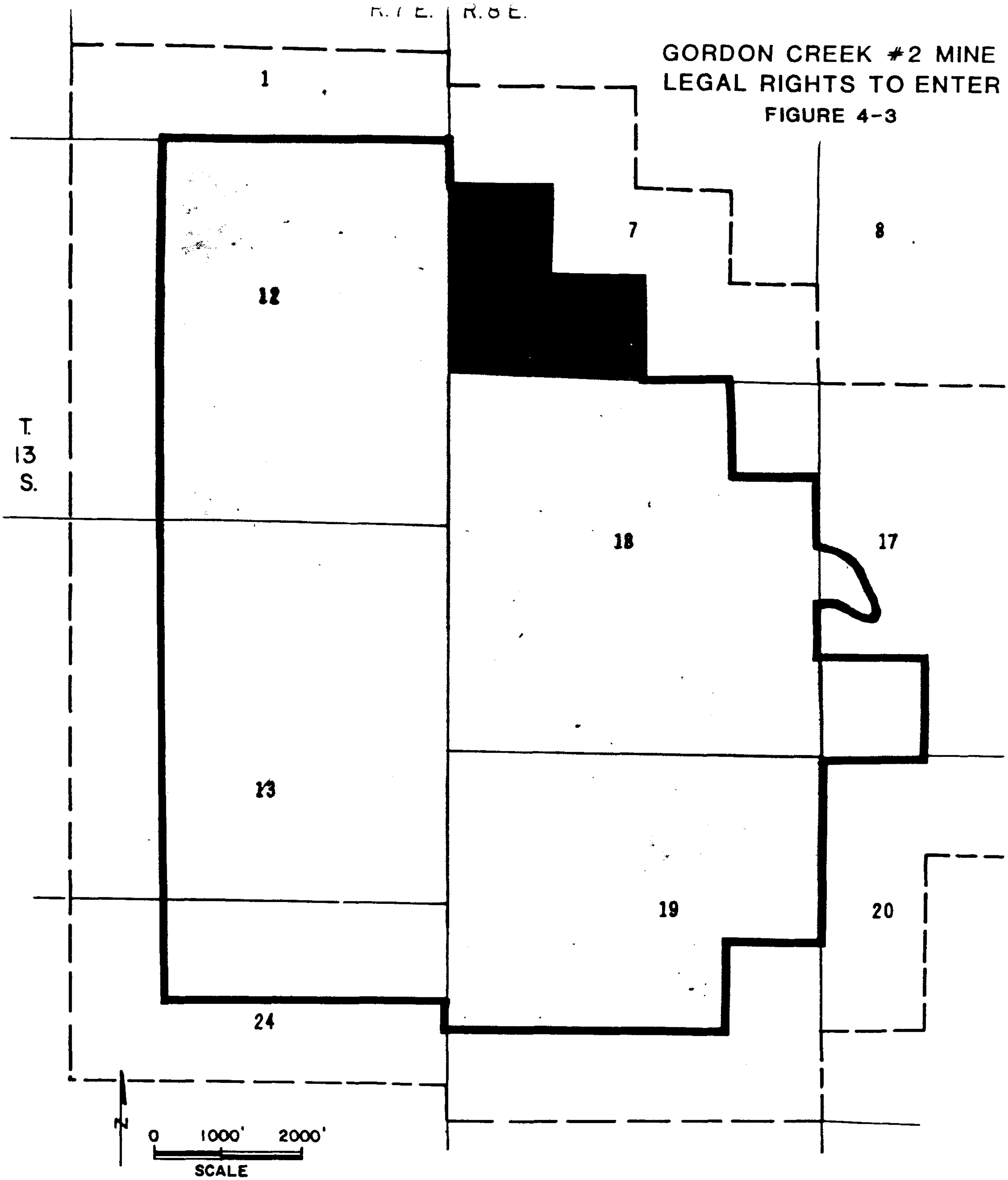
3. Gordon Creek Mining Lease, Dated April 19, 1967 from F.V. Colombo, M.D., lessor, to Ura Swisher Lessee, assigned to Swisher Coal Co. (now Mountain Coal Company) June 8, 1967, as amended September 25, 1975 by Marilyn C. Halamandaris, Carolyn C. Bushman, Roselyn Colombo and Frank V. Colombo, Jr., as lessors, and Swisher Coal Co., as lessee, covering coal, surface rights of ingress and egress thereto, and the right to mine coal (not including strip mining) in the following described lands:

   Township 13 South, Range 8 East, SLM

   Section 17: SW 1/4 SW 1/4
   Section 18: SE 1/4, SE 1/4 SW 1/4
   Section 19: NE 1/4, NE 1/4 NW 1/4, N 1/2 SW 1/4, NW 1/4 SE 1/4

4. Agreement Dated April 19, 1978 between Utah Coal and Chemicals Corporation, grantor, and Swisher Coal Company ( now Mountain Creek Coal Company), grantee, whereby grantee has the right to construct and use a passageway within the SW 1/4 SE 1/4 of Section 7, Township 13 South, Range 8 East, SLM, for the purpose of ingress and egress to grantee's adjacent property for the hauling of coal.

GORDON CREEK #2 MINE
LEGAL RIGHTS TO ENTER
FIGURE 4-3




PERMIT TO MINE FROM U.S.A.

COAL LEASED BY MOUNTAIN COAL COMPANY (INCLUDING RIGHTS TO USE SURFACE)

PERMIT AREA

CONTIGUOUS TO PERMIT AREA

5. *Agreement dated July 3, 1975 between Carbon County and Swisher Coal Company (now Mountain Coal Company), as amended August 18, 1975 whereby Carbon County grants Swisher the right to use the County Road formerly designated as State Highway 139 in its coal mine operation without any restriction as to weight, size of vehicles or type of use.*

6. *Federal Coal Lease U-47975 dated December 1, 1981, from the United States of America, lessor and Kanawha and Hocking Coal Company as lessee. Partial assignment of said lessee was made by Kanawha and Hocking Coal Company to Beaver Creek Coal Company (now Mountain Coal Company) on October 28, 1982; the Partial Assignment of said Federal Coal Lease was made June 6, 1983; and the new lease created was assigned Serial No. U-3159. Lands assigned are described as follows:*

   *Township 13 South, Range 7 East, SLM*

   *Section 13: S 1/2 S 1/2 NW 1/4 NE 1/4, S 1/2 NE 14, E 1/2 W 1/2, SE 1/4*

   *Section 24: N 1/2 NE 1.4, NE 1/4 NW 1/4*

   *Township 13 South, Range 8 East, SLM*

   *Section 19: Lots 1 and 2, SE 1/4 NW 1/4*

   *Containing 656.05 acres.*

7. Sublease agreement (October, 1983) with C&W Coal Producers Corporation (formerly Wasatch Coal) for mining on 80-acres of the following coal lands:

Township 13 South, Range 8 East, SLM

Section 17, SW 1/4, NW 1/4, NW 1/4, SW 1/4

#### 4.3.5 Associated Surface Mining

The surface operations associated with underground coal mining activities do not involve the surface mining of coal. The private mineral estate to be mined (coal) has not been severed from the private surface estate.

## 4.4 Existing Land Use

### 4.4.1. Regional Land Use

Agricultural

Irrigated lands are common throughout the region. More recently, part of the irrigation water is being consumed by growing communities. This has not affected tillage rotation operations appreciably.

Historically, the livestock industry has played an important part of the region's economy. Early settlers depended on range land for grazing sheep, cattle and horses. Presently, the trend is towards more cattle grazing and fewer sheep. Typically, ranchers conduct their operations adjacent to the grazing area. The BLM and USFS lands are used extensively for grazing.

*Forestry*

*Timber operations were once closely tied to ranch operations. Early settlers needed the timber for fences, corrals, mine timber, railroad ties, etc. In more recent years, the majority of the sawmills have closed due to less demand for wood products.*

*Current uses of forest products have changed somewhat since earlier times. The demand is now for fence-posts, poles, Christmas trees and sawtimber. Present levels of forest products use is in up-swing with population growth.*

*Recreation*

*A large variety of wildlife zones are present ranging from desert to high mountain forest. Large amounts of data are present for game species due to their economic value. Mule deer are the most abundant big game in the region. Deer populations are low and rangelands are improving.*

*Winter range for deer is the most limiting factor for expansion at the present time. Hunting is expected to rise in popularity as population in Carbon and Emery Counties increase. Mule deer and elk are popular big game species that are hunted.*

*Lakes, streams and rivers of this region provide habitat for 40 varieties of fishes. Rainbow, cut-throat, brown and brook trout are some of the better known game fish pursued by fishermen.*

*In addition to hunting and fishing, USFS and BLM provide lands for a variety of recreational activities in this region. They include camping, hiking, pioneering, snowmobiling, snow skiing, etc.*

### *4.4.2 Mine Plan Area Land Use*

#### *Past and Present Land Use*

*The land on which No. 2/7/8 Mines are located has long been used for coal mining. Other than coal mining, this area has been used for deer hunting, sightseeing and hiking. There are no developed campgrounds or public roads within the area and none planned for the future.*

*Private landowners presently administer the lands in this area for limited livestock forage. Wildlife habitat, watershed, dispersed recreation and coal mining are also land uses. There are no range improvements on the area. Access to the lease tract is limited to jeep trails into the higher elevations leading to Beaver Creek which is above the No. 2/ 7/8 Mine leases. There are no plans to alter this access situation.*

*The above described uses of this land are primarily the same for stream valleys, steep slopes or flats, hilltop areas, with the exception of coal mining, which is located on the slope and beneath the hilltop areas.*

### *4.4.3 Affect of Operation on Land Use and Mitigation measures*

*The surface disturbance created by the mining operations at No. 2/7/8 Mines is limited to what is presently disturbed. Therefore, the potential to affect the land use is discussed below.*

*The surface disturbance at the No. 2/7/8 Mines consists for the most part of access and haul roads that service the mining operation. There will be little impact on rangeland as the mine plan area is below areas used for summer grazing by private landowners.*

*The cultural resources survey showed that there are four dilapidated cabins within the permit area. These cabins are considered sites used by various early inhabitants. There are no public roads or public parks in or near mining operations that would suffer adverse impacts from mining operations.*

*A series of two sedimentation ponds are constructed below the disturbed area to prevent sediment from entering Gordon Creek. A berm along the haul road, adjacent to Gordon Creek, prevents runoff from entering the stream.*

*Mining has been completed at this operation, and the site will be reclaimed upon approval. All roads will be eliminated, and a temporary, 3-celled sediment pond will be constructed to catch runoff and any sediment from the reclaimed area above.*

#### 4.4.4 Post-Mining Land Use

The post-mining land use is proposed to be the same as the pre-mining land use, namely: wildlife habitat. Stock grazing has been prevented at the site since the 1960's due to the steep terrain and fencing. The reclaimed area will be fenced to prevent stock grazing during the reclamation liability period.

The post-mining land use will be achieved by the return of the area to a natural state and through the use of the seed mixes and reclamation techniques as described in Section 3.5 of this application.

### 4.5 Post-Mining Land Uses

The post-mining uses of the land will be the same as the pre-mining and present uses described above. The disturbed areas will be reclaimed to a degree acceptable to the Division of Oil, Gas and Mining and the land will once again support its principle pre-mining uses: i.e., deer forage, hunting, sightseeing, watershed and hiking. Also private landowners will continue to graze sheep and cattle on areas near Beaver Creek, which is above the mine site.

The restoration of the area will be achieved by regrading the yards, reclaiming the roads and portal areas to a practical degree, planting all disturbed areas and monitoring the revegetation effort to the satisfaction of the Division of Oil, Gas and Mining.

## *4.6 Socio-Economic Considerations*

*The coal mining industry within Emery County has shown several erratic periods of renewed growth and sudden decline. During the 1950-1960 census period, the population of Emery County declined 8.79 percent. From 1960-1970, Emery County's Population declined .74 percent per year. From 1970 to 1975, the population increased from 5,137 to an estimated 6,7000 persons, a 23 percent increase.*

*Carbon and Emery Counties are economically dependent upon conditions in the coal market. This in evident by the slump in population of these counties that occurred between 1950-1970. The recent increase in coal mining has centered on Emery County where mining employment has increased over 210 percent from 1969 to 1980. The increase has been more modest in Carbon (40-50 percent).*

*As of this date, the mines have been closed and structures have been removed. Final reclamation of the site will occur upon Agency approval.*

# *CHAPTER 5*
# *CULTURAL AND PALEONTOLOGICAL RESOURCES*

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## *APPENDICES*

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## *5.1 Scope*

*All mining and site disturbance has been completed at this operation and all structures have been removed. The only future activity planned will be the final reclamation in 1993, and any necessary maintenance until bond release.*

*The entire permit area was intensively surveyed (ClassIII) in 1980 by the Utah Archaeological Research Corporation. During that survey, no sites were identified in the proposed disturbed areas. Four historical sites were found in the survey area; however, these were not near any of the disturbed areas planned for reclamation. (See Plate 5-1). The site report is included as Appendix 5-1.*

*There will be no additional disturbance at this site; therefore, there will be no impacts to the historical sites.*

## 5.2 *Methodology*

*The first phase of the project was to conduct a literature search in order to compile all previously known and recorded cultural information for the project area. Included in this phase of the project was an evaluation of all geological, physiographical, floral, and faunal information which might be pertinent to the understanding of the various cultures in the area.*

*Phase II of the project was an intensive archaeological field survey of the entire project area. Evenly spaced parallel transects were used by the consultants where possible. On extremely steep terrain of the project area, different survey methods were used. Because of the nature of the historical sites found during this phase of the project, it was possible to conduct interviews with persons familiar with the history of the immediate area in order to gather specific information pertaining to these sites. This was accomplished after the field work had been done. This report includes the results of both phases of the project, plus appendices containing archaeological site information and locations.*

## 5.3 *Archaeological Resources*

### 5.3.1 *Archaeological Literature Review and Summary*

*Human activity in the Castle Valley area extends over a period beginning as much as 12,000 years ago and lasting until the present. Human exploitation patterns are governed by different levels of technological development and the ways these technologies are applied in extracting development and the ways these technologies are applied in extracting resources from a changing ecological system.*

*These economic and technological changes through time are the key to understanding cultural dynamics in the Castle Valley area.*

*Prehistoric human activity in the Castle Valley area can be divided into four phases: Paleo Indian, Archaic, Fremont and Numic.*

*Paleo Indian*

*The Paleo Indian phase is represented by a lifestyle geared toward the hunting of the now extinct pleistocene mammals such a mammoth and giant bison (Bison antiquus). It dates from approximately 12,000 B.P. until 7000 B.P. and can be divided into three subphases: Llano, Folsom and Plano (Jennings, 1977).*

*The Llano culture dates from approximately 12,000 - 10,000 years ago and is characterized by the hunting of mammoths. Evidence for this culture is generally found in sites where these animals were killed and butchered, and bones along with hunting and butchering tools were left behind. Evidences for this subphase of the Paleo Indian culture in the Castle Valley area are scanty. One site, the Tripp site, yielded one Clovis point (Tripp, 1966). Other Clovis points have been reported from other parts of Utah (Lindsay, 1976, BLM files).*

*During the Folsom period (11,000 B.P. to 9000 B.P.), emphasis turned from the hunting of the rapidly diminishing mammoth to the Bison Antiquus. A smaller and thinner point, known as the Folsom Point, came into use at this time. As in the case of the Llano culture, evidence for the Folsom culture comes from kill and* *butchering sites. These sites are found predominantly on the high plains east of the Rocky Mountains, although many sites are found outside that area.*

*In the Castle Valley area, only one site has been found which might date to this period. Site 42Em8, also known as the Silverhorn Site, was excavated by Gunnerson in the 1950's (Gunnerson, 1956). One point which is very similar to the Folsom point was found by a local collector is an arroyo cut. Other materials from the site are very similar to materials taken from other Folsom sites.*

*Evidence for the Plano subphase (9000 B.P. to 7000 B.P.) is minimal in Utah. During this time, a great diversity of projectile points were manufactured and activity became restricted pretty much to an area east of the Rocky Mountains.*

*In summary, although there is very little evidence for Paleo Indian activity in the Castle Valley area, what evidence there is does show that this area was used by these early big game hunting people.*

*Archaic*

*Beginning about 8000 to 9000 years ago, the lifestyle of the aboriginal populations shifted from the hunting of big game animals to a dependence on smaller game animals and the gathering of wild plant foods. This period is known as the Archaic Phase and in the Castle Valley area can be divided into four sub-phases based on changes in both projectile point types and population densities (Schroedl, 1976).*

*The Black Knoll subphase lasted from approximately 8300 B.P. to 6200 B.P. and is characterized by two types of dart points, the Pinto and the Northern Side Notch (Schroedl, 1976). During this period, hunting was done with the atlatl (spear thrower) and the primary species utilized were deer and mountain sheep with some dependence on antelope and bison. A variety of wild plants and insects were also utilized. Caves and rockshelters were the main areas of occupation. Near the end of this phase, projectile points of the Elko series were introduced. Around 7200 B.P., there was an increase in population.*

*The Castle Valley subphase lasted from 6200 B.P. to 4500 B.P.. Subsistence strategies and the use of caves and rockshelters were essentially the same as in the Black Knoll subphase. The main difference between the two subphases is a change in projectile point types. During the Castle Valley subphase, points such as the Rocker Base, Sudden Side Notch and Hawken Side Notch appeared. Toward the end of the Castle Valley subphase, the Humboldt point become the dominant point style.*

*The Green River subphase began about 4500 B.P. and lasted until about 3300 B.P. Subsistence strategies appear to have continued basically unchanged from the previous subphase. The Humboldt point continued in use through this period but other points, such as the Gypsum and San Rafael Side Notch, became popular. During this time, the northeastern part of the Colorado Plateau received influence from the Plains.*

*The last subphase of the Archaic, Dirty Devil, lasted from approximately 3300 B.P. to 1500 B.P.. Subsistence activities during the early part of this period were essentially unchanged from the previous periods but, between 1600 B.P. and 2000 B.P., evidences of corn horticulture began to appear (Winter, 1973; Hurst, 1948, Jennings, in press). The Gypsum point continued to be the dominant projectile point in use during this period but, toward the end of the Dirty Devil (1600 B.P. to 1500 B.P.), the bow-and-arrow came into use. The end of the Dirty Devil subphase marked the transition from an Archaic hunting and gathering lifeway to the beginning of sedentary village life.*

*Archaeological evidence for the presence of Archaic peoples in the Castle Valley area is relatively abundant. For example, in Emery County, a total of 16 Archaic sites are known; one on the Wasatch Plateau, four from the San Rafael Area and the remaining eleven are from Castle Valley (Sargent, 1977). A total of four Archaic rockshelters have been excavated in and near the Castle Valley area (Wylie, 1971; Lindsay and Lund, 1976; DeBloois, in preparation; Jennings, Schroedl and Homer, in preparation). From the information gathered at these sites, it appears there was a preference for upland hunting - lowland gathering during Archaic times, possibly reflecting a seasonal round (Jennings, 1975; Schroedl, 1976; Lindsay and Lund, 1976). Toward the end of this period, there was a gradual shift from seasonal hunting and gathering to the beginnings of corn horticulture and a more sedentary way of life.*

*Fremont*

*The Fremont culture dates from approximately 1800 B.P. to 650 B.P. and, in general, is characterized by the use of permanent habitations, ceramics and some dependence upon corn horticulture. The Fremont culture inhabited most of Utah north of the Colorado River and part of eastern Colorado. Traditionally, the Fremont have been divided into five regional variants; Parowan, Sevier, Great Salt Lake, Uintah and San Rafael. Recently Madison and Lindsay (1977) have re-evaluated the information and proposed a three-fold division: the Sevier culture, located west of the Wasatch Plateau and dependent primarily upon marsh land environments for subsistence; the Fremont culture, located east of the Wasatch Plateau and north of the Colorado River, dependent upon corn horticulture and living in small permanent villages adjacent to permanent, streams; and the unnamed plains-derived culture located in northeastern Utah, dependent upon bison hunting and collecting of wild plants for subsistence and living in shallow pit-like structures.*

*The Castle Valley area lies entirely within the Fremont culture area. Fremont sites in the area are characterized by the presence of Emery Gray pottery, with some Uintah Gray in the north and Sevier Gray and Ivie Creek Black-on-White in the west. Snake Valley Gray and Anasazi trade wares are also present in the area.*

*Diagnostic projectile points include Rose Spring, Desert Side Notch and Bull Creek types with a continuation of the use of Elko series and Gypsum type dart points.*

*Villages tended to be small. Semi-subterranean and surface dwellings were built and both stones and adobe were utilized in their construction. These small villages were usually located on ridges or knolls near permanent streams where both water and rich soils were present. Caves and rockshelters were often utilized for storage and habitation.*

*Although no Fremont sites have been excavated in the immediate vicinity of the Castle Valley Spur, there has been considerable work done on Fremont sites in other parts of the Castle Valley area. The main body of work has been done by the University of Utah with excavations at 42Em47 (Gunnerson, 1956), Windy Ridge Village, Crescent Ridge and Power Pole Knoll (Madsen, 1975), Innocents Ridge (Schroedl and Hogan, 1975), levels of Clyde's Cavern (Wylie, 1971) and Pint-Size Shelter (Lindsay and Lund, 1976). The U.S. Forest Service also found Fremont remains in Joe's Valley Alcove (DeBloois, in preparation).*

*The Numic-speaking people, commonly known as the Ute, Paiute, Southern Paiute, Shoshoni and Bannock, were the last aboriginal peoples to inhabit Utah prior to European contact. Although there is considerable debate as to their origins (Lamb, 1958, Taylor, 1959; Gunnerson, 1962; Madsen, 1975), the Numic speakers were definitely in the southwestern Great Basin by 650 B.P. (Madsen, 1975). Some sites indicate that the Numic and Fremont were inhabiting some areas contemporaneously (Madsen, 1975). They rapidly spread throughout the Great Basin and Colorado Plateau and, by the arrival of the Europeans, in the 1700 - 1800's, they appear to have been occupying virtually all of Utah and Nevada and portions of surrounding states (Warner, 1976; Powell, 1875).*

*Archaeologically, we know very little about the Numic. All that remains of their occupation of the area are bits of pottery, arrowheads and, in unusual circumstances, fragments of basketry, clothing and other perishable materials. Their pottery is easily distinguished from other types in that it is crudely made using a paddle-and-anvil technique, is typically thick walled, has large temper particles, is poorly smoothed, is fired in an oxidizing atmosphere and occasionally has fingernail-incised decoration (Eueler, 1964). The distinctive projectile point is the Desert Side Notch point.*

*The Numic practiced an Archaic-type subsistence, depending upon the hunting and gathering of wild plants, animals and insects for survival. Groups tended to be loosely formed and usually consisted of no more than an extended family.*

*Large areas were needed for subsistence activities but these were too ill-defined and different bands utilized portions of the same areas.*

*With the arrival of the Europeans, the Numic lifeway rapidly began to change. Traditional hunting and gathering grounds were cut off by white expansion. The various Numic bands were severely restricted in their movements and were eventually forced to change their lifeway. Today, the Numic speaking peoples are restricted to several reservations scattered throughout Utah, Nevada, Colorado, Idaho and Arizona.*

*Unfortunately, not much evidence of Numic occupation of the Castle Valley area has been found. Sargent (1977) lists only two Numic sites which post-dated 650 B.P. (Adovasio, 1971). Historical accounts say very little about Indians being present in the area at the time of white arrival (McElprang, 1949).*

## *5.4 Historical Resources*

### *5.4.1 Historical Literature Review and Summary*

*The first documented exploration of the Castle Valley area began with the Dominquez-Escalante expedition of 1776. The purpose of the expedition was to explore a possible route from the Spanish settlements in New Mexico to Monterey on the California coast (Miller 1968). The expedition actually passed to the north of the Castle Valley area, but it served to open up the area to further Spanish exploration.*

*Subsequent Spanish expeditions into the area, and American fur trapping activities both served to eventually open up a main route between New Mexico and California. This route, known as the Old Spanish Trail, came through the San Juan Country, crossed the Colorado River at Moab, continued to the Green River crossing at the present town of Green River, extended through the San Rafael Desert into the Castle Valley, then crossed the Wasatch Plateau through Salina Canyon and continued on through southern Utah, Nevada and into California. The main traffic on this route included numerous trading, trapping, Indian slave and horse trading expeditions (Miller 1968). The trail was in use almost yearly until after the Mexican War. After that, the trail received* *use from travelers, immigrants, mail carriers and army troops (Stokes and Cohenour 1956).*

*In 1853, Captain J.W. Gunnison of the Corps of Topographical Engineers traversed the length of Castle Valley. On October 11, Lieutenant E.C. Beckwith reported that coal had been found and brought to camp. At that time, the party was camped some three miles east of the present town of Emery. Several days after leaving Castle Valley, Captain Gunnison and several members of his party were killed by Indians (Stokes and Cohenour 1956).*

*In 1869, and again in 1871, Major John W. Powell led exploring expeditions down the Green and Colorado Rivers and in so doing opened up an area which until then had been virtually unknown to whites.*

*In 1873, Lieutenant R.L. Hoxie of the Corps of Engineers and his party mapped the topography and geology of eastern Utah including the Castle Valley area.*

*The first attempts to establish permanent settlements in the area were undertaken by the Mormon Church. In 1854, a party lead by William Huntington traveled through Castle Valley on their way to the San Juan River and Navajo country. On the basis of his report, the Elk Mountain Mission was sent out by Brigham Young in 1855 to establish a mission near the present town of Moab. Indian hostilities plus hardships forced the mission to be abandoned that same year (McElprang, 1959). During this period, there was some sheep and cattle grazing in the more favorable ridges and valleys of the Wasatch Plateau (Dilly, 1900).*

*The first attempt at a permanent settlement in the area was by James McHadden and Leander Lemmon in 1875. They diverted water from Huntington Creek onto some land near the mouth of Huntington Canyon (Stokes and Cohenour, 1956). By 1877, word had reached the Mormon settlements to the west of good water and arable land along some of the creeks in Castle Valley. In September of that year, a priesthood meeting was held in Mount Pleasant in which 75 men from the Sanpete Stake were called to settle in Castle Valley. However, only a few men responded to the call. Another call was given in the Fall of 1878 with a more favorable response. Orange Seeley was called to superintend the founding of the settlements. By the Fall of 1878, the crops were sufficient for the families of the settlers to come into the valley. During this time, Ferron, Castle Dale, Huntington, Wilsonville, Lawrence, Molen and Orangeville were settled.*

*In 1880, the Utah Legislative Assembly created Emery County which included the present counties of Carbon, Grand and Emery. Price was not officially established until 1882 when a group of Mormon settlers on the Price River were organized into a ward. In 1883, the Rio Grande Railroad was built through Price and from that time on the settlement became the hub of the area. In 1894, the northern part of Emery County was made into Carbon County and Price was named the county seat (McElprang, 1949).*

*Even though coal had been reported by Gunnison in 1853, the coal industry in the area really didn't get going until 1875. In that year, the Fairview Coal Mining and Coke Company opened its operations at Connelsville in the upper part of Huntington Canyon. The coke was made there* *and shipped by wagon to Springville. However, the operation soon became unprofitable and after three years it was abandoned (Powell 1976).*

*With the large Mormon settlements to the west growing, the need for coal naturally increased. In 1875, the Pleasant Valley Coal Company built a wagon road from Springville up Spanish Fork Canyon to the coal fields in the Pleasant Valley area. By 1877, a mine had been opened in Winter Quarters Canyon and the area began a rich coal production which continues today. To alleviate problems of transporting the coal over the sometimes not passable wagon road, the Pleasant Valley Railroad Company built a narrow gauge through Spanish Fork Canyon in 1879.*

*This new coal prosperity lured the Denver and Rio Grande Railroad into routing its new line through Price and Spanish Fork Canyon rather than following the originally proposed line through Castle Valley and Salina Canyon to the south (McElprang 1949).*

*In 1882, the D&RGW purchased the Pleasant Valley Railroad Company and the Pleasant Valley Coal Company. Threatened by the possibility of losing its hold of the Utah coal industry, the Union Pacific Railroad Company moved into Pleasant Valley in 1882 and formed the Utah Central Coal Company. Later, it opened the Union Pacific Mine near Scofield in 1884. During this period, the railroad companies almost totally dominated the Utah coal. Companies active in the area were Consumers Mutual Coal Company, National Coal Company, and Sweet Coal company. Camps were built at all three locations, and Coal City (Dempseyville) was laid out in 1921 to serve as a business and residential neighborhood for the mines* *located 2 miles away at National and Consumers (Carr 1972). Coal City lasted for only a few years, and National and Consumers died out by the 1940's and 1950's. Coal mining operations continue in the area today.*

*Most of the coal mines were productive through the first three decades of the Twentieth Century, but with the coming of the depression and the increasing use of other fuels, coal production gradually decreased and many of the camps had to close down.*

*The downward trend of coal production continued through the 1940's and 1950's with a brief up-swing during World War II. During the 1950's many operations had to shut down. With the increased demand for energy in the 1970's there has been a stepped-up pace in coal mining operations, a trend which appears to be promising for the 1980's.*

*History of Archaeological Work*

*The first account of an archaeological site being reported in the Castle Valley area comes from the 1860 journal of Major John Wesley Powell. On his journey down the Green River, Powell noted the presence of some ruins, possibly in the vicinity of Chandler Creek (Dellenbaugh, 1926).*

*The first expedition into the area for the purpose of doing archaeological work was in 1929 - 1930 by the Claflin-Emerson expedition and mention was made of several sites (Morss, 1931; Gunnerson, 1969).*

*In 1935, A.B. Reagan did survey in the area and noted a pictograph panel (Reagan, 1935).*

*Range Creek to the north of Castle Valley was investigated by Leh in 1936 and several granaries were noted (Leh, 1936).*

*Work continued to be sporadic through the 1930's and 1940's. During the 1950's, however, interest was turned again to eastern Utah. In 1954, Morss made mention of the site from which the Pilling Cave figurines came (Morss, 1954). In the 1950's, the University of Utah passed through the Castle Valley area as a part of the statewide archaeological survey. They surveyed on Range, Last Change, Ivie, Quitchupah, Muddy and Ferron Creeks and recorded 49 sites (Gunnerson, 1957). Since that time, the University of Utah has been extensively involved in the archaeological of the area.*

*Their work includes several surveys (see bibliography) and a number of excavations which constitute the main body of archaeological knowledge for the Archaic and Fremont of eastern Utah. The excavations include: the Silverhorn site, a possible Paleo Indian site (Gunnerson, 1956); 42Em5, a Fremont structure (Gunnerson, 1957); Clyde's Cavern, a rock shelter in Emery County with nine strata ranging from Archaic through Numic (Wylie, 1971); three small Fremont villages - Windy Ridge, Crescent Ridge and Power Pole Knoll (Madsen,1975); Innocents Ridge, a Fremont village with five structures (Schroedl and Hogan, 1975); the Poplar Knob sit (Taylor, 1957); Snake Rock Village (Gunnerson, 1957; Aikens, 1967); the Old Woman site (Taylor, 1957); the Round Spring site (Gunnerson, 1957); the Fallen Woman, Old Road and Ivie Ridge sites (Wilson and Smith, 1976); and Sudden Shelter, an Archaic rock shelter (Jennings, Schroedl and Holmer, in preparation). The University of Utah also conducted excavations north of the project area in Nine Mile Canyon in 1936 (Gillin, 1955).*

*Other excavations in the area include Pint Shelter, an Archaic-Fremont site dug by the Utah State Division of History (Lindsay and Lund, 1976) and Joe's Valley Alcove, another Archaic-Fremont site dug by the U.S. Forest Service in 1974 (DeBloois, unpublished manuscript).*

*The decade of the 70's has brought about a marked increase in surveys as a result of cultural resource management. Institutions involved in the bulk of the work have been Brigham Young University (see Bibliography), the Museum of Northern Arizona (Keller, 1975 a,b,c,d; 1976), Southern Utah State College (Dykman and Thompson, 1976) and agencies such as the Bureau of Land Management, the U.S. Forest Service and the Antiquities Section of the Division of State History. Most of the work done in the last few years, since the expansion of cultural resource management, has been surveying, with very little excavation taking place.*

### *5.4.2 Historical Field Survey*

*A field survey of Mountain Coal Company's Gordon Creek property was carried out from mid-July through early-August, 1980. The project area is located on the eastern edge of the Wasatch Plateau, one of the dominant topographical features of eastern Utah. The area is drained by the North Fork of Gordon Creek to the south and Beaver Creek to the north. Topography in the area is extremely rugged. Elevations vary from 7500 feet along Gordon Creek to over 9300 feet on the ridge tops. Much of the area is dominated by slopes usually in excess of 60 percent and many places are regularly broken up by 100 percent slopes.*

*Gordon Creek and its tributary canyons have relatively narrow canyon bottoms with reliable streams and limited alluvial soils. Beaver Creek, with elevations between 8200 and 8700 feet, is an open canyon with a permanent stream which has numerous beaver dams and resulting alluvial soils.*

*The area receives in the neighborhood of 16 inches of rain per year. Vegetation includes Subalpine and Montane communities. The major game species in the area are mule deer and elk, with smaller species abundant.*

*Because of the extremely rugged terrain, it was not possible to systematically examine the area using evenly spaced parallel transects. As a result, different methods were used depending upon the terrain being examined. The bottoms of Gordon Creek Canyon, Bryner Canyon, Coal Canyon, and several unnamed canyons were examined by one or two surveyors who walked transects the entire canyon length within the project area. Canyon slopes leading down to the canyon bottoms were also examined in this way. Beaver Creek presented a different problem. Because of large beaver ponds and areas of dense vegetation, it was not possible or even practical to examine the entire canyon bottom. Those parts of Beaver Creek Canyon which are free of beaver ponds and impassable undergrowth, were systematically examined by walking transects spaced 15 meters apart throughout those areas. The relatively flat ridge tops in the area were also examined by walking paralleled transects over the entire area. The steep slopes which dominate most of the area also presented a special problem. In this terrain evenly spaced transects or transects following the natural contours were entirely out of the question. Since roads had been cut into the slopes in several locations it was possible to utilize them in examining the slope areas for archaeological sites. Passes were made along these roads and with binoculars the areas above and below each road were examined for cultural remains. Slope areas where there were no roads were examined by hiking up and down prominent ridges and* *looking off to both sides with binoculars. In this way, work hazards were kept to a minimum and the entire area received an adequate sampling.*

*Survey Results*

*The Archaeological survey of the Gordon Creek properties recorded four historic archaeological sites and one isolated prehistoric artifact. A search of the site files at the Utah Division of State History turned up no previously recorded sites in, or near, the project area.*

*The lone prehistoric artifact (4W/x1) is an Elko Corner Notched point (see Appendix 3). Radiocarbon dates for Elko points range from 2000 B.C. to A.D. 1080, making the point virtually useless as a time marker (Heizer 1978). Evidence from Hogup Cave extends the Manufacture of Elko Corner Notched points to as late as A.D. 1350 (Aikens 1970). Artifact 4W/x1 was found on the surface in disturbed soils (a roadway) with no other artifacts in association, so nothing definite can be said about the age or cultural affiliation of the point(see Plate 5-1, Archaeological Map).*

*The near total lack of any prehistoric archaeological materials may be explained by several factors. Although favorable conditions such as abundant water and game are present on the Wasatch Plateau, human activity would have been kept to a minimum in much of the project area because of extremely rugged terrain. Hauck (1979) in his Central Coal Project sampling study on the Wasatch Plateau stated, "Most sites recorded in the Wasatch Plateau region are found on either fairly level plateau surfaces or at the base of escapements in moderately* *level canyons and valleys" (Hauck 1979: 255). Very little of the surface of the project area meets this criteria. Beaver Creek is an exception.*

*Another factor which does not favor prehistoric activity in the area is elevation. Hauck states that the majority (60 percent) of sites in the Wasatch Plateau lie between 8000 to 9000 feet, while less than ten percent lie between 9000 to 10,000 feet (Hauck, 1979: 237). Most of the level terrain in the area lies at or about 9000 feet. Once again, Beaver Creek is an exception to this rule, with average elevations of about 8500 feet.*

*As would be expected, the lone prehistoric artifact found in the area was located approximately 500 feet from Beaver Creek in a shallow valley which runs perpendicular to the creek. As mentioned, the artifact was located in an old roadway which had been cut down into the surrounding sediments approximately two feet. It is very likely that the artifact came from sub-surface deposits disturbed by road construction. The road cut was examined for other remains, but none were found. This sedimentation covering prehistoric archaeological deposits adjacent to Beaver Creek creates a problem. Extensive dam building by beavers has aided in the accumulation of deep sediments in the valley floor and subsequent dense growth of vegetation. Any archaeological materials deposited adjacent to Beaver Creek would be long since covered by sediments and/or vegetation, and would therefore be undetectable in a surface reconnaissance of the area. Although none of the open and exposed areas around Beaver Creek contained prehistoric archaeological remains, the possibility still exists that they are present, and more work would have to be done in the area in order to detect their presence and extent.*

*Evidence of historic activity in the area is abundant. Four sites were found during the field reconnaissance. All four sites (42Cb209 - 42Cb212) are historic structures dating to the late 1920's or early 1930's (see Plate 5-1 Archaeological Map). The four sites represent several important activities in the historical development of the Carbon County area. Appendix III provides the Utah Antiquities Site Reports for the above four sites. These reports contain detailed descriptions of each historic site. Remains of historic mining, trapping, and homesteading activities are also abundant in areas immediately adjacent to the project area.*

*The Beaver Creek area was probably first exploited in the 1870's by some of the first settlers to come to Castle Valley. Among them were James Price, Caleb Rhodes, and Abraham Powell, settlers who supplemented their incomes by trapping beaver. They were naturally drawn to the large beaver colonies along Beaver Creek (Movell Jewkes, personal communications, 1980). Remains of early trapper cabins can still be found along Beaver Creek several miles north of the project area.*

*In the 1880's coal mining operations began to develop in Pleasant Valley to the west of the project area, and Scofield grew into the largest town in the area. In the 1890's Carbon County was created when Emery County divided, and a rivalry grew between Scofield and Price over the location of the County Seat. Because Price was located on the main line of the Denver and Rio Grande Western Railroad, it was chosen as the County Seat. The people of Scofield subsequently built a wagon road over the mountain in order to gain access to Price.*

*This road followed along Beaver Creek and then wound down the ridges and slopes of the plateau in Section 8 and 17 of Township 13 South, Range 8 East, to the canyon bottom of Gordon Creek, whence it continued on to Price. Much of the current road through the area follow the course of this old wagon road. The spring in the SW 1/4 of the SW 1/4 of the SW 1/4 of Section 7, Township 13 South, Range 8 East, was the location of one of the major camp spots along this road. Nothing remains to indicate the camp site.*

*In 1920, George Frandsen acquired Sections 5, 6, and part 4 of Township 13 South, Range 8 East from the U.S. Government for homesteading. He used the area for raising sheep and cattle, and occasionally took lumber out of the area for sale to local mills. Sometime between 1925 and 1928 Frandsen's children homesteaded sections of land close to the ones he had taken, and the family worked a ranching operation which was prosperous until the early 1950's. The Frandsens built three cabins on their land, two of them in Section 8 and one in Section 13, Township 13 South, Range 7 East. The cabin in Section 13 was built by Pete Frandsen sometime in the early 1920's (Movell Jewkes, ibid.). This cabin (42Cb209) is located in the project area and is still standing, although in dilapidated condition (see Plate 5-1, Archaeological Map).*

*About the time the Frandsens were getting their ranch going up on the plateau, coal was being developed down on Gordon Creek. Prospecting had begun in the area as early as 1908, but no mines were opened until the 1920's. Among the larger mines to be opened in the area were Sweets in 1925, Consumers in 1928, and National in 1928. Mining camps sprang up at the mines and for a short time Coal City (Dempseyville), located two miles east of the mines served as the business and residential center of the mining district. Remains of the main mining camps and coal mining operations can still be seen, although none of them are located in the project area. National Coal Company had some operations up Gordon Creek from the mining camps (Movell Jewkes, ibid.), and remains of cabins and work areas can still be seen. Three sites (42Cb210 - 42Cb212) are located in this area (See Plate 5-1, Archaeological Map). Coal mining operations have continued intermittently in the area until the present.*

*These four historic archaeological sites represent the beginning of a significant trend in land use in the are which has continued until today. Beginning in the 1920's both ranchers and coal miners began to extensively exploit the resources of the area, not always agreeing about the manner in which each other went about doing it. That form of multiple use of the land in the Gordon Creek area is still being practiced, and opinions still vary as to how the land could best be used.*

## 5.5 Paleontological Resources

*During the 1980 field season geologic investigations were performed by a Beaver Creek Coal Company geologist at the Gordon Creek No. 2 Mine. At that time, the Black Hawk Formation (coal bearing unit) was examined and no animal fossil remains were found on the surface of the permit area. However, dinosaur footprints are known to occur in the Black Hawk Formation so it is possible they are present in the coal at the No. 2 Mine. Plant fossil remains were found to be present in the exposed formations in the permit area. Among the plant fossil remains that were found or expected to occur are broad-leaf Angiosperms genera with a scattering of palms, conifers, and ferns. The dominant conifer is the pine-like Araucaria. In the more landward areas, delta and coastal plain setting, Sequoia is the dominant conifer.*

## 5.6 Future Cultural Resource Discoveries & Mitigation Efforts

*If any previously unidentified cultural resources should be discovered during reclamation operations at the Gordon Creek No. 2/7/8 Mines, Mountain Coal Company will ensure that the site is not disturbed and will immediately notify the Utah Division of Oil, Gas and Mining. The current plan does not call for any actions resulting in impacts to the historic sites identified above. Also, subsidence resulting from the operation is not expected to impact the sites (See Section 3.4.8 for a discussion of subsidence).*

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# Section 7
# HYDROLOGY

## 7.1 Ground Water Hydrology

### Scope

The purpose of this Section is to provide a review of the hydrogeologic information relevant to the Gordon Creek No. 2 and No. 7 Mines, and a plan of action to keep the existing underground coal mining operation in compliance with regulations of the Office of Surface Mining (OSM) and the Utah Division of Oil, Gas and Minerals (DOG&M) with respect to ground water hydrology.

Specifically, this section includes an evaluation of the hydrological setting of the Gordon Creek No. 2 and No. 7 Mines, their relation to the regional ground water hydrology, and a determination of the possible hydrologic impacts of the mining activity.

### 7.1.1 Method of Study

This study was largely based on a review of existing and available data. A field reconnaissance of the area was also made. Available data included drill hole logs, mine maps and water quality measurements from ARCO (Atlantic Richfield Company) published and open-file reports from the U.S. Geological Survey, Utah Geological and Mineral Survey (USGS), Bureau of Land Management (BLM), U.S. Forest Service (USFS) and; mining permit applications on file with OSM.

The field reconnaissance at the mine site permitted observation of the rock types which are present in the area, the geologic setting of springs and seeps, and confirmation of the geologic observations made from in-house aerial photo reconnaissance. In addition, information on hydrologic conditions encountered during mining are reviewed.

### 7.1.2 Existing Ground Water Resources

#### 7.1.2.1 Regional Ground Water Hydrology

The ground water resources of the Wasatch Plateau coal fields have not been studied to any great detail The region has been characterized generally as one of regional ground water recharge (Price and Arnow, 1974). The lithologic nature of the Upper Cretaceous strata generally makes them unsuitable as significant aquifers. Much of the precipitation that falls in the Wasatch Plateau probably is removed from the area by overland flow and evapotranspiration. The water that does enter the ground moves only short distances before discharging as springs and seeps. The regional water table is probably several hundred feet below the surface (Price and Arnow, 1974). It probably coincides with the bottoms of the major streams, as these depend on ground water for their perennial flow.

The principal water-bearing formations of the Wasatch Plateau are the sandstone units of the Mancos Shale Group. These include the Emery and Ferron Sandstones (Price and Arnow, 1974). These sandstone units occur in the southern part of Emery County and probably do not extend into the Gordon Creek area (Fisher, 1960). The basal unit of the Mesa Verde Group, the Star Point Sandstone, because of the nature of its lithology, is probably the principal aquifer in the Gordon Creek area. Price and Arnow (1979), however, do not identify the Gordon Creek area as a region for potential large-scale ground water development.

Drilling in the area shows that boreholes into the Star Point sometimes encounter water. Piezometers completed into the Star Point at the Skyline Mine, west of Gordon Creek, indicate that the water in the formation is under artesian pressure (Vaughn Hansen, 1979). Ground water movement through the Star Point is generally in a northeasterly direction.

Aquifer testing of the Star Point in the Skyline Mine area has shown it to have very low capacity. A pump test conducted in that area showed that the Star Point contributed little or no ground water (Vaughn Hansen, (1979).

The Black Hawk Formation, which overlies the Star Point, is comprised of several hundred feet of interbedded sandstone, shale, siltstone and coal. The sandstone units are generally very fine to fine grained and have a high clay content. Ground water that occurs in this formation occurs in perched zones.

The Aberdeen Sandstone, is a marine sandstone unit similar in character to the Star Point. It is stratigraphically located within the Black Hawk Formation. Though absent within the Gordon Creek No. 2 Mine site, drilling has indicated that it is under artesian pressure in the area at the junction of Jump Creek with Beaver Creek (Plate 7-1). The Aberdeen Sandstone has been traced in outcrop and found to pinch out immediately east of the Gordon Creek No. 2 mine lease.

Both the Black Hawk Formation and the Star Point Sandstone serve as a source of springs and seeps in the Wasatch Plateau region. The larger springs are often important sources for stock watering and domestic supply. Perennial springs are also significant in providing basal flow to streams in the region.

Field observation indicates that springs discharge in differing geologic settings (Figure 7-1). Smaller springs and seeps occur along valley sides where water infiltrates from the surface, moves a short distance and discharges at a lower point on the surface. Larger springs occur where the surface recharge encompasses a larger area or is some distance away and water moves through the subsurface a longer distance before discharging near the base of valleys. These types of springs generally show seasonal or more frequent variations, depending on the amount of precipitation available for recharge. A third type of springs occurs where discharge is from a sedimentary unit that has wide aerial extent and contains sufficient water in storage that short term recharge fluctuations have little effect on the discharge quantity.

Springs and seeps are common in the Wasatch Plateau. A field study in the Skyline Mine area, indicated an average of one spring per 40 acres (Vaughn Hansen, 1979). Geologic conditions play an important role in the occurrence of springs. Water that percolates into the ground moves through the permeable sediments downgradient along this

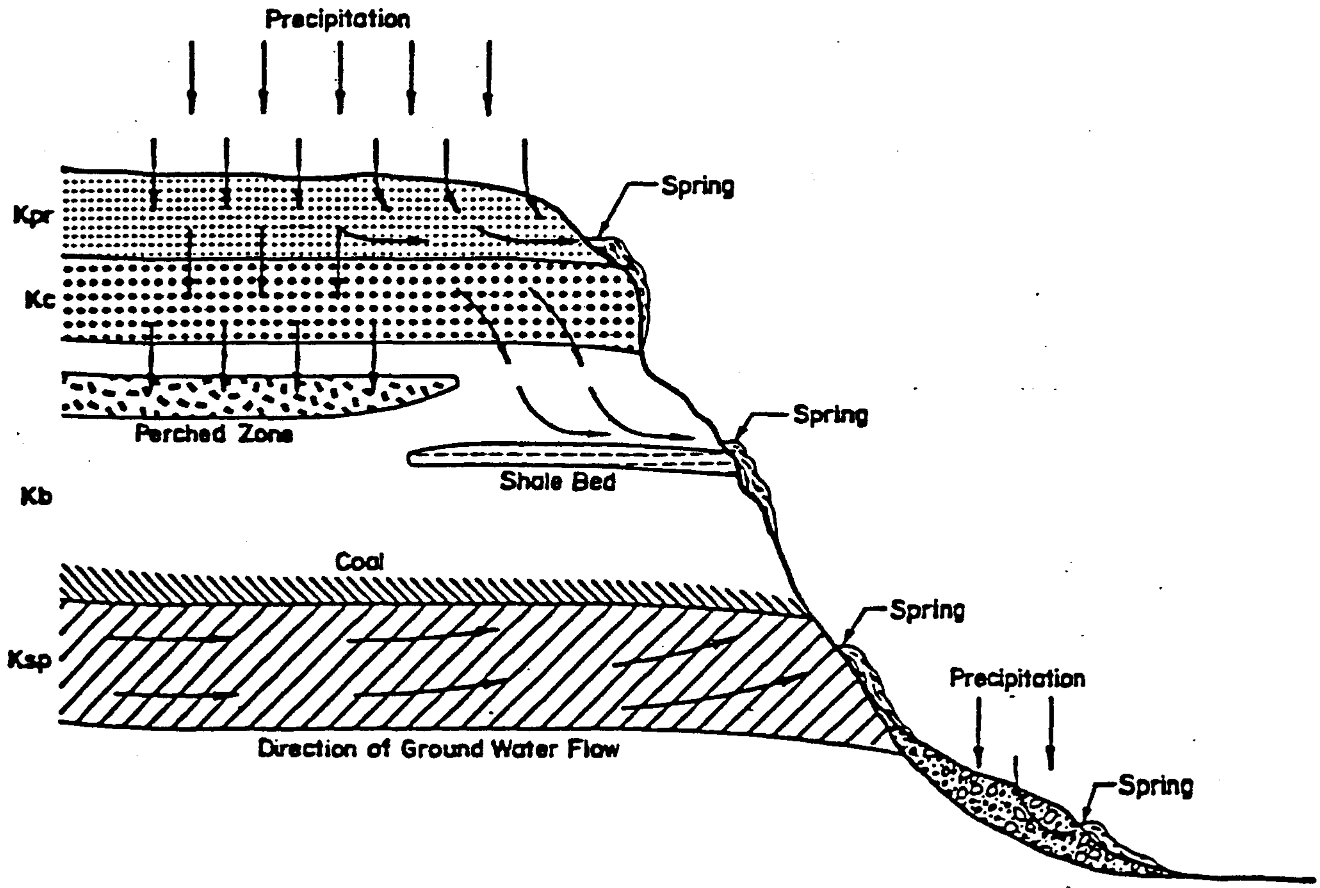



FIGURE 7-1: Schematic diagram of ground water occurrence and movement through Upper Cretaceous strata in the Wasatch Plateau.

interface until an outlet is reached, such as the ground surface at a lower elevation than from where the water originally entered the system.

7.1.2.2 Mine Plan Area Aquifers

In the Gordon Creek No. 2 and No. 7 Mines, water is occasionally encountered during the mining operation. After removal of the Castle Gate "A" coal seam, water occasionally seeps into the mine from the roof or more rarely, from the floor. Generally, minor amounts of water are encountered when mining beneath a fluvial sandstone channel. The channels behave as perched aquifers that are confined by associated flanking shales. Water production diminishes rapidly and does not pose a significant problem. Most of the water is used within the mine for dust suppression. These sandstone channels principally trend NE-SW at the Gordon Creek No. 2 and No. 7 Mines lease.

Because the Black Hawk Formation is not significant as an aquifer, little work has been done to determine its hydraulic characteristics. Price and Arnow (1974), in general, characterize all the upper Cretaceous sediments as having low hydraulic conductivities on low specific yields (0.2 to 0.7 percent). Two pump tests conducted in the basal part of the Black Hawk in the Eccles Canyon show that this formation is a very poor aquifer (Vaughn Hansen, 1979). Transmissivities determined were 21.0 and 16.3 gpd/ft from these pump tests. Recovery tests on these same two wells resulted in transmissivities of 16.6 and 17.9 gpd/ft respectively.

Drill hole data shows that water was encountered in several zones. Plate 7-1 shows available hydrologic data from drill holes in the area. Available data is not sufficient to allow any conclusions to be drawn concerning seasonal variations in head. In most instances, the amount of water appeared insignificant and not all test holes encountered water as they were drilled through the Black Hawk Formation. In drill holes where water was encountered, most of the production appeared to originate from either near surface fractures, or thin sandstone units at depth. The extensive shale beds likely prevent, or at least severely restrict hydraulic interconnection among the various sandstone units.

Due to the discontinuous and lenticular nature of the sandstone units and inter-bedded impervious shales in the area, an adequate prezometric surface map cannot be generated with presently available data.

The Price River Formation, which has similar lithologies to that of the Black Hawk does not have much significance as an aquifer. Laboratory tests on sandstone from the Price River show that it has generally high porosity (21 percent) but apparently a low permeability (Cordova, 1964).

Ground water occurrence and availability may be controlled by faults. However, little data is available to determine how faults may affect the distribution of ground water. In the Eccles Canyon and Winter Quarters Canyon areas it was determined that faults are relatively insignificant as conduits for ground water movement (Vaughn Hansen, 1979). Some faults and/or intense fracture zones have produced water in the Gordon Creek No. 2 and No. 7 Mines during mining. However, similar to the channels, the production diminishes rapidly.

Several springs and seeps have been identified in the Gordon Creek No. 2 and No. 7 Mines vicinity. (See Plates 7-1, 3-7, 3-7a.) Most seeps are seasonal and do not serve as a source of stock water or base flow. However, Beaver

Creek Coal Company does not have enough data to quantify the seasonal variations in head. Field observation indicate the source of water for many of these is nearby and generally upslope within a short distance. Water enters the ground near the top of a slope or a topographic depression and exits as a spring or seep lower down.

Due to the generally dry nature of the mines and the limited water information from drilling, it is not possible to provide detailed information on the recharge, storage and discharge characteristics of aquifers.

Two springs of local significance in the Gordon Creek lease area are the Jewkes Spring and Gunnison Homestead Spring (monitor sites 2-5-W and 2-6-W, respectively, Plate 7-2). Discharge from these springs reportedly remains fairly constant over time. The ground water source for these springs is discharged from a sandstone unit that probably has a fairly large aerial extent within the Black Hawk Formation. The Gunnison Homestead Springs also appears to be augmented by ground water discharging from the channel sediments in the Beaver Creek Valley. As stated previously, the Gordon Creek No. 2 and No. 7 Mine area is heavily faulted. These fault zones may provide the interconnection among various saturated zones of the Gordon Creek area.

### 7.1.3 Water Quality

Ground water from the Upper Cretaceous sediments in the Wasatch Plateau is characterized by total dissolved solids (TDS) contents of less than 1,000 milligrams per liter (mg/l) (Doelling, 1972). Ground water from the Price River Formation has TDS ranging from 238 to 303 mg/l (milligrams per liter). Water from the Black Hawk Formation is also fresh, but its TDS content has a wider range varying between about 245 and 903 mg/l (Davis and Doelling, 1977). Total dissolved solids from springs issuing from the Black Hawk and Star Point Sandstone and Price River Formations were found to range from 63 to 796 mg/l (Waddle and Others 1981).

A limited amount of ground water quality data is available for the Gordon Creek area. There are no ground water monitoring wells in the No. 2 and No. 7 Lease area. Wells to the west of the lease area show that the water is of the calcium bicarbonate type (Table 7-1). The TDS concentration is quite low. In the lease area, water quality is available from surface points above and below the mining and from several springs (Table 7-2). Flow rates at the monitoring stations are shown in Table 7-3.

In the Gordon Creek Area, there does not appear to be a significant difference between the surface water quality and ground water quality (Figure 7-2). In general, the surface water has somewhat higher TDS, which is probably the result of increased mineralization due to increased travel distance. Comparisons of TDS, $SO_4$, electrical conductivity, between water from springs (2-5-W and 2-6-W) and surface water (2-3-W and 2-4-W) show similar water characteristics (Figures 7-3, 7-4 and 7-5). This indicates that much of the water in the perennial streams, is a result of ground water discharging. To assess the mining impacts on the ground water hydrology, a spring and surface water monitoring program is used to characterize the water quality. Information on the quantity and quality of ground and surface water is provided monthly on water monitoring reports, and on a yearly basis in the annual report.

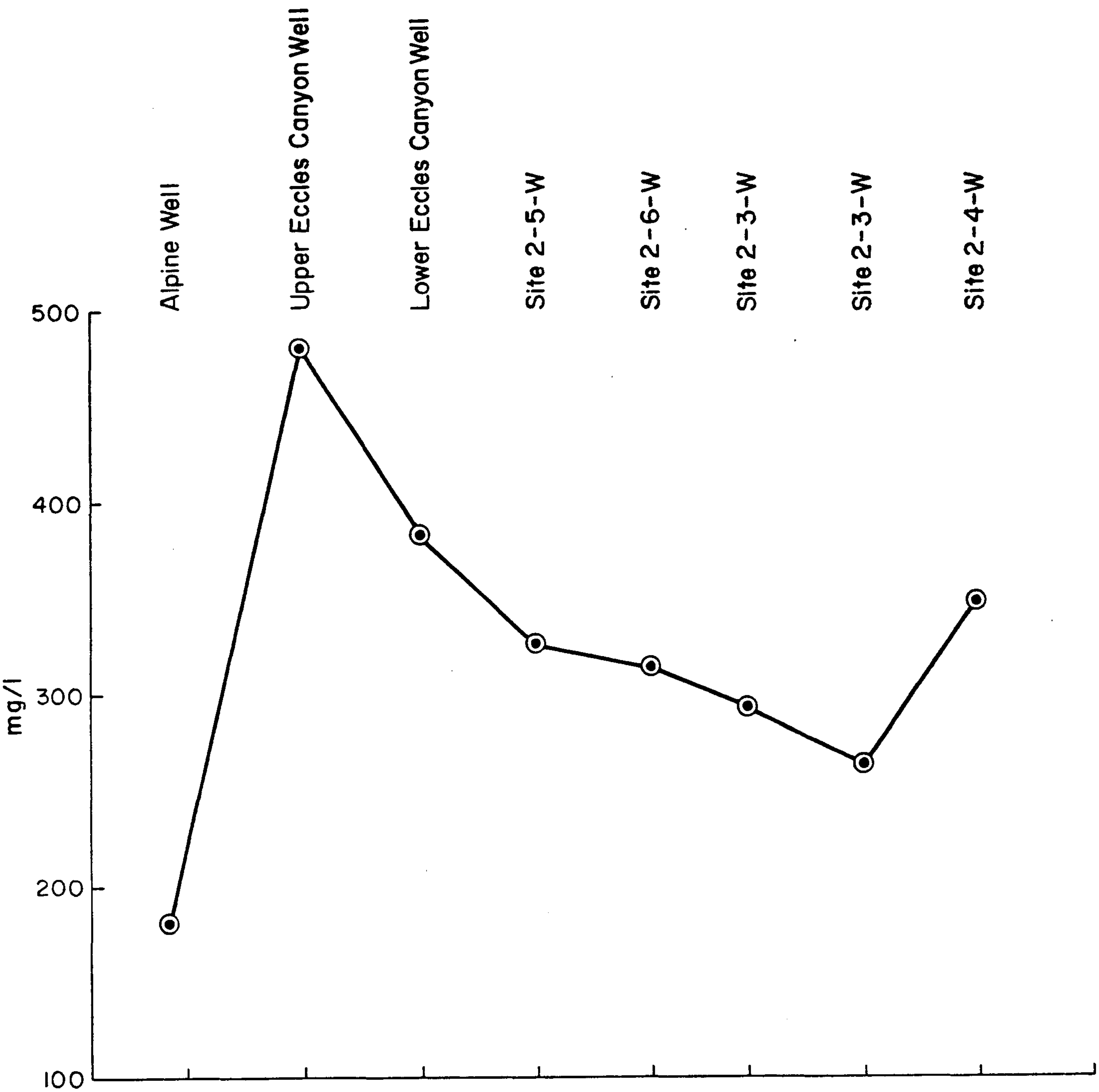



FIGURE 7-2: Total dissolved solids concentrations in ground water, spring water and surface water in the Gordon Creek area.

TABLE 7-1

WATER QUALITY FROM WELLS COMPLETED

IN

UPPER CRETACEOUS SEDIMENTS

| Well | Alpine Well | Upper Eccles Canyon | Lower Eccles Canyon |
|---|---|---|---|
| Location: | T135 R7E S8 | T135 R6E S13 SW¼ | T135 R7E S17 SW¼ |
| Stratigraphic Unit Formation | Black Hawk Sandstone | Star Point Sandstone | Star Point |
| Sodium | 21.3 | 76.5 | 3.9 |
| Calcium | 32 | 43.2 | 112.8 |
| Potassium | 1.3 | 12.5 | 2.1 |
| Iron | 0.53 | 0.22 | 0.24 |
| Magnesium | 9.6 | 30.7 | 11.5 |
| Bicarbonate | 197.6 | 278.6 | 329.4 |
| Chloride | 2.0 | 1.0 | 3.0 |
| Sulfate | 118 | 185 | 63 |
| Nitrate | 0.02 | 0.01 | 0.01 |
| TDS | 182 | 480 | 384 |
| Conductivity | 285 | 745 | 540 |
| pH | 7.4 | 7.3 | 7.4 |

Concentration in mg/l

Conductivity in umhos/cm

pH in standard units

# TABLE 7-2

## WATER QUALITY DATA FROM SELECTED MONITORING POINTS IN THE GORDON CREEK NO. 2 AND NO. 7 MINES AREA

### NOTES

1. Units in mg/l
2. Standard Units
3. Units in mhos/cm
4. Units in gpm

TABLE 7-2
SAMPLE SITE 2-2-W

| Parameter | 6-6-80 | 7-21-80 | 8-27-80 | 9-22-80 | 10-3-80 | 11-3-80 | 1-14-81 | 2-23-81 |
|---|---|---|---|---|---|---|---|---|
| Mn(1) | .010 | .010 | .011 | .010 | .011 | .010 | .040 | .041 |
| Fe(1) | .030 | .020 | .025 | .027 | .022 | 0.31 | .110 | .070 |
| $So_4$(1) | 26 | 27 | 45 | 64.5 | 46.5 | 73.5 | 69.0 | 84.0 |
| Cl(1) | 2.0 | 10 | 10 | 4.1 | 10 | 2.04 | 9.75 | 14.39 |
| $No_3$(1) | 1.95 | .42 | 4.0 | :13 | .02 | .26 | .28 | .17 |
| pH(2) | 8.0 | 7.3 | 7.2 | 7.2 | 7.3 | 7.4 | 7.0 | 7.7 |
| TDS (1) | 204 | 285 | 330 | 377 | 340 | 375 | 450 | 420 |
| TSS(1) | 68 | 13 | 175 | 16 | 12 | 9 | 21 | 5 |
| Elec. Conduct | 310 | 440 | 470 | 580 | 510 | 540 | 643 | 650 |
| Discharge | 1100 | 1609 | -- | 58 | 38 | 50 | -- | -- |

(DATE SAMPLED spans the date columns.)

TABLE 7-2 (Continued)
SAMPLE SITE 2-2-W

| Parameter | 3-81 | 4-81 | 5-81 | 6-81 | 7-81 | 8-81 | 9-19-81 | 10-28-81- |
|---|---|---|---|---|---|---|---|---|
| | | | | DATE SAMPLED | | | | |
| Mn(1) | | | | | | | Dry | 2.68 |
| Fe(1) | | | | | | | | 12.35 |
| $So_4$(1) | | | | | | | | 273 |
| Cl(1) | | | | | | | | 1634 |
| $No_3$(1) | | | | | | | | 2.66 |
| pH(2) | | | | | | | | 7.10 |
| TDS (1) | | | | | | | | 4000 |
| TSS(1) | | | | | | | | 9980 |
| Elec. Conduct | | | | | | | | 6100 |
| Discharge | | | | | | | | -- |

TABLE 7-2 (Continued)
SAMPLE SITE 2-2-W

| | DATE SAMPLED | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | 11-16-81 | 12-10-81 | 1-12-82 | 2-15-82 | 3-23-82 | 4-23-82 | 5-26-82 | 6-21-82- |
| Mn(1) | Dry | Dry | Dry | .635 | .66 | 2.06 | .005 | .640 |
| Fe(1) | | | | 4.98 | 1.82 | .060 | .050 | 1.42 |
| $So_4$(1) | | | | 12 | 126 | 6 | 18 | 144 |
| Cl(l) | | | | 265.4 | 106.8 | 352.0 | 46.0 | 349.5 |
| $No_3$(l) | | | | .56 | .17 | .24 | .01 | .39 |
| pH(2) | | | | 8.10 | 7.8 | 8.1 | 7.8 | 7.8 |
| TDS (1) | | | | 702 | 438 | 825 | 355 | 952 |
| TSS(1) | | | | 816 | 1501 | 2132 | 4 | 3010 |
| Elec. Conduct | | | | 1050 | 690 | 1270 | 530 | 1450 |
| Discharge | | | | -- | -- | -- | -- | -- |

TABLE 7-2 (Continued)
SAMPLE SITE 2-2-W

| | DATE SAMPLED | | | | | |
|---|---|---|---|---|---|---|
| Parameter | 7-19-82 | 8-20-82 | 9-22-82 | 10-15-82 | 11-20-82 | 12-21-82 |
| Mn(1) | Dry | Dry | Dry | Dry | Frozen | Frozen |
| Fe(1) | | | | | | |
| $So_4$(1) | | | | | | |
| Cl(1) | | | | | | |
| $No_3$(1) | | | | | | |
| pH(2) | | | | | | |
| TDS (1) | | | | | | |
| TSS(1) | | | | | | |
| Elec. Conduct | | | | | | |
| Discharge | | | | | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-3-W

| Parameter | 6-6-80 | 7-21-80 | 8-27-80 | 9-22-80 | 10-3-80 | 11-3-80 | 1-14-81 | 2-23-81 |
|---|---|---|---|---|---|---|---|---|
| | DATE SAMPLED | | | | | | | |
| Mn(1) | .010 | .060 | .02 | .018 | .014 | .017 | | |
| Fe(1) | .030 | .10 | .12 | .125 | .119 | .15 | | |
| $So_4$(1) | 26 | 10.5 | 13.5 | 22.5 | 16 | 21 | | |
| Cl(l) | 2.0 | 10 | 6 | 0.1 | 8 | .42 | | |
| $No_3$(l) | 1.95 | .96 | .96 | .92 | 1.89 | 1.04 | | |
| pH(2) | 8.0 | 7.6 | 7.3 | 7.2 | 7.35 | 7.4 | | |
| TDS (1) | 204 | 300 | 35 | 320 | 310 | 320 | | |
| TSS(1) | 68 | 6 | 13 | 1 | 1 | 17 | | |
| Elec. Conduct | 310 | 460 | 450 | 490 | 485 | 460 | | |
| Discharge | 1100 | 397 | -- | 34 | 35 | 30 | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-3-W

| Parameter | 3-81 | 4-81 | 5-81 | 6-81 | 7-81 | 8-81 | 9-19-81 | 10-28-81- |
|---|---|---|---|---|---|---|---|---|
| Mn(1) | | | | | | | .25 | Inaccessibl |
| Fe(1) | | | | | | | 2.16 | |
| $So_4$(1) | | | | | | | 9 | |
| Cl(1) | | | | | | | 20 | |
| $No_3$(1) | | | | | | | .20 | |
| pH(2) | | | | | | | 8.1 | |
| TDS (1) | | | | | | | 345 | |
| TSS(1) | | | | | | | 28 | |
| Elec. Conduct | | | | | | | 540 | |
| Discharge | | | | | | | -- | |

(DATE SAMPLED spans columns 3-81 through 10-28-81-.)

TABLE 7-2 (Continued)
SAMPLE SITE 2-3-W

| | DATE SAMPLED | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | 11-16-81 | 12-10-81 | 1-12-82 | 2-23-82 | 3-23-82 | 4-23-82 | 5-26-82 | 6-21-82- |
| Mn(1) | .23 | Frozen | Frozen | Inaccessible | Inaccessible | Inaccessible | Inaccessible | .030 |
| Fe(1) | 19 | | | | | | | .17 |
| $So_4$(1) | 24 | | | | | | | 6 |
| Cl(1) | 2.43 | | | | | | | 4.9 |
| $No_3$(1) | .19 | | | | | | | .7 |
| pH(2) | 7.6 | | | | | | | 8.2 |
| TDS (1) | 360 | | | | | | | 250 |
| TSS(1) | 2 | | | | | | | 16 |
| Elec. Conduct | 525 | | | | | | | 390 |
| Discharge | -- | | | | | | | -- |

TABLE 7-2 (Continued)
SAMPLE SITE 2-3-W

| Parameter | DATE SAMPLED 7-19-82 | 8-20-82 | 9-22-82 | 10-15-82 | 11-20-82 | 12-21-82 |
|---|---|---|---|---|---|---|
| Mn(1) | .026 | .09 | .05 | .03 | Inaccessible | Inaccessible |
| Fe(1) | .175 | .75 | .24 | 2.82 | | |
| $So_4$(1) | .1 | 21 | 14 | 18 | | |
| Cl(l) | 15.6 | 5 | 5 | 4 | | |
| $No_3$(l) | .64 | 1.05 | .53 | .49 | | |
| pH(2) | 7.9 | 8.3 | 8.25 | 7.86 | | |
| TDS (1) | 250 | 290 | 310 | 355 | | |
| TSS(1) | 10 | 6 | 10 | 4 | | |
| Elec. Conduct | 520 | 540 | 410 | 460 | | |
| Discharge | -- | -- | -- | -- | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-4-W

| | DATE SAMPLED | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | 6-6-80 | 7-21-80 | 8-27-80 | 9-22-80 | 10-3-80 | 11-3-80 | 1-14-81 | 2-23-81 |
| Mn(1) | 0.15 | .01 | .015 | .02 | .012 | .012 | | |
| Fe(1) | .04 | .05 | .059 | .065 | .061 | .052 | | |
| $So_4$(1) | 33.5 | 10.5 | 10.5 | 19.5 | 12 | 15 | | |
| Cl(1) | 4 | 4 | 8 | .01 | 12 | .27 | | |
| $No_3$(1) | 3.80 | 1.41 | 1.34 | 1.29 | 1.26 | 1.24 | | |
| pH(2) | 7.9 | 7.6 | 7.5 | 7.2 | 7.46 | 7.6 | | |
| TDS (1) | 246 | 285 | 300 | 299 | 298 | 330 | | |
| TSS(1) | 58 | 10 | 11 | 74 | 1 | 5 | | |
| Elec. Conduct | 370 | 440 | 430 | 460 | 450 | 470 | | |
| Discharge 910 | 367 | -- | 25 | 25 | 38 | | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-4-W

| Parameter | 3-81 | 4-81 | 5-81 | 6-81 | 7-81 | 8-81 | 9-19-81 | 10-28-81- |
|---|---|---|---|---|---|---|---|---|
| Mn(1) | | | | | | | .29 | Inaccessib |
| Fe(1) | | | | | | | 1.51 | |
| $So_4$(1) | | | | | | | 6 | |
| Cl(l) | | | | | | | 20 | |
| $No_3$(l) | | | | | | | 1.10 | |
| pH(2) | | | | | | | 8.3 | |
| TDS (1) | | | | | | | 325 | |
| TSS(1) | | | | | | | 707 | |
| Elec. Conduct | | | | | | | 500 | |
| Discharge | | | | | | | -- | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-4-W

| Parameter | 11-16-81 | 12-10-81 | 1-12-82 | 2-23-82 | 3-23-82 | 4-23-82 | 5-26-82 | 6-21-82- |
|---|---|---|---|---|---|---|---|---|
| | DATE SAMPLED | | | | | | | |
| Mn(1) | Frozen | Frozen | Frozen | Inaccessible | Inaccessible | Inaccessible | Inaccessible | .01 |
| Fe(1) | | | | | | | | .03 |
| $So_4$(1) | | | | | | | | 3 |
| Cl(l) | | | | | | | | 6.2 |
| $No_3$(l) | | | | | | | | 1.04 |
| pH(2) | | | | | | | | 8.2 |
| TDS (1) | | | | | | | | 227 |
| TSS(1) | | | | | | | | 10 |
| Elec. Conduct | | | | | | | | 335 |
| Discharge | | | | | | | | -- |

TABLE 7-2 (Continued)
SAMPLE SITE 2-4-W

| Parameter | DATE SAMPLED 7-19-82 | 8-20-82 | 9-22-82 | 10-15-82 | 11-20-82 | 12-21-82 |
|---|---|---|---|---|---|---|
| Mn(1) | .012 | .03 | .03 | .03 | Inaccessible | Inaccessible |
| Fe(1) | .035 | .39 | .03 | 3.3 | | |
| $So_4$(1) | .1 | 16 | 14 | 13 | | |
| Cl(1) | .80 | 3 | 6 | 3 | | |
| $No_3$(1) | 1.35 | 1.46 | 1.08 | 1.27 | | |
| pH(2) | 8.1 | 8.19 | 7.75 | 7.77 | | |
| TDS (1) | 252 | 285 | 305 | 310 | | |
| TSS(1) | 23 | 4 | 20 | 4 | | |
| Elec. Conduct | 295 | 490 | 420 | 400 | | |
| Discharge | -- | -- | -- | -- | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-5-W

| Parameter | DATE SAMPLED 6-6-80 | 7-21-80 | 8-27-80 | 9-22-80 | 10-3-80 | 11-3-80 | 1-14-81 | 2-23-81 |
|---|---|---|---|---|---|---|---|---|
| Mn(1) | .004 | .001 | .01 | .015 | .009 | .013 | | |
| Fe(1) | .03 | .01 | .01 | .02 | .02 | .02 | | |
| $So_4$(1) | 40 | 13.5 | 12 | 10.5 | 6 | .22 | | |
| Cl(1) | 6 | 10 | 8 | 0.1 | 6 | .22 | | |
| $No_3$(1) | .67 | 1.15 | 1.51 | 1.02 | 1.44 | 1.19 | | |
| pH(2) | 7.7 | 7.3 | 7.1 | 6.8 | 7.2 | 7.0 | | |
| TDS (1) | 292 | 289 | 290 | 490 | 300 | 308 | | |
| TSS(1) | 4 | 3 | 1 | 4 | 1 | 1 | | |
| Elec. Conduct | 450 | 440 | 415 | 460 | 460 | 440 | | |
| Discharge | 1.10 | 38 | | 9 | 9 | 5 | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-5-W

| Parameter | DATE SAMPLED 3-81 | 4-81 | 5-81 | 6-81 | 7-81 | 8-81 | 9-19-81 | 10-28-81- |
|---|---|---|---|---|---|---|---|---|
| Mn(1) | | | | | | | .21 | Inaccessib |
| Fe(1) | | | | | | | 1.44 | |
| $So_4$(1) | | | | | | | 6 | |
| Cl(1) | | | | | | | 25 | |
| $No_3$(1) | | | | | | | .8 | |
| pH(2) | | | | | | | 8.1 | |
| TDS (1) | | | | | | | 320 | |
| TSS(1) | | | | | | | 135 | |
| Elec. Conduct | | | | | | | 490 | |
| Discharge | | | | | | | 1 | |

Water Monitoring - Operational

Water quality samples will be collected quarterly at sample locations 2-1-W, 2-2-W, 2-7-W, 2-8-W, and 2-9-W and 2-10-W. Samples will be analyzed for parameters listed in Table 7-18. The sampling programs provide information on seasonal flow and water quality on intermittent and ephemeral streams that have a potential to be affected by mine discharge and surface disturbance. Stations 2-2-W and 2-9-W will also be monitored quarterly for oil and grease, since they are below the mine site.

In addition, discharge from the NPDES monitoring point, 2-1-W, will be sampled for flow, pH, TDS, TSS, Iron, Manganese and Oil and Grease, according to UPDES permit monitoring requirements.

Stations 2-3-W, 2-4-W, 2-5-W and 2-6-W, located in the Beaver Creek area, will be monitored by a bi-annual basis for flow and quality. Flow will be measured using a portable flume.

A discussion of surface water monitoring locations, type, frequency and flow device may be found in Table 7-17. A map of the monitoring locations is provided on Plate 7-2. Analyses will be for parameters listed in Table 7-18.

Note: Total Settleable Solids will not be tested at non-UPDES stations.

TABLE 7-17

SURFACE WATER MONITORING PROGRAM

GORDON CREEK No. 2/7/8 Mines

| STATION | LOCATION | TYPE | FREQUENCY | FLOW DEVICE | RESULTS TO: | REMARKS |
|---|---|---|---|---|---|---|
| 2-1-W | Discharge of Sediment Pond | NPDES Discharge | Monthly or as Occurs | Hand-Held Flow Device | EPA, DOGM | Monitored per NPDES Permit |
| 2-2-W | North Fork Gordon Creek | Intermittent Stream | Monthly Flow Quarterly Quality | Portable Flume or Current Meter | DOGM, OSM | |
| 2-3-W | Lower Beaver Creek | Perennial Stream | Bi-annual Flow Bi-annual Quality | Portable Flume | DOGM, OSM | When accessible |
| 2-4-W | Upper Beaver Creek | Perennial Stream | Bi-annual Flow Bi-annual Quality | Portable Flume | DOGM, OSM | When accessible |
| 2-5-W | Jewkes Spring in Beaver Creek | Spring | Bi-annual Quality and Quantity | Hand-HeldS | DOGM, OSM | When accessible |
| 2-6-W | Gunnison Homestead Spring | Spring | Bi-annual Quality and Quantity | Portable Flume | DOGM, OSM | When accessible |
| 2-7-W | Lf.Fk.Bryner Canyon above #7 Mine | Ephemeral Stream | Quarterly Flow and Quality | Portable Flume | DOGM, OSM | |
| 2-8-W | Rt.Fk.Bryner Canyon above #2 Mine | Ephemeral Stream | Quarterly Flow and Quality | Portable Flume | DOGM, OSM | |
| 2-9-W | Bryner Canyon below #2 Mine | Ephemeral Stream | Quarterly Flow and Quality | Staff Gauge Portable Flume | DOGM, OSM | |
| 2-10-W | Inflow to Sediment Pond 7A | Ephemeral Stream | Quarterly Flow and Quality | Hand-Help Flow Device | DOGM, OSM | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-6-W

| Parameter | DATE SAMPLED 6-21-80 | 7-21-80 | 8-27-80 | 9-22-80 | 10-3-80 | 11-3-80 | 1-14-81 | 2-23-81 |
|---|---|---|---|---|---|---|---|---|
| Mn(1) | .033 | .02 | .019 | .014 | .02 | .014 | | |
| Fe(1) | .14 | .04 | .08 | .08 | .07 | .02 | | |
| $So_4$(1) | 36 | 12 | 12 | 12 | 10.5 | 7.6 | | |
| Cl(1) | 6 | 12 | 10 | .5 | 10 | 1.2 | | |
| $No_3$(1) | .49 | .63 | .81 | .75 | .83 | .96 | | |
| pH(2) | 8.1 | 7.8 | 7.3 | 7.2 | 7.4 | 7.8 | | |
| TDS (1) | 285 | 285 | 270 | 273 | 480 | 295 | | |
| TSS(1) | 13 | 26 | 1 | 1.7 | 64 | 24 | | |
| Elec. Conduct | 440 | 440 | 385 | 420 | 430 | 420 | | |
| Discharge | 136 | 22 | | | 4 | 3 | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-6-W

DATE SAMPLED

| Parameter | 3-81 | 4-81 | 5-81 | 6-81 | 7-81 | 8-81 | 9-19-81 | 10-28-81- |
|---|---|---|---|---|---|---|---|---|
| Mn(1) | | | | | | | .016 | Inaccessib |
| Fe(1) | | | | | | | .15 | |
| $So_4$(1) | | | | | | | 6 | |
| Cl(1) | | | | | | | 25 | |
| $No_3$(1) | | | | | | | .77 | |
| pH(2) | | | | | | | 8 | |
| TDS (1) | | | | | | | 280 | |
| TSS(1) | | | | | | | 216 | |
| Elec. Conduct | | | | | | | 430 | |
| Discharge | | | | | | | -- | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-6-W

| Parameter | DATE SAMPLED 11-16-81 | 12-10-81 | 1-12-82 | 2-23-82 | 3-23-82 | 4-23-82 | 5-26-82 | 6-21-82- |
|---|---|---|---|---|---|---|---|---|
| Mn(1) | .01 | Frozen | Frozen | Inaccessible | Inaccessible | Inaccessible | Inaccessible | .015 |
| Fe(1) | .03 | | | | | | | .04 |
| $So_4$(1) | 27 | | | | | | | 6 |
| Cl(l) | 4.95 | | | | | | | 6 |
| $No_3$(l) | .40 | | | | | | | .13 |
| pH(2) | 7.6 | | | | | | | 8.1 |
| TDS (1) | 300 | | | | | | | 274 |
| TSS(1) | 5 | | | | | | | 7 |
| Elec. Conduct | 450 | | | | | | | 420 |
| Discharge | -- | | | | | | | -- |

TABLE 7-2 (Continued)
SAMPLE SITE 2-6-W

| | DATE SAMPLED | | | | | |
|---|---|---|---|---|---|---|
| Parameter | 7-19-82 | 8-20-82 | 9-22-82 | 10-15-82 | 11-20-82 | 12-21-82 |
| Mn(1) | .013 | .09 | .03 | .03 | Inaccessible | Inaccessible |
| Fe(1) | 3.55 | .66 | .18 | 4.22 | | |
| $So_4$(1) | .1 | 21 | 14 | 16 | | |
| Cl(l) | 14 | 6 | 6 | 5 | | |
| $No_3$(l) | .19 | .56 | .68 | .63 | | |
| pH(2) | 7.9 | 8.16 | 8.16 | 7.68 | | |
| TDS (1) | 252 | 285 | 310 | 360 | | |
| TSS(1) | 7 | 6 | 70 | 455 | | |
| Elec. Conduct | 520 | 500 | 390 | 440 | | |
| Discharge | -- | -- | -- | -- | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-7-W

| Parameter | 6-21-80 | 7-21-80 | 8-27-80 | 9-22-80 | 10-3-80 | 11-3-80 | 1-14-81 | 2-23-81 |
|---|---|---|---|---|---|---|---|---|
| Mn(1) | .049 | Dry | Dry | Dry | Dry | Dry | | |
| Fe(1) | .23 | | | | | | | |
| $So_4$(1) | 34.5 | | | | | | | |
| Cl(1) | 24 | | | | | | | |
| $No_3$(1) | .21 | | | | | | | |
| pH(2) | 7.9 | | | | | | | |
| TDS (1) | 544 | | | | | | | |
| TSS(1) | 293 | | | | | | | |
| Elec. Conduct | 840 | | | | | | | |
| Discharge | 60 | | | | | | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-7-W

| | DATE SAMPLED | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | 3-81 | 4-81 | 5-81 | 6-81 | 7-81 | 8-81 | 9-19-81 | 10-28-81- |
| Mn(1) | | | | | | | Dry | Dry |
| Fe(1) | | | | | | | | |
| $So_4$(1) | | | | | | | | |
| Cl(1) | | | | | | | | |
| $No_3$(1) | | | | | | | | |
| pH(2) | | | | | | | | |
| TDS (1) | | | | | | | | |
| TSS(1) | | | | | | | | |
| Elec. Conduct | | | | | | | | |
| Discharge | | | | | | | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-7-W

| Parameter | 11-16-81 | 12-10-81 | 1-12-82 | 2-23-82 | 3-23-82 | 4-23-82 | 5-26-82 | 6-21-82- |
|---|---|---|---|---|---|---|---|---|
| | | | | DATE SAMPLED | | | | |
| Mn(1) | Dry | Dry | Dry | Frozen | Dry | Dry | 0.3 | 0.1 |
| Fe(1) | | | | | | | .05 | .03 |
| $So_4$(1) | | | | | | | 45 | 42 |
| Cl(1) | | | | | | | 16.4 | 15.8 |
| $No_3$(1) | | | | | | | .01 | .01 |
| pH(2) | | | | | | | 7.9 | 7.6 |
| TDS (1) | | | | | | | 425 | 421 |
| TSS(1) | | | | | | | 8 | 15 |
| Elec. Conduct | | | | | | | 650 | 640 |
| Discharge | | | | | | | 20-30 | -- |

TABLE 7-2 (Continued)
SAMPLE SITE 2-7-W

| Parameter | 7-19-82 | 8-20-82 | 9-22-82 | 10-15-82 | 11-20-82 | 12-21-82 |
|---|---|---|---|---|---|---|
| | DATE SAMPLED | | | | | |
| Mn(1) | Dry | Dry | Dry | Dry | Dry | Dry |
| Fe(1) | | | | | | |
| $So_4$(1) | | | | | | |
| Cl(1) | | | | | | |
| $No_3$(1) | | | | | | |
| pH(2) | | | | | | |
| TDS (1) | | | | | | |
| TSS(1) | | | | | | |
| Elec. Conduct | | | | | | |
| Discharge | | | | | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-8-W

| | DATE SAMPLED | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | 6-6-80 | 7-21-80 | 8-27-80 | 9-22-80 | 10-3-80 | 11-3-80 | 1-14-81 | 2-23-81 |
| Mn(1) | .038 | .02± | Dry | Dry | Dry | Dry | | |
| Fe(1) | .20 | .10 | | | | | | |
| $So_4$(1) | 32 | 64.5 | | | | | | |
| Cl(l) | 6 | 12 | | | | | | |
| $No_3$(l) | .05 | .06 | | | | | | |
| pH(2) | 7.8 | 7.7 | | | | | | |
| TDS (1) | 462 | 375 | | | | | | |
| TSS(1) | 29 | 62 | | | | | | |
| Elec. Conduct | 700 | 570 | | | | | | |
| Discharge 20 | 5 | | | | | | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-8-W

| | DATE SAMPLED | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | 3-81 | 4-81 | 5-81 | 6-81 | 7-81 | 8-81 | 9-19-81 | 10-28-81- |
| Mn(1) | | | | | | | Dry | Dry |
| Fe(1) | | | | | | | | |
| $So_4$(1) | | | | | | | | |
| Cl(1) | | | | | | | | |
| $No_3$(1) | | | | | | | | |
| pH(2) | | | | | | | | |
| TDS (1) | | | | | | | | |
| TSS(1) | | | | | | | | |
| Elec. Conduct | | | | | | | | |
| Discharge | | | | | | | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-8-W

| Parameter | 11-16-81 | 12-10-81 | 1-12-82 | 2-23-82 | 3-23-82 | 4-23-82 | 5-26-82 | 6-21-82- |
|---|---|---|---|---|---|---|---|---|
| | DATE SAMPLED | | | | | | | |
| Mn(1) | Dry | Dry | Dry | Dry | Dry | Dry | .005 | .008 |
| Fe(1) | | | | | | | .02 | .02 |
| $So_4$(1) | | | | | | | 78 | 90 |
| Cl(l) | | | | | | | 50.2 | 24.1 |
| $No_3$(l) | | | | | | | .01 | .11 |
| pH(2) | | | | | | | 7.7 | 7.7 |
| TDS (1) | | | | | | | 550 | 578 |
| TSS(1) | | | | | | | 10 | 21 |
| Elec. Conduct | | | | | | | 840 | 880 |
| Discharge | | | | | | | 10-15 | -- |

TABLE 7-2 (Continued)
SAMPLE SITE 2-8-W

| Parameter | 7-19-82 | 8-20-82 | 9-22-82 | 10-15-82 | 11-20-82 | 12-21-82 |
|---|---|---|---|---|---|---|
| | DATE SAMPLED | | | | | |
| Mn(1) | .01 | .03 | .06 | .03 | Dry | Dry |
| Fe(1) | .023 | .57 | .56 | .12 | | |
| $So_4$(1) | 60 | 119 | 104 | 33 | | |
| Cl(1) | 14.9 | 8 | 9 | 8 | | |
| $No_3$(1) | .01 | .26 | .02 | .06 | | |
| pH(2) | 8.2 | 8.03 | 8.23 | 8.12 | | |
| TDS (1) | 496 | 470 | 460 | 530 | | |
| TSS(1) | 17 | 84 | 56 | 4 | | |
| Elec. Conduct | 550 | 720 | 730 | 680 | | |
| Discharge | -- | -- | -- | -- | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-9-W

| Parameter | DATE SAMPLED 6-6-80 | 7-21-80 | 8-27-80 | 9-22-80 | 10-3-80 | 11-3-80 | 1-14-81 | 2-23-81 |
|---|---|---|---|---|---|---|---|---|
| Mn(1) | .05 | Dry | Dry | Dry | Dry | Dry | | |
| Fe(1) | .02 | | | | | | | |
| $So_4$(1) | 41 | | | | | | | |
| Cl(1) | 12 | | | | | | | |
| $No_3$(1) | .08 | | | | | | | |
| pH(2) | 7.9 | | | | | | | |
| TDS (1) | 612 | | | | | | | |
| TSS(1) | 91 | | | | | | | |
| Elec. Conduct | 940 | | | | | | | |
| Discharge | 60 | | | | | | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-9-W

| | DATE SAMPLED | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | 3-81 | 4-81 | 5-81 | 6-81 | 7-81 | 8-81 | 9-19-81 | 10-28-81- |
| Mn(1) | | | | | | | Dry | Dry |
| Fe(1) | | | | | | | | |
| $SO_4$(1) | | | | | | | | |
| Cl(1) | | | | | | | | |
| $NO_3$(1) | | | | | | | | |
| pH(2) | | | | | | | | |
| TDS (1) | | | | | | | | |
| TSS(1) | | | | | | | | |
| Elec. Conduct | | | | | | | | |
| Discharge | | | | | | | | |

TABLE 7-2 (Continued)
SAMPLE SITE 2-9-W

| Parameter | 11-16-81 | 12-10-81 | 1-12-82 | 2-23-82 | 3-23-82 | 4-23-82 | 5-26-82 | 6-21-82- |
|---|---|---|---|---|---|---|---|---|
| | DATE SAMPLED | | | | | | | |
| Mn(1) | Dry | Dry | Dry | Frozen | Dry | Dry | 0.3 | 0.35 |
| Fe(1) | | | | | | | .48 | .13 |
| $So_4$(1) | | | | | | | 84 | 105 |
| Cl(l) | | | | | | | 30.2 | 28.5 |
| $No_3$(l) | | | | | | | .07 | .06 |
| pH(2) | | | | | | | 8.0 | 8.1 |
| TDS (1) | | | | | | | 500 | 575 |
| TSS(1) | | | | | | | 136 | 227 |
| Elec. Conduct | | | | | | | 740 | 880 |
| Discharge | | | | | | | 20-25 | -- |

TABLE 7-2 (Continued)
SAMPLE SITE 2-9-W

| | DATE SAMPLED | | | | | |
|---|---|---|---|---|---|---|
| Parameter | 7-19-82 | 8-20-82 | 9-22-82 | 10-15-82 | 11-20-82 | 12-21-82 |
| Mn(1) | Dry | Dry | Dry | Dry | Dry | Dry |
| Fe(1) | | | | | | |
| $So_4$(1) | | | | | | |
| Cl(1) | | | | | | |
| $No_3$(1) | | | | | | |
| pH(2) | | | | | | |
| TDS (1) | | | | | | |
| TSS(1) | | | | | | |
| Elec. Conduct | | | | | | |
| Discharge | | | | | | |

Table 7-3
FLOW RATES AT BEAVER CREEK MONITORING STATIONS

| Date | 2-1-W Sed Pond | 2-2-W USGS 2-4 Gordon Creek | 2-3-W USGS 2-3 Lower Beaver Creek | 2-4-W USGS 2-1 Upper Beaver Creek | 2-5-W Jewkes Spring | 2-6-W Gunnison Homestead | 2-7-W S. Fork Bryner | 2-8-W N. Fork Bryner | 2-9-W Lower Bryner | USGS 2-2 Middle Beaver Creek | USGS 2-5 Gordon Creek | OSM2 Lower Bryner |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| June, 78 | 694 | 123 | 34.2 | | | | | | | 123 | 725.5 | Dry |
| 8-16-78 | 70.2 | 8.89 | 2.19 | | | | | | | 12.4 | 81.7 | Dry |
| 9-15-78 | 59.7 | --- | Dry | | | | | | | 6.05 | 94.2 | Dry |
| 11-10-78 | 70.2 | 8.89 | Frozen | | | | | | | ** | ** | ** |
| 12-13-79 | Dry | Dry | ** | ** | Dry | | | | | | | |
| 1/23/80 | Dry | Dry | ** | ** | ** | | | | | | | |
| 2-29-80 | Dry | Dry | ** | ** | ** | | | | | | | |
| 3-14-80 | Dry | Dry | ** | ** | ** | | | | | | | |
| 4-17-80 | Dry | 50gpm | ** | ** | ** | | | | | | | |
| 5-2-80 | Dry | 700gpm | ** | ** | ** | | | | | | | |
| 6-6-80 | Dry | 620 | 1100 | 910 | 110 | 136 | 60 | 20 | 60 | | | |
| 7-21-80 | Dry | 1609 | 397 | 367 | 38 | 22 | Dry | 5 | Dry | | | |
| 8-27-80 | Dry | | | | | | Dry | Dry | Dry | | | |
| 9-22-80 | Dry | 48 | 34 | 25 | 9 | | Dry | Dry | Dry | | | |
| 11-3-80 | Dry | 50 | 30 | 38 | 5 | 3 | Dry | Dry | Dry | | | |
| 12-12-80 | Dry | -- | [-------Inaccessible-------------------] | | | | Dry | Dry | Dry | | | |
| 1-81 | | | | | | | | | | | | |
| 2-81 | | | | | | | | | | | | |
| 3-81 | | | | | | | | | | | | |
| 4-81 | | | | | | | | | | | | |
| 5-81 | | | | | | | | | | | | |
| 6-81 | | | | | | | | | | | | |
| 7-81 | | | | | | | | | | | | |
| 8-81 | | | | | | | | | | | | |
| 9-19-81 | Dry | Dry | - | Dry | 1 | - | Dry | Dry | Dry | | | |
| 10-81 | Dry | - | ** | ** | ** | ** | Dry | Dry | Dry | | | |
| 11-16-81 | Dry | Dry | - | Frozen | Frozen | - | Dry | Dry | Dry | | | |
| 12-10-81 | Dry | Dry | Frozen | Frozen | Frozen | Frozen | Dry | Dry | Dry | | | |
| 1-12-82 | Dry | Dry | Frozen | Frozen | Frozen | Frozen | Dry | Dry | Dry | | | |
| 2-15-82 | Dry | - | ** | ** | ** | ** | Frozen | Frozen | Frozen | | | |

Table 7-3 (continued)
FLOW RATES AT BEAVER CREEK MONITORING STATIONS

| Date | 2-1-W Sed Pond | 2-2-W USGS 2-4 Gordon Creek | 2-3-W USGS 2-3 Lower Beaver Creek | 2-4-W USGS 2-1 Upper Beaver Creek | 2-5-W Jewkes Spring | 2-6-W Gunnison Homestead | 2-7-W S. Fork Bryner | 2-8-W N. Fork Bryner | 2-9-W Lower Bryner | USGS 2-2 Middle Beaver Creek | USGS 2-5 Gordon | OSM2 Lower Bryner |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3-23-82 | Dry | - | ** | ** | ** | ** | Dry | Dry | Dry | | | |
| 4-23-82 | Dry | - | ** | ** | ** | ** | Dry | Dry | Dry | | | |
| 5-25-82 | Dry | - | ** | ** | ** | ** | 220-30 | 210-15 | 20-25 | | | |
| 6-21-82 | Dry | - | - | - | 60 | - | - | - | - | | | |
| 7-19-82 | Dry | Dry | - | - | 30 | - | Dry | - | Dry | | | |
| 8-20-82 | Dry | Dry | - | - | 17.5 | - | Dry | - | Dry | | | |
| 9-22-82 | Dry | Dry | - | - | 10 | - | Dry | - | Dry | | | |
| 10-15-82 | Dry | Dry | 21095 | 21993 | 9 | - | Dry | - | Dry | | | |
| 11-20-82 | Dry | Frozen | ** | ** | ** | ** | Dry | Dry | Dry | | | |
| 12-21-82 | Dry | Frozen | ** | ** | ** | ** | Dry | Dry | Dry | | | |

* All readings in gallons per minute
**Inaccessible

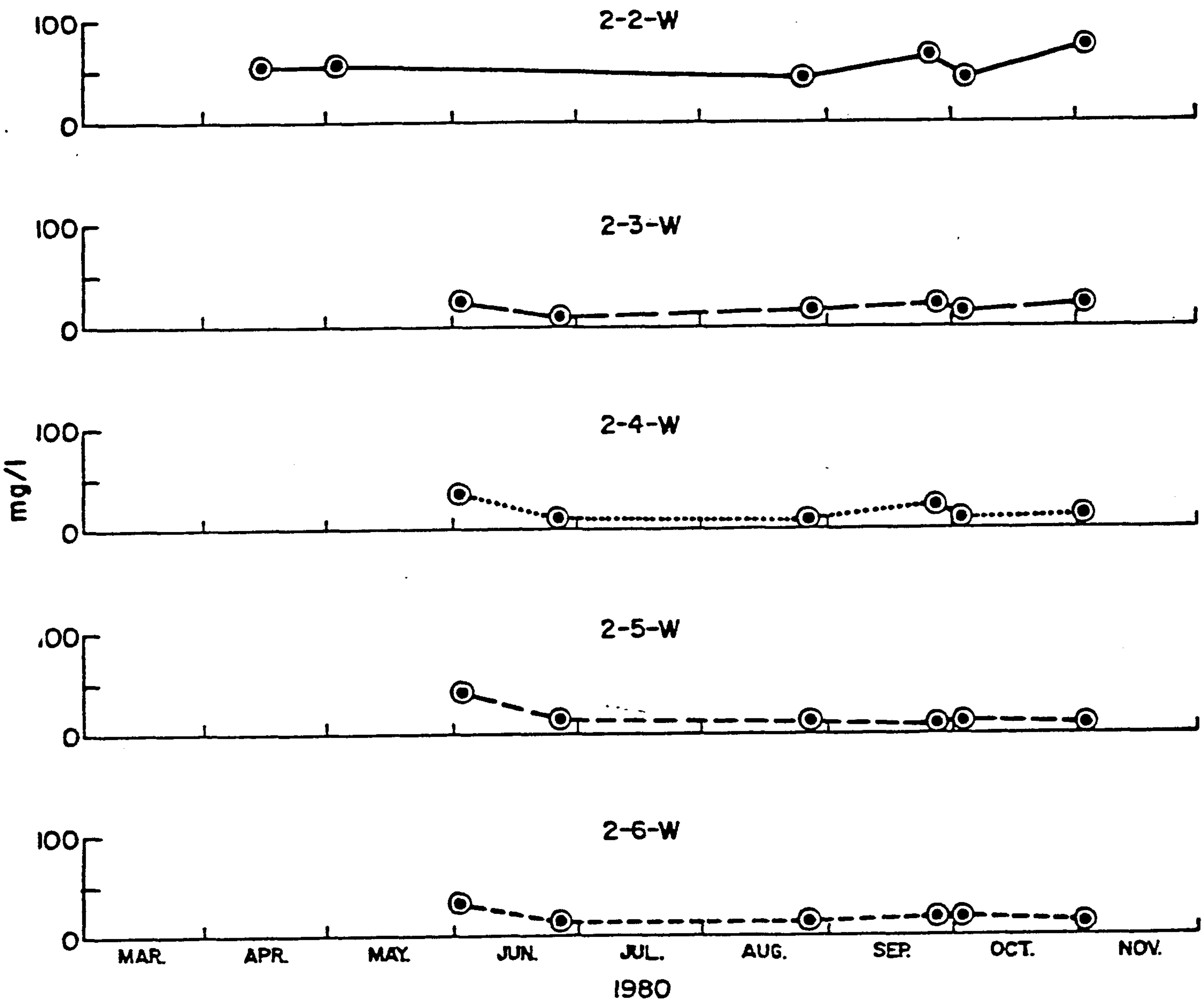



FIGURE 7-3: Comparison of $SO_4$ concentrations in spring and surface water in the Gordon Creek No. 2 Mine area (see Plate 7-3 for location and sample type).

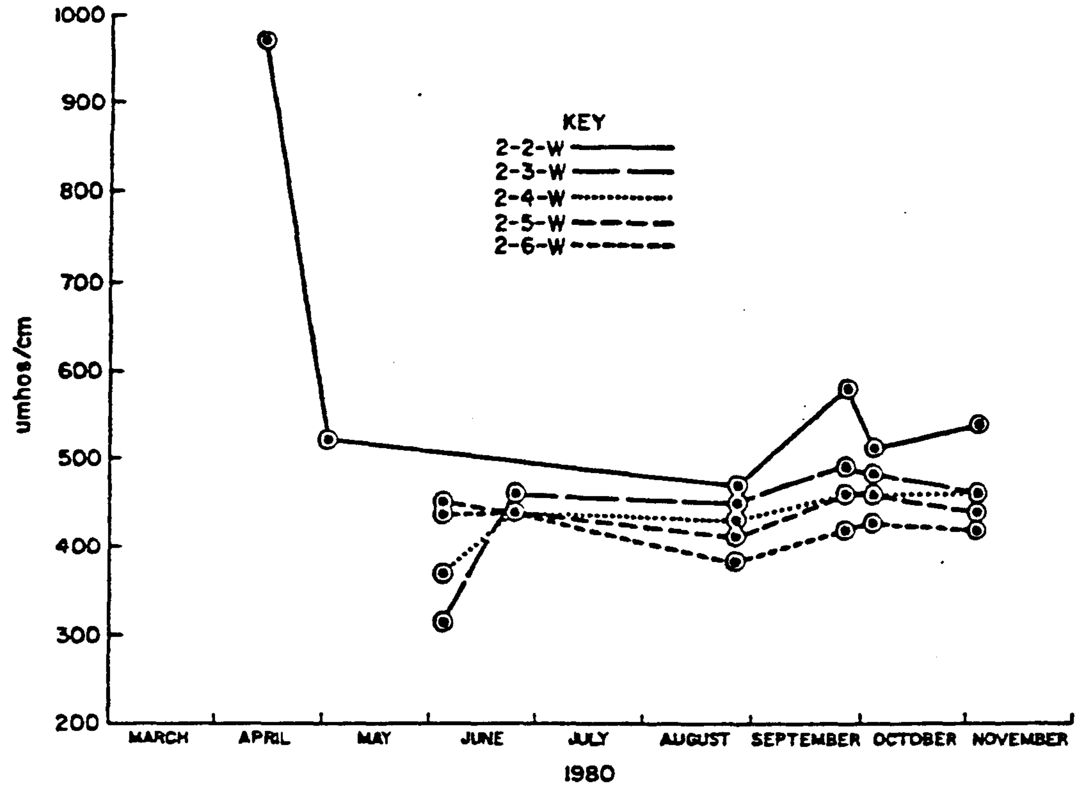



FIGURE 7-4: Comparison of electrical conductivity in spring and surface water in the Gordon Creek No. 2 Mine area.

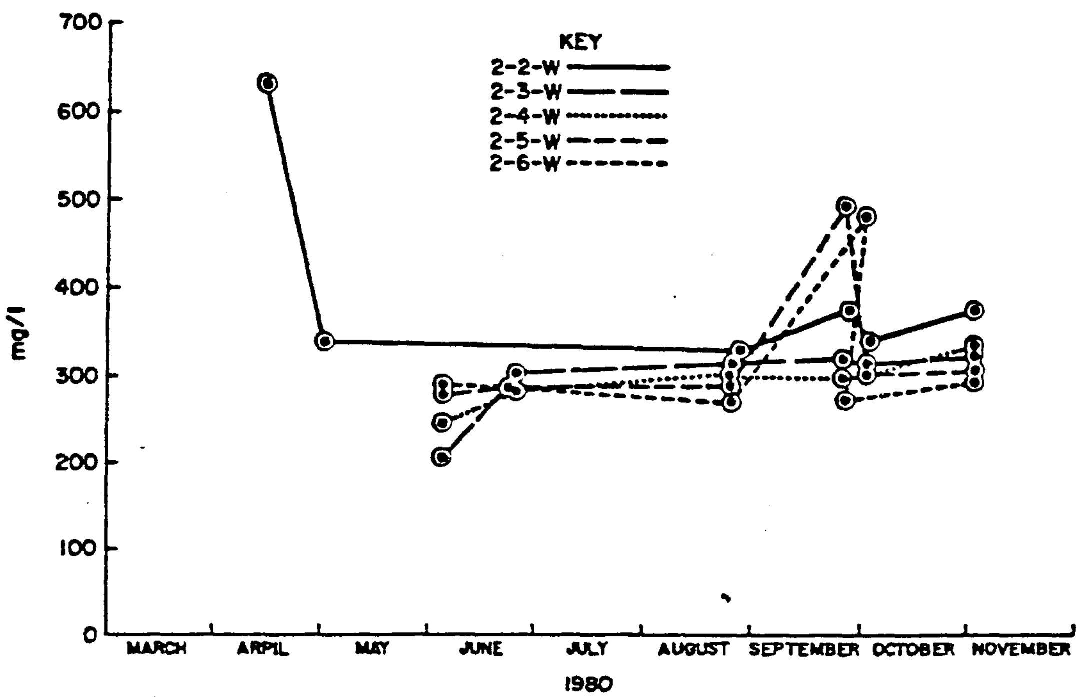



FIGURE 7-4. Comparison of TDS concentrations in spring and surface water in the Gordon Creek No. 2 Mine area.

TABLE 7-4

ABBREVIATED WATER QUALITY STANDARDS FOR
CLASS 3C and 4 WATER USES

| Constituent | Class 1C | Class 3A |
|---|---|---|
| **Physical** | | |
| Minimum D.O. (mg/l) | 5.5 | 6.0 |
| Maximum Temperature | - | 20°C |
| Maximum Temperature Change | - | 2°C |
| pH | 6.5 - 9.0 | 6.5 - 9.0 |
| Turbidity Increase (NTU) | - | 10 |
| **Chemical** (Maximum mg/l) | | |
| Cadmium, dissolved | 0.010 | 0.0004 |
| Chromium, dissolved | 0.05 | 0.1 |
| Copper, dissolved | 0.01 | 0.2 |
| Cyanide | - | 0.005 |
| Iron, dissolved | - | 1.0 |
| Lead, dissolved | 0.05 | 0.05 |
| Mercury, total | 0.0002 | 0.00005 |
| Phenol | - | 0.01 |
| Selenium, dissolved | 0.01 | 0.01 |
| Silver, dissolved | 0.05 | 0.01 |
| Zinc, dissolved | - | 0.05 |
| Chlorine | - | 0.002 |
| $H_2S$ | - | 0.002 |
| **Pollution Indicators** | | |
| BOD (mg/l) | 5.0 | 5.0 |
| $no_3$ as N (mg/l) | - | 4.0 |

### 7.1.4 Water Supply

The use of water in the Gordon Creek area is almost exclusively for stock watering. Furthermore, no water rights have been filed by Beaver Creek Coal Company for ground water.

### 7.1.5 Mine Dewatering

At the present time, no significant quantities of ground water have been encountered at the Gordon Creek No. 7 Mine. Consequently, water is pumped out of Sweet's Canyon into the mine for use in dust abatement. It is not anticipated that large quantities of ground water will ever be encountered throughout the duration of mining, and likewise discharge of water from the mine will not be necessary. Small quantities of water that may be encountered during mining operations will be used in conjunction with dust abatement for mining machinery.

### 7.1.6 Effect of Mining Operations on Ground Water

#### Hydrologic Impacts

An underground mining operation like the Gordon Creek No. 7 Mine, is expected to have little impact on the ground water system. Probably the principal hydrologic effect that might occur is a change in water quality of downstream surface waters as a result of the proximity of surface facilities to the drainage. Water that comes into contact with mining wastes or stockpiles and flows into surface drainage without flowing through a sediment pond might result in increased sediment loads in streams and also possibly a greater mineralization of that water; however, this is not the case at this property because all disturbed runoff is treated in a sediment pond.

The principal aquifer in the area, the Star Point Sandstone, is well below the mining activity. It is unlikely that mining of the Castle Gate "A" seam, approximately 200 feet above the Star Point, would have any effect on that sandstone.

The effects of subsidence on springs in the Black Hawk and Price River Formations shall be minimal. Based on the mining methods used and the limited history of other mines in the area, little subsidence is expected to occur, and if it does, subsidence would not necessarily occur at a location where a spring might be affected. Nevertheless, some springs and seeps might be destroyed or at least have their discharges reduced. It is equally likely, however, that additional springs and seeps could be created. Rock fractures and depressions could divert more rainfall and snowmelt underground. This could prove to be beneficial because more water would be available to the ground water system is lost due to overland flow and evapotranspiration.

The potential effects on ground water quality are also assumed to be minimal. Present data on ground water, springs water and surface water indicate little quality difference. The rock strata in the area are very similar, so mining and resulting subsidence would not expose the ground water to chemical source much different from those the water was previously in contact with.

To date, the mining operations have not impacted ground water at the No. 2 or No. 7 Mines. In fact, water is pumped from Sweet's Canyon to the Mine for use in dust abatement. If significant amounts of water are encountered, water samples and flow measurements will be taken.

### 7.1.7 Mitigation and Control Plans

Presently, Beaver Creek Coal Company does not foresee any impacts to ground water. However, Beaver Creek Coal Company has an agreement with Helper Associates, owner of the water from the Gunnison Homestead Spring, to replace any water that is impacted by mining operations. The replacement water would come out of Beaver Creek Coal Company's 377.1 shares of water from Scofield Reservoir. During 1985, the Gordon Creek area water usage amounted to 37.19 acre-feet, leaving ample reservoir water to replace the 9.46 acre-feet in question at the spring. The water quality of this replacement water is shown in Table 3-1. The subsidence monitoring plan will also be used to detect any impacts to the existing springs as discussed in Section 3.4.8.

### 7.1.8 Ground Water Monitoring Plans

In the event an inflow of ground water should be encountered, with a point source and quantity of 1 gpm or greater and with a sustained flow over a 30-day period, this point will become a regular monitoring point for ground water. Similar points will also be set up (if encountered). Monitoring will be on a monthly basis for flow and water quality for a baseline period of one year, and will be reported on the standard sampling chart (see Figure 7-18). In addition, a quarterly report shall be submitted to the Division, including: a map of underground workings showing sample locations, identification of the source, quantity and quality data and a table or discussion of the mine water balance. Such monitoring will continue for a baseline period of one year or until the area is rendered inaccessible. Should discharge from the mine become necessary, water may be treated in the sedimentation pond if needed to meet effluent limitations. Discharged water would also be monitored for flow and water quality on a monthly basis.

## 7.2 Surface Water Hydrology

### Scope

Through a combination of field efforts by Beaver Creek Coal Company personnel and a literature review by Hydro-Sciences, Inc., 12687 West Cedar Drive, Lakewood, Colorado 80228; surface water hydrology information has been assembled to satisfy regulations set forth by the Utah Division of Oil Gas & Mining (DOG&M) and the Office of Surface Mining (OSM) for the Gordon Creek No. 2 and No. 7 Mines. The existing information, as well as the potential impacts of mining on surface water is provided below.

### 7.2.1 Methodology

The hydrologic study was based on review of literature and available data obtained from the USGS, the U.S. Forest Service (USFS), the State of Utah, Beaver Creek Coal Company, and other mine permit applications. A field reconnaissance was performed to confirm the location and characteristics of surface water courses, springs and seeps.

### 7.2.2 Existing Surface Water Resources

#### 7.2.2.1 Regional Surface Water Hydrology

Most of the regional area is drained by tributaries to the Green and Colorado Rivers; principal tributaries are the Price and San Rafael Rivers and Muddy Creek. The Green River flows through the eastern edge of the Central Utah region.

The USGS has recently completed a report entitled "Hydrologic Reconnaissance of the Wasatch Plateau - Book Cliffs Coal Field Area, Utah", which considers the development of coal resources in central Utah (Waddell and Other, 1981). The Gordon Creek No. 2 and No. 7 Mines lie within the study area near head-waters of tributaries to the Price River. Much of the water from the Price River is diverted for irrigation use.

Approximately 50 to 70 percent of the stream flow occurs during the May-July snowmelt runoff period (Waddell and Others, 1981).

Summer precipitation does not usually produce more runoff. Intense rainfall may cause high runoff in localized areas. The 100-year, six-hour precipitation is approximately 2.5 inches in the mountain areas.

Water quality in the Price River and its tributaries is good at the higher elevations. In most cases, the surface waters at the higher elevations have the maximum concentration of dissolved solids of less than 250 mg/l and are a calcium bicarbonate type.

At lower elevations below diversions, the water changes to a sodium sulfate type with dissolved solids ranging from 250 to more than 6000 mg/l (Waddell and Others, 1981). These changes are caused by irrigation return flows and natural runoff from Urcas underlain by Mancos Shale.

7.2.2.2 Mine Plan Area Surface Water Hydrology

Three principal surface water courses are found within 100 horizontal feet of the mine permit area - Beaver Creek, North Fork of Gordon Creek, and Bryner Canyon (See Plate 7-2, Surface Water Courses).

Beaver Creek is a perennial stream that flows through the permit area. Perennial flow is maintained by a series of beaver ponds and by Jewkes Spring and Gunnison Homestead Spring. Both springs have dried up during drought periods, but normally provide contributions during low-flow periods. The discharge rate from Jewkes Spring during 1980 varied from 1.10 to 38 gallons-per-minute (See Table 7-3). The discharge from Gunnison Homestead Spring during 1980 varied from 136 to three gallons-per-minute (See Table 7-3).

The Gunnison Homestead Spring is actually a seepage area along a small tributary to Beaver Creek. Discharge measurements are taken near the mouth of the channel. Thus, the higher flow rates in June includes surface runoff from snowmelt conditions.

The general flow direction of Beaver Creek is north-east towards the Price River. The Gordon Creek lease block is near the head-waters of Beaver Creek. The watershed areas of Beaver Creek or its tributaries above the lease boundary are less than one square mile. The drainage pattern in the upper portions of the Beaver Creek Basin near the lease block is a dendritic. The detailed representation of the Beaver Creek channel profile is included in Plate 7-4. The valley profile is not as steep as Bryner Canyon or North Fork of Gordon Creek. Beaver ponds are common along the stream channel.

Flow and water quality have been monitored at several locations. Station 2-3-W is the Lower Beaver Creek Station located near the lease boundary as shown in Plate 7-2. The station was originally located further downstream below the lease boundary, but was moved in 1982 to the location where a Parshall Flume could be installed. Water quality samples have been collected monthly when weather permits. Station 2-4-W is located on Upper Beaver Creek just above the lease block as shown in Plate 7-2. A Parshall Flume was installed at the site in 1982. Water quality samples have been collected monthly when weather permits. Station USGS 2-2 refers to a water quality monitoring location on Beaver Creek near the center of the lease block which was abandoned in 1978. Flow in Beaver Creek is perennial throughout most of the year. The discharge rule during the late-Summer and Fall is very low (See Table 7-3). Flow at the lower station is slightly larger than the upper station. Water quality characteristics are similar.

The USGS maintains a gauging station near the mouth of Beaver Creek (Station No. 09312700). During the period of record from 1960 to 1975, the minimum annual discharge of 338 acre-feet occurred during Water Year 1961; the maximum annual discharge of 1610 acre-feet occurred in Water Year 1973.

Bryner Canyon is a small basin of about one square mile in an area that is located almost entirely within the lease block. Bryner Canyon contains the mine facilities and surface operations and, thus, is the only stream that could be directly impacted by surface disturbance associated with mining. Bryner Canyon contains an ephemeral stream which flows east into the North Fork of Gordon Creek just below the coal lease. The stream normally flows during the snowmelt period and usually dry throughout the remainder of the year. The stream was dry at all monitoring periods through the summer and Fall of 1978 as indicated in Table 7-3. Flow was observed at the three monitoring locations in Bryner Canyon during snowmelt. A small flow of 5 gpm was also observed in the north or right Fork of Bryner Canyon on July 21, but the flow infiltrated in to the channel and was not observed at the lower station.

Several intermittent springs or seeps are found on the Bryner Canyon watershed. The primary spring in Bryner Canyon appears as seepage emanating from below the coal seam immediately south of the west portal. Even when this spring is flowing, stream flow is not observed in the main channel unless there is snowmelt or an extreme rainfall event that produces flow. Even during much of the snowmelt period, Bryner Canyon maintains characteristics of an ephemeral stream since discharge rates often decrease going down stream.

The North Fork of Gordon Creek is the other principal stream found on the lease block. Drainage area above the lease block, about four square miles is considerably larger than Bryner Canyon. Stream flows in the North Fork are also larger than flows in Bryner Canyon. Flow begins much earlier during the snowmelt season (Table 7-2). A comparison of the data in Table 7-3 from the two locations on the North Fork monitored during 1978 shows that the stream is losing flow between the upper and lower station. Thus, the lower reaches of the North Fork of Gordon Creek within the Coal lease exhibit characteristics of an ephemeral stream in the sense that the ground water table is generally below the bottom of the channel and flow is from the stream.

A detailed representation of the North Fork of Gordon Creek channel profile is included in Plate 7-4. The profile is steeper than Beaver Creek. The channel gradient is relatively uniform across the coal lease. The canyon sides are steep and rocky. The characteristics of the channel and valley are indicative of a stream in a youthful stage of development.

Surface Water Quality

Permanent water quality sampling locations are shown in Plate 7-2. Sample points 2-3-W and 2-4-W correspond with stream gauging stations on Beaver Creek. Sample points

2-5-W and 2-6-W correspond with monitoring of Jewkes Spring and Gunnison Homestead Spring respectively. Sample points 2-7-W and 2-8-W are on Bryner Canyon above the facilities area, whereas 2-9-W is located on Bryner Canyon below the facilities area. Station 2-9-W also corresponds with a gauging station. Sample point 2-2-W is on the North Fork of Gordon Creek below the facilities area. The discharge from the sedimentation pond is designated sample point 2-1-W.

Water quality data from sample locations are provided in Table 7-2. As discussed in Section 7.1.3, surface water quality does not appear to be significantly different from ground water quality.

According to Appendix B, Wastewater Disposal Regulations Part II, Standards of Quality for Waters of the State (of Utah), The Price River and its tributaries from the confluence with Green River to Castle Gate, are classified 3C and 4. This reach includes the North Fork Gordon Creek (Sweets Canyon), but not Beaver Creek. Class 3C means that the particular stream is protected for non-game fish and other aquatic life, and Class 4 means that the stream is protected for agricultural uses. Table 7-3a lists numerical standards for both of these classes.

Beaver Creek is included in the classifications for the Price River and tributaries from Castle Gate to its head-waters. These are 1C (Protected for domestic use with prior treatment), 3A (Protected for cold water fisheries) and 4 (Agricultural). Table 7-3b lists numerical standards for classes 1C and 3A.

### 7.2.3 Surface Water Development, Control and Diversions

#### 7.2.3.1 Water Supply (Surface)

Water for use underground is pumped out of Sweets Canyon Creek from a pumping station below the mine. Water rights were obtained from Sweet Coal Company (See Appendix 2). The system was reconstructed in 1985. The hydrologic design data is provided on the following sheets.

Note: The Sweet's Canyon Pond is proposed to be left as a permanent structure after reclamation. Design flow estimates and calculations for the permanent structure are detailed in Section 7.2.8, Reclamation Hydrology. The following hydrologic design represents the original construction design and present, as-built conditions. Portions of this description are repeated in Section 7.2.8 as applicable for clarification purposes.

Sweet's Canyon Hydrologic Design

The design flow estimates were developed using the SCS program TR-20. Flow estimates were developed for both Bryner Canyon and the North Fork of Gordon Creek above the confluence with Bryner Canyon. Flows from Bryner Canyon are developed using the estimates obtained from 2 & 7 mine disturbed area drainage calculations. Revised flow estimates developed using the Type II rainfall distribution are provided in Table 7-5. Flow estimates are also developed for the Right Fork of Bryner Canyon for drainage from the access road and Area C representing all other areas draining to Bryner Canyon below the No. 2 mine site. These estimates are provided in Table 7-6 and were developed using the Type II rainfall distribution.

Temporary Diversion, North Fork of Gordon Creek

A permenent diversion channel is designed to keep flows in the North Fork Gordon Creek separate from water in the truck fill-up pond. A berm separates the diversion channel from the pond as shown in the attached exhibit. The existing channel slopes were surveyed in order to develop the diversion designs.

The channel was designed for a flow of 362 cfs, the peak flow from a 100-year, 24-hour precipitation event. The channel upstream of the diversion just above the pump house headgate enters with a slope of 0.028. From the pump house headgate to the drop structure, the slope is 0.0252. The slope of the drop structure is 0.28 while the bedslope of the natural channel below is about 0.03.

TABLE 7-5 - INPUT SPECIFICATIONS AND RESULTS OF TR-20 FLOW ESTIMATES
NO. 2 & 7 MINE DISTURBED AREAS

| | Area B | No. 7 Site | Combined | Sub Drainages Sub-1 | Sub-2 | Combined | Sub-3 | Total Combined |
|---|---|---|---|---|---|---|---|---|
| Area - Acres | 204 | 7.7 | 211.7 | 1.54 | 6.4 | 219.6 | 25.6 | 244.2 |
| Curve Number | 63 | 86 | | 86 | 89 | -- | 63 | -- |
| Slope Length (feet) | 4500 ft. | 1650 ft. | -- | 480 ft. | 900 ft. | -- | 1500 ft. | -- |
| Slope (%) | 23% | 16% | -- | 6% | 4% | -- | 37% | -- |
| Lag (hrs.) | 0.36 hrs. | 0.12 hrs. | -- | 0.06 hrs. | 0.11 hrs. | -- | 0.14 hrs. | -- |
| Time of Concentration (hrs.) | 0.6 hrs. | 0.20 hrs. | -- | 0.1 hrs. | 0.18 hrs. | -- | 0.23 hrs. | -- |
| Ten-year, 24-hour Precipitation Results | | | | | | | | |
| Precipitation (in) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Peak Discharge (cfs) | 4.0 | 6.2 | 6.5 | 1.4 | 6.3 | 13.6 | 0.6 | 13.7 |
| Total Runoff (acre-feet) | 1.73 | 0.54 | 2.27 | 0.11 | 0.55 | 2.93 | 0.22 | 3.15 |
| 25-year, 24-hour Precipitation Results | | | | | | | | |
| Precipitation (in) | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 |
| Peak Discharge (cfs) | 24.6 | 10.2 | 27.2 | 2.3 | 9.9 | 30.8 | 5.4 | 36.0 |
| Total Runoff (acre feet) | 5.36 | 0.9 | 6.26 | 0.18 | 0.87 | 7.31 | 0.67 | 7.97 |

## TABLE 7-6 - INPUT SPECIFICATIONS AND RESULTS OF TR-20 FLOW ESTIMATES SWEETS CANYON WATER TRUCK FILL-UP

| | Sub Drainages | | | | | |
|---|---|---|---|---|---|---|
| | 2 & 7 Mine Disturbed Area (Total combined from Table 1 | Right Fork Bryner Canyon | Access Road To 2 Mine | Area C | Combined Bryner Canyon | North Fork Gordon Creek |
| Area - Acres | 244.2 | 203 | 22 | 148 | 617 | 3,620 |
| Curve Number | -- | 63 | 84 | 63 | -- | 63 |
| Slope Length (feet) | -- | 4300 | 150 | 5600 | -- | 26,900 |
| Slope (%) | -- | 26 | 35 | 20 | -- | 10 |
| Lag (hrs.) | -- | 0.36 | 0.06 | 0.45 | -- | 2.1 |
| Time of Concentration (hrs.) | -- | 0.60 | 0.1 | 0.75 | -- | 3.5 |
| Ten-year, 24-hour Precipitation Results | | | | | | |
| Precipitation (in) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Peak Discharge (cfs) | 13.8 | 3.9 | 20.2 | 2.7 | 28.7 | 39.0 |
| 25-year, 24-hour Precipitation Results | | | | | | |
| Precipitation (in) | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 |
| Peak Discharge (cfs) | 35.6 | 24.5 | 33.3 | 15.8 | 77.6 | 155 |
| 50-yr., 24-hr. Precipitation Results | | | | | | |
| Precipitation (in) | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 | 2.9 |
| Peak Discharge (cfs) | 46.0 | 33.1 | 37.2 | 21.5 | 103.3 | 201 |
| 100-yr., 24 hr. Precipitation Results | | | | | | |
| Precipitation (in) | - | - | - | - | 3.2 | 3.2 |
| Peak Discharge (cfs) | - | - | - | - | 154 | 362 |

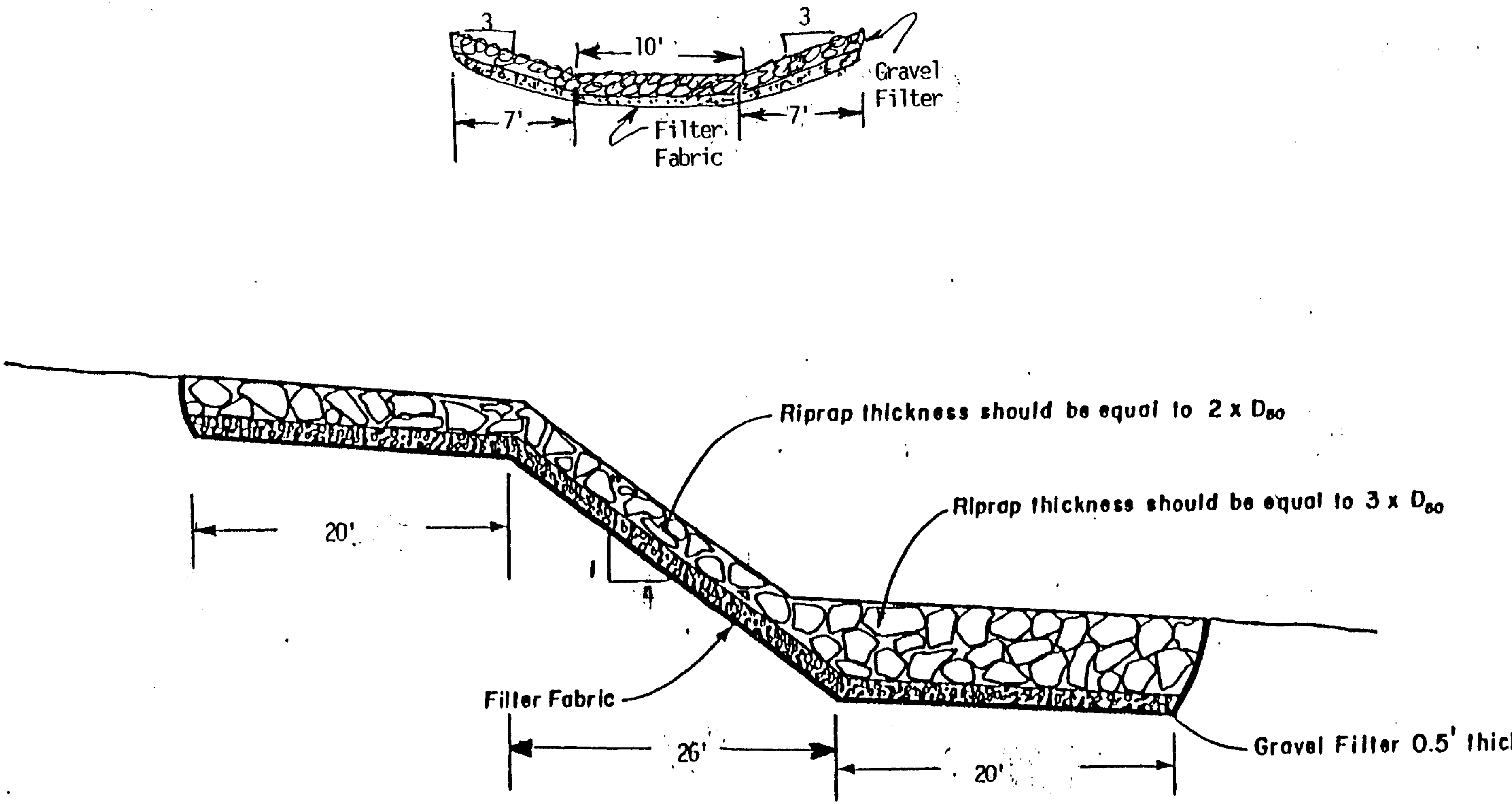



Figure 7-5 design of riprap drop structures.

7.2.3.1 <u>Water Supply (Surface)</u> (continued)

A trapezoidal channel is designed for the diversion above the drop structure using Manning's Equation. Design specifications are provided below for the discharge from a 100-year, 24-hour precipitation event:

| | | |
|---|---|---|
| Discharge (cfs) | = | 362 |
| Slope (%) | = | 2.52 |
| Velocity (ft/sec) | = | 6.76 |
| Normal Depth (ft) | = | 3.57 |
| Bottom Width (ft) | = | 15 |
| Side Slope | = | 1.5:1 |
| Manning's n | = | 0.035 |

A rip rapped drop structure is designed according to the specifications in Figure 1. Design specifications for a trapezoidal shaped section are provided below for the discharge from a 100-year, 24-hour precipitation event:

| | | |
|---|---|---|
| Discharge (cfs) | = | 362 |
| Slope (%) | = | 28.0 |
| Velocity (ft/sec) | = | 19.71 |
| Normal Depth (ft) | = | 1.84 |
| Bottom Width (ft) | = | 10 |
| Side Slope | = | 3:1 |
| Manning's n | = | 0.040 |

<u>Rip Rap Sizing</u>

Rip rap is sized to provide channel protection for flows

up to 39 cfs representing the peak discharge from a ten-year, 24-hour precipitation event. The slope of the drop structure is 0.28. For a trapezoidal channel with a ten-foot bottom width, 3"1 side slopes and a roughness coefficient of 0.04, the estimated normal depth is 0.37.

feet. Angular rock rip rap with a median diameter of 1.25 to 1.5 ft is sued for channel protection. The safety factor is estimated using the following equation from Simons and Senturk (1977):

$$SF = COS\ \theta\ TAN\ \emptyset \quad (n'\ TAN\ \emptyset + SIN\ \theta\ COS\ B)$$

where:

$\emptyset$ the angle of repose is 42°

$\theta$ the side slope angle is 18.4

$B = TAN^{-1}\ (n\ TAN\ \emptyset\ /\ SIN\ \theta) = 66.38$

$n = 21\ T_s/(w_s - w)\ D_{50} = 0.8$

ws the specific wt. of water is 62.4 lbs/ft$^3$

$D_{50}$ is the median rock diameter = 1.25 ft.

$T_s$ the maximum tractive force = 0.77 wds = 4.978 lbs/ft$^3$

d is the depth of flow = 0.28

$n' = (n/2)\ (1 + SIN\ B) = 0.768$

Thus, for $D_{50}$ equal to 1.25 ft. the safety factor is:
SF = COS 18.4 TAN 42/(0.768 TAN 42 + SIN 18.4 COS 62.3)
= 1.04 ft. For $D_{50}$ equal 1.5 + the safety factor is 1.2.

Therefore, a median rip rap diameter of 1.25 to 1.5 feet should provide adequate channel protection for peak discharges from events in excess of the ten-year, 24-hour precipitation event.

Bryner Canyon - Diversion

Bryner Canyon will be diverted around the water truck fill-up pond by routing flows across the main access road through a culvert, down a road side diversion ditch for about 115 ft. and back across the road through a culvert.

The culverts and diversion ditch are sized for a peak discharge from a ten-year, 24-hour precipitation event.

Both road culverts are 36-inch corregated metal pipe with mitered entrance equipped with trash racks. The culverts can accommodate flows up to 35 cfs without head water depth exceeding the culvert diameter. Thus, the culverts will safely pass the 29 cfs flow from a ten-year, 24-hr. precipitation event. Headwater depths would reach about 2.5 times the culvert diameter during a flow of 78 cfs which correspondence with the peak discharge from a 25-year, 24-hour precipitation event.

The diversion ditch is a trapezoidal channel designed using Manning's Equation. Design specifications are provided below to the discharge from a ten-year, 24-hour precipitation event:

| | | |
|---|---|---|
| Discharge (cfs) | = | 29 |
| Slope | = | 0.045 |
| Velocity (ft/sec) | = | 6.2 ft. |
| Normal depth (ft) | = | 0.9 ft. |
| Bottom width | = | 3.0 |
| Side Slope | = | 25:1 |
| Mannings n | = | 0.036 |

This diversion channel is protected with rip rap with a median diameter of seven inches. Rip rap was sized using the procedures from "Erosion and Sediment Control; Surface Mining in the Easter U.S." (EPA - 625/3-76-006) as developed in Figure 2.

A rip rapped apron is provided at the outlet of the culverts.

A channel is provided to bring flows back to the old Bryner Canyon stream channel at non-erosive velocities. The channel is a trapezoidal channel with design specifications developed below for the discharge from a ten-year, 24-hour precipitation event:

| | | |
|---|---|---|
| Design Discharge (cfs) | = | 29 |
| Slope | = | 0.033 |
| Velocity (ft/sec) | = | 4.9 |
| Normal depth (ft) | = | 0.52 |
| Bottom width (ft) | = | 10.0 |
| Side Slope | = | 2.5:1 |
| Bed Slope | = | 0.033 |
| Mannings n | = | 0.033 |

## 7.2.3.2 Sediment Control Structures and Diversion

### 7.2.3.2.1 Surface Water Handling Plan

An amended Surface Water Handling Plan has been implemented for the Gordon Creek No. 2 and No. 7 Mine facility area. The intent of the Plan is to capture and treat all surface runoff which may have come in contact with areas disturbed by the surface mine facilities. Also, any surface runoff which may have come in contact with areas receiving transient coal dust will be captured in sediment ponds for settling of suspended solids before being released. The amendments proposed in this plan will provide for the containment of more water than was previously captured and will result in better water quality downstream of the mine facility.

This Section contains a description of the revised water drainage plan, along with a description of the associated facilities which are employed to affect the drainage plan.

The descriptions include the following sections:

- o Bryner Canyon Left Fork
- o No. 7 Mine area
- o Bryner Canyon Right Fork
- o No. 2 Mine area
- o Pond No. 7A
- o Pond No. 2

Bryner Canyon Left Fork

Under the amended plan, all of the surface runoff in the Left Fork of Bryner Canyon is captured in the drainage and sediment control system. The area involved is shown on the Mine Area Hydrology Map (Plate 7-5) as Area B. Runoff from this area flows down the Bryner Canyon natural drainage until it enters the area designated as the No. 7 Site. A small amount of this water passes through the area designated as Sub-2. Rainfall and resultant runoff in the Left Fork of Bryner Canyon is allowed to flow in natural drainages and encounters no disturbed areas until it enters the No 7 Site or the Sub-2 area. A description of the water handling scheme in those areas is shown in the No. 7 Mine Area Section and No. 2 Mine Area Section.

<u>No. 7 Mine Area</u>

The No. 7 Mine Area, shown on the Mine Area Hydrology Map (Plate 7-5) as No. 7 Site, receives most of the drainage from the Left Fork of Bryner Canyon. Drainage control in the No. 7 Site consists of a combination of one-half culverts and full culverts. The No. 7 Mine Drainage Plan Map (Plate 7-7) shows the location of the culverts and drainage system in the No. 7 Mine Area.

One-half culverts and full culverts are employed in this drainage to facilitate the collection of side slope drainage. The culverts and one-half culverts function basically as a heavily armored drainage ditch and improve the integrity of the diversion.

Water enters the new culvert system at the upper end through an open one-half culvert. The one-half culvert is buried in the ground so that it can receive water falling on adjacent areas as well as water guided into the head structure of the one-half culvert. The use of a one-half culvert in this area is intended to minimize the siltation of the ditch through this area and minimize infiltration of water from the ditch into the fill material over which it is constructed. In addition, the one-half culvert eliminates additional contribution of sediment from the channel.

The one-half culvert joins a full-round culvert section as shown on the No. 7 Mine Drainage Plan Map (Plate 7-7). The full culvert is buried in the ground with a small surface ditch located beside it to collect any runoff from adjacent areas. This section of full-round culverts passes through an area of potentially unstable natural slopes. There exists in this area, one known slide and the potential for others. By burying the culvert in this area, damage to the drainage system from land slides is minimized. The unstable area is up-slope of the culvert and any future slope failures should flow over the buried culvert with a minimum of damage. At the end of the unstable area, the full culvert is routed into a one-half culvert for a short stretch in order to collect any surface runoff from the adjacent drainage basin which may have accumulated along the course of the full culvert.

From the one-half culvert, water is again routed into a full-round culvert. The purpose of burying a full-round culvert in this area is to accommodate the bends in the drainage and ensure containment of flow by using a flexible culvert installed around the sharp bend. This section of flexible culvert also has a small surface drainage ditch beside it to collect any runoff from adjacent areas and to collect runoff from the small drainage which enters the main contained drainage in the bend.

After coming around the bend, the flexible culvert is routed into an open one-half culvert which is placed on top of the existing liner cloth armored slope. Installation of the one-half culvert in this area consists of moving aside the rip rap found in the existing channel, placing the culvert on the liner in the existing channel and staking the culvert into position. The rip rap was then replaced around the outside of the culvert and shotcreted/grouted into place. Water bars were installed at intervals along the one-half culvert to collect water which may fall on adjacent drainage areas and guide it into the culvert.

This method has been chosen for this area based on a number of factors. A degree of slope stabilization has been achieved by the installation of brattice cloth. By placing the culvert over the liner, a minimum amount of damage to the current slope will occur. Carrying the water in the culvert minimizes erosion of the slope and eliminates sediment contribution through the channel. In addition, water infiltration into the fill through this portion of the drainage channel is minimized. Replacing and shotcreting the rip rap in place around the one-half culvert will further enhance the stability of this area. Periodically collecting the water into the one-half culvert will minimize the water in the rip rap portion of the channel and any subsequent infiltration to the fill, as well as reducing sediment contribution from the channel.

The one-half culvert extends down the steep slope from the No. 7 Mine Area facilities area. At the toe of this slope, the one-half culvert discharges into a full-round flexible culvert. This flexible culvert carries the water over the potentially unstable slope in the steep portion of the natural drainage.

The flexible culvert is placed on top of the ground surface and is staked in place. This method of culvert installation was chosen to minimize damage to the culvert from any movement which potentially could occur, although this area has been regraded and stabilized.

The full-round flexible culvert discharges just below the toe of the old land slide area. A rip rap energy dissipator is installed at the end of the culvert to reduce the energy of the water and minimize erosion in the natural drainage. Surface water runoff flows in the natural drainage from this point to pond No. 7A. It is not necessary to extend the culvert beyond this location due to channel capacity and gradient.

Use of one-half, full-round and flexible culvert types is intended to carry runoff waters through the No. 7 Mine area, minimize infiltration into fill material, minimize erosion on steep slopes in the area, and reduce or eliminate additional sediment contributions from the drainage.

Bryner Canyon Right Fork

The Right Fork of Bryner Canyon is undisturbed by the mining operations. This area is designated on the Mine Area Hydrology Map (Plate 7-5) as Area A. Runoff from the Right Fork of Bryner Canyon is collected where the Right Fork enters the main canyon. Runoff water from this undisturbed area is routed through the No. 7 Mine facilities area in a 24" enclosed culvert. Operation of the culvert is described under the Mine

No. 2 Area Drainage section. Modification to the existing drainage plan for runoff from the Right Fork of Bryner Canyon includes routing runoff through the Mine area in an enclosed culvert to eliminate introduction of sediment from the vicinity of the Gordon Creek No. 2 and No. 7 Mines area.

No. 2 Mine Area

Major modifications to the Gordon Creek No. 2 Mine area drainage system are proposed in this amendment. The changes include the construction of a new pond designated No. 7A, the enlargement of the pond designated No. 2, the construction of the outfall structures associated with the ponds, and the construction of an enclosed culvert to carry the Right Fork waters through the Mine area in an uncontaminated manner. The No. 2 Mine Drainage Plan Map (Plate 7-6) shows the location of these structures.

Water from the Right Fork of Bryner Canyon is collected in the existing culvert at the intersection of the Right Fork of Bryner Canyon with the main canyon. The culvert runs from the Right Fork of Bryner Canyon through the Mine area, around pond 7A to a discharge below the Mine area. Routing of surface water from the undisturbed areas in the Right Fork of Bryner Canyon prevents this water from mixing with surface water from disturbed areas as it flows through the Mine area.

Surface runoff from the Left Fork of Bryner Canyon, which includes the Gordon Creek No. 7 Mine area, enters the Gordon Creek No. 2 Mine area from pond 7A. A description of the drainage plan for pond No. 7A is found in the Pond No. 7A Section of this Amendment.

Surface runoff from rainfall directly on the Gordon Creek No. 2 Mine area is routed by a series of ditches and culverts to pond No. 2. The handling of surface water from the No. 2 Mine area is essentially the same under this Amendment as it was under the previous Plan.

Runoff from the south slope of the Mine area is collected in a ditch along the toe of the slope and to pond No. 2. This ditch will serve to collect any coal fines which inadvertently find their way onto the slope. Runoff from the slope north of the Mine area is collected in an existing ditch along the toe of the slope and to pond No. 2. These structures have not changed this Amendment. The ditch along the toe of the slope south of the Mine area will be reconstructed as a result of this Amendment due to the installation of culverts in this vicinity. Culverts to be installed along the tow of the slope south of the Mine area will serve three functions:

- o Connect Pond No. 7A and No. 2 in series;
- o Route Right Fork of Bryner Canyon undisturbed flow past the disturbed area;
- o Route the 25-year, 24-hour precipitation event from the Left Fork of Bryner Canyon through the No. 2 Mine area, by-passing Pond No. 2.

A culvert will be installed to carry the ten-year, 24-hour runoff peak flow from pond No. 7A to pond No. 2. This culvert connects the two ponds in series. Connecting the ponds in series provides adequate volume for sediment collection and detention of the ten-year, 24-hour storm.

A second culvert installed along the tow of the slope will carry the water from the undisturbed Right Fork of Bryner Canyon and surface runoff from precipitation events greater than the ten-year, 24-hour storm from pond No. 7A.

Water from the Right Fork of Bryner Canyon is carried in culvert No. 4 to manhole No. 1. The 25-year, 24-hour storm waters will flow from pond No. 7A to manhole No. 1. In manhole No. 1, the two flows are mixed and are carried through the Mine area and discharged below the Mine area.

Pond No. 7A

Pond No. 7A receives drainage from the Left Fork of Bryner Canyon and the Gordon Creek No. 7 Mine area. An outfall structure for this pond has been designed using the following concept. The ten-year, 24-hour storm will be routed in series through pond No. 7A and pond No. 2. The 25-year, 24-hour peak flow will be routed from the pond in a separate spillway and will discharge below the Mine area. The peak flow from the 25-year, 24-hour flood is combined with the runoff from the Right Fork of Bryner Canyon in manhole No. 1 at the base of pond No. 7A. The principal spillway, designed to carry the ten-year, 24-hour peak flow, is completely separate from the emergency spillway which will pass the peak from from the 25-year, 24-hour storm. The principal spillway is designed to allow the pond to be operated either in a full mode or an empty mode. The spillway consists of a vertical corrugated metal pipe riser with sized perforations to dewater the pond to the designated sediment level in a controlled manner. The top of the riser is open to allow peak flow from the ten-year, 24-hour flood.

Although the pond is self-regulating, Beaver Creek Coal Company can control the water level in pond No. 7A by means of a hand-operated gate which is located in manhole No. 2.

Capacity of pond No. 7A will be achieved by borrowing material for the embankment from within the pond limits.

The storage capacity table, stage storage curve and summary of the design features of pond No. 7A are shown on the Pond No. 2 Design Map (Plate 7-8).

Pond No. 2

Operation of ponds No. 7A and No 2 in series provides sufficient storage volume to contain one-hundred percent of the design runoff from a ten-year, 24-hour precipitation event. This Amendment includes enlarging pond No. 2 due to storage requirements for the runoff from the drainage area. Enlargement will be completed by excavating in the existing pond area and raising the elevation of the outflow structures and embankment. The increased capacity of pond No. 2, when combined with pond No. 7A, will provide four acrefeet of total storage volume. Sediment storage comprises 0.66 acre-feet of the designed volume with water storage comprising the remaining 3.34 acrefeet of storage.

The reconstruction of the pond No. 2 will involve buttressing the downstream slope with additional fill material, excavating the pond to the dimensions shown on the Pond No. 2 Design Map (Plate 7-8) and constructing a new discharge structure for the pond. The new discharge structure for the pond consists of separate spillways to carry the ten-year, 24-hour event peak flow and the 25-year, 24-hour event peak flow. The ten-year, 24-hour spillway (principal spillway) will be a floating intake spillway, while the 25-year, 24-hour spillway will be a corrugated metal riser pipe.

Details of the spillway are shown on the Pond No. 2 Details Map (Plate 7-8a) and the Pond No. 2 Spillway Details Map (Plate 7-8b). The ten-year, 24-hour spillway is designed to float on the water surface to dewater the pond in a controlled manner and allow compliance with existing NPDES permits. This allows the pond to be operated in an empty mode with no operator assistance to release water from the pond after runoff. There will be a valve on the outlet to the principal spillway so that Beaver Creek Coal Company can control the level of the pond if required.

The criteria used to design the ten-year, 24-hour spillway for pond No. 2 include:

- o Pond shall be self-operating
- o Pond shall be empty except in the event of a large precipitation event
- o Spillway shall remove the cleanest water possible from the pond to meet NPDES permit requirements
- o Spillway must be controllable so that water level can be raised in the pond if necessary
- o The required detention time can be met for a ten-year, 24-hour precipitation event

The floating spillway meets these criteria. By floating, the spillway always draws the cleanest water from just below the top of the pond. As water recedes in the pond, the spillway descends. The spillway is stopped at the level of sediment accumulation in the pond and dewatering ceases.

The spillway is contained within a six-foot diameter sump. The lip of the sump is at sediment elevation preventing sediment from being drawn into the spillway and clogging it. A valve located at the point where the ten-year, 24-hour spillway discharges into the emergency spillway provides for pond control. Under normal operating conditions, it is anticipated that the valve will remain open.

Discharge from the spillway is into the existing 24-inch corrugated metal pipe which carries the flow to the bottom of the canyon.

A storage capacity table, stage storage curve and a pond design summary are shown on the Pond No. 2 Design Map (Plate 7-8).

7.2.3.2.2 Pond Operation

Both pond No. 7A and pond No. 2 are self-operating ponds. No human help is needed to contain or release flow from precipitation events. Controls have been provided on each pond to allow for manual control should it be desired.

Pond No. 7A

The principal spillway from pond No. 7A is a 24-inch corrugated metal riser pipe with perforations above the sediment level of the pond. The perforations allow release of all water above the sediment level. Water flow through the perforations is slow so as to increase the detention time of the sediment pond system.

During the ten-year, 24-hour precipitation event, water will over-top the lip of the principal spillway. Water will flow over the top of the riser until flow decreases. Water will then be released from the pond through the holes in the riser.

A manhole has been provided in the principal spillway downstream of the dam. The manhole contains a gate which can be used to control the flow of water through the principal spillway. During normal pond operation, this gate will remain open.

During precipitation events larger than the ten-year, 24-hour storm, water will flow through the emergency spillway. The emergency spillway is a six-foot diameter corrugated metal riser pipe. The principal spillway is designed to pass only the ten-year, 24-hour storm event. The excess over the ten-year, 24-hour storm will be discharged through the emergency spillway.

Pond No. 2

The principal spillway to pond No. 2 is a floating hose inlet. The hose inlet rises with the pond level assuring that the cleanest possible water is drawn off at all times. Flow rates through the hose are small to assure adequate detention time. A valve on the outlet allows the pond level to be controlled. The valve will remain open during normal operation.

During precipitation events greater than the ten-year, 24-hour storm, water will flow through the emergency spillway. The emergency spillway is a six-foot diameter corrugated metal riser pipe.

Open Channel Emergency Spillway - Pond 2

In response to a Division Order, and open channel emergency spillway has been added to Pond No. 2. Details of the spillway are shown on revised Plates 7-8 and 7-8b. Calculations for spillway sizing and flow depths are shown on pages 7-80b and 7-80c. Calculations are based on the Broad-Crested Weir Formula and the OSM Hydrology Program.

The spillway is designed to carry the runoff from a 25 year - 6 hour event, which calculates out to be 11.30 cfs for this site. The open spillway is designed with a 5% slope across the dam and a 30% slope down the edge of the outslope. At the above slopes, and with the cross-sectional area shown on Plate 7-8b (6' bottom width, 2h:1v side slopes, 1.6; depth), the flow depths are 0.64' and 0.24' respectively. The spillway elevation is located 1.6' below the top of the dam, allowing for adequate freeboard during maximum design flow. The spillway is also 0.1' above the existing cmp overflow, and will only be used in the event of failure or overtopping of the existing pipe overflows.

AMENDMENT TO
APPROVED ... Plan
Approved ...ning
by KW DO-91B 11/5/91

SEDIMENT POND NO. 2

EMERGENCY SPILLWAY

Broad-Crested Weir Formula — $Q = 3.087\ b\ H^{1.5}$

Q = 11.3 cfs

b = 7' (Average Width)

H = 0.64' (Depth of Flow)

AMENDMENT TO
APPROVED Mining & Reclamation Plan
Approved, Division of Oil, Gas & Mining
By KW DO-9HB date 11/8/91

Channel Flow Calculation

For: POND 2 - EMERGENCY SPILLWAY (OUTSLOPE

| | | |
|---|---|---|
| Bed Slope = | .3 | |
| Manning's N = | .04 | |
| Bottom Width = | 6 | feet |
| Channel Side Slope = | .5 | |
| Flow Depth = | .2371288 | feet |
| Cross Sectional Area = | 1.535233 | square feet |
| Wetted Perimeter = | 7.060472 | feet |
| Hydraulic Radius = | .2174405 | feet |
| Discharge = | 11.3 | cubic feet/sec |
| Velocity = | 7.360448 | feet/sec |

AMENDMENT TO
APPROVED Mining & Reclamation Plan
Approved, Division of Oil, Gas & Mining
KW DO-91B date 11/5/91

### 7.2.3.2.3 Hydrology

Hydrologic calculations are based on the drainage and sub-drainage areas shown on the Mine Area Hydrology Map (Plate 7-5). Drainage from the Right Fork of Bryner Canyon, designated as Area A on the map, does not pass over disturbed land. This runoff is carried through the Mine area in a buried culvert to prevent co-mingling with runoff from disturbed areas.

The surface facilities are divided into three sub-areas. These area are designated as No. 7 Site, which includes all disturbed areas upstream of pond No. 7A, and Sub-1 and Sub-2 of the No. 2 Mine area as shown on the Mine Area Hydrology Map (Plate 7-5). Runoff volumes, peak flows, and sediment yields have been calculated for each of the areas and sub-areas.

#### Runoff Volume and Peak Flow

The technique used to determine runoff volumes and peak flow for design of diversions, culverts and sediments ponds is the SCS runoff curve number and the associated computer model TR-20. Curve numbers were determined by a weighted average based on the percentage of each basin occupied by a given land surface category. Land surface categories were assigned the following curve numbers:

| | |
|---|---|
| o Undisturbed Forest Land | 63 |
| o Disturbed Land | 90 |
| o Reclaimed Land | 80 |

A curve number of 63 for undisturbed areas was selected as a conservative estimate for the design use. This curve number corresponds with estimates from Table 2 in McCuen (1982) for forests and woods with soils from both soil group B and C as found at the site. Also, it provides higher design flows than would be obtained using other estimating procedures.

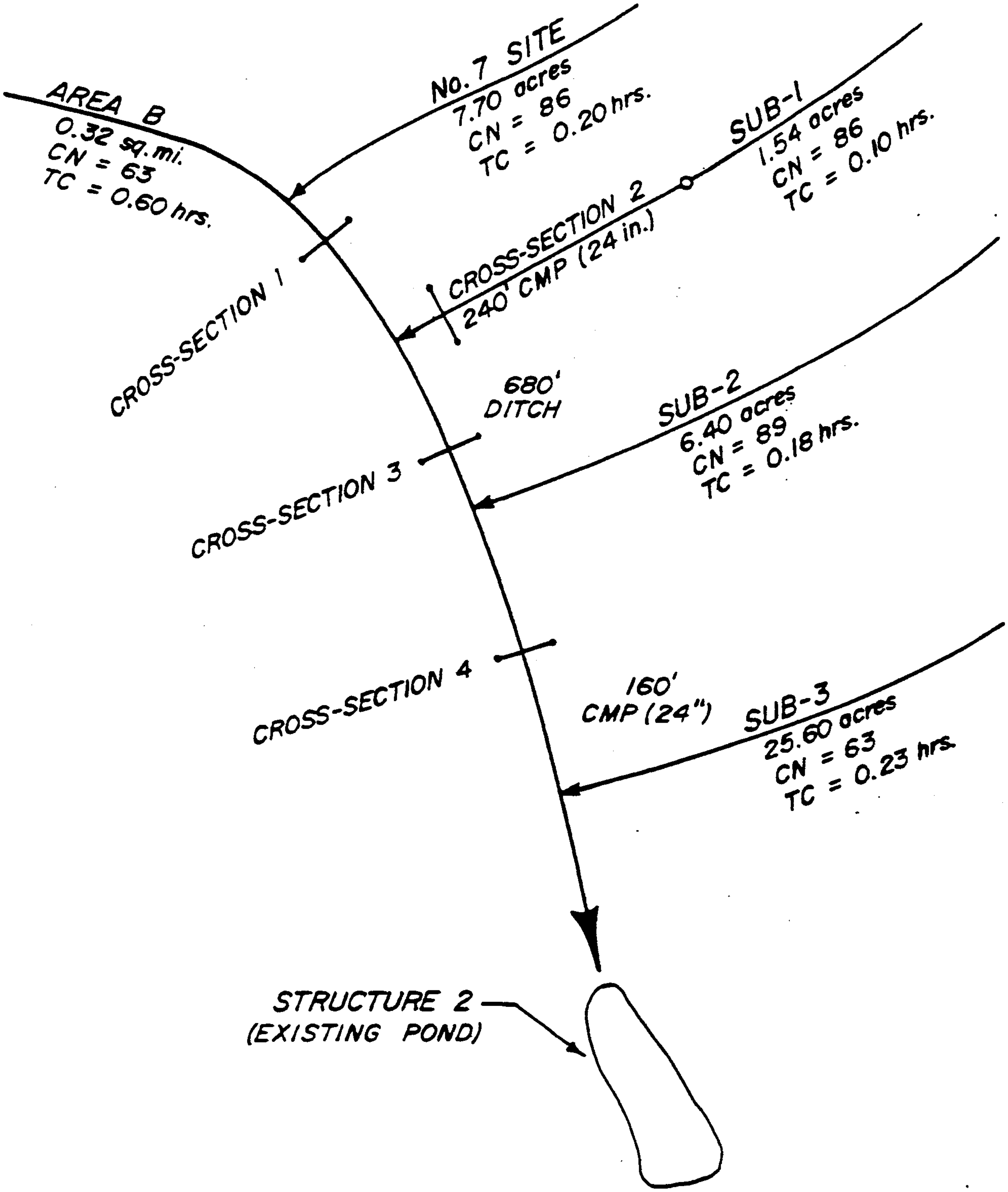
Curve numbers for reclaimed areas for hydrologic soil group C are based on estimates in OSM (1981). Values are given in the range 74-88; a value of 80 was used. For disturbed areas, including active mine areas and surface facilities, estimates in OSM (1981) range from 87 to 98; a value of 90 was used because of the lack of paved surfaces and minimal impervious area found at the mine site.

Time of concentration was determined from basin lag using the curve number method for estimating basin lag (SCS Technical Release No. 55). Antecedent Moisture Condition II was used for all runoff estimates. Design rainfalls were determined from the "Precipitation Frequency Atlas of the Western United States" (NOAA Atlas 2, Volume VI - Utah, 1973) for the location of the Gordon Creek No. 2 and No. 7 Mine facilities. The SCS Type II rainfall distribution was used to assign rainfall intensities throughout the 24-hour design storm.

Input specifications and results of TR-20 flow estimation for each sub-drainage area are provided in Table 7-8, Input Specifications and Results of TR-20 Flow Estimates. A schematic of drainage configuration for TR-20 modeling is provided in Figure 7-6, TR-20 Analysis: Schematic of Drainage Configuration for Gordon Creek No. 2 and No. 7 Mines.

TABLE 7-8
INPUT SPECIFICATIONS AND RESULTS OF TR-20 FLOW ESTIMATES

| | Sub-Drainages | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Area B | No. 7 Site | Combined | Sub-1 | Sub-2 | Combined | Sub-3 | Total Combined | Rt. Fork Bryner Canyon |
| Area - Acres | 204.0 | 7.7 | 211.7 | 1.54 | 6.4 | 219.6 | 25.6 | 244.2 | 203.0 |
| Curve Number | 63 | 86 | -- | 86 | 89 | -- | 63 | -- | 63 |
| Slope Length (feet) | 4500 | 1650 | -- | 480 | 900 | -- | 1500 | -- | 4000 |
| Slope (percent) | 23 | 16 | -- | 6 | 4 | -- | 37 | -- | 26 |
| Lag (hours) | 0.36 | 0.12 | -- | 0.06 | 0.11 | -- | 0.14 | -- | 0.35 |
| Time of Concentration (hours) | 0.6 | 0.20 | -- | 0.1 | 0.18 | -- | 0.23 | -- | 0.6 |
| Ten-Year, 24-Hour Precipitation Results | | | | | | | | | |
| Precipitation (inches) | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Peak Discharge (cfs) | 4.0 | 6.2 | 6.5 | 1.4 | 6.3 | 13.6 | 0.6 | 13.7 | 3.9 |
| Total Runoff (acre-feet) | 1.73 | 0.54 | 2.27 | 0.11 | 0.55 | 2.93 | 0.22 | 3.15 | -- |
| 25-Year, 24-Hour Precipitation Results | | | | | | | | | |
| Precipitation (inches) | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 | 2.7 |
| Peak Discharge (cfs) | 24.6 | 10.2 | 27.2 | 2.3 | 9.9 | 30.8 | 5.4 | 36.0 | 24.4 |
| Total Runoff (acre-feet) | 5.36 | 0.9 | 6.26 | 0.18 | 0.87 | 7.31 | 0.67 | 7.97 | -- |




# TR-20 ANALYSIS

SCHEMATIC OF DRAINAGE CONFIGURATION FOR
GORDON CREEK Nos. 2 & 7 MINES

FIGURE 7-6

## Sediment Yield

The Universal Soil Loss Equation (USLE) was used to estimate sediment yield from disturbed areas. Sediment yield was calculated by estimating the soil loss from all disturbed areas. All soil loss from areas Sub-1, Sub-2 and No. 7 site was assumed to be delivered to, and deposited in the ponds. Soil loss from undisturbed areas B and Sub-3 were estimated based on the Report of the Water Management Subcommittee on Factors Affecting Sediment Yield in the Pacific Southwest Area.

Erosion rate (A) in tons-per-acre-per-year is determined using the USLE as:

$$A = (R)\ (K)\ (LS)\ (VM)$$

The variables R, K, LS, and VM are defined as follows:

Variable "R" is the rainfall factor which can be estimated from the empirical relation $R = 27P^{2.2}$ where P is the two-year, six-hour precipitate value for which the Gordon Creek No. 2 and No. 7 Mine facilities area is 1.1 inches. Therefore, the estimated value for "R" is 33.3, which is somewhat larger than the value from an iso-erodent map provided by Wischmeyer (1977) for the approximate location of the Gordon Creek No. 2 and No. 7 Mine facility.

Variable "K" is the soil erodibility factor. For disturbed areas, the "K" value was conservatively estimated to be 0.5. This value is representative of compacted disturbed areas such as roads, embankments, and parking areas and is higher than would be expected for reclaimed areas or undisturbed soils. For reclaimed and undisturbed soils, a "K" factor of 0.35 was used.

Variable "LS" is the length slope factor. The "LS" factors determined for sub-areas and segments are listed in Table 2, USLE Estimate Factors for Gordon Creek No. 2 and No. 7 Mine Facilities Area. The "LS" factor was determined using the relation:

$$LS = \frac{(0.43 + 0.3^2 + 0.043S^2)}{6.613} \left(\frac{L}{72.6}\right)^m COS^2\left(TAN^{-1}\frac{S}{100}\right)$$

Where "S" is the slope in percent, "L" is the slope length in feet, and "m" is an exponent which varies with slope.

Variable "VM" is the factor accounting for vegetation cover and disturbance affects. The "VM" factors were developed from the work of Clyde, Israelsen and Packer (1976). A "VM" factor of 1.2 was considered representative of compacted fill and scraped and compacted sites; a "VM" factor of 1.0 was assigned to the highwall; and a "VM" factor of 0.38 for reseeded areas after twelve months of revegetation was assigned to road cut and fill slopes and to the topsoil salvage area.

Sediment yield calculations are shown in Table 7-10, USLE Estimates of Sediment Yield for Gordon Creek No. 2 and No. 7 Mine Facility Areas. A unit weight of 100 $lb/ft^3$ is used to convert sediment yield in weight per unit time to volume capacity requirements.

The following criteria evaluations were used:

| | |
|---|---|
| A. Surface Geology | 5 |
| B. Soil | 0 |
| C. Climate | 5 |
| D. Runoff | 0 |
| E. Topography | 20 |
| F. Ground Cover | -10 |
| G. Land Use | -10 |
| H. Upland Erosion | 0 |
| I. Channel Erosion | 0 |
| Sediment Yield Classification | 10 |

A numerical sediment yield classification of "10" falls within the Class 5 as noted in the report. Class 5 runs from a low numerical value of "0" to a high of "25". Sediment yield from Class 5 areas is determined to be less than 0.2 acre-feet per square mile per year. Using a composite area for Area B and Sub-3 of 229.6 acres yields an estimated three-year total sediment yield of less than 0.22 acre feet. This value has been rounded down to 0.1 acre feet since the sediment yield classification is in the lower portion of the Class range.

Sediment Pond Capacity

Ponds for the facilities area for the Gordon Creek No. 2 and No. 7 Mines, including the Left Fork of Bryner Canyon, have sufficient capacity to contain three years of sediment storage of 0.85 acre-feet and a ten-year, 24-hour storm runoff volume of 3.15 acre-feet, or a total capacity of 4.0 acre-feet below the emergency spillway.

Sediment levels will be checked quarterly, either by levels or direct reading of sediment markers, depending on water levels in ponds.

Sediment ponds will be cleaned when sediment reaches 60% of the design storage volume, as shown on Tables 7-11 and 7-13.

TABLE 7-9

USLE ESTIMATE FACTORS FOR

GORDON CREEK NO. 2 FACILITIES AREA

| Drainage | R | K | LS | C | P |
|---|---|---|---|---|---|
| Sub 1 | 33.3 | 0.5 | 1.56 | 1 | 1 |
| Sub 2 | 33.3 | 0.5 | 0.96 | 1 | 1 |

TABLE 7-10
USLE ESTIMATES OF SEDIMENT YIELD FOR GORDON CREEK NO. 2 and NO. 7 MINE FACILITY AREAS

| Drainage or Segment | R Factor | K Factor | Area Acres | Avg. Slope Length, Ft. | Slopes % | LS Factor | VM Factor | A Tons/Acre Per Year | Yield Acre Ft. Per Year |
|---|---|---|---|---|---|---|---|---|---|
| No. 2 Mine Site | | | | | | | | | |
| Sub-1 | 33.3 | 0.5 | 1.54 | 200 | 6 | 0.95 | 1.2 | 18.98 | 0.0134 |
| Sub-2 | 33.3 | 0.5 | 6.4 | 250 | 4 | 0.58 | 1.2 | 11.59 | 0.0341 |
| No. 7 Mine Site | | | | | | | | | |
| Road Cut Slope | 33.3 | 0.35 | 1.65 | 50 | 75 | 20.5 | 0.38 | 90.8 | 0.0688 |
| Road and Ditch Below Slope | 33.3 | 0.5 | 0.33 | 500 | 12 | 4.85 | 1.2 | 97 | 0.0147 |
| Road and Ditch Between Upper and Lower Culvert | 33.3 | 0.5 | 0.57 | 200 | 12 | 2.8 | 1.2 | 55.9 | 0.0025 |
| Fill Slope Road | 33.3 | 0.35 | 1.95 | 90 | 45 | 14.5 | 0.38 | 64.2 | 0.0575 |
| Top Soil Stockpile | 33.3 | 0.35 | 0.9 | 100 | 55 | 20.7 | 0.38 | 91.7 | 0.038 |
| Pond and Pad Area | 33.3 | 0.5 | 1.5 | 100 | 7 | 0.85 | 1.2 | 17.0 | 0.012 |
| Highwall | 33.3 | 0.35 | 0.8 | 40 | 120 | 44.2 | 1.0 | 28.4 | 0.0104 |
| Undisturbed Areas* | | | 229.6 | | | | | | 0.033 |
| Total Acre-Feet Per Year | | | | | | | | | 0.284 |

* See text for development of sediment yield from undisturbed areas.

Addendum

Following a discussion with the Utah DOG&M, Beaver Creek Coal Company added a fifth culvert to this drainage and sedimentation control plan. The culvert designated as No. 5 runs along the cut side of the access road leading from the Gordon Creek No. 2 Mine to the Gordon Creek No. 7 Mine. Culvert No. 5 is identified on the No. 7 Mine Drainage Plan Map (Plate 7-7). The drainage area which contributes runoff to culvert No. 5 is also identified in the No. 7 Mine Drainage Plan Map (Plate 7-7).

Hydrologic calculations for this area were completed by using the SEDIMOT II computer model. A copy of the summary tables for data inputs and calculated outputs from the SEDIMOT II computer model is included on the following pages.

Hydrologic calculations have also been completed for the small drainage area designated as "side drainage" on the Mine Area Hydrology Map (Plate 7-5). This area contributes runoff to the drainage around the portion of culvert No. 1 which is above ground. It was necessary to complete the estimate of peak flow from this area in order to size the slope protection needed under the culvert.

Since both structures involved in these calculations are drainage-control structures only and are not involved in the removal of sediment from the runoff waters, hydrology only was run on these watersheds. Sediment from these watersheds has been included in the calculations found previous to this Addendum in the Hydrology Section.

WATERSHED IDENTIFICATION CODE

BEAVER CREEK COAL COMPANY, CULVERT NO. 5 PEAK FLOW ESTIMATE

*********************************************

********************INPUT VALUES*******************

| | | | |
|---|---|---|---|
| STORM DURATION | = | 24.00 | HOURS |
| PRECIPITATION DEPTH | = | 2.00 | INCHES |

1

* * * * * * * * * * * * * * * * * * * * * * *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* * * * * * * * * * * * * * * * * * * * * * *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

| WATER SHED | AREA ACRES | CURVE NUMBER | TC HR | TT HR | ROUTING COEFFICIENTS K-HRS | X | UNIT HYDRO |
|---|---|---|---|---|---|---|---|
| 1 | 11.50 | 63.00 | .077 | .000 | .100 | .10 | .0 |

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

| WATERSHED | PEAK FLOW (CFS) | RUNOFF (INCHES) |
|---|---|---|
| 1 | .44 | .10 |

NOTE: SEDIMENT DOES NOT INCLUDE POSSIBLE DEPOSITION BY DELIVERY RAT

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

| | | | |
|---|---|---|---|
| RUNOFF VOLUME | = | .0975 | ACRE-FT |
| PEAK DISCHARGE | = | .2768 | CFS |
| AREA | = | 11.5000 | ACRES |
| TIME OF PEAK DISCHARGE | = | 12.10 | HRS |

* * * * * * * * * * * *
NULL STRUCTURE
* * * * * * * * * * * *

WATERSHED IDENTIFICATION CODE

BEAVER CREEK COAL COMPANY, SIDE DRAINAGE PEAK FLOW CALCULATION

*********************************************

********************INPUT VALUES********************

| | | | |
|---|---|---|---|
| STORM DURATION | = | 24.00 | HOURS |
| PRECIPITATION DEPTH | = | 2.00 | INCHES |

1

* * * * * * * * * * * * * * * * * * * * * * *
JUNCTION 1, BRANCH 1, STRUCTURE 1
* * * * * * * * * * * * * * * * * * * * * * *

*** HYDRAULIC INPUT VALUES FOR SUBWATERSHEDS ***

| WATER SHED | AREA ACRES | CURVE NUMBER | TC HR | TT HR | ROUTING COEFFICIENTS K-HRS | X | UNIT HYDRO |
|---|---|---|---|---|---|---|---|
| 1 | 5.50 | 63.00 | .040 | .000 | .010 | .01 | .0 |

* * * COMPUTED VALUES FOR INDIVIDUAL WATERSHEDS * * *

| WATERSHED | PEAK FLOW (CFS) | RUNOFF (INCHES) |
|---|---|---|
| 1 | .21 | .10 |

NOTE: SEDIMENT DOES NOT INCLUDE POSSIBLE DEPOSITION BY DELIVERY RATIO 2

***** SUMMARY TABLE FOR TOTAL WATERSHED *****

| | | | |
|---|---|---|---|
| RUNOFF VOLUME | = | .0466 | ACRE-FT |
| PEAK DISCHARGE | = | .2110 | CFS |
| AREA | = | 5.5000 | ACRES |
| TIME OF PEAK DISCHARGE | = | 12.00 | HRS |

* * * * * * * * * * * *
NULL STRUCTURE
* * * * * * * * * * * *

7.2.3.2.4 Hydraulics

This drainage and sediment control plan incorporates several different structures to control surface water. These structures consist of sediment ponds, ditches and culverts.

Sediment Ponds

The design of the sediment pond systems incorporates the following criteria:

- o Calculate the runoff from ten-year, 24-hour precipitation event for the drainage basins within the mining area
- o Calculate the sediment from a drainage area for each system

This methodology provides for holding the runoff volume from a ten-year, 24-hour precipitation event and the calculated sediment contribution for three years within the sediment pond system.

Each sediment pond has two discharge structures. One structure, the principal spillway, carries the peak flow for a ten-year, 24-hour storm and the other, the emergency spillway, is designed to pass the peak flow from a 25-year, 24-hour storm.

The spillway design uses peak flow from a 25-year, 24-hour event as the high water line. Freeboard of 1.0 feet is added to this elevation to determine the top of the settled embankment elevation. An additional five percent of design height is then added to the embankment to allow for settlement.

The sediment pond embankments are designed with a top width of twelve feet and upstream and downstream slopes of 2H:1V and 3H:1V, respectively. Stage storage curves have been estimated based on projected topography at each site. The state storage curves show the quantity of water and sediment which can be contained by one-foot increments from the bottom on a structure to the design elevation of the structure.

Control of water discharged from each structure is through a rip rap energy dissipator at the outlet of the spillway. The energy dissipator slows the flow to minimize erosion.

Ditch

A temporary diversion ditch has been designed to control runoff in the No. 2 and No. 7 Mine areas. The temporary ditch routes runoff from the affected areas into sediment pond No. 2.

From hydrologic calculations, each diversion ditch has been designed for passing peak flow from a ten-year, 24-hour precipitation event. In addition, freeboard of 1.0 feet has been added to ensure adequate capacity of the ditch.

Due to the nature of temporary diversion ditches, the ditch has been elevated at minimum and maximum slopes. The minimum slope case utilizes the peak flow to determine the cross-sectional design of the ditch at highest capacity and lowest slope or velocity. Similarly, the highest slope section of the ditch has been evaluated for velocity to determine if armoring is required to minimize erosion and contribution of solids to the system from the diversion ditch. Calculations show that no ditch sections have velocities in excess of five-feet-per-second.

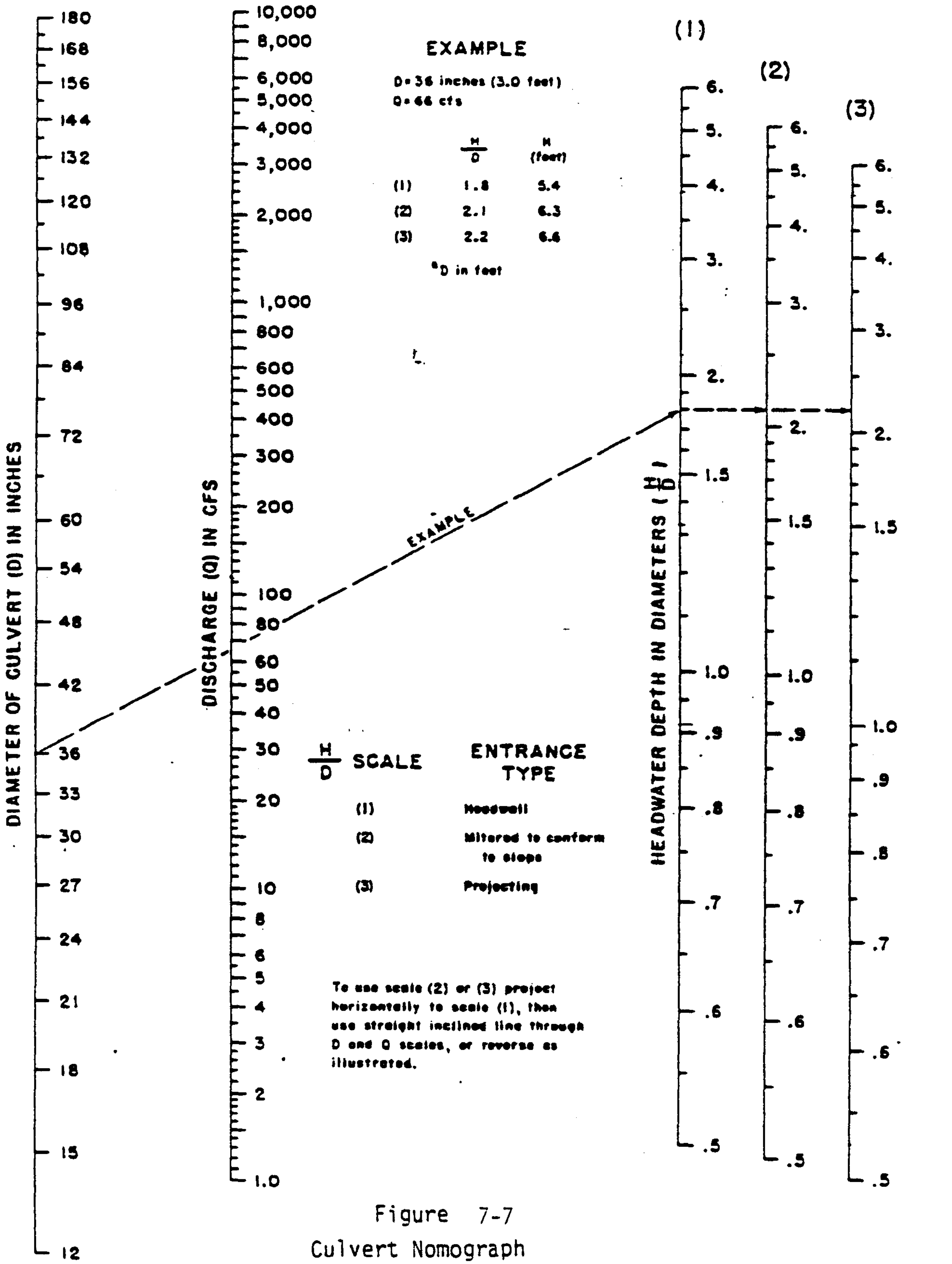



Figure 7-7

Culvert Nomograph

Headwater depth for corrugated-metal pipe culverts with entrance control. (U.S. Bureau of Public Roads.) 288–D–2909.

## Culverts

The design of culverts use the peak flow from a ten-year, 24-hour precipitation event. This design uses circular corrugated metal pipe with projecting inlet as the assumed base case for all culverts to be installed within the road system.

The calculation method takes the estimated peak flow and uses a nomograph published by the United States Bureau of Public Roads to determine the proper culvert size. The nomograph is attached as Figure 7-7, Culvert Nomograph.

Where appropriate, culvert sizes are checked using Manning's Equation for flow of water in pipes and a modified form of Bernoulli's Equation. The following design equations were used in making the hydraulic calculations:

## Design Equations

- Wier Equation for CMP risers

$$Q = CLH^{1.5}$$

Where Q = flow rate (cfs)
C = wier constant = 3.38
L = length of wier (ft)
H = height of water over wier (ft)

- Bernoulli's Equation

$$Q = (a\ (2gh)^{\frac{1}{2}})\ /\ (1 + K_2 + K_b + K_c L)^{\frac{1}{2}}$$

Where Q = flow rate (cfs)
a = cross-sectional area of pipe ($ft^2$)
g = gravitational constant
h = head causing flow
$K_2$ = entrance head loss coefficient
$K_b$ = bend head loss coefficient
$K_c$ = friction head loss coefficient
L = length of pipe

$$K_c = (5087n^2)\ /\ d_i^{4.3}$$

Where n = Mannings coefficient of roughness
$d_i$ = pipe I.D. (inches)

- Manning's Equation for water flow in pipes

$$Q = (1.49/n)\ AR^{66}\ S^{.5}$$

Where Q = flow rate (cfs)
n = Mannings roughness coefficient
A = cross-sectional area of pipe ($ft^2$)
R = hydraulic radius (ft)
S = slope (ft/ft)

- Manning's Equation for water flow in ditches

$$D = (Qn/KS^{.5})^{.375}$$

Where D = depth of flow (ft)
Q = flow rate (cfs)
n = Mannings roughness coefficient
K = discharge factor based on channel slope
S = slope (ft/ft)

o Manning's Equation for water velocity in ditches

$$V = (1.49/n)\ R^{66}\ S^{.5}$$

Where V = water velocity (ft/sec)
n = Mannings roughness coefficient
R = hydraulic radius (ft)
S = slope (ft/ft)

o Orifice Equation

$$Q = C_c\ C_y\ A_o\ (2gh)^{\frac{1}{2}}$$

Where Q = flow rate (cfs)
$C_c$ = coefficient of contraction
$C_y$ = coefficient of velocity
A = area of opening ($ft^2$)
g = gravitation constant
h = head (ft)

Design calculations for each culvert are shown in the Hydraulic Calculations portion of this Section.

## Hydraulic Calculations

### Spillway Sizing Pond No. 7A

- Principal Spillway, ten-year, 24-hour Event

  Discharge Pipe Sizing

  Try 12-inch Diameter CMP for Discharge Pipe

Q (target) = 6.5 cfs = $(a(2gh)^{\frac{1}{2}})/(1 + K_e = K_b + K_c L)^{\frac{1}{2}}$

$a = .785\ ft^2$

h = 18 feet

$K_e = 1$

$K_b = 0$

$K_c = (5087\ (.03^2))\ /\ 12^{4/3} = .168$

L = 90 feet

Q = 6.8 cfs; use 12-inch Pipe Through Dam

Riser Pipe Sizing

$Q = CLH^{1.5}$

Q = 6.5

C = 3.32[2]

H = 0.5

L = 5.5'; use 24-inch Diameter Riser Pipe

- Pond 7A Emergency Spillway, 25-year, 24-hour Event

  Riser Pipe

  Q = 27.2 - 6.0 = 21.2 cfs

  $Q = CLH^{1.5}$

  C = 3.32

  H = 0.5

  $L = Q\ /\ CH^{1.5}$

  L = 18.0 ft; Use 6-foot Diameter CMP riser

Discharge Pipe, From Nomograph, Use 30-Inch CMP with Head = 1.08 Diameter

Spillway Sizing Pond No.2

o Ten-year, 24-hour Spillway

The spillway is 3-inch I.D. rubber hose approximate length of 25 feet. Flow at low head

$Q = (a(2gh)^{\frac{1}{2}}) \ / \ (1 + K_e = K_b + K_c \ L)^{\frac{1}{2}}$

$a = .20 \ ft^2$

$g$ = gravitational constant

$h = .5$ ft

$K_e = 1$

$K_b = 0$

$K_c = (5087 \ (.015)^2) \ / \ 8^{1.33} = .072$

$L = 25$

$Q = 0.10$ cfs

Flow at maximum head

$h = 11.0$

$Q = 0.45$ cfs

o 25-year, 24-hour Spillway

$Q = 24.1$ cfs - $9.45$ cfs = $23.6$ cfs

Riser Pipe

$Q = CLH^{1.5}$

$C = 3.32$

$H = 0.5$

$L = 20.1$

Riser is six-foot diameter CMP

Discharge Pipe, From Nomograph, Use 24-inch CMP with head = 2.2 diameters

Culvert Sizing

- Culvert No. 1

  Size drainage to carry ten-year, 24-hour storm

  Minimum Grade = 1.1%

  $Q = 1.49 / n\ AR^{.66}\ S^{.5}$

  For a 24-inch diameter half culvert

  A = 1.57

  R = 0.5

  S = 0.011

  n = .026

  Q = 6.0

  Ten-year, 24-hour runoff for entire site = 6.5 cfs

The lowest slope section of the drainage will not see the entire flow. Therefore, use 24-inch half culvert and 24-inch full culvert for the drainage.

- Culvert No. 2

  Q = 27.2 cfs + 24.4 = 51.6 cfs

  Culvert sizing from nomograph

  42-inch culvert will carry flow at head = 1.07 diameters

  Culvert check from Bernoulli's Equation

  $Q = (a\ (2gh)^{\frac{1}{2}})\ /\ (1 + K_e + K_b + K_c L)^{\frac{1}{2}}$

  $a = 9.62\ ft^2$

  $K_e = 1$

  $K_b = 0.5$

  $K_c = (5087\ (.03^2))\ /\ 42^{1.33} = .032$

  L = 570

  h = 26.0 ft

  Q = 86 cfs

Culvert from Mannings Equation

$Q = (1.49/n)\ AR^{.66}\ S^{.5}$

$n = .026$

$A = 9.62\ ft^2$

$R = .87$

$S = .018$

$Q = 67.5\ cfs$

Use 42-inch pipe for culvert No. 2

- Culvert No. 3

Minimum Slope = 1.8%

Q = 6.8 cfs

Culvert sizing from nomograph

18-inch culvert will carry flow at head = 1.4 dia.

Culvert check from Bernoulli's equation

$Q = (a\ (2gh)^{\frac{1}{2}})\ /\ (1 + K_e + K_b + K_cL)^{\frac{1}{2}}$

$a = 1.76\ ft^2$

$K_e = 1$

$K_b = .5$

$K_c = (5087\ (.03^2))\ /\ a8^{1.33} = .098$

$L = 850\ ft.$

$h = 32\ ft$

$Q = 8.6\ cfs$

$Q = (1.49/n)\ AR^{.66}\ S^{.5}$

n = 0.026

$A = 1.76\ ft^2$

R = 0.37

S = 0.018

Q = 7.02 cfs

Use 18-inch pipe for Culvert No. 3.

- Culvert No.4 (Right Fork Bryner)
  Minimum Slope = 1.8%
  Q= 3.9 cfs
  Culvert Sizing from Nomograph 18" culvert will carry flow at head = 0.8 dia. (Actual Culvert Used = 24" CMP)

  Culvert from Manning's equation:
  $Q = (1.49/n)\ AR^{.66}\ S^{.5}$
  n = 0.026
  A = 3.14
  R = 0.50
  S = 0.018
  Q = 15.28

10 year - 24 hour runoff for this area is 3.9 cfs. Therefore, the existing 24 inch culvert is more than adequate to carry the design flow.

- Culvert No.5

$Q = 1.49/n\ AR^{.66}\ S^{.5}$

For a 12-inch diameter half-culvert

A = 0.39
R = 0.25
S = 0.088
n = 0.026
Q = 2.65

Ten-year, 24-hour runoff for this location is 0.44 cfs. Therefore, a 12-inch half-culvert is more than adequate to carry the design flow.

Ditch Sizing No. 2 Mine Area

Q = 8.3 cfs
Minimum Slope = 2.1%
Assume ditch shape per Figure 7-8, Typical Diversion Ditch Design
$D = (Qn/K\ S^{.5})^{.375}$

Try 2-foot channel bottom width

$n = 0.040$

$K = 5.27$

$S = 0.021$

$D = 0.75$ feet

- Velocity Check

Depth at section of 6.9% Slope = .4

$V = (1.49/n) R^{.66} S^{.5}$

Where $n = .04$

$R = .30$

$S = .069$

$V = 4.4$ ft/sec

No Rip Rap Needed.

From Figure 7-13, $D_{50} = 0.3$ foot = 4 inches

- Flow Around Culvert

Velocity = $(1.49/n) R^{2/3} S^{1/2}$

Where $r = 0.1$

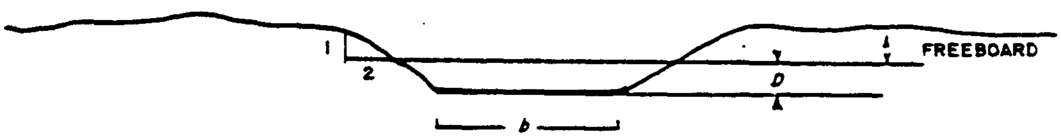
$s = 0.39$

$V = 3.5$ ft/sec

$Q = 0.21$ cfs

Use two-inch drain rock to armor slope under pipe.

# TYPICAL DIVERSION DITCH DESIGN




*D*– DESIGN FLOW DEPTH

*b*– DITCH BOTTOM WIDTH

NOTES: 1. Shape of ditch in field may vary

2. Cross sectional area of ditch in field will be as great or greater than calculated

**FIGURE 7-8**

TYPICAL DIVERSION DITCH DESIGN

TABLE 7-11

POND NO. 2 DESIGN SUMMARY

| Parameter | Value |
|---|---|
| Design Water Volume | 2.38 Ac-Ft |
| Design Sediment Volume | 0.36 Ac-Ft |
| Total Design Volume | 2.74 Ac-Ft |
| Elevation Crest of Embankment | |
| Design | 7895.0 Ft |
| Constructed | 7895.2 Ft |
| Elevation, 25-Year, 24-Hour Flow | 7894.0 Ft |
| Freeboard | 1.0 Ft |
| Elevation, 25-Year, 24-Hour Spillway Crest | 7893.5 Ft |
| Elevation, Ten-Year, 24-Hour Spillway Crest | 7883.0 Ft |
| Elevation, Design Water Volume | 7893.5 Ft |
| Elevation, Design Sediment Volume | 7883.0 Ft |
| Elevation, 60% Sediment Volume (Cleaning Point) | 7881.8 Ft |
| Peak Flow, 25-Year, 24-Hour Event | 24.1 cfs |
| Peak Flow, Ten-Year, 24-Hour Event | 13.7 cfs |

# TABLE 7-12

## STORAGE CAPACITY TABLE

## POND NO. 2

| Elevation | Area (Acres) | Avg. Area (Acres) | Depth (Ft.) | Volume (Ac-Ft) | Accum. Volm Ac-Ft |
|---|---|---|---|---|---|
| | | | | 0.00 | 0.00 |
| 7880 | 0.10 | 0.11 | 1.00 | 0.11 | 0.11 |
| 7881 | 0.12 | | | | |
| | | 0.13 | 2.00 | 0.26 | 0.37 |
| 7883 | 0.15 | | | | |
| | | 0.16 | 2.00 | 0.32 | 0.69 |
| 7885 | 0.18 | | | | |
| | | 0.19 | 2.00 | 0.38 | 1.07 |
| 7887 | 0.21 | | | | |
| | | 0.22 | 2.00 | 0.44 | 1.51 |
| 7889 | 0.24 | | | | |
| | | 0.25 | 2.00 | 0.51 | 2.02 |
| 7891 | 0.27 | | | | |
| | | 0.29 | 2.00 | 0.58 | 2.60 |
| 7893 | 0.31 | | | | |
| | | 0.33 | 2.00 | 0.65 | 3.25 |
| 7895 | | | | | |

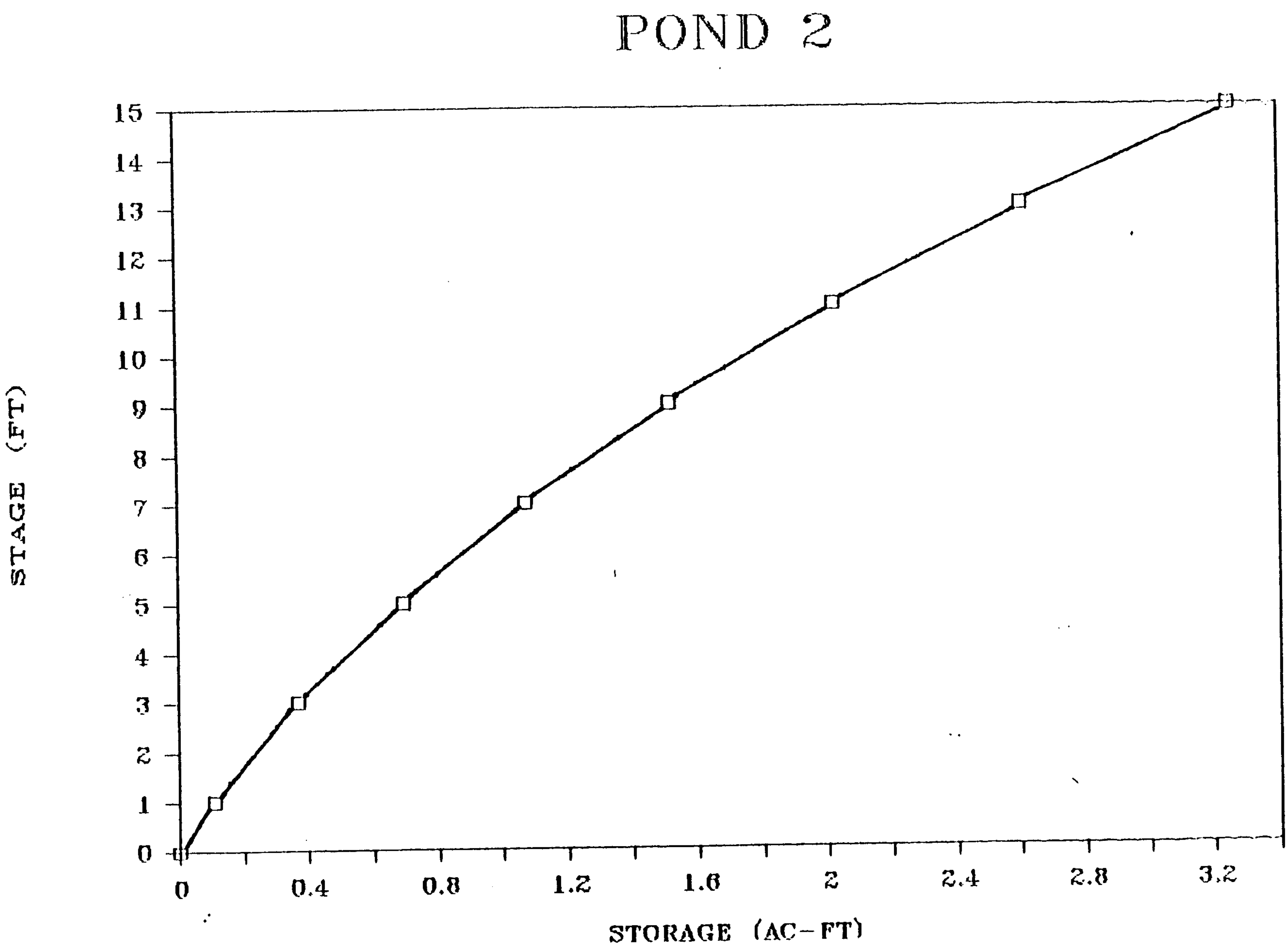



Figure 7-9 Pond No. 2 Stage/Storage Curve

TABLE 7-13

POND NO. 7A DESIGN SUMMARY

| Parameter | Value |
|---|---|
| Design Water Volume | 0.96 Ac-Ft |
| Design Sediment Volume | 0.30 Ac-Ft |
| Total Design Volume | 1.26 Ac-Ft |
| Elevation Crest of Embankment | |
| Design | 7942.5 Ft |
| Constructed | 7943.0 Ft |
| Elevation, 25-Year, 24-Hour Flow | 7941.5 Ft |
| Freeboard | 1.0 Ft |
| Elevation, 25-Year, 24-Hour Spillway Crest | 7941.5 Ft |
| Elevation, Ten-Year, 24-Hour Spillway Crest | 7933.7 Ft |
| Elevation, Design Water Volume | 7940.5 Ft |
| Elevation, Design Sediment Volume | 7933.7 Ft |
| Elevation, 60% Sediment Volume (Cleaning Point) | 7932.0 Ft |
| Peak Flow, 25-Year, 24-Hour Event | 27.2 cfs |
| Peak Flow, Ten-Year, 24-Hour Event | 6.5 cfs |

## TABLE 7-14
## STORAGE CAPACITY TABLE
## POND NO. 7A

| Elevation | Area (Acres) | Avg. Area (Acres) | Depth (Ft.) | Volume (Ac-Ft) | Accum. Volm Ac-Ft |
|---|---|---|---|---|---|
| | | | | 0.00 | 0.00 |
| 7927 | 0.02 | 0.02 | 1.00 | 0.02 | 0.02 |
| 7928 | 0.02 | 0.03 | 2.00 | 0.06 | 0.08 |
| 7930 | 0.04 | 0.05 | 2.00 | 0.10 | 0.18 |
| 7932 | 0.06 | 0.08 | 2.00 | 0.15 | 0.33 |
| 7934 | 0.09 | 0.10 | 2.00 | 0.21 | 0.54 |
| 7936 | 0.12 | 0.14 | 2.00 | 0.27 | 0.81 |
| 7938 | 0.15 | 0.17 | 2.00 | 0.34 | 1.15 |
| 7940 | 0.19 | 0.21 | 2.00 | 0.42 | 1.57 |
| 7942 | 0.23 | | | | |

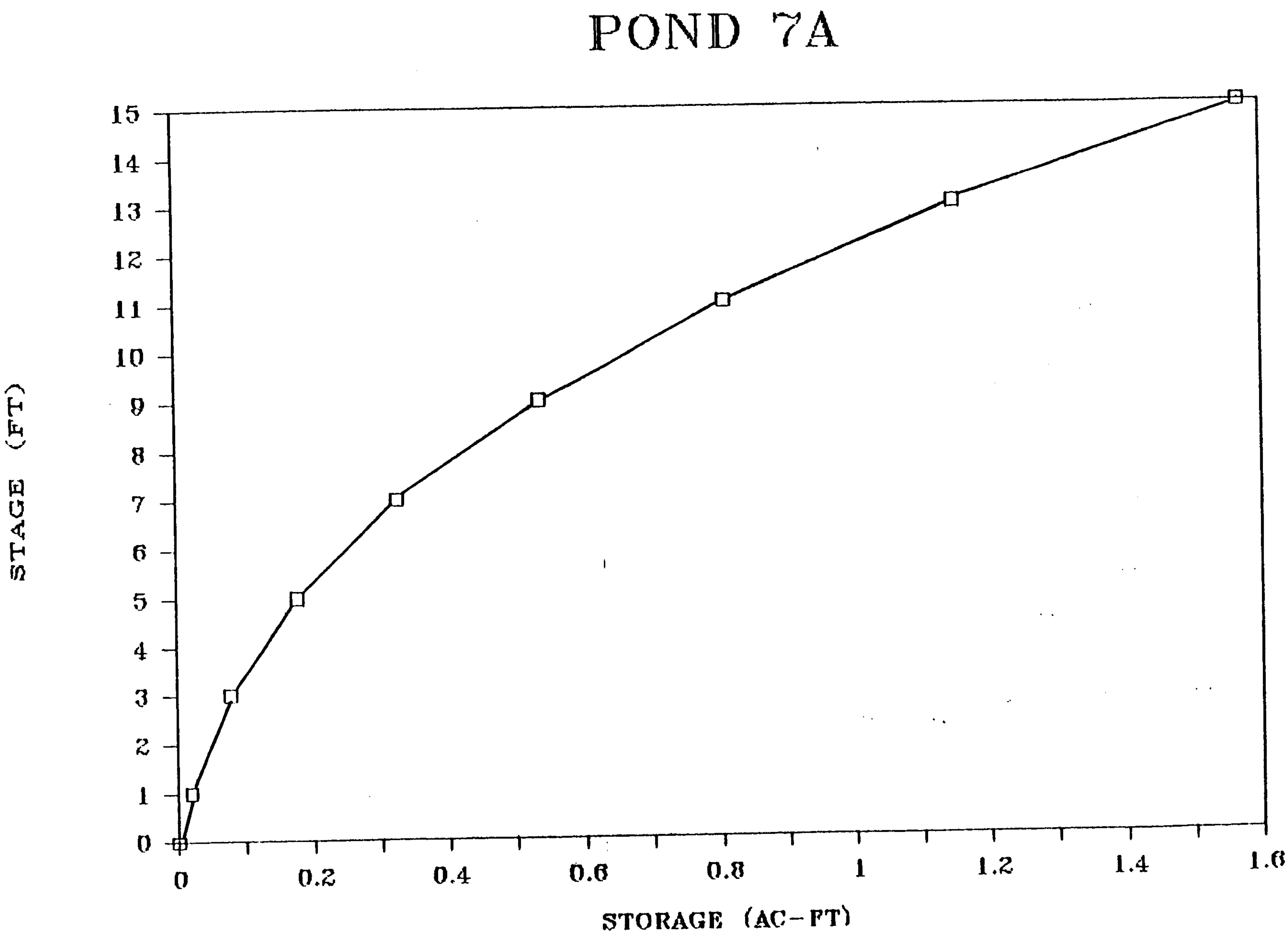



Figure 7-10 Pond No. 7A Stage/Storage Curve

## Detention Time

For the ten-year, 24-hour storm event, pond No. 7A and No. 2 are connected in series. Combined water storage capacity of the two ponds is 3.38 acre-feet. Calculated runoff for a ten-year, 24-hour storm is 3.15 acre-feet. Total detention time for the two ponds will be the difference between the mean time of water inflow to the two ponds and the mean time of water outflow from pond No. 2.

An inflow hydrograph for the two ponds has not been calculated. A conservative assumption for the inflow would be an instantaneous flow of 3.15 acre-feet of water into the pond system.

A hydrograph has been calculated for the outflow from pond No. 2. The pond No. 2 outflow hydrograph shows that the control imposed by the pond No. 2 spillway would cause a mean detention time of 47.05 hours for 2.91 acre-feet of water. Inherent in this outflow hydrograph calculation is the assumption that 0.24 acre-feet are released instantaneously. The assumption of instantaneous release of 0.24 acre-feet of water serves to reduce the calculated detention time as the long term release time is averaged with the assumed instantaneous release. There is no instantaneous release of water during the design event. This calculation has been made solely to assure a conservative estimate of detention time.

Using these calculations, the system has a mean detention time of 43.45 hours for 3.15 acre-feet of water. Detention time for the system meets the 24-hour minimum required for a ten-year, 24-hour precipitation event.

Pond No. 7 Outflow Hydrograph

For purposes of calculating an outflow hydrograph from pond No. 7A, the pond was assumed to be full with the principal spillway flowing at capacity and the emergency spillway not flowing.

Spillway capacity for various elevations was calculated based on the following equations:

$Q = CLH^{1.5}$ for water flowing over the top of the riser

$Q = c_c C_v A_o (2gh)^{\frac{1}{2}}$ for water flow through the perforations

$C_c$ = coefficient of contraction = 0.62
$C_v$ = coefficient of velocity = 0.95

The upper limit of spillway capacity is determined to be 6.8 cfs based on the restriction imposed by the outflow pipe. The results of the calculations are shown on Figure 7-11, Pond No. 7A Principal Spillway Hydraulics. Using the principal spillway hydraulics and the stage storage curve, Table 7-15, Pond No. 7A Outflow Hydrograph, was calculated graphically.

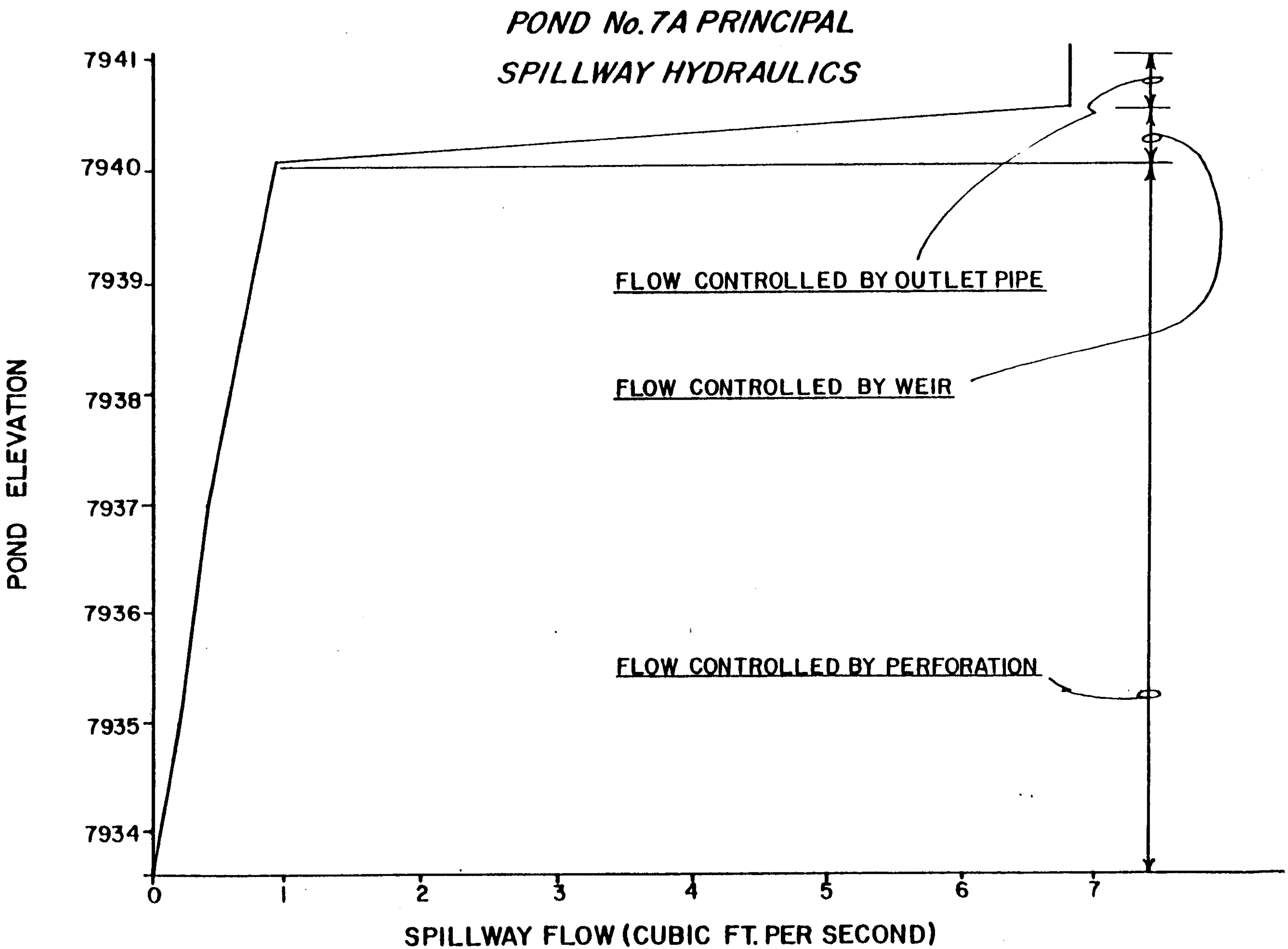

POND No. 7A PRINCIPAL
SPILLWAY HYDRAULICS
7941
7940
7939
7938
7937
7936
7935
7934
POND ELEVATION
FLOW CONTROLLED BY OUTLET PIPE
FLOW CONTROLLED BY WEIR
FLOW CONTROLLED BY PERFORATION
0
1
2
3
4
5
6
7
SPILLWAY FLOW (CUBIC FT. PER SECOND)

FIGURE 7-11

TABLE 7-15

POND NO. 7A

OUTFLOW HYDROGRAPH

| TIME | OUTFLOW |
|---|---|
| 0 | 0.10 |
| 0.3 | 0.05 |
| 1.0 | 0.07 |
| 2.0 | 0.07 |
| 3.0 | 0.03 |
| 3.5 | 0.06 |
| 4.5 | 0.05 |
| 5.5 | 0.05 |
| 6.5 | 0.04 |
| 7.5 | 0.04 |
| 8.5 | 0.04 |
| 9.5 | 0.03 |
| 10.5 | 0.03 |
| 11.5 | 0.03 |
| 12.5 | 0.03 |
| 13.5 | 0.02 |
| 14.5 | 0.02 |
| 15.5 | 0.02 |
| 16.5 | 0.02 |
| 17.5 | 0.02 |
| 18.5 | 0.02 |
| 19.5 | 0.01 |
| 20.5 | 0.01 |
| 21.5 | 0.01 |
| 22.5 | 0.01 |
| 23.5 | 0.01 |
| 24.5 | 0.01 |
| 25.5 | 0.01 |
| 26.5 | 0.01 |
| 27.5 | 0.01 |
| 28.5 | 0.01 |
| 29.5 | 0.01 |

## Pond No. 2 Outflow Hydrograph

An outflow hydrograph for pond No. 2 was estimated based on an assumed water level in the pond and inflow from a full pond No. 7A.

Spillway capacity for various elevations was calculated based on the following equation:

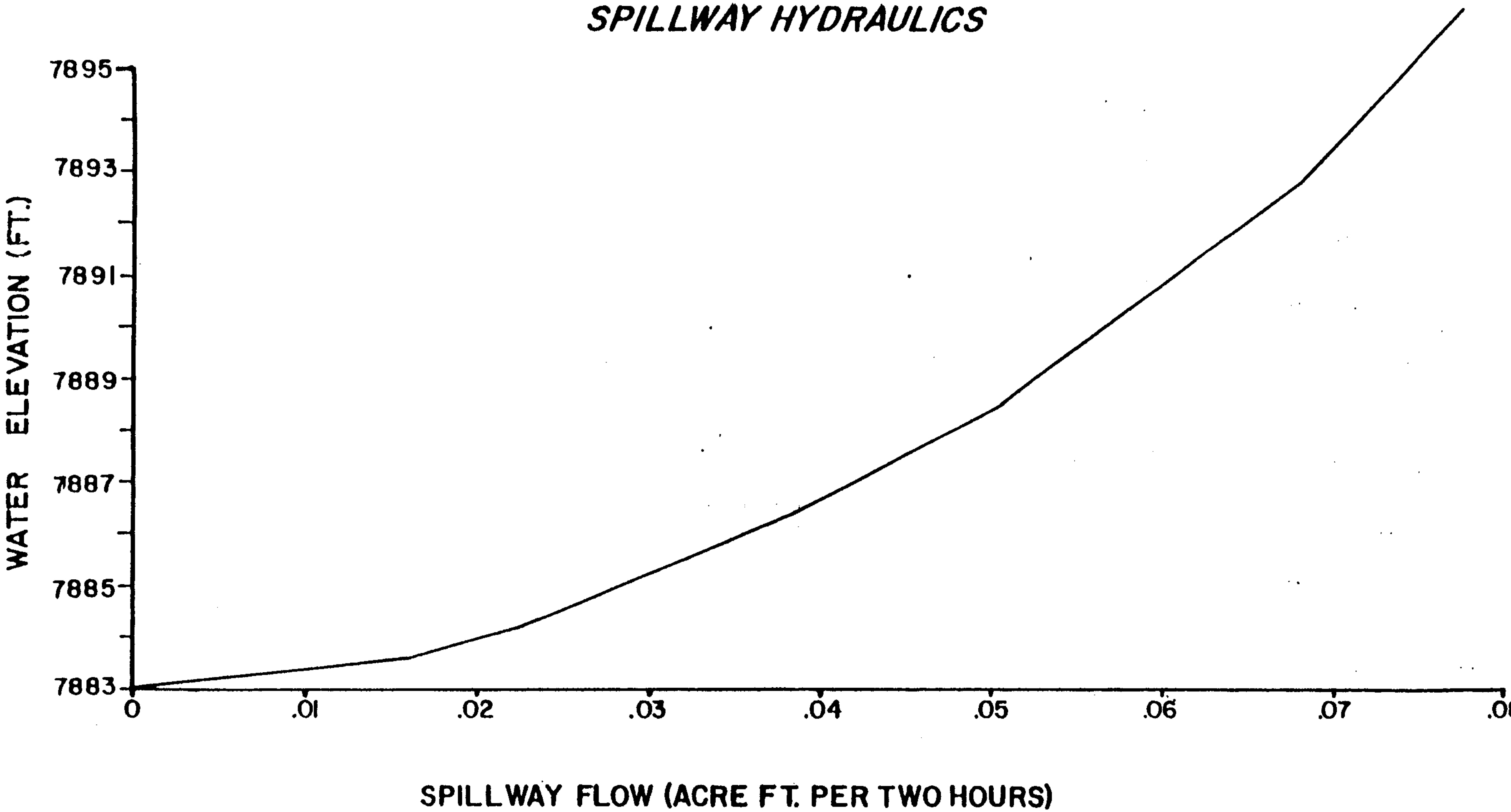
$Q = a\,(2gh)^{\frac{1}{2}} \;/\; (1 + K_e + K_b + K_c L)^{\frac{1}{2}}$ for the 3-inch hose type outlet

$K_e = 1$
$K_b = 0$
$K_c = 5076n^2 \;/\; d_i^{4.3} = 0.26$
$n$ = Mannings $n = 0.014$
$d_i$ = hose I.D. = 3 inches
$L$ = length of hose = 25 feet

Results of the calculations are shown on Figure 7-12, Pond No. 2 Principal Spillway Hydraulics. Using the principal spillway hydraulics and the stage storage curve and the pond No. 7A Outflow Hydrograph, Table 7-16, Pond No. 2 Outflow Hydrograph was calculated graphically.

*FIGURE* 7-12

***POND No.2 PRINCIPAL SPILLWAY HYDRAULICS***






5/8/86

TABLE 7-16

POND NO. 2 OUTFLOW HYDROGRAPH

| Time | Outflow | Inflow | Time | Outflow | Inflow |
|---|---|---|---|---|---|
| 0 | 0.07 | 0.21 | 64 | 0.05 | -- |
| 2 | 0.07 | 0.13 | 66 | 0.05 | -- |
| 4 | 0.07 | 0.10 | 68 | 0.05 | -- |
| 6 | 0.07 | 0.08 | 70 | 0.04 | -- |
| 8 | 0.07 | 0.07 | 72 | 0.04 | -- |
| 10 | 0.07 | 0.06 | 74 | 0.04 | -- |
| 12 | 0.07 | 0.06 | 76 | 0.04 | -- |
| 14 | 0.07 | 0.04 | 78 | 0.04 | -- |
| 16 | 0.07 | 0.04 | 80 | 0.04 | -- |
| 18 | 0.07 | 0.04 | 82 | 0.04 | -- |
| 20 | 0.07 | 0.02 | 84 | 0.04 | -- |
| 22 | 0.07 | 0.02 | 86 | 0.03 | -- |
| 24 | 0.07 | 0.02 | 88 | 0.03 | -- |
| 26 | 0.07 | 0.02 | 90 | 0.03 | -- |
| 28 | 0.07 | 0.02 | 92 | 0.03 | -- |
| 30 | 0.07 | -- | 94 | 0.03 | -- |
| 32 | 0.07 | -- | 96 | 0.03 | -- |
| 34 | 0.06 | -- | 98 | 0.03 | -- |
| 36 | 0.06 | -- | 100 | 0.02 | -- |
| 38 | 0.06 | -- | 102 | 0.02 | -- |
| 40 | 0.06 | -- | 104 | 0.02 | -- |
| 42 | 0.06 | -- | 106 | 0.02 | -- |
| 44 | 0.06 | -- | 108 | 0.02 | -- |
| 46 | 0.06 | -- | 110 | 0.02 | -- |
| 48 | 0.06 | -- | 112 | 0.01 | -- |
| 50 | 0.06 | -- | 114 | 0.01 | -- |
| 52 | 0.06 | -- | 116 | 0.01 | -- |
| 54 | 0.05 | -- | 118 | 0.01 | -- |
| 56 | 0.05 | -- | 120 | 0.01 | -- |
| 58 | 0.05 | -- | 122 | 0.01 | -- |
| 60 | 0.05 | -- | 124 | 0.01 | -- |
| 62 | 0.05 | -- | | | |

## Rip Rap Sizing

Rip rap is specified in the Drainage and Sediment Control Plan in two places. The first place is the outlet of the No. 1 Culvert, the second location is under the No. 1 Culvert where it lays on top of the ground. Rip rap sizing for these applications has been completed by calculating the velocity of the water and using Figure 7-13, Design of Outlet Protection. Figure 7-13 relates water velocity and water flow rate to establish a rip rap size. The size is specified as $D_{50}$ dimension. The rip rap specified for the outlet to Culvert No. 1 has a $D_{50}$ of four inches. Existing large rock found in the bottom of the drainage at this point will be utilized for rip rap material. The existing rocks will exceed the required $D_{50}$ dimension and provide more than adequate protection of the slope and stilling of the water in this area.

For slope protection under the pipe where it lays above the ground, two-inch drain rock will be used. The velocity of flow in this area is minimal due to the fact that most of the water at this point is inside the culvert. Slope protection at this location is not really required by the water velocity, but will be installed due to the steepness of the slope in this area.

- Culvert 1 Discharge

  Water Velocity = $(1.49/n)\ R^{2/3}\ S^{1/2}$

  Where n = Mannings roughness coefficient

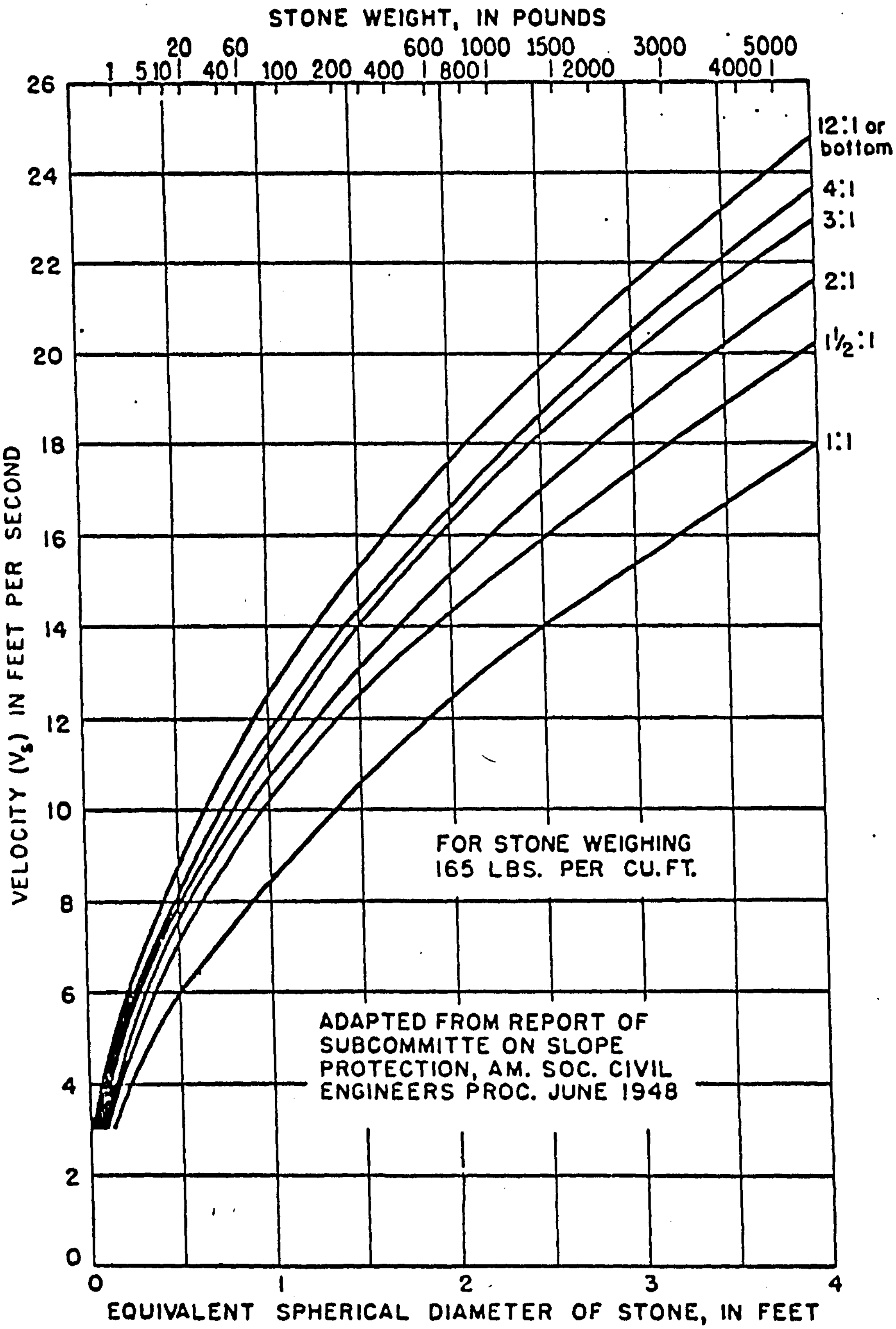
  r = hydraulic radius

  s = slope

  Use n = 0.035 V = 8.7 ft/sec

  r = 0.35 Q = 6.5 cfs

  s = 0.17




SIZE OF STONE THAT WILL RESIST DISPLACEMENT FOR VARIOUS VELOCITIES AND SIDE SLOPES

Figure 7-13

#### 7.2.3.2.5 Maintenance and Monitoring

The No. 2 pond discharge will be monitored as per the requirements of the NPDES Permit. Additional monitoring stations will be submitted with the Water Monitoring Program for this area.

The sedimentation ponds shall be inspected after each major storm and the sediment cleaned out as necessary. Sediment shall be removed from the ponds when volume of sediment accumulates to 60% of design sediment volume.Sediment removed shall be immediately taken to a refuse site approved by the Division for final disposal.

Ditches, culverts and other drainage controls shall be inspected after each major storm and cleaned as necessary. The pond embankments will be revegetated with the temporary seed mix described in Section 3.5.5.2. Any areas with rills where revegetation is not successful or where rills and gullies develop will be repaired and revegetated accordingly.

### 7.2.4 Effects of Mining on Surface Water

Bryner Canyon contains the only stream that may be directly impacted by surface disturbance associated with the Gordon Creek No. 2 and No. 7 Mine operations. All of the surface disturbance is pre-existing. Disturbed areas, such as road cuts, are being revegetated in order to minimize surface erosion. Diversions and sediments ponds have been designed and constructed to control runoff and to improve water quality characteristics of discharge from disturbed areas.

The effects of subsidence on surface waters will likely be minimal. The North Fork of Gordon Creek and lower reaches of Bryner Canyon are below coal or are not above areas to be mined. The upper branches of Bryner Canyon only flow during the snowmelt season. It is unlikely that subsidence will alter the snowmelt runoff process. It is possible that spring slows could be altered by subsidence fracturing. It is difficult to predict whether the spring flows will be decreased, increased or unaffected by subsidence fracturing. However, since the magnitude of spring flows in Bryner Canyon is small and they do not maintain stream flow, any impacts will be insignificant.

Beaver Creek is the only perennial stream that could possibly be impacted by mine subsidence. The Beaver Creek channel is at least 600 feet above the Castle Gate "A" Coal Seam. Subsidence fractures are unlikely to affect the surface that far above the coal seam to be subsided. Furthermore, most of the coal below Beaver Creek has been previously mined. Thus, subsidence is not expected in the vicinity of Beaver Creek.

### 7.2.5 Mitigation and Control Plans

Two surface water courses lie within the area to be affected by surface disturbance or overlying areas to be mined. The Bryner Canyon Creek is an ephemeral stream which lies adjacent to the surface disturbance. The present sedimentation control structures are sufficient to prevent impacts to this stream. The structures will be maintained throughout mining operations. Beaver Creek is a perennial stream that lies over areas that have been mined and has a potential to be impacted by subsidence.

The on-going water monitoring program will be used to evaluate any changes in water quality at Bryner Canyon Creek that may be attributed to mining operations. Should problems occur, the source of the problem will be identified and corrected.

7.2.6 Surface Water Monitoring Plans

Beaver Creek Coal Company currently has an on-going, permanent water monitoring program for springs, surface water courses, and an NPDES discharge location. The majority of these locations have been monitored since 1977 on a monthly basis when weather permitted.

The stream monitoring locations installed and maintained by Beaver Creek Coal Company will provide the basis to detect possible impacts of mining on both ground water and spring flows to surface waters. The spring monitoring will provide an integrated measure of conditions from several discontinuous and perched aquifers found above the coal. Even an intensive well monitoring program would be unable to provide the level of information of potential subsidence effects that will be provided by the spring monitoring program. In addition, Beaver Creek Coal Co. will continually evaluate the flow of Beaver Creek for obvious changes. If the underground point sources (discussed in Sec. 7.1.8), located within 500' horizontally from the Beaver Creek channel, should indicate flows of 30% or greater of the baseline seasonal flow on Beaver Creek, and the rate continues over 2 consecutive monthly readings, a mass balance investigation will be performed on the Beaver Creek monitoring sites to determine if mining activities have affected the Beaver Creek flow.

compliance

Water quality samples will be collected quarterly at sample locations 2-1-W, 2-2-W, 2-7-W, 2-8-W, and 2-9-W and 2-10-W. Samples will be analyzed for parameters tested in Table 7-18. The sampling programs provide information on seasonal flow and water quality on intermittent and ephemeral streams that have a potential to be affected by mine discharge and surface disturbance. Stations 2-2-W and 2-9-W will also be monitored quarterly for oil and grease, since they are below the active mine site.

In addition, discharge from the NPDES monitoring point, 2-1-W, will be sampled monthly for flow, pH, TDS, TSS, Iron, Manganese and Oil and Grease, according to NPDES permit monitoring requirements. NPDES Permit is located at end of this section. LE 7-31-90

A discussion of surface water monitoring locations, type, frequency and flow device may be found in Table 7-17. A map of the monitoring locations is provided on Plate 7-2. Sample points 2-3-W and 2-4-W are continuous stream gauging stations located on Beaver Creek at downstream and upstream points respectively. The gauges are operated through the flow season from about May through November. The stream and stilling wells are frozen throughout the Winter. The gauges are serviced monthly at which time the water is analyzed in the field for pH, temperature and specific conductance. In addition, samples will be taken bi-annually for chemical analyses on stations 2-3-W, 2-4-W, 2-5-W, and 2-6-W. Analyses will be for parameters listed in Table 7-18. Beaver Creek Coal Company will notify the Division of any exceedance of water quality standards or parameters within 5 days of receipt of results.

Quarterly reports will be submitted to the Division within 60 days following the end of the quarter. Annual reports will also be submitted no later than March 31 of the following year. Those reports will summarize probable impacts and trends.

Note; Total Settleable Solids will not be tested at non-NPDES stations; however, the requirements of UMC 817.46 (u) will be met for sediment pond removal.

The monitoring of stream flow and spring flows in the Beaver Creek drainage provides information to assess possible effects of mine subsidence on the hydrologic balance of Beaver Creek and contributing springs.

### 7.2.7 Alluvial Valley Floor Assessment

A reconnaissance investigation for Alluvial Valley Floor (AVF) Assessment was performed in accordance with State and OSM Regulations. On the basis of these regulations, the first consideration in the AVF investigation is the identification of unconsolidated stream-laid deposits (alluvial deposits). Furthermore, these deposits should be located within the valley floor and should not include isolated high terraces, alluvial fans, or landslide deposits. Once alluvial valley floor deposits are identified, then the capability to support floor irrigated or subirrigated agricultural activities must be assessed. Identification of locations where unconsolidated stream-laid deposits occur was performed using a suficial geology map of this area. Quarternary Alluvial deposits are labeled "Qal" on the suficial geology map. Furthermore, an analysis of aerial photographs of the mine permit site and adjacent areas was conducted in order to identify possible alluvial depost that were not included in the suficial geology map. A break in valley side slopes producing an identifiable valley floor served as the primary criteria for selecting these possible alluvial deposits. Aerial photo analyses revealed two small locations along Beaver Creek where possible alluvial deposits exist. These locations are designed as alluvium and labeled "Qal" on Plate ~~7-1~~ 6-1.

From a geomorphic standpoint, the rugged mountainous terrain of the permit site has resulted in drainages still in a youthful stage of development. The streams are confined in narrow, steep-sided V-shaped valleys with generally steep channel

TABLE 7-17
SURFACE WATER MONITORING PROGRAM
GORDON CREEK No. 2 and No. 7 MINES

| STATION | LOCATION | TYPE | FREQUENCY | FLOW DEVICE | RESULTS TO: | REMARKS |
|---|---|---|---|---|---|---|
| 2-1-W | Discharge of Sediment Pond | NPDES Discharge | Monthly or as Occurs | Bucket & Stop Watch | Utah Dept. Health | |
| 2-2-W | North Fork Gordon Creek | Intermittent Stream | Quarterly Flow and Quality | Portable Flume or Current Meter | Utah Dept. Health | |
| 2-3-W | Lower Beaver Creek | Perennial Stream | Continuous Flow | Parshall Flume | Utah Dept. Health | |
| 2-4-W | Upper Beaver Creek | Perennial Stream | Continous Flow | Parshall Flume | Utah Dept. Health | |
| 2-5-W | Jewkes Spring in Beaver Creek | Spring | Monthly Flow | Bucket & Stop Watch | Utah Dept. Health | |
| 2-6-W | Gunnison Homestead Spring | Spring | Monthly Flow | Portable Flume | Utah Dept. Health | |
| 2-7-W | Bryner Canyon above Mine | Ephemeral Stream | Quarterly Flow and Quality | Portable Flume | Utah Dept. Health | |
| 2-8-W | Bryner Canyon above Mine | Ephemeral Stream | Quarterly Flow and Quality | Portable Flume | Utah Dept. Health | |
| 2-9-W | Bryner Canyon below Mine | Ephemeral Stream | Quarterly Flow and Quality | Staff Gauge Portable Flume | Utah Dept. Health | |
| 2-10-W | Inflow to Sediment Pond | Ephemeral Stream | Quarterly Flow and Quality | Bucket & Stop Watch | Utah Dept. Health | |

Figure 7-18
Beaver Creek Coal Company Water Monitoring Report

Property: ____________________

Date Sampled: __________ Date Analyzed: __________
Station: ____________________
Location: ____________________
Type: ____________________
Frequency: ____________________

Field Measurements:

| | | |
|---|---|---|
| Water Level or Flow | : | |
| PH | : | |
| Specific Conductivity | : | (ohms/cm) |
| Temperature | : | (°c) |
| Dissolve . Oxygen (Perennial streams only) | : | (ppm) |

Laboratory Measurements (mg/l):

| | | |
|---|---|---|
| ** Total Settleable Solids | : | |
| Total Suspended Solids | : | |
| Total Dissolved Solids | : | |
| Total Hardness (as $CACO_3$) | : | |
| Acidity ($CaC0_3$) | : | |
| *Carbonate ($C0_3{}^{-2}$) | : | |
| *Bicarbonate ($(HC)_3{}^{-1}$) | : | |
| *Calicum (Ca) | : | |
| Chloride ($Cl^-$) | : | |
| Iron (Fe) | : | |
| *Magnesium (Mg) | : | |
| *Total Manganese (Mn) | : | |
| *Potassium (K) | : | |
| *Sodium (Na) | : | |
| *Sulfate ($SO_4{}^{-2}$) | : | |
| *** Oil & Grease | ; | |
| Cation - Anion Balance | : | |

* Dissolved Form
** NPDES Samples only
*** Designated Samples Only

AMENDMENT TO
APPROVED Mining & Reclamation Plan
Approved, Division of Oil, Gas & Mining
by J. Whitehead date 12/5/88

gradients. Meanders normally associated with AVF development are absent except in a few isolated locations along Beaver Creek. The site along Beaver Creek that was designated as possible alluvium in the aerial photograph analysis exhibits stream meandering and numerous beaver ponds. A field visit to the site in August, 1980, confirmed the photo analysis. Soils in the valley were still flooded or water logged. The other site designated as possible alluvium is on a tributary to Beaver Creek in the southwest corner of Section 7, Township 13 South, Range 8 East. This small deposit occurs on the mouth of the tributary and probably consists of alluvial and debris flow materials. The site was partially flooded and the soils were water logged during a field visit to the site in August, 1980.

The valley floor along Beaver Creek and its tributary in Section 7 would be incapable of supporting agricultural activities without proper drainage. Even with adequate drainage, agricultural development would be restricted to grasses and pasture because of the high elevations and short growing seasons. Possible alluvial deposits were also identified at the mouth of Bryner Canyon and continuing downstream along Gordon Creek. The alluvial deposits at this location are below the coal outcrop and thus, could not be directly impacted by mine subsidence. The soils investigations showed the upper reaches of this alluvial deposit to be disturbed and consisting of about 90 percent fill material. Disturbance results from road cuts and coal waste. Included in the area are small areas of Patmos and Podo soils as well as areas of rock outcrops. Even before disturbance, the site had limited range and wildlife capability. The valley floor is quite narrow along this reach of Gordon Creek.

Agricultural developments are not found along Gordon Creek or Beaver Creek in the vicinity of the mines. The agricultural potential of the valley floors in the area is limited by the soil capability and the short growing season. The narrow valleys are occupied by the stream and the road and both break up the narrow valley so that development of hay meadows or improved pasture is impractical.

## 7.3 References

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## 7.2.8 Reclamation Hydrology

Once mining is completed, structures will be removed from the site, and the earthwork/drainage portion of the reclamation plan will begin. This section will deal specifically with the hydrologic portion of the reclamation, including permanent structures as well as temporary controls.

### 7.2.8.1 General

After final reclamation work begins on the upper pads and haul roads, straw dikes, silt fences, or earth berms will be established to control possible erosion from newly graded and seeded areas. The Mine site drainage will be reclaimed in 2 stages. During Phase I, as shown on Plate 3-7B, the diversions and culverts will be removed, the natural drainage channel will be restored, and the area will be recontoured to the final configuration; however, the sediment ponds will be left in place. The No.7 Mine area and drainage above the No.2 Mine site will flow into the restored channel above, and then into the existing sediment pond 7A. The outlet structures on pond 7A will be left in place to pass any overflows; however, the outlet culverts will be severed just below the pond and removed from that point below. The drainage from the right fork of Bryner Canyon will be restored and will flow into the restored main channel just below Pond 7A. The No.2 Mine disturbed area will be recontoured and bermed to drain to the sediment Ponds 7A and 2 as shown on Plate 3-7B. Pond No.2 will also remain in place along with existing overflow/discharge structures until revegetation standards are met. Two small reclaimed areas will not drain to the ponds, as shown on Plate 3-7B. These areas are labeled as Small Area Exemptions 1 and 2, and consist of 0.11 and 0.9 acres, respectively. The areas will have alternate sediment controls, consisting of silt fences, straw bales, or containment berms as shown.

Once revegetation standards are met, Phase II of the reclamation project will begin. This will consist of the removal of both sediment ponds and all discharge structures, and final grading, channel restoration, and reseeding of the restored areas.

All channels will be rip-rapped as shown on Plates 3-1A, 3-7 and 3-7a to eliminate erosion and cutting of the side slopes. The sedimentation ponds will be the last control structures to be removed. Upon removal of the ponds, water will flow into Bryner Canyon and then into Gordon Creek. All other areas will be mulched as described in Chapter 3 to minimize erosion as much as possible. Fencing will be placed only as required to protect revegetation efforts from livestock over-grazing.

The drainage diversions will be filled with the material from the berm. Any contaminated material will be discarded in an area approved by the DOG&M. However, since this will be of a minimal amount, the remaining material will be recompacted back into the diversion and reseeded. Restored drainages will be rip-rapped using well-graded, properly sized material and fortified with the Plus-18inch rock removed from the backfilling operations.

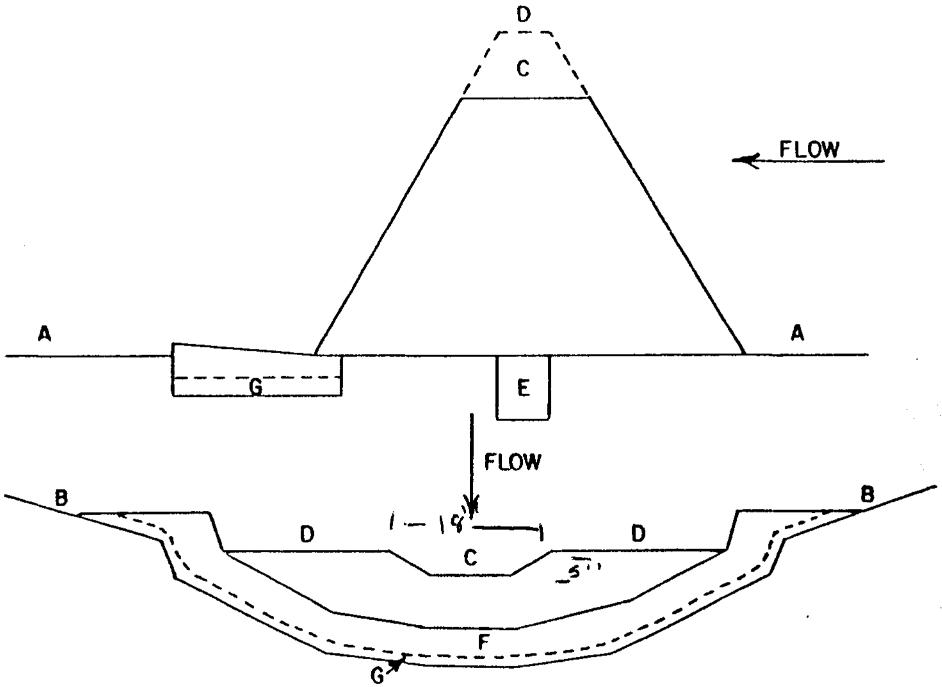
Reclaimed channel and rip-rap sizing have been designed to accomodate the 100 year-24 hour storm event. Gradients of the natural and proposed channels are shown on Plate 3-10.

Cross sections of the natural channels are shown on Plate 3-11. A typical cross section of the proposed reclaimed channel and rip-rap is shown on Plate 3-12. Channel locations and rip-rap size are shown on Plates 3-1A, 3-7 and 3-7a. A filter blanket of 3/4" gravel will be placed below the rip-rap to a depth as shown on Table 7-22.

7.2.8.1.1 No.2/7 Mine Site

The proposed restored channel is sized to carry the 100 year-24 hour storm event for this area. The entire channel will be rip-rapped for erosion protection.

It is likely that some seeps or springs will still exist within or above the portal highwall, since three are evident at this time. Since it is proposed to leave the highwall at the No.7 Mine portal site, and since it is a rock face, it is proposed to allow the seeps to continue running down the rock face to the lower bench. At this point, the seepage will be intercepted by a loose rock check dam and conveyed to the main restored channel via a rip-rapped ditch (36-inch wide by 12-inch deep, minimum).




Construction Plans for a Loose-Rock Check Dam

1. Section of the dam parallel to the centerline of the gully.
2. Section of the dam at the cross section of the gully.
   A = original gully bottom; B = original gully cross section;
   C = spillway; D = crest of free board; E = excavation for key;
   F = excavation for apron; G = filter blanket.

FIGURE 3-10

Notes:

1. A well-graded distribution of angular rock from 6-24 inches must be used. The angle of rest for this angular rock should correspond to a slope ratio not less than 1.5 to 1.0. The structure shall be 24-30 inches high. The angular rock shall be placed so as to form an 18-inch wide by 5-inch deep notch in the center of the creek channel to form a centralized spillway.

2. The keyway must be 24 inches wide and deep and excavated into the streambed and banks. The keyway into the banks must be 36 inches deep.

3. The apron section must be 10 feet long and placed with an adverse slope of six inches over the 10 feet length. A filter blanket (two inch minus material, six inches deep) must be placed under aprons. Riprap side slope protection measures for the length of the apron and two feet above the gabion crest must be included. The angle of rest for the 6-24 inch well-graded material used to construct the gabion must be strictly adhered to.

## LOOSE-ROCK CHECK DAM

The rip-rap will be of a median diameter of six inches. A similar procedure will be employed at other seep locations and at the intersections of small side drainages with the main channel. (See Figure 7-14 for details on the Loose Rock Check Dams, and Plates 3-7 and 3-7a for locations of the seeps, dams and channels in the mine site area).

Drainage and runoff characteristics for the No.2/7 Mine area are summarized on Table 7-19, and characteristics for all of the reclaimed drainage areas are shown on Table 7-20. Hydrologic details for all reclaimed drainage areas are shown on Table 7-21. Design Parameters and Calculations are described in Section 7.2.8.2.

The general plan for the reclamation hydrology for the No.2 and 7 Mine Areas is as follows, starting from the top down:

<u>No.7 Mine Area</u> - The area will be recontoured as described in Chapter 3. All culverts and diversions will be removed and a restored channel will be constructed across the disturbed area as shown on Plate 3-7A. This channel will be constructed per the design Plate 3-12, and will convey undisturbed drainage from above, as well as disturbed (reclaimed) area runoff to the natural drainage below, located between the No.7 and No. 2 Mine Areas. This drainage will flow to the sediment pond 7A as shown on Plate 3-7B. The sediment pond will remain in place until revegetation standards are met. As previously described, seeps and side canyon drainages will be controlled through the use of loose-rock check dams and rip-rapped channels into the main drainage.

No.2 Mine Area

Interim - During the first phase of reclamation, the sediment ponds will remain in place. All culverts inlets will be replaced by channels; however, the culvert outlet from the sediment ponds will remain until pond removal. The mine yard will be recontoured, and a main drainage channel will be restored across the pad area, as shown on Plate 3-7. The disturbed area will be bermed and drained to the sediment pond until revegetation standards are met on the property.

Final - Once revegetation standards are met, the sediment ponds, diversion/inlet and outlet culverts will be removed, the area recontoured and reseeded per the plan. The drainage from the mine site and above will flow down Bryner Canyon into the North Fork of Gordon Creek.

Right Fork of Bryner Canyon - During reclamation, the 24" culvert from the right fork to Pond 7A will be removed and replaced with a restored, rip-rapped channel as shown on Plates 3-7 and 3-12. This drainage will enter the main restored channel and flow to the Bryner Canyon Drainage.

Haul Road - The road will be eliminated to the gate and the area reseeded according to plan. From the gate down, the road belongs to Carbon County; therefore, there are no plans to alter the road or the drainage below this point.

Bryner Canyon - The Bryner Canyon drainage, although altered by previous mining and reclamation activities, is considered stable and in as natural of a state as can be expected for its location. There are no plans to alter this drainage system below the mine area.

7.2.8.1.2 Sweet's Canyon - It is proposed to leave the water truck fill pond in place as a permanent structure. It is the Company's intention to turn the system over to the landowner upon completion of operations. See Appendix 9 for the landowner request on the pond. The system is designed for long-term stability and provides not only a utility improvement for the area, but also serves to benefit wildlife by providing additional riparian area.

Justification for leaving the pond in place is based on meeting the following criteria from U.M.C. 817.49:

(a)(1) The impounded water will be used for wildlife enhancement (i.e. - fish pond, beaver habitat and riparian area). The water quality of the pond is more than adequate to meet Class 3C Water Use as required for fisheries. Typical water quality of the pond is shown in Table 7-23.

(a)(2) The water level will be maintained at the overflow level shown on Plate 3-1A. This level has been maintained since construction, and has been shown adequate to support fish life in the pond.

(a)(3) The pond is presently fenced to prevent public access. The landowner will have the option to leave or remove the fence after bond release. It is the intent of Beaver Creek Coal Company to maintain the fence until bond release.

(a)(4) The impoundment of the water amounts to approximately 2 acre feet at any given time. This is more than adequately covered by the water rights owned by Beaver Creek Coal Company in this canyon. Adequate rights for the pond will be transferred to the landowner along with the pond after final reclamation.

Water quality of the stream is at least maintained, and likely enhanced by the pond. The pond acts as a settling area for part of the stream runoff, and since there is no other water treatment in the pond, the quality of the outflow is at least as good as that of the inflow.

(a)(5) The pond does not meet the size or other criteria of 30 CFR 77.216(a).

(a)(6) The size of the pond has been shown adequate for its intended purpose (i.e. - fish and beaver habitat and riparian area), and will remain as such after reclamation.

(a)(7) The pond is presently used as fish and beaver habitat as well as for mine water supply. The only change is post-mining use will be the elimination of the need for mine water supply.

(b) The pond is a permanent structure.

(c) The pond slopes are a maximum of 1.5H:1V as shown on Plate 3-1A; however, a stability analysis of the pond embankment has been performed and shows the slope to be stable. The stability analysis is summarized in Appendix 10 of this M.R.P.. In addition, pond slopes are protected by vegetation. Inlets and outlets are protected from erosion by a culvert/headgate and rip-rapped overflow structure.

(d) Slope protection is provided by a diverse cover of vegetation. Sediment is controlled by vegetation and by the settling action of the pond itself.

(e) Embankments and surrounding areas are vegetated as required by U.M.C. 817.111-817.117.

(f) The pond does not meet the size or other criteria of 30 CFR 77.216(a).

(g) The pond and embankment is routinely maintained to perform its intended function.

(h) The pond is certified and inspected on a quarterly basis. Copies of the pond inspection reports are submitted to the Division with the Annual Report.

(i) Any plans for modification of the pond will be submitted to the Division for approval prior to construction.

7.2.8.2 Reclamation Hydrology Design

The following designs are submitted for 2 separate areas of the Mine Reclamation. The first is for the upper, or #2 and 7 Mine Areas, and the second is specifically for the Sweet's Canyon Pond Area. Parameters and calculations for each of the designs are included with each section.

7.2.8.2.1 No. 2/7 Mine Area Reclamation Hydrology Design

7.2.8.2.1.1 Channels

As mentioned earlier, main drainage channels will be restored at the following locations: No.7 Mine Pad Area to Left Fork of Bryner Canyon; Right Fork of Bryner Canyon across No.2 Mine Pad Area; Main Bryner Canyon Channel Across No.2 Mine Pad.

All restored channels will be the same size as shown on Plate 3-12. The only variation in channel configuration will be in the M.D. size of the rip-rap protection, due to variations in slope and flow. The depth of flow in the various channels will also vary according to slope and flow.

Parameters

The following parameters were used in the reclamation channel design for this area:

100 year - 24 hour precipitation event - 3.20"

Peak Flow Methodology - SCS-TR55

Antecedent Moisture Condition - II

Runoff Curve Numbers

Undisturbed Area - 63

Disturbed Area - 86

Drainage Area - Planimetered from Plates

Slope Length - Measured from Plates

Land Slope - Measured from Plates

Lag Time - Based on: $\frac{L^{0.8}(S+1)^{0.7}}{1900\ Y^{0.5}}$

where: L= Slope Length in feet

$S= \frac{1000}{CN} -10$

Y= Land Slope in %

$T_L$= Lag in Hours

Time of Concentration - $t_c = \frac{t_1}{0.6}$

where: $t_c$= Time of Concentration in hours.

$t_1$= Lag time in hours.

Peak Flow - $Q_{100}=Q'\ A\ P_{100}$

where: $Q_{100}$=Peak Flow from 100 year - 24 hour event in cfs.

Q' = Peak Discharge on Figure 2.40, p.115, "Applied Hydrology and Sedimentology for Disturbed Areas", Barfield, Warner and Haan, 1983.

A= Drainage Area in square miles.

$P_{100}$= Runoff Volume in inches.

Velocity - Manning's Equation: $V=\frac{1.49R^{.67}S^{.5}}{n}$

where: V= Velocity in fps

n= Manning's Number =0.035

$R-\frac{A}{P}$; A=area of Flow in $ft^2$;

P= Wetted Perimeter in ft;

R= Hydraulic Radius in ft.

S= Slope in feet per foot

Note: Manning's n for rip-rapped channels is taken from Table 3.1, p.159, (Channels, Earth; Stony Bed) "Applied Hydrology and Sedimentology for Disturbed Areas", Barfield, Warner and Haan, 1983.

*Depth of Flow - $D=\frac{A}{W}$

where: D= Depth of Flow in feet

A= Area of Flow in $ft^2$, calculated from Q=AV; Q=flow in cfs;

V= Velocity in fps.

W= Width of Flow Section in feet

Erosion Protection - Erosion Protection in assumed required above velocities of flow greater than 5 fps.

* Reference: "Applied Hydrology and Sedimentology for Disturbed Areas," Barfield, Warner and Haan, 1983.

Calculations - The following calculations are for each of the sub areas shown on Table 7-5 and applicable areas shown on Table 7-6. Each set of calculations will show : Time of Concentration ($t_c$) and Peak Flow from a 100 year - 24 hour precipitation event ($Q_{100}$). Velocity of Flow (V), and Depth of Flow (D) are included only on the combined or total area calculation. Formulas and parameters used are those described in the previous section. Specific values for all parameters are summarized on Table 7-19.

Sub-Drainage B. (Undisturbed Area)

1 - Time of Concentration $t_c = \frac{t1}{0.6} = 0.60$ hours

$$t_1 = \frac{(4500)^{0.8}(6.87)^{0.7}}{1900(23)^{0.5}} = 0.36 \text{ hours}$$

2 - Peak Flow = 71.72 cfs

$$Q = 450\left(\frac{204}{640}\right)0.5 = 71.72$$

No.7 Site (Disturbed Area)

1 - $tc = \frac{t1}{0.6} = 0.20$ hours

$$t_1 = \frac{(1650)^{0.8}(2.63)^{0.7}}{1900(16)^{0.5}} = 0.12 \text{ hours}$$

2 - $Q_{100}$ = 17.33 cfs

$$Q_{100} = 800 \left(\frac{7.7}{640}\right) 1.8 = 17.33$$

Combined No.7 Pad Channel

1. Peak Flow; $Q_{100}$ = 89.05 cfs

   $Q_{100} = 71.72 + 17.33 = 89.05$

2. Velocity; V = 16.98 fps.

   $$V = \frac{1.49}{.035} R^{.67} S^{.5} = 16.98$$

   R = A/P = 1

   S = 15.9

3. Depth of Flow; D = 0.43 ft.

$$A = \frac{Q}{V} = \frac{89.05}{16.98} = 5.24\ ft^2$$

$$d = \frac{A}{W} = \frac{5.24}{12} = 0.43$$

Sub - 1 (Disturbed Area)

1. $t_c = \frac{tl}{0.6} = 0.1$ hours.

$$t_1 = \frac{(480)^{0.8}(2.63)^{0.7}}{} = 0.06$$

2. $Q_{100}$ = 4.33 cfs

$$Q_{100} - 1000\ \frac{(1.54)}{640}\ 1.8 = 4.33$$

Sub - 2 (Disturbed Area)

1. $t_c = \frac{tl}{0.6} = 0.18$ hours

$$t_1 = \frac{(900)^{0.8}(2.63)^{0.7}}{1900\ (4)^{0.5}} = 0.11$$

$Q_{100}$ = 15.12 cfs

$$Q_{100} = 840\ \frac{(6.4)}{(640)}\ 1.8 = 15.12$$

Sub - 3 (Undisturbed Area)

1. $t_c = \frac{tl}{0.6} = 0.23$ hours

$$t_1 = \frac{(1500)^{0.8}(6.87)^{0.7}}{1900\ (37)^{0.5}} = 0.14$$

2. $Q_{100}$ = 15.20 cfs

$$Q_{100} = 760\ \frac{(25.6)}{(640)}\ 0.5 = 15.20$$

Area A - Right Fork Bryner (Undisturbed Area)

1. $t_c = \frac{tl}{0.6} = \underline{0.6 \text{ hours}}$

   $t_1 = \frac{(4000)^{0.8}\ (6.87)^{0.7}}{1900(26)^{0.5}} = 0.35$

2. $Q_{100} = \underline{71.37 \text{ cfs}}$

   $Q_{100} = 450\ \left(\frac{203}{640}\right)\ 0.5 = 71.37$

3. $V = \underline{11.10 \text{ fps}}$

   $V = \frac{1.49}{0.035} R^{.67} S^{0.5} = 11.10$

   $R = \frac{A}{p} = 1$

   $S = 6.80\%$

4. Depth of Flow; $D = \underline{0.54 \text{ ft.}}$

   $A = \frac{Q}{V} = \frac{71.37}{11.10} = 6.43 \text{ ft.}^2$

   $D = \frac{A}{W} = \frac{6.43}{12} = 0.54 \text{ ft.}$

Main Channel - Combined (Area B, #7, Sub 1,2,3, Rt. Fork)

1. Peak Flow; $Q_{100} = \underline{195.1 \text{ cfs}}$

   $Q_{100} = 71.72 + 17.33 + 4.33 + 15.12 + 15.20 + 71.37 = 195.07$

2. Velocity; $V_1 = \underline{10.77 \text{ fps}}$

   $V_2 = \underline{23.22 \text{ fps}}$

   $V = \frac{1.49}{0.035} R^{.67} S^{0.5}$; $V_1 = 10.77$, $V_2 = 23.32$

   $R = A/P = 1$

   $S_1 = 6.40\%$

   $S_2 = 30.0\%$

3. Depth of Flow; $D_1$ = 1.51 ft.

$D_2$ = 0.70 ft.

$$A_1 = \frac{Q}{V_1} = \frac{195.1}{10.77} = 18.12 \text{ ft}^2$$

$$A_2 = \frac{Q}{V_2} = \frac{195.1}{23.32} = 8.37 \text{ ft}^2$$

$$D_1 = \frac{A_1}{W} = \frac{18.12}{12} = 1.51 \text{ ft.}$$

$$D_2 = \frac{A_2}{W} = \frac{\quad}{12} = 0.70 \text{ ft.}$$

Results from the above calculations are summarized on Tables 7-19 and 21.

7.2.8.2.1.2 Seeps / Small Side Drainages

Seeps and small side drainages are not quantified individually, since they represent a small amount of drainage with correspondingly low flows. Instead, these drainages will all be fitted with a loose-rock check dam for velocity control, and each outflow drainage consists of 36 inch wide by 12 inch deep minimum ditch, lined with a minimum of 12 inches of rip-rap with a $D_{50}$ of 6 inches to prevent erosion. A typical section of the loose-rock check dam is shown in Figure 7-14.

The drainage area designated Sub-3 on Plate 7-5 will be an exception to the above. Because of the slightly larger area and flow from this side drainage, the outflow drainage will consist of a 48 inch wide by 18 inch deep minimum ditch, lined with a minimum of 18 inches of rip-rap with a $D_{50}$ of 9 inches over a filter blanket of -3/4 inch gravel a minimum of 6 inches deep. The drainage will also be fitted with 2 loose rock check dams for velocity control.

7.2.8.2.2 Sweet's Canyon Pond Area Reclamation Hydrology Design

7.2.8.2.2.1 Channels

There are two (2) channels involved in the Sweet's Canyon Pond Area:

(1) The Bryner Canyon Diversion which flows under the County Road through 36" culverts and enters the North Fork of Gordon Creek below the pond via a rock lined ditch. This diversion is part of the county road drainage and is proposed to be left as is;

(2) The permanent diversion of the North Fork of Gordon Creek, which carries flow from Sweet's Canyon around the south edge of the proposed permanent pond. The specific criteria for this diversion is detailed below.

Parameters - Parameters for this area are the same as those listed in Section 7.2.8.1.2. The design flow estimates were developed using the SCS TR-55 Method. Flow estimates were developed for both Bryner Canyon and the North Fork of Gordon Creek above the confluence with Bryner Canyon. Flows from Bryner Canyon are developed using the estimates obtained for 2 & 7 mine disturbed area drainage calculations. Flow estimates are also developed for the Right Fork of Bryner Canyon for drainage from the access road and Area C representing all other areas draining to Bryner Canyon below the No. 2 mine site. These estimates are provided in Table 7-20 and were developed using the Type II rainfall distribution.

Permanent Diversion, North Fork of Gordon Creek

A diversion channel is designed to keep flows in the North Fork Gordon Creek separate from water in the truck fill-up pond. An armored berm separates the diversion channel from the pond as shown in Plate 3-1A. The existing channel slopes were surveyed in order to develop the diversion designs.

The channel was designed for a flow of 362 cfs, the peak flow from a 100-year, 24-hour precipitation event. The channel upstream of the diversion just above the pump house headgate enters with a slope of 0.028. From the pump house headgate to the drop structure, the slope is 0.0252. The slope of the drop structure is 0.28 while the bedslope of the natural channel below is about 0.03.

The following is a description and summary of the hydrologic characteristics of this channel at each of the changes in slope:

Natural Channel above Diversion

Discharge (cfs) = 362
Slope (%) = 2.80
Velocity (fps) = 7.12
Normal Depth (ft)= 3.39
Bottom Width (ft)= 10
Side Slope = 1.5:1
Manning's n = 0.035

A trapezoidal channel is designed for the diversion above the drop structure using Manning's Equation. Design specifications are provided below for the discharge from a 100-year, 24-hour precipitation event:

| | | |
|---|---|---|
| Discharge (cfs) | = | 362 |
| Slope (%) | = | 2.52 |
| Velocity (ft/sec) | = | 6.76 |
| Normal Depth (ft) | = | 3.57 |
| Bottom Width (ft) | = | 15 |
| Side Slope | = | 1.5:1 |
| Manning's n | = | 0.035 |

A rip rapped drop structure is designed according to the specifications in Figure 7-5. Design specifications for a trapezoidal shaped section are provided below for the discharge from a 100-year, 24-hour precipitation event:

| | | |
|---|---|---|
| Discharge (cfs) | = | 362 |
| Slope (%) | = | 28.0 |
| Velocity (ft/sec) | = | 19.7 |
| Normal Depth (ft) | = | 1.32 |
| Bottom Width (ft) | = | 10 |
| Side Slope | = | 3:1 |
| Manning's n | = | 0.04 |

Natural Channel below Diversion

| | | |
|---|---|---|
| Discharge (cfs) | = | 362 |
| Slope (%) | = | 3.00 |
| Velocity (ft/sec) | = | 7.37 |
| Normal Depth (ft) | = | 4.09 |
| Bottom Width (ft) | = | 12 |
| Side Slope | = | 1.5:1 |
| Manning's n | = | 0.035 |

Calculations for the above channel sections are shown under the calculation portion of this section.

The main point of concern with the permanent diversion is the point where the natural stream intercepts the diversion and pond inlet structure. As a further measure of protection of the berm area at the pond inlet, and for 100' downstream, the following 2 additions are proposed for final reclamation:

(1) To raise the height of the berm separating the diversion and pond by a minimum of 18" to allow for adequate freeboard during peak flows, and

(2) To armor the outer (streamside) slope of the berm with 12" of -3/4" gravel overlain by a layer of rip-rap with a $D_{50}$ of 24". The $D_{50}$ for the rip-rap is taken from the graph on Figure 7-13, based on the expected flow and velocity in the natural channel above. In addition, the toe of the berm slope along the channel and the inlet area of the pond will be further protected by placement of a row of 24" plus boulders along the perimeter. These boulders will be placed prior to filter blanket and placement of rip-rap. This will help hold the rip-rap in place along the slope, as well as acting as deflectors for the flow from the natural channel above.

Details of the existing and proposed reconstruction of the channels are shown on Plates 3-1A (1 and 2). Hydrologic data, including velocities and flow depths, are summarized in Tables 7-20 and 7-21.

<u>Bryner Canyon - Diversion</u>

The Bryner Canyon drainage is diverted around the water truck fill-up pond by routing flows across the main access road through a culvert, down a road side diversion ditch for about 115 ft. and back across the road through a culvert.

The culverts and diversion ditch are sized for a peak discharge form a ten-year, 24-hour precipitation event.

Both road culverts are 36-inch corregated metal pipe with mitered entrance equipped with trash racks. The culverts can accommodate flows up to 35 cfs without head water depth exceeding the culvert diameter. Thus, the culverts will safely pass the 29 cfs flow from a ten-year, 24-hour precipitation event. Headwater depths would reach about 2.5 times the culvert diameter during a flow of 78 cfs which corresponds with the peak discharge from a 25-year, 24-hour precipitation event. Headwater protection is provided by concrete.

The diversion ditch is a trapezoidal channel designed using Manning's Equation. Design specifications are provided below to the discharge from a ten-year, 24 hour precipitation event:

| | | |
|---|---|---|
| Discharge (cfs) | = | 29 |
| Slope (%) | = | 0.045 |
| Velocity (ft/sec) | = | 6.2 ft. |
| Normal Depth (ft) | = | 0.9 ft. |
| Bottom Width (ft) | = | 3.0 |
| Side Slope | = | 2.5H:1V |
| Manning's n | = | 0.036 |

This diversion channel is protected with rip rap with a median diameter of seven inches. Rip rap was sized using the procedures for "Erosion and Sediment Control; Surface Mining in the Eastern U.S." (EPA- 625/3-76-006).

A rip rapped apron is provided at the outlet of the culverts.

A channel is provided to bring flows back to the old Bryner Canyon stream channel at non-erosive velocities. The channel is a trapezoidal channel with design specifications developed below for the discharge from a ten-year, 24-hour precipitation event:

| | | |
|---|---|---|
| Discharge (cfs) | = | 29 |
| Slope (%) | = | 0.033 |
| Velocity (ft/sec) | = | 4.9 |
| Normal Depth (ft) | = | 0.52 |
| Bottom Width (ft) | = | 10.0 |
| Side Slope | = | 2.5:1 |
| Bed Slope | = | 0.033 |
| Manning's n | = | 0.033 |

Combined Bryner Canyon

1 - Peak Flow; $Q_{100}$ = 302.7 cfs

$$Q_{100} = 195.1 + 61.9 + 45.7 = 302.70$$

2 - Velocity ; V = 11.58 fps

$$V = \frac{1.49}{0.035} R^{.67} S^{0.5} = 11.58$$

$$R = A/p = 1$$

$$S = 7.40$$

3 - Depth of Flow; D = 3.27 ft.

$$A = \frac{Q}{V} = \frac{302.7}{11.58} = 26.14 \text{ ft}^2$$

$$D = \frac{A}{W} = \frac{26.14}{} = 3.27 \text{ ft.}$$

North Fork of Gordon Creek (Undisturbed Area)

1 - Time of Concentration; $t_c = \frac{t_1}{0.6}$ = 3.5 hours

$$t_1 = \frac{(26,900)^{0.8}(6.87)^{0.7}}{1900\ (10)^{0.5}} = 2.1$$

2 - Peak Flow : $Q_{100}$ = 362.0 cfs

$$Q_{100} = 128 \frac{(3620)}{(640)} 0.5 = 362$$

3 - Velocity

Natural Drainage Above - V = 7.12 fps

a. $V = \frac{1.49}{0.035} R^{.67} S^{0.5} = 7.12$

$$R = \frac{A}{p} = 1$$

$$S = 2.8\%$$

Upper End of Diversion ; V = 6.76 fps

$$V = \frac{1.49}{0.035} R^{.67} S^{0.5} = 6.76 \text{ fps}$$

$$R = \frac{A}{p} = 1$$

$$S = 2.52\%$$

Drop Structure ; V = 19.71 fps

$V = \frac{1.49}{0.040} R^{.67} S^{0.5} = 19.71$ fps

$R = \frac{A}{P} = 1$

S = 28.0%

Natural Channel below Structure; V = 7.37 fps

$V = \frac{1.49}{0.040} R^{.67} S^{0.5} = 7.37$ fps

$R = \frac{A}{P} = 1$

S = 3.00%

4 - Depth of Flow

Natural Drainage Above ; D = 3.39 ft.

$$A = \frac{Q}{V} = \frac{362}{7.12} = 50.84 \text{ ft}^2$$

$$D = \frac{A}{W} = \frac{50.84}{15} = 3.39 \text{ ft.}$$

Upper End of Diversion ; D= 3.57 ft.

$$A = \frac{Q}{V} = \frac{362}{6.76} = 53.55 \text{ ft}^2$$

$$D = \frac{A}{n} = \frac{53.55}{15} = 3.57 \text{ ft.}$$

Drop Structure ; D = 1.84 ft.

$$A = \frac{Q}{V} = 362 = 18.37 \text{ ft}^2$$

$$D = \frac{A}{W} = \frac{18.37}{10} = 1.84 \text{ ft.}$$

Natural Channel below Structure; D = 4.09 ft.

$$A = \frac{Q}{V} = \frac{362}{7.37} = 49.12 \text{ ft}^2$$

$$D = \frac{A}{W} = 49.12 = 4.09 \text{ ft.}$$

Pond Inlet

The pond inlet consists of a 12" culvert with headgate. The potential head on the culvert will be approximately 3D. Based on the culvert nomograph, Figure 7-7, this culvert can carry approximately 6.0 cfs of the flow from the North Fork of Gordon Creek.

Pond Outlet

The pond outlet consists of a rock lined, trapezoidal overflow to the stream. The overflow has the following dimensions:

| | |
|---|---|
| Bottom Width | - 6' |
| Total Depth | - 1.5' |
| Side Slope | - 1:1 |
| Top Width | - 9' |
| Slope | - 45% |

The expected outflow from the pond would be the same as that from the inflow culvert - 6.0 cfs. Based on this flow, the overflow would have the following hydrologic characteristics:

1 - Flow ; Q = 6.0 cfs
(Based on inflow)

2 - Velocity; V= 24.99 fps

$$V = \frac{1.49 R^{.67} S^{.5}}{0.040} = 24.99$$

$$R = \frac{A}{p} = 1$$

$$S = 45\%$$

3 - Depth of Flow ; D = 0.04 ft.

$$A = \frac{Q}{V} = \frac{6.0}{24.99} = 0.24 \text{ ft}^2$$

$$D = \frac{A}{W} = \frac{0.24}{6} = 0.04 \text{ ft}$$

7.2.8.2.3 Rip-rap Design

Rip-rap will be placed on all reclaimed channels. The required median stone diameter ($D_{50}$) of all rip-rap has been taken from the chart on Figure 7-13 (p.7-120) "Design of Outlet Protection". The required $D_{50}$ for each channel reach was determined by matching the expected peak flow with the calculated velocity, and reading the result directly from the chart.

All rip-rap will conform to the following specification:

1 - Angular, non-slaking rock.

2 - Well graded, meeting the following approximate size distribution:

$2D_{50}$ - Top Size
$D_{50}$-$2D_{50}$ - 50%
$0.5D_{50}$ -$D_{50}$ - 30%
Less than $0.5D_{50}$ - 20%

3 - Depth of placement shall be a minimum of 2 x $D_{50}$.

4 - All rip-rap will be placed over a filter blanket consisting of - 3/4" road gravel placed to a minimum depth of one-half the thickness of the median diameter of the rip-rap, but in no case less than 6 inches deep.

5 - Rip-rap will be placed by end dumping or similar methods to prevent segregation.

Rip-rap will be placed at the locations shown on Table 7-22. This table will also summarize the median stone diameter ($D_{50}$) of the rip-rap to be used at each location, along with the minimum depth of the filter blanket. Locations of the restored, rip-rapped channels are shown on Plates 3-1A, 3-7 and 3-7A.

Note: The maximum size stone proposed for use in rip-rap is 36" diameter. This is due to the infeasibility of placing and holding larger stones on the grades in this area. Past experience has shown an 18" M.D. rip-rap with 36" maximum size stone to be effective in reclaimed channels in this area.

It is anticipated that required rip-rap will be segregated on site during the earthmoving phase of reclamation. If insufficient quantities of any required size become apparent, needed material will be purchased at that time.

TABLE 7-19

RUNOFF CHARACTERISTICS - NO. 2/7 MINE AREA

| Sub Drainages | AreaB | No.7Site | No.7 Combined | Sub-1 | Sub-2 | Sub-3 | Rt. Fork Bryner | Main Channel Combined |
|---|---|---|---|---|---|---|---|---|
| Area - Acres | 204 | 7.7 | 211.7 | 1.54 | 6.4 | 25.6 | 203.0 | 448.24 |
| Curve Number | 63 | 86 | | 86 | 89 | 63 | 63 | ---- |
| Slope Length (feet) | 4500 | 1650 | --- | 480 | 900 | 1500 | 4300 | ---- |
| Slope (%) | 23 | 16 | 15.9 | 6 | 4 | 37 | 26 | 6.4/30.0 |
| Lag (hrs) | 0.36 | 0.12 | --- | 0.06 | 0.11 | 0.14 | 0.36 | ---- |
| Time of Concentration (hrs) | 0.6 | 0.20 | --- | 0.1 | 0.18 | 0.23 | 0.60 | ---- |
| 100-year, 24-hour Precipitation Results | | | | | | | | |
| Precipitation (in) | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 |
| Peak Discharge (cfs) | 71.7 | 17.3 | 89.0 | 4.3 | 15.1 | 15.2 | 71.4 | 195.1 |

## TABLE 7-20 RUNOFF CHARACTERISTICS
## SWEETS CANYON WATER TRUCK FILL-UP

Sub Drainages

| | 2 & 7 Mine Area (Total combined from Table 7-19) | Access Road To 2 Mine | Area C | Combined Bryner Canyon | North Fork Gordon Creek |
|---|---|---|---|---|---|
| Area - Acres | 448.24 | 22 | 148 | 617 | 3,620 |
| Curve Number | ------ | 84 | 63 | --- | 63 |
| Slope Length (feet) | ------ | 150 | 5600 | --- | 26,900 |
| Slope (%) | ------ | 35 | 20 | --- | 10 |
| Lag (hrs.) | ------ | 0.06 | 0.45 | --- | 2.1 |
| Time of Concentration (hrs.) | ------ | 0.1 | 0.75 | --- | 3.5 |
| 100-year, 24-hour Precipitation Results | | | | | |
| Precipitation (in) | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 |
| Peak Discharge (cfs) | 195.1 | 61.9 | 45.7 | 302.7 | 362.0 |

TABLE 7-21
RECLAIMED AREA HYDROLOGY
SUMMARY SHEET

| Location | No.7 Mine Area | Rt. Fork Bryner Canyon | Upper No.2 Mine Area | Lower No.2 Mine Area | Upper Gordon Creek Diversion | Gordon Creek Drop Structure | Side Drainage and Seeps |
|---|---|---|---|---|---|---|---|
| Drainage Area (Ac.) | 211.7 | 203.0 | 448.2 | 448.2 | 3620 | 3620 | ------- |
| Precip. 100yr.-24hr.(in) | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 |
| Peak Discharge $Q_{100}$(cfs) | 89.0 | 71.4 | 195.1 | 195.1 | 362.0 | 362.0 | 5.0 |
| Slope (%) | 15.9 | 6.80 | 6.40 | 30.00 | 2.52 | 28.00 | 28.50 |
| Bottom Width (ft) | 10 | 10 | 10 | 10 | 15 | 10 | 2 |
| Side Slope (h:v) | 2:1 | 2:1 | 2:1 | 2:1 | 1.5:1 | 3:1 | 2:1 |
| Manning's | 0.035 | 0.035 | 0.035 | 0.035 | 0.035 | 0.040 | 0.035 |
| Velocity (fps) | 10.73 | 8.31 | 11.27 | 19.00 | 9.55 | 19.69 | 7.17 |
| Flow Depth (ft) | 0.63 | 0.75 | 1.36 | 0.87 | 2.09 | 1.32 | 0.21 |
| Rip-Rap $D_{50}$(ft) | 1.25 | 1.00 | 1.00 | 1.50 | 1.00 | 1.50 | 0.50 |
| Rip-Rap Depth (ft) | 2.50 | 2.00 | 2.00 | 3.00 | 2.00 | 3.00 | 1.0 |
| Filter Blanket Depth (ft) | 0.625 | 0.50 | 0.50 | 0.75 | 0.50 | 0.75 | 0.50 |

TABLE 7-22
RIP-RAP
LOCATION AND SIZING

| Location | Flow (cfs) | Velocity (fps) | Rip-Rap $D_{50}$ (ft.) | Filter Thickness (ft.) |
|---|---|---|---|---|
| No.7 Mine Area | 89.0 | 10.73 | 1.25 | 0.625 |
| Rt. Fork Bryner Canyon | 71.4 | 8.31 | 1.00 | 0.50 |
| Upper No.2 Mine Area | 195.1 | 11.27 | 1.25 | 0.625 |
| Lower No.2 Mine Area | 195.1 | 19.00 | 1.50 | 0.75 |
| Gordon Creek Diversion (Upper) | 362.0 | 9.55 | 1.00 | 0.500 |
| Berm Between Pond & Creek | 362.0 | 9.55 | 1.50 | 0.75 |
| Gordon Creek Drop Structure | 362.0 | 19.69 | 1.50 | 0.75 |
| Side Drainages | *5.0 | *7.17 | 0.50 | 0.50 |
| Seeps | *0.5 | *7.17 | 0.50 | 0.50 |

*Estimated Maximum

TABLE 7-23

WATER QUALITY

SWEET'S CANYON POND

(AWAITING LABORATORY RESULTS)

### 7.2.8.3 Post-Mining Water Monitoring

Upon completion of Phase I and Phase II reclamation, the water monitoring program will be modified as follows:

| Location | Station | Operational | Phase I | Phase II |
|---|---|---|---|---|
| Sed.Pond Discharge | 2-1-W | Monthly | Monthly | Eliminate |
| North Fork Gordon Creek | 2-2-W | Monthly Flow<br>Quarterly Quality | Quarterly | Quarterly |
| Lower Beaver Creek | 2-3-W | Continuous Flow<br>Bi-Annual Quality | Bi-Annual | Eliminate |
| Upper Beaver Creek | 2-4-W | Continuous Flow<br>Bi-Annual Quality | Bi-Annual | Eliminate |
| Jewkes Spring | 2-5-W | Bi-Annual | Bi-Annual | Eliminate |
| Gunnison Spring | 2-6-W | Bi-Annual | Bi-Annual | Eliminate |
| Lt. Fork Bryner | 2-7-W | Quarterly | Quarterly | Quarterly |
| Rt. Fork Bryner | 2-8-W | Quarterly | Quarterly | Quarterly |
| Bryner Cyn. Below Mine | 2-9-W | Quarterly | Quarterly | Quarterly |
| Inflow to Sed. Pond 7A (Change to inlet of Sed. Pond 2 at Phase I) | 2-10-W | Quarterly | Quarterly | Quarterly |

The only change in sample location will be for station 2-10-W, which will be sampled at the inlet to the final sediment pond (#2) upon completion of Phase I reclamation.

Parameters will be as shown on Figure 7-18. Sampling procedures will be as described in Section 7.2.6 of this chapter. Reports will be submitted to DOG&M within 60 days following the end of each sampling period. Station 2-1-W is a UPDES discharge point, and will be sampled and reported as required in the UPDES permit.

Post-mining sample locations are shown on Plates 3-7, 3-7A and 3-7B.

# Channel Flow Calculation

## For: No. 7 Mine Area

| | | |
|---|---|---|
| Bed Slope = | .159 | |
| Manning's N = | .035 | |
| Bottom Width = | 10 | feet |
| Channel Side Slope = | .2 | |
| Flow Depth = | .6304345 | feet |
| Cross Sectional Area = | 8.291582 | square feet |
| Wetted Perimeter = | 16.4292 | feet |
| Hydraulic Radius = | .5046858 | feet |
| Discharge = | 89 | cubic feet/sec |
| Velocity = | 10.73378 | feet/sec |

TABLE 7-24 (cont.)

# Channel Flow Calculation

## For: Rt. Fork Bryner Canyon

| | | |
|---|---|---|
| Bed Slope = | 6.800001E-02 | |
| Manning's N = | .035 | |
| Bottom Width = | 10 | feet |
| Channel Side Slope = | .5 | |
| Flow Depth = | .7478086 | feet |
| Cross Sectional Area = | 8.596521 | square feet |
| Wetted Perimeter = | 13.3443 | feet |
| Hydraulic Radius = | .6442091 | feet |
| Discharge = | 71.4 | cubic feet/sec |
| Velocity = | 8.305685 | feet/sec |

TABLE 7-24 (cont.)

## Channel Flow Calculation

## For: Upper No. 2 Mine Area

| | | |
|---|---|---|
| Bed Slope = | .064 | |
| Manning's N = | .035 | |
| Bottom Width = | 10 | feet |
| Channel Side Slope = | .5 | |
| Flow Depth = | 1.361133 | feet |
| Cross Sectional Area = | 17.31669 | square feet |
| Wetted Perimeter = | 16.08717 | feet |
| Hydraulic Radius = | 1.076429 | feet |
| Discharge = | 195.1 | cubic feet/sec |
| Velocity = | 11.26659 | feet/sec |

TABLE 7-24 (cont.)

## Channel Flow Calculation

## For: Lower No. 2 Mine Area

| | | |
|---|---|---|
| Bed Slope = | .3 | |
| Manning's N = | .035 | |
| Bottom Width = | 10 | feet |
| Channel Side Slope = | .5 | |
| Flow Depth = | .8740913 | feet |
| Cross Sectional Area = | 10.26898 | square feet |
| Wetted Perimeter = | 13.90906 | feet |
| Hydraulic Radius = | .7382948 | feet |
| Discharge = | 195.1 | cubic feet/sec |
| Velocity = | 18.99896 | feet/sec |

# Channel Flow Calculation

## For: Upper Gordon Creek Diversion

| | | |
|---|---|---|
| Bed Slope = | .0252 | |
| Manning's N = | .035 | |
| Bottom Width = | 15 | feet |
| Channel Side Slope = | .667 | |
| Flow Depth = | 2.090694 | feet |
| Cross Sectional Area = | 37.91364 | square feet |
| Wetted Perimeter = | 22.5355 | feet |
| Hydraulic Radius = | 1.682396 | feet |
| Discharge = | 362 | cubic feet/sec |
| Velocity = | 9.548016 | feet/sec |

# Channel Flow Calculation

## For: Gordon Creek Drop Structure

| | | |
|---|---|---|
| Bed Slope = | .28 | |
| Manning's N = | .04 | |
| Bottom Width = | 10 | feet |
| Channel Side Slope = | .333 | |
| Flow Depth = | 1.317313 | feet |
| Cross Sectional Area = | 18.38428 | square feet |
| Wetted Perimeter = | 18.33892 | feet |
| Hydraulic Radius = | 1.002473 | feet |
| Discharge = | 362 | cubic feet/sec |
| Velocity = | 19.69074 | feet/sec |

# Channel Flow Calculation

## For: Sub-3 Drainage

| | | |
|---|---|---|
| Bed Slope = | .37 | |
| Manning's N = | .035 | |
| Bottom Width = | 4 | feet |
| Channel Side Slope = | .5 | |
| Flow Depth = | .3077922 | feet |
| Cross Sectional Area = | 1.420641 | square feet |
| Wetted Perimeter = | 5.376489 | feet |
| Hydraulic Radius = | .2642321 | feet |
| Discharge = | 15.2 | cubic feet/sec |
| Velocity = | 10.6994 | feet/sec |

TABLE 7-24 (cont.)

## Channel Flow Calculation

## For: Side Drainages and Seeps

| | | |
|---|---|---|
| Bed Slope = | .285 | |
| Manning's N = | .035 | |
| Bottom Width = | 3 | feet |
| Channel Side Slope = | .5 | |
| Flow Depth = | .2044493 | feet |
| Cross Sectional Area = | .6969468 | square feet |
| Wetted Perimeter = | 3.914325 | feet |
| Hydraulic Radius = | .1780503 | feet |
| Discharge = | 5 | cubic feet/sec |
| Velocity = | 7.174149 | feet/sec |

### 7.2.8.3 Post-Mining Water Monitoring

Upon completion of Phase I and Phase II reclamation, the water monitoring program will be modified as follows:

| Location | Station | Operational | Phase I | Phase II |
|---|---|---|---|---|
| Sed.Pond Discharge | 2-1-W | Monthly | Monthly | Eliminate |
| North Fork Gordon Creek | 2-2-W | Monthly Flow<br>Quarterly Quality | Quarterly | Quarterly |
| Lower Beaver Creek | 2-3-W | Continuous Flow<br>Bi-Annual Quality | Bi-Annual | Eliminate |
| Upper Beaver Creek | 2-4-W | Continuous Flow<br>Bi-Annual Quality | Bi-Annual | Eliminate |
| Jewkes Spring | 2-5-W | Bi-Annual | Bi-Annual | Eliminate |
| Gunnison Spring | 2-6-W | Bi-Annual | Bi-Annual | Eliminate |
| Lt. Fork Bryner | 2-7-W | Quarterly | Quarterly | Quarterly |
| Rt. Fork Bryner | 2-8-W | Quarterly | Quarterly | Quarterly |
| Bryner Cyn. Below Mine | 2-9-W | Quarterly | Quarterly | Quarterly |
| Inflow to Sed. Pond 7A (Change to inlet of Sed. Pond 2 at Phase I) | 2-10-W | Quarterly | Quarterly | Quarterly |

The only change in sample location will be for station 2-10-W, which will be sampled at the inlet to the final sediment pond (#2) upon completion of Phase I reclamation.

Parameters will be as shown on Figure 7-18. Sampling procedures will be as described in Section 7.2.6 of this chapter. Reports will be submitted to DOG&M within 60 days following the end of each sampling period. Station 2-1-W is a UPDES discharge point, and will be sampled and reported as required in the UPDES permit.

Post-mining sample locations are shown on Plates 3-7, 3-7A and 3-7B.

## 7.3 References

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*APPENDIX 7-5*

*B.T.C.A. AREA*

*(OLD FAN PORTAL AREA)*

*Appendix 7-5*
*B.T.C.A. Area*
*Old Fan Portal Area*

*Introduction:*

*The Old Fan Portal Area is a remote site to the east of the Gordon Creek No. 2 Mine yard. This area does not drain to any sediment ponds. The area was reclaimed in 1984, and straw bales were placed below and within the reclamation to treat runoff until vegetation could be established.*

*A Sed-Cad analysis was performed on the site in the fall of 1994 (Appendix 7-3). This analysis showed that the revegetated area is adequate for sediment control; however, a small, barren slope above the site and the un-reclaimed slope below the site continued to be potential sediment problems. The upper slope runoff has been controlled, and the lower slope will be reclaimed as part of the final minesite reclamation. As an interim measure, silt fences were installed below the potential runoff areas, and the entire area is designated as a B.T.C.A. Area.*

*Specifications:*



*Location:*

*The B.T.C.A. Area is designated on Plate 3-2 Acreage, treatment and runoff controls are also shown on the Plate.*

*Area:*

*The revegetated area is approximately 1.64 acres. The drainage area is 2.66 acres, as indicated in the Sed-Cad analysis in Appendix 7-3.*

*Runoff:*

*Runoff calculations are detailed in Appendix 7-3. The total runoff from the area for a 10 year-24 hour event is calculated to be 0.10 acre-feet with a peak flow of 1.35 cfs.*

*Treatment:*

*Since the area does not drain to a sediment pond, runoff will be treated by vegetation and silt fences as shown on Plate 3-2.*

*Maintenance:*

*All controls will be checked on a regular basis, and will be maintained as needed to ensure proper operation.*



278NOV2.MCC

2/7 MINES

Mining
DOCUMENT NO. 1611k

Permit No.: UTG040004

**STATE OF UTAH**
**DEPARTMENT OF HEALTH**
**BUREAU OF WATER POLLUTION CONTROL**
P.O. BOX - 16690
SALT LAKE CITY, UTAH 84116-0690

*Authorization to Discharge Under the*

*Utah Pollutant Discharge Elimination System*

*Utah General Permit for Coal Mining*

In compliance with provisions of the **Utah Water Pollution Control Act**, Title 26 Chapter 11 Utah Code Annotated, 1953 as amended, the **Act**. The coal company identified in the application is authorized to discharge to Waters of the State as identified in the application in accordance with discharge point(s), effluent limitations, monitoring requirements and other conditions set forth herein.

This general permit shall become effective on May 4, 1989.

This general permit and the authorization to discharge shall expire at midnight, April 30, 1993.

Signed this 4th day of May 1989

Authorized Permitting Official
Executive Secretary
Water Pollution Control Committee

*TABLE OF CONTENTS*

# I. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

## A. Definitions.

1. The "30-day (and monthly) average", is the arithmetic average of all samples collected during a consecutive 30-day period or calendar month, whichever is applicable. The calendar month shall be used for purposes of reporting self-monitoring data on discharge monitoring report forms.

2. The "7-day (and weekly) average", is the arithmetic average of all samples collected during a consecutive 7-day period or calendar week, whichever is applicable. The 7-day and weekly averages are applicable only to those effluent characteristics for which there are 7-day average effluent limitations. The calendar week which begins on Sunday and ends on Saturday, shall be used for purposes of reporting self-monitoring data on discharge monitoring report forms. Weekly averages shall be calculated for all calendar weeks with Saturdays in the month. If a calendar week overlaps two months (i.e., the Sunday is in one month and the Saturday in the following month), the weekly average calculated for that calendar week shall be included in the data for the month that contains the Saturday.

3. "Daily Maximum" ("Daily Max.") is the maximum value allowable in any single sample or instantaneous measurement.

4. "Composite samples" shall be flow proportioned. The composite sample shall, as a minimum, contain at least four (4) samples collected over the compositing period. Unless otherwise specified, the time between the collection of the first sample and the last sample shall not be less than six (6) hours nor more than 24 hours. Acceptable methods for preparation of composite samples are as follows:

   a. Constant time interval between samples, sample volume proportional to flow rate at time of sampling;

   b. Constant time interval between samples, sample volume proportional to total flow (volume) since last sample. For the first sample, the flow rate at the time the sample was collected may be used;

   c. Constant sample volume, time interval between samples proportional to flow (i.e., sample taken every "X" gallons of flow); and,

   d. Continuous collection of sample, with sample collection rate proportional to flow rate.

5. A "grab" sample, for monitoring requirements, is defined as a single "dip and take" sample collected at a representative point in the discharge stream.

6. An "instantaneous" measurement, for monitoring requirements, is defined as a single reading, observation, or measurement.

7. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

8. "Bypass" means the diversion of waste streams from any portion of a treatment facility.

9. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

10. "Executive Secretary" means Executive Secretary of the Utah Water Pollution Control Committee.

11. "EPA" means the United States Environmental Protection Agency.

12. The term "10-year, 24-hour precipitation event" shall mean the maximum 24-hour precipitation event with a probable recurrence interval of once in 10 years as defined by the National Weather Service and Technical Paper No. 40, **Rainfall Frequency Atlas of the U.S.**, May 1961, and subsequent amendments or equivalent regional or rainfall probability information developed therefrom.

13. "Active mining area" means the areas on and beneath land used or disturbed in activity related to the extraction, removal, or recovery of coal from its natural deposits. This term excludes coal preparation plants, coal preparation plant associated areas and post-mining areas.

14. "Reclamation area" means the surface area of a coal mine which has been returned to required contour and on which revegetation (specifically, seeding or planting) work has commenced.

15. The term "coal preparation plant" means a facility where coal is crushed, screened, sized, cleaned, dried, or otherwise prepared and loaded for transit to a consuming facility.

16. The term "coal preparation plant associated areas" means the coal preparation plant yards, immediate access roads, coal refuse piles, and coal storage piles and facilities.

17. The term "settleable solids" is that matter measured by the volumetric method specified below:

The following procedure is used to determine settleable solids:

Fill an Imhoff cone to the one-liter mark with a thoroughly mixed sample. Allow to settle undisturbed for 45 minutes. Gently stir along the inside surface of the cone with a stirring rod. Allow to settle undisturbed for 15 minutes longer. Record the volume of settled material in the cone as milliliters per liter. Where a separation of settleable and floating material occurs, do not include the floating material in the reading.

18. Mine drainage means any drainage, and any water pumped or syphoned, from an active mining area or a post mining area.

19. Alkaline mine drainage means mine drainage which before any treatment has a pH equal to or greater than 6.0 and total iron concentration less then 10 mg/l.

20. Post mining areas means: 1) a reclamation area or 2) the underground workings of an underground coal mine after extraction removal or recovery of coal from its natural deposit has ceased and prior to bond release.

B. Criteria for Inclusion in The General Permit for Coal Mining.

This General permit shall apply only to the discharge of treated wastewater from:

Coal mining operations either new or existing in Utah which include or will include in part or in whole alkaline mine water drainage, storm water runoff from coal preparation plant associated areas, active mining areas, and post mining areas. The total amount of total dissolved solids discharged from all mine water and decant operations is limited to one ton per day.

C. Notice of Intent for a General Permit for Coal Mining.

1. Any facility which desires a general permit for coal mining and meets the requirement of B. above can be issued a general permit only by following the procedures listed below.

   Submit a Notice of Intent (NOI) to obtain a general permit for coal mining. The NOI shall include the following items:

   a. Name of the facility.

   b. Facility contact person and phone number for that person.

   c. The facility mailing address (include zip code).

   d. Complete items e through q of the NOI if the information contained in those items has not already been submitted in a previous NOI or individual UPDES application, or if circumstances have changed such that the information previously submitted would be out of date or incorrect.

   e. Facility location such as street address, county, city or town, state and zip code. Include the latitude and longitude of the facility to the nearest 15 seconds.

f. Name of the operator if other than the owner. Indicate here if the owner will be the operator and the phone number where the operator can be reached during normal and off work hours, and the address of the operator.

g. Statement as to whether the facility or any existing or proposed discharge points are located on Indian lands or within National Forest boundaries.

h. List of any other permits (including other UPDES permits) that the facility has or is attempting to obtain such as UIC or RCRA.

i. Statements as to whether the facility has any hazardous waste treatment storage or disposal areas.

j. List location and identification number (such as 001, 002, etc.) of each existing discharge and/or proposed discharge point(s). This includes the latitude and longitude to the nearest 15 seconds and the name of the receiving water(s).

k. A description of the source of the wastewater for each discharge point.

l. A description of the treatment given or proposed for the wastewater at each discharge point and if necessary a justification of why no treatment is required.

m. Indicate for each discharge point flow characteristics such as whether flow is or will be continuous or intermittent and indicate projected and/or actual average and maximum flows in gpd.

n. For each discharge point submit data for the following parameters:

1) Biochemical oxygen demand (BOD)
2) Chemical oxygen demand (COD)
3) Total organic carbon (TOC)
4) Total suspended solids (TSS)
5) Flow
6) Ammonia (as N)
7) Oil and grease
8) Temperature
9) pH
10) Total dissolved solids (TDS)
11) Total iron
12) Date and time of sampling for each parameter
13) Date and time of analysis for each parameter
14) Laboratory which has completed the analysis for each parameter

If no data is available, indicate why the data is not available.

The Executive Secretary may waive the reporting requirements for any of these pollutants and parameters if the applicant submits a request for such a waiver before or with the NOI which demonstrates that information adequate to support issuance of the permit can be obtained through less stringent reporting requirements.

0. Indicate for each discharge point the presence or absence of any toxic and/or priority pollutants as listed by EPA in 40 CFR Part 403.

p. Area Maps (Active Mining Operations)

Facilities are required to submit an Area Map in the form specified hereafter.

The Area Map(s) and any necessary revised Area Map(s) shall be submitted in the form specified below and shall be made from USGS topographical maps (7.5 or 15-minute series) or other appropriate sources as approved by the Executive Secretary or his designee. Each revised area map shall be 8 1/2 inches by 11 inches and shall be in black and white suitable to produce readable copies by rapid printing methods. (Xerox, Dennison, Offset printing, etc.) or as approved by the Executive Secretary. Where additional 8 1/2 inch by 11 inch maps are required to show the area of operation, they shall be numbered and a key shall be shown on the first map. The first map section shall have the company name, mine/job name, address, and UPDES number clearly printed thereon. Also, one line of latitude and one line of longitude shall be marked on each map section. The Area Map(s) shall delineate the following, using the graphics as indicated:

1. Existing area of operation shall be outlined by a solid line and the map shall show areas at least one mile beyond the existing areas of operation. ____________

2, Existing point source(s) (Solid Triangle)

3. The projected area of operation for the next five years --------- (Dashed Outline)

4. Projected point source(s) for the next five years (Opened Triangle)

5. The active-inactive status of all discharge points which are listed in the application. These discharge points shall be assigned numbers 001, 002, 003, etc.

6. The location of springs, rivers and other surface water bodies.

7. The location of any hazardous waste treatment, storage and disposal areas, and where any fluids are injected into the ground.

q. If there are any changes corrections, or other modifications or adjustments of the location of the point source discharges, the permittee shall submit a revised Area Map(s) as described in p. above. Such maps must be submitted 30 days prior to commencement of the discharge.

r. The NOI must be signed by a responsible official of the company with the following format:

> I certify under penalty of law that I have personally examined and am familiar with the information submitted in the application and all attachments and that, based on my inquiry of those persons immediately responsible for obtaining the information contained in the NOI application, I believe the information is true, accurate and correct. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.
>
> __________ ________ ____
>
> Name and Official Title Signature Date

2. Additional information or clarification of information submitted in the NOI may be requested by the Executive Secretary.

3. The NOI to obtain a General Permit for Coal Mining shall be submitted 180 days before expiration of the general permit or an individual permit, for all facilities desiring to continue or obtain a general permit; with the exception of those facilities that have submitted an NOI within one year of the expiration date of the general permit need not resubmit another NOI.

4. New facilities must submit a NOI at least 180 days before the beginning date of discharge.

5. The Executive Secretary will respond to the submission of the NOI by reviewing the NOI within 30 days for a UPDES new source or discharger and 60 days for an existing source and notifying the permittee whether more information is needed or if the NOI is complete, issue the general permit.

D. Specific Limitations and Self-Monitoring Requirements.

1. During the period beginning immediately and lasting through the duration of this permit, the permittee is authorized to discharge from all point sources associated with active mining operations indicated on the Area Maps submitted and approved pursuant to Part I. C. 1p. Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristics | Discharge Limitations a/ Average 30-day | 7-Day | Monitoring Requirements Daily Maximum | Measurement Frequency | Sample Type |
|---|---|---|---|---|---|
| Flow, gpd | N/A | N/A | N/A | Monthly | Measured b/ |
| Suspended Solids, mg/L | 25 | 35 | 70 | Monthly | Grab |
| Total Iron, mg/L | N/A | N/A | 2.0 | Monthly | Grab |
| Dissolved Solids, lbs/day | N/A | N/A | N/A c/ | Monthly | Grab |
| Oil Grease, mg/L | N/A | N/A | 10 | Monthly | Grab |

The pH shall not be less than 6.5 standard units nor greater than 9.0 standard units and shall be monitored twice per month by a grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

There shall be no discharge of sanitary wastes or any process water from coal preparation plants.

a/ See Definitions, Part I. A. for definition of terms.

b/ For the intermittent discharges, the duration of the discharge shall be reported along with the flow.

c/ The total amount of Total Dissolved Solids (TDS) discharged from all mine water and decant operations is limited to one ton (2,000 pounds) per day.

2. Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): at any point which is representative of each discharge prior to its mixing with the receiving stream and as indicated by the solid triangles on the current Area Maps submitted pursuant to part I. C. 1p.

3. Any overflow, increase in volume of a discharge or discharge from a bypass system caused by precipitation within a 24-hour period less than or equal to the 10-year, 24-hour precipitation event (or snowmelt of equivalent volume) at any outfall may comply with the following limitation instead of the Total Suspended Solids limitations contained in Part I. D. 1. provided the facility has been designed, constructed and operated to adequately treat up to a 10 year 24 hour storm event:

| Effluent Characteristic | Daily Maximum |
|---|---|
| Settleable Solids | 0.5 ml/L |

In addition to the monitoring requirements specified under Part I. D. 1., all effluent samples collected during storm water discharge events shall also be analyzed for settleable solids. Such analyses shall be conducted on grab samples.

4. Any overflow, increase in volume of a discharge or discharge from a bypass system caused by precipitation within a 24-hour period greater than the 10-year, 24-hour precipitation event (or snowmelt of equivalent volume) at any outfall may comply with the following limitations instead of the otherwise applicable limitations:

   The pH shall not be less than 6.5 standard units nor greater than 9.0 standard units. However, as stated under Part I. D. 3., all effluent samples collected at any outfall during storm water discharge events shall be analyzed for settleable solids and the parameters identified under Part I. D. 1.

5. The operator shall have the burden of proof that the discharge or increase in discharge was caused by the applicable precipitation event described in Parts I. D. 3. and D. 4. The alternate limitations in Parts I. D. 3. and D. 4. shall not apply to treatment systems that treat underground mine water only.

6. Best Management Practices. The company shall implement and maintain best management practices for the control of road salt storage and dust suppressent runoff and for the prevention of the discharge of process water from coal preparation plants. In addition the facility must minimize the discharge of salt by using the largest practical amount of saline water for process and dust control.

# II. MONITORING, RECORDING AND REPORTING REQUIREMENTS

A. Representative Sampling. Samples taken in compliance with the monitoring requirements established under Part I shall be collected from the effluent stream prior to discharge into the receiving waters. Samples and measurements shall be representative of the volume and nature of the monitored discharge.

B. Monitoring Procedures. Monitoring must be conducted according to test procedures approved under Utah Administrative Code (UAC) Section R448-2-10, unless other test procedures have been specified in this permit.

C. Penalties for Tampering. The Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

D. Reporting of Monitoring Results. Monitoring results obtained during the previous calendar quarter shall be summarized for each calendar month on separate Discharge Monitoring Report Forms (DMR, EPA No. 3320-1). All three DMRs for the calendar quarter shall be postmarked no later than the 28th day of the calendar month following the completed reporting period. If no discharge occurs during the reporting period, "no discharge" shall be reported. Legible copies of these, and all other reports required herein, shall be signed and certified in accordance with the requirements of Signatory Requirements (see Part IV), and submitted to the Utah Bureau of Water Pollution Control and to EPA at the following addresses:

Original to:
Utah Department of Health
Bureau of Water Pollution Control
288 North 1460 West
P.O. Box 16690
Salt Lake City, Utah 84116-0690
Attention: Compliance and Monitoring Program

Copy to:
United States Environmental Protection Agency
Region VIII
Denver Place
999 18th Street, Suite 500
Denver, Colorado 80202-2405
Attention: Water Management Division
Compliance Branch (8WM-C)

E. Compliance Schedules. Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any Compliance Schedule of this permit shall be submitted no later than 14 days following each schedule date.

F. Additional Monitoring by the Permittee. If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under UAC Section R448-2-10 as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased frequency shall also be indicated.

G. Records Contents. Records of monitoring information shall include:
1. The date, exact place, and time of sampling or measurements:
2. The individual(s) who performed the sampling or measurements;
3. The date(s) and time(s) analyses were performed;
4. The individual(s) who performed the analyses;
5. The analytical techniques or methods used; and,
6. The results of such analyses.

H. Retention of Records. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by request of the Executive Secretary at any time. Data collected on site, copies of Discharge Monitoring Reports, and a copy of this UPDES permit must be maintained on site during the duration of activity at the permitted location.

I. Twenty-four Hour Notice of Noncompliance Reporting.

1. The permittee shall (orally) report any noncompliance which may seriously endanger health or the environment as soon as possible, but no later than twenty-four (24) hours from the time the permittee first became aware of the circumstances. The report shall be made to the Utah Bureau of Water Pollution Control, (801) 538-6146, or 24 hour answering service (801) 538-6333.

2. The following occurrences of noncompliance shall be reported by telephone to the Utah Bureau of Water Pollution Control, Compliance and Monitoring Branch at (801) 538-6146 by the first workday (8:00 a.m. - 5:00 p.m. Mountain Time) following the day the permittee became aware of the circumstances:

   a. Any unanticipated bypass which exceeds any effluent limitation in the permit (See Part III. G., Bypass of Treatment Facilities.);

   b. Any upset which exceeds any effluent limitation in the permit (See Part III. H., Upset Conditions.); or,

   c. Violation of a maximum daily discharge limitation for any of the pollutants listed in the permit.

3. A written submission shall also be provided within five days of the time that the permittee becomes aware of the circumstances. The written submission shall contain:

   a. A description of the noncompliance and its cause;

   b. The period of noncompliance, including exact dates and times;

   c. The estimated time noncompliance is expected to continue if it has not been corrected; and,

d. Steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

e. Steps taken, if any, to mitigate the adverse impacts on the environment and human health during the noncompliance period.

4. The Executive Secretary may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the Compliance and Monitoring Branch, Utah Bureau of Water Pollution Control, (801) 538-6146.

5. Reports shall be submitted to the addresses in Part II. D., Reporting of Monitoring Results.

J. Other Noncompliance Reporting. Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for Part II. D. are submitted. The reports shall contain the information listed in Part II. I. 3.

K. Inspection and Entry. The permittee shall allow the Executive Secretary, or an authorized representative, or EPA upon the presentation of credentials and other documents as may be required by law, to:

1. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;

2. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

4. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

# III. COMPLIANCE RESPONSIBILITIES

A. Duty to Comply. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application. The permittee shall give advance notice to the Executive Secretary of the Water Pollution Control Committee of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

B. Penalties for Violations of Permit Conditions. The Act provides that any person who violates a permit condition implementing provisions of the Act is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions is subject to a fine not exceeding $25,000 per day of violation. Any person convicted under Section 26-11-16(2) of the Act a second time shall be punished by a fine not exceeding $50,000 per day. Except as provided in permit conditions on Part III. G., Bypass of Treatment Facilities and Part III. H., Upset Conditions, nothing in this permit shall be construed to relieve the permittee of the civil or criminal penalties for noncompliance.

C. Need to Halt or Reduce Activity not a Defense. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate. The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

E. Proper Operation and Maintenance. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

F. Removed Substances. Collected screenings, grit, solids, sludges, or other pollutants removed in the course of treatment shall be buried or disposed of in such a manner so as to prevent any pollutant from entering any waters of the state or creating a health hazard. Sludge/digestor supernatant and filter backwash shall not directly enter either the final effluent or waters of the state.

G. Bypass of Treatment Facilities.

1. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs 2 and 3 of this section. Return of removed substances, as described in Part III. F., to the discharge stream shall not be considered a bypass under the provisions of this paragraph.

2. Notice:

a. Anticipated bypass. If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least 60 days before the date of the bypass.

b. Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required under Part II. I., Twenty-four Hour Reporting.

3. Prohibition of bypass.

a. Bypass is prohibited and the Executive Secretary may take enforcement action against a permittee for a bypass, unless:

(1) The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage ;

(2) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and,

(3) The permittee submitted notices as required under paragraph 2 of this section.

b. The Executive Secretary may approve an anticipated bypass, after considering its adverse effects, if the Executive Secretary determines that it will meet the three conditions listed above in paragraph 3. a. of this section.

H. Upset Conditions.

1. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with technology based permit effluent limitations if the requirements of paragraph 2 of this section are met. The Executive Secretary's administrative determination regarding a claim of upset cannot be judiciously challenged by the permittee until such time as an action is taken for noncompliance.

2. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

   a. An upset occurred and that the permittee can identify the cause(s) of the upset;

   b. The permitted facility was at the time being properly operated;

   c. The permittee submitted notice of the upset as required under Part II. L., Twenty-four Hour Notice of Noncompliance Reporting; and,

   d. The permittee complied with any remedial measures required under Part III. D., Duty to Mitigate.

3. Burden of proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

I. Toxic Pollutants. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Federal Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

J. Changes in Discharge of Toxic Substances. Notification shall be provided to the Executive Secretary as soon as the permittee knows of, or has reason to believe:

1. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

   a. One hundred micrograms per liter (100 ug/L);

   b. Two hundred micrograms per liter (200 ug/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/L) for 2,4-dinitrophenol and for 2-methyl-4, 6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;

   c. Five (5) times the maximum concentration value reported for that pollutant in the permit application in accordance with UAC Section R448-8-3.4 (7) or (10); or,

   d. The level established by the Executive Secretary in accordance with UAC Section R448-8-4.2 (6).

2. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

a. Five hundred micrograms per liter (500 ug/L);

b. One milligram per liter (1 mg/L) for antimony:

c. Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with UAC Section R448-8-3.4(9); or,

d. The level established by the Executive Secretary in accordance with UAC Section R448-8-4.2(6).

## IV. GENERAL REQUIREMENTS

A. Planned Changes. The permittee shall give notice to the Executive Secretary as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

1. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source as defined in UAC Section R448-8-1.5.; or,

2. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under Part IV. A. 2.

B. Anticipated Noncompliance. The permittee shall give advance notice of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

C. Permit Actions. This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

D. Duty to Reapply. If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The application should be submitted at least 180 days before the expiration date of this permit.

E. Duty to Provide Information. The permittee shall furnish to the Executive Secretary, within a reasonable time, any information which the Executive Secretary may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Executive Secretary, upon request, copies of records required to be kept by this permit.

F. Other Information. When the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or any report to the Executive Secretary, it shall promptly submit such facts or information.

G. Signatory Requirements. All applications, reports or information submitted to the Executive Secretary shall be signed and certified.

1. All permit applications shall be signed as follows:

a. For a corporation: by a responsible corporate officer;

b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively;

c. For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Executive Secretary shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to the Executive Secretary, and,

   b. The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.)

3. Changes to authorization. If an authorization under paragraph IV. G. 2. is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new authorization satisfying the requirements of paragraph IV. G. 2. must be submitted to the Executive Secretary prior to or together with any reports, information, or applications to be signed by an authorized representative.

4. Certification. Any person signing a document under this section shall make the following certification:

   > "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

H. Penalties for Falsification of Reports. The Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or by both.

I. Availability of Reports. Except for data determined to be confidential under UAC Section R448-8-3.2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Executive Secretary. As required by the Act, permit applications, permits and effluent data shall not be considered confidential.

J. Oil and Hazardous Substance Liability. Nothing in this permit shall be construed to preclude the permittee of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Federal Clean Water Act or the Utah Water Pollution Control Act.

K. Property Rights. The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

L. Severability. The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

M. Transfers. This permit may be automatically transferred to a new permittee if:

1. The current permittee notifies the Executive Secretary at least 30 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new permittee containing a specific date for transfer of permit responsibility, coverage, and liability between them; and,

3. The Executive Secretary does not notify the existing permittee and the proposed new permittee of his or her intent to modify, or revoke and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in paragraph 2 above.

N. State Laws. Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable state law or regulation under authority preserved by Section 26-11-19 of the Act.

O. Water Quality Standard Requirement - Reopener Provision
This permit may be reopened and modified (following proper administrative procedures) to include the appropriate effluent limitations and compliance schedule, if necessary, if one or more of the following events occurs:

1. Water Quality Standards for the receiving water(s) to which the permittee discharges are modified in such a manner as to require different effluent limits than contained in this permit.

2. A final wasteload allocation is developed and approved by the State and/or EPA for incorporation in this permit.

3. A revision to the current 208 plan is approved and adopted which calls for different effluent limitations than contained in this permit.

# SECTION 9

## VEGETATIVE RESOURCES

Surface disturbance for the No.8 Mine construction will occur on approximately 0.90 acres within the Mixed Conifer vegetation type, as shown on Plate 9-1 of this submittal.

Please refer to Section 9 of the Gordon Creek No.2 and 7 Mine Permit for details on Vegetative Resources, and Section 3, pages 3-90 and 3-91 for details on seed mixes for reclamation.

The Division Vegetation Guidelines (p.5) states that a separate reference area is not required for proposed disturbance of less than 1 acre. The proposed No.8 Mine disturbance is only 0.9 acres. The standard of revegetation success will be the 1983 baseline data, completed for the No.7 Mine.

# SECTION 9
# VEGETATION RESOURCES
# GORDON CREEK No. 2 MINE

## 9.1 Scope

The vegetation resources data information for the Gordon Creek No. 2 Mine was prepared by Beaver Creek Coal Company based upon studies performed by Espey, Huston and Associates, Inc. from July 30 to August 8, 1980. The study area included the entire 1630-acre lease area located in Carbon County, approximately 15 miles northwest of Price, Utah.

The major components of the study were the preparation of a vegetation map of the permit area, a qualitative and quantitative description of the vegetation within the study area, and the establishment of vegetation reference area. The study also included a site-wide examination to identify any threatened or endangered species which may be present on the lease area.

Based on a review of the results of those studies, it was decided by ARCO (Atlantic Richfield Company) personnel that some additional information was needed to supplement the initial work. The scope of the 1981 work was discussed with the Utah Division of Oil, Gas & Mining (DOG&M) in early-July to obtain their input and gain approval of the studies.

The 1981 studies performed by Stoecker-Keammerer and Associates consisted of obtaining cover, frequency and production data for two reference areas established in the oak shrubland type and the mountain grassland. The justification for establishing these reference areas is that they represent the vegetation types which will be established on the disturbed areas once they are reclaimed. All of the data was collected during the second week of July, 1981.

## 9.2 Methodology

### 9.2.1 Floristics

A floristic survey was conducted at the same time as the 1980 quantitative vegetation sampling. The purpose of the floristic survey was to determine and list the plant species present within the lease area, including any threatened or endangered species. This was accomplished by a walking reconnaissance of the mine area, noting species' occurrence and their distribution in the various communities. Plant identification was aided by the use of numerous references (Cronquist et al, 1972; Judd, 1962; McDougall, 1973; Parker, n.d.; Tidestrom, 1925; Weber, 1976; and Welsh and Moore, 1973).

### 9.2.2 Vegetation Map

The vegetation map (see Plate 9-1) of the Gordon Creek No. 2 Mine Permit Area was prepared using a combination of aerial photo interpretation and field checking. Black-and-white and color infrared aerial photographs (at a scale of approximately 1:12,000) were used to map the location and extent of the various vegetation types. The photo interpretation was augmented by field checking and aerial reconnaissance of the site. Community types were delineated based on two or more dominant species.

The vegetation types were also quantified in terms of acreage and percent of the study area (Table 9-1). The final map was prepared on a topographic mylar base at a scale of 1:6000 (1 inch = 500 feet). The aerial extent of the mapped plant community types was determined by planimetering their location on the 1:6000 vegetation map.

### 9.2.3 Reference Areas

Reference areas are land areas that are selected to represent the species' composition, topography, soils and aspect of affected communities within the permit area. During the 1980 study, a reference area for the douglas fir forest type was chosen and sampled. Subsequent examination and evaluation of existing vegetation patterns within the lease area suggest that it is unlikely that the douglas fir type occurred within the affected area. Since all the affected areas most likely consisted of a mosaic of oak shrublands and mountain grasslands and, since the douglas fir forest type most likely did not occur within the disturbed area, no attempt will be made to restore this type on currently affected areas. Therefore, no reference area for this type is needed. Earlier versions of this permit application included data for a douglas fir reference area. This data has been eliminated from this submittal. Reference areas for the oak shrubland and mountain grassland types were selected during the 1981 study. These reference areas were located within the permit area on sites which would not be disturbed throughout the life of the mine. Each reference area was one hectare (2.5 acres) in area (200m by 50m) and was selected to be characteristic of the vegetation type it represented. Locations of these two reference areas are shown on the vegetation map (Plate 9-1).

In July, 1983, a representative from the U.S. Department of Agriculture, Soil Conservation Service (SCS) viewed the reference areas and provided productivity estimates. Figure 9-0 is a letter containing that statement. The SCS was contacted in the summer of 1989. A request for a new range condition was deferred until such time that a normal precipatation year is available.

United States Department of Agriculture
Soil Conservation Service
350 North 4th East
Price, Utah 84501

July 20, 1983

Scott M. Raymond
Environmental Coordinator
Beaver Creek Coal Co.
P. O. Box AU
Price, Utah 84501

Dear Scott:

Listed below are the statements of productivity and range condition for the Dak reference area and the Salina wildrye reference area at the No. 2 Mine:

The oak vegetation site is producing about 1,800 lbs. per acre air dry. The site is in good condition.

The Salina wildrye site is producing about 900 lbs. per acre air dry. There is not too much known about the Salina wildrye site, but I feel this site is in good condition also.

George S Cook
George S. Cook
Range Conservationist

Table 9-1
Aerial Extent and Percent of Total Area
For Each Vegetation Type
Gordon Creek No. 2 Permit Area

| Mapping Unit | | Acres | Percent of Total Area |
|---|---|---|---|
| Aspen Woodland | | 440.3 | 27.01 |
| Mixed Coniferous Forest | | 247.6 | 15.20 |
| Cherry Thicket | | 15.0 | 0.92 |
| Willow Thicket | | 15.0 | 0.92 |
| Riparian Community | | 12.4 | 0.76 |
| Oak Shrubland | | 306.5 | 18.81 |
| Mixed Mountain Shrubland | | 47.9 | 2.94 |
| Manzanita Shrubland | | 1.5 | 0.09 |
| Big Sagebrush Shrubland | | 305.6 | 18.75 |
| Bottomland Sagebrush Shrublands | | 19.9 | 1.22 |
| Mountain Grassland | | 166.6 | 10.22 |
| Wet Sedge Meadow | | 15.5 | 0.94 |
| Disturbed Area | | 34.1 | 2.09 |
| Open Water | | 2.1 | 0.13 |
| | TOTAL | 1630.0 | 100.00 |

### 9.2.4 Vegetation Cover and Productivity

The two vegetation types most affected by mining operations are oak shrubland and mountain grassland. Cover and production data were gathered for these two types.

#### 9.2.4.1 Cover

During 1981, cover data was collected using a quadrat approach. Individual 1.0 $m^2$ quadrats were randomly located in the reference areas. Random sampling was accomplished by using pairs of random coordinates. The first number of the pair was the measured distance along one side (long axis) of the reference area, and the second number was the paced distance perpendicular to the tape at the position of the first number. Random sampling locations within each of the reference areas are shown in Figures 9-1 and 9-2. In each quadrat, total vegetation cover (canopy cover) including shrub canopy, cover by bare soil and cover by letter and rock were visually estimated. For each quadrat, these three components added to 100 percent. Canopy cover for each species and cover by litter, rock, bare soil, lichens and mosses in the ground layer were also visually estimated. Because of overlap, these components added to more than 100 percent. Cover data was summarized by calculating mean values for each species and each component. Relative cover (percent of total cover) and frequency values were also determined.

#### 9.2.4.2 Productivity

During 1981, production data was collected using a harvest method. Individual 1.0 $m^2$ quadrats were randomly located throughout each of the reference areas (Figures 9-1 and 9-2). Random locations were determined using pairs or random coordinates in the same manner used for locating cover quadrats. In each of the clipped quadrats, grasses and semi-shrubs were fractionated on the basis of species; forbs were separated into annuals and perennials. Shrubs were not clipped except for low-growing species such as Oregon grape (Mahonia repens) and mountain lover (Pachystima myrsinites). Clipped samples were over-dried for 24 hours at 100°C and were weighed to the nearest milligram. Data was summarized by obtaining mean production values for each species or species group.

### 9.2.5 Density

During 1981, density data for shrubs was obtaining using a line-strip transect approach. Randomly located transects 15m by 3m were used to obtain shrub density data in the reference areas. Cover data for the shrub layer was obtained using a line intercept approach along the 15m line defining the center line of each line-strip transect.

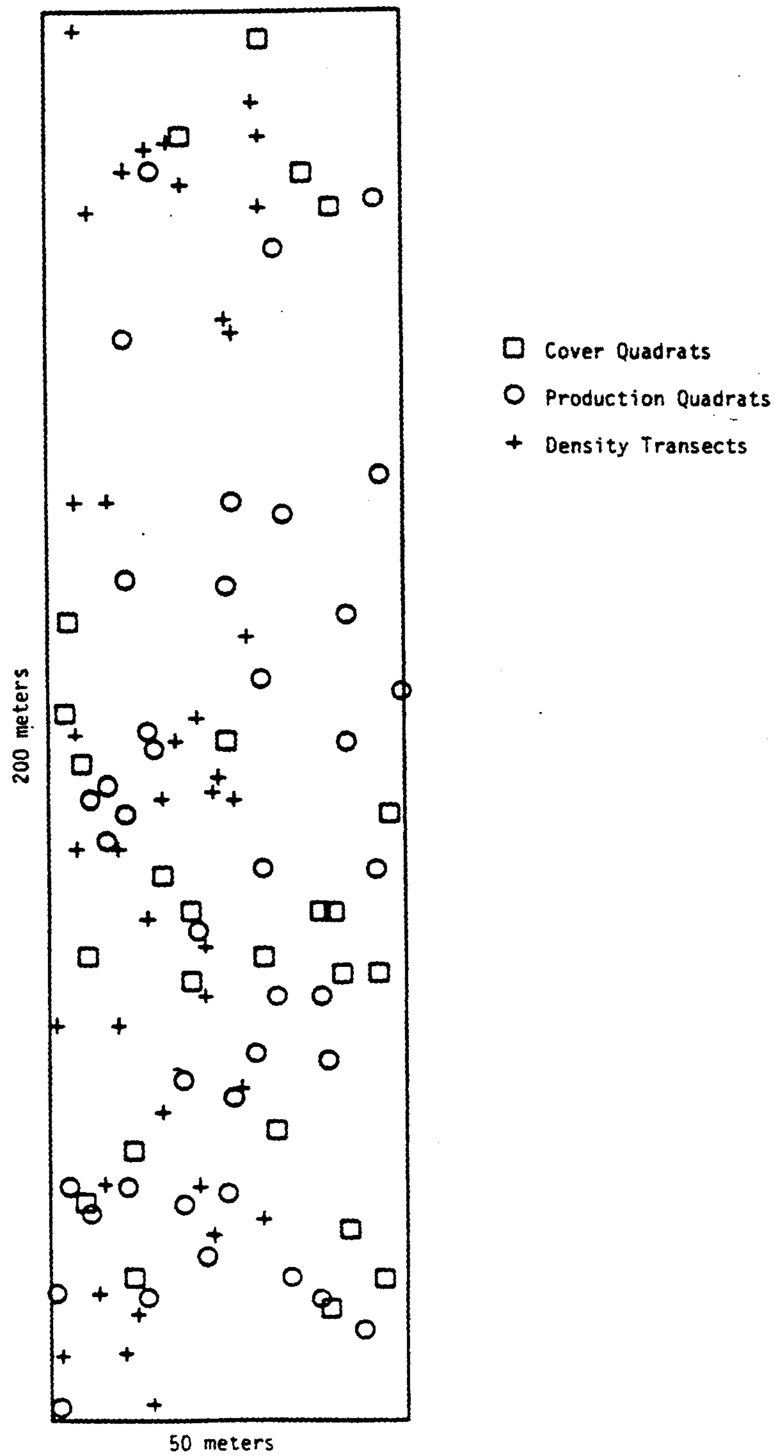
Within each of the shrub line-strip transects, individual shrubs were tallied on the basis of height class in order to obtain some measure of community structure. For individuals with multiple stems, separate counts were made for the number of individuals per transect, as well as the number of stems per individual. Total density was calculated both on the basis of the number of individuals per hectare as well as the number of stems per hectare. Random sampling locations for the line-strip transects are shown in Figures 9-1 and 9-2.

### 9.2.6 Data Analysis

#### 9.2.6.1 Definitions

During 1981, the following definitions applied to data gathering and reduction:

FIGURE 9-1




1. Sampling locations in the Bunchgrass Community Reference Area at Gordon Creek No. 2.

FIGURE 9-2

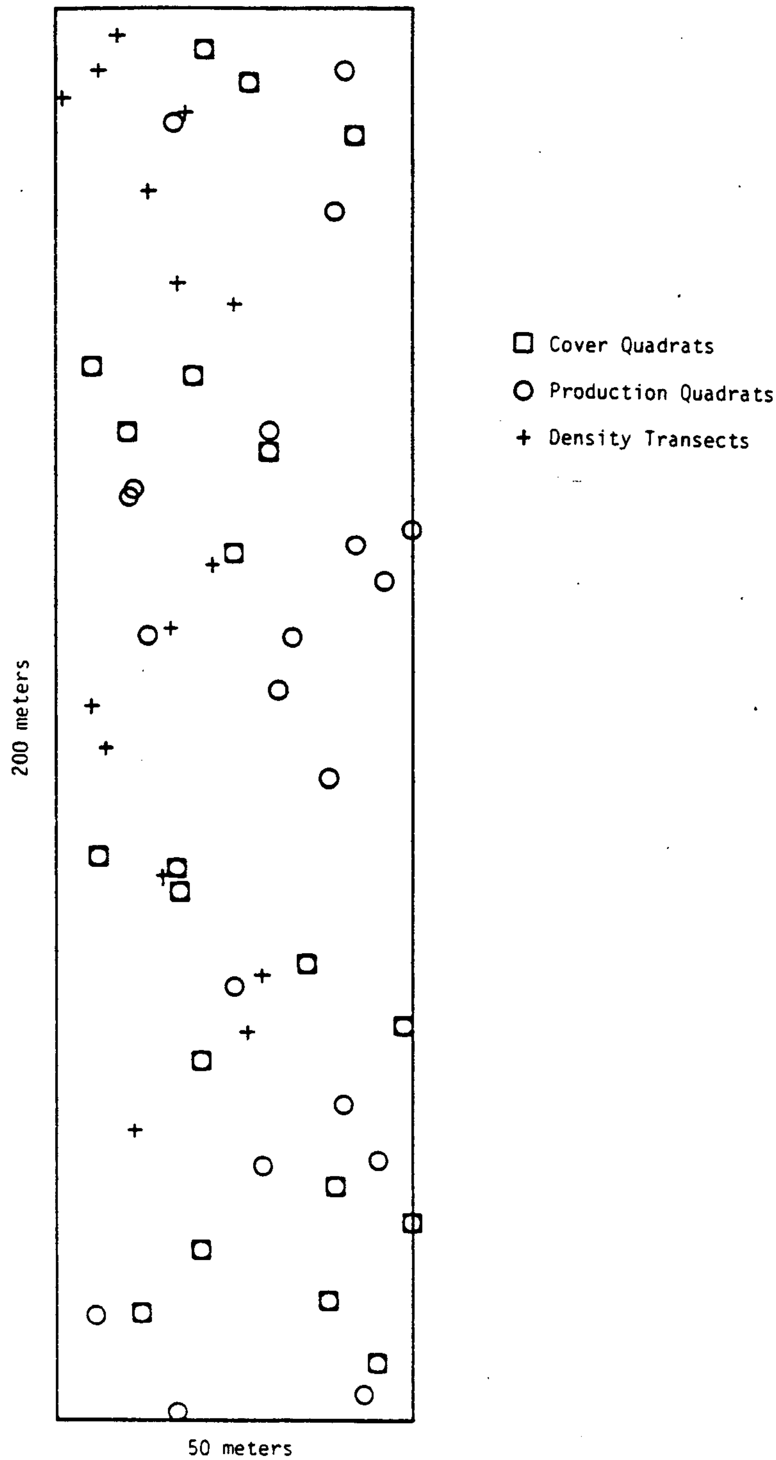



Figure 2. Sampling locations in the Mixed Mountain Shrubland Reference Area at Gordon Creek No. 2.

Relative Density =

$$\frac{\text{the number of sampled trees of species}}{\text{the total number of trees sampled}} \text{ X } 100$$

Frequency =

$$\frac{\text{the number of plots occupied by a species}}{\text{the total number of plots sampled}} \text{ X } 100$$

Relative Frequency =

$$\frac{\text{the number of plots occupied by a species}}{\text{the sum of all plots of all species}} \text{ X } 100$$

Total Basal Area =

a species density X a species relative basal area

Relative Basal Area =

$$\frac{\text{the total basal area of a species}}{\text{the sum of the total basal area for all species}} \text{ X } 100$$

Percent Importance =

$$\text{Relative Density} + \frac{\text{Relative Frequency + Relative Basal Area}}{3}$$

Data reduction for the quadrat sampling results were carried out as follows:

Frequency =

$$\frac{\text{number of quadrats a species occurs in}}{\text{the number of quadrats samples}} \text{ X } 100$$

Percent Cover =

$$\frac{\text{the total aerial coverage values}}{\text{the total number of plots sampled}}$$

Sample adequacy during 1981 was evaluated using the following formula (Chochran, 1977):

$$n_{ade} = \frac{t^2 s^2}{(dx)^2}$$

where

$n_{ade}$ = adequate number of samples

t = t value (t-distribution) for a given level of confidence

(+ = 1.645 for 90% Confidence; + = 1.282 for 80% confidence)

$s^2$ = sample variance estimate

d = the level of accuracy desired for the estimate of the mean (d = 0.1 in all calculations)

x = sample mean

## 9.3 Existing Vegetation Resources

### 9.3.1 General Site Description

The Gordon Creek No. 2 Mine study area is located along the eastern edge of the Wasatch Plateau in Carbon County, Utah. The elevation range is about 7600 to 9300 feet (2315 - 2830m).

Topographically, the study area consists of steep slopes on the face of the plateau and along drainages, flat surfaces on terraces or flood plains in valley bottoms and relatively gentle terrain on top of the plateau. The area is underlain by nearly flat sedimentary rocks of the Tertio-Cretaceous North Horn Formation and the Lower Tertiary Flagstaff Formation.

The study area has a highly continental climate, with large daily and seasonal variations in temperature. The lower elevations of the permit area are quite dry, with average annual precipitation of 14 inches or less, mostly falling as Spring rain showers.

Higher elevations receive more precipitation, much of it as snow which persists through the Winter.

### 9.3.2 Vegetation Types

The vegetation map for the Gordon Creek No. 2 Mine permit area (Plate 9-1) depicts 14 mapping units. The vegetation has been divided into two forest types (Aspen Woodlands and Mixed Coniferous Forests), seven shrubland types (Cherry Thickets, Willow Thickets, Oak Shrublands, Mixed Mountain Shrublands, Manzanita Shrublands, Big Sagebrush Shrublands, and Bottomland Sagebrush Shrublands), one shrub/forest type (Riparian Community), two grassland types (Mountain Grassland and Wet Sedge Meadow), disturbed areas, and open water areas. Five of these types (Aspen Woodlands, Mixed Coniferous Forests, Oak Shrublands, Big Sagebrush Shrublands and Mountain Grassland) account for 90 percent of the entire permit area (Table 9-1). The remaining nine types account for only ten percent of the area. Each of the mapping units is briefly described in the discussion below.

#### 9.3.2.1 Oak Shrubland (Reference Area)

The oak shrubland types is the most extensive of the upland shrub types and covers 206 acres (18.8 percent) within the mapped area. It is the second most abundant of all the mapped types. Oak shrublands occur on steep slopes which tend to be drier than the slopes which support aspen woodlands and mixed coniferous forests. These slopes tend to be more south and west facing; however, the oak shrublands are not limited to these aspects. Major shrub species include Gambles oak (Quercus gambelii) and mountain snowberry (Symphoricarpos oreophilus). The major species is slender wheatgrass (Agropyron trachycaulum).

Cover, Frequency, Species Diversity

Table 9-2 summarizes the data deriving these parameters for the oak shrubland reference area. The major grass species in the type is slender wheatgrass, and the most common forb is a species of beard tongue (Penstemon sp.), Gambles oak and mountain snowberry. Approximately 92 percent of the relative cover within this type is provided by the shrub component.

The dominant shrub species in terms of density is Gambles oak, which has a total density of 47,946 individuals per hectare. Most of these individuals fall within the shortest height class (0.25m to 0.75m) (Table 9-3).

Productivity

Perennial forbs and Oregon grape (Mahonia repens) provide approximately 68 percent of the total biomass (Table 9-4). Mean total production was 11.9 grams per square meter (106 pounds per acre). Tall shrub components were not included in the production measurements.

Because of the very steep slope on which the reference area is located, there is very limited utilization by domestic livestock. Herb and low shrub production is limited. This limited production is not related to poor range condition, but rather to competition with the tall shrubs which characterize the oak woodland type. For this particular vegetation type, the reference area appears to be in at least good condition.

Sample Adequacy

Sample adequacy was attained for cover and shrub density (Table 9-5). In the oak shrubland reference area, sample adequacy was not attained for production; however, the maximum number of 40 samples required by the Utah DOG&M was obtained.

TABLE 9-2
Oak Shrubland Reference Area
Cover, Frequency and Species Diversity Summaries for Herb Layer Components
Based on Date from 20 $1m^2$ Quadrats. (1981 Data)

| Community | Mean Cover (%) | Relative Cover (%) | Range of Cover Values | Percent Frequency | Relative Frequency (%) | I.V.* | Rank |
|---|---|---|---|---|---|---|---|
| PERENNIAL GRASSES AND SEDGES | | | | | | | |
| Agropyron trachycaulum | 0.3 | 0.53 | 0-4 | 30.0 | 3.92 | 4.45 | 10 |
| Bromus anomalus | 0.1 | 0.01 | 0-1 | 5.0 | 0.65 | 0.65 | 26 |
| Bromus ciliatus | 0.1 | 0.01 | 0-1 | 5.0 | 0.65 | 0.65 | 26 |
| Carex geyeri | 0.1 | 0.01 | 0-1 | 5.0 | 0.65 | 0.65 | 26 |
| Carex sp. | 0.4 | 0.71 | 0-3 | 60.0 | 7.84 | 8.55 | 6 |
| Elymus salinus | 0.1 | 0.01 | 0-1 | 15.0 | 1.96 | 1.96 | 15 |
| Poa pratensis | 0.1 | 0.18 | 0-1 | 5.0 | 0.65 | 0.83 | 22 |
| Poa sp. | 0.1 | 0.18 | 0-1 | 5.0 | 0.65 | 0.83 | 22 |
| Stipa lettermannii | 0.2 | 0.35 | 0-3 | 10.0 | 1.31 | 1.66 | 16 |
| Sub-Total | 1.1 | 1.95 | | | | | |
| FORBS | | | | | | | |
| Arenaria lateriflora | 0.1 | 0.18 | 0-2 | 10.0 | 1.31 | 1.49 | 17 |
| Artemisia ludoviciana | 0.1 | 0.18 | 0-1 | 25.0 | 3.27 | 3.45 | 12 |
| Aster sp. | 0.1 | 0.01 | 0-1 | 10.0 | 1.31 | 1.31 | 18 |
| Cheonpodium album | 0.1 | 0.1 | 0-1 | 5.0 | 0.65 | 0.65 | 26 |
| Descurainia pinnata | 0.1 | 0.01 | 0-1 | 5.0 | 0.65 | 0.65 | 26 |
| Erysimum asperum | 0.1 | 0.01 | 0-1 | 10.0 | 1.31 | 1.31 | 18 |
| Gayophytum ramossissimum | 0.1 | 0.01 | 0-1 | 10.0 | 1.31 | 1.31 | 18 |
| Helianthella uniflora | 0.1 | 0.18 | 0-1 | 20.0 | 2.61 | 2.79 | 14 |

TABLE 9-2 (Continued)
Oak Shrubland Reference Area

| Community | Mean Cover (%) | Relative Cover (%) | Range of Cover Values | Percent Frequency | Relative Frequency (%) | I.V.* | Rank |
|---|---|---|---|---|---|---|---|
| FORBS (Continued) | | | | | | | |
| Lactuca serriola | 0.1 | 0.01 | 0-1 | 5.0 | 0.65 | 0.65 | 26 |
| Penstemon sp. | 1.2 | 2.12 | 0-6 | 70.0 | 9.15 | 11.27 | 3 |
| Senecio integerrimus | 0.1 | 0.01 | 0-1 | 5.0 | 0.65 | 0.65 | 26 |
| Smilacina stellata | 0.2 | 0.35 | 0-3 | 5.0 | 0.65 | 1.00 | 21 |
| Solanum triflorum | 0.3 | 0.53 | 0-3 | 35.0 | 4.58 | 5.11 | 9 |
| Sub-Total | 2.0 | 3.54 | | | | | |
| SEMI-SHRUBS | | | | | | | |
| Mahonia repens | 0.9 | 1.59 | 0-8 | 35.0 | 4.58 | 6.17 | 7 |
| Pachystima myrsinites | 0.6 | 1.06 | 0-5 | 60.0 | 7.84 | 8.90 | 5 |
| Sub-Total | 1.5 | 2.65 | | | | | |
| SHRUBS | | | | | | | |
| Amelanchier itahensis | 1.5 | 2.65 | 0-10 | 65.0 | 8.50 | 11.15 | 4 |
| Artemisia tridentata | 1.3 | 2.29 | 0-26 | 5.0 | 0.65 | 2.94 | 13 |
| Cerocarpus montanus | 2.0 | 3.53 | 0-30 | 20.0 | 2.61 | 6.14 | 8 |
| Prunus virginiana | 0.1 | 0.18 | 0-1 | 5.0 | 0.65 | 0.83 | 22 |
| Purshia tridentata | 0.1 | 0.18 | 0-2 | 5.0 | 0.65 | 0.83 | 22 |
| Quercus gambelii | 34.0 | 59.96 | 14-56 | 100.0 | 13.57 | 73.03 | 1 |
| Rosa woodsii | 0.3 | 0.53 | 0-2 | 30.0 | 3.92 | 4.45 | 10 |
| Symphoricarpos oreophilus | 12.8 | 22.57 | 0-38 | 80.0 | 10.46 | 33.03 | 2 |
| Sub-Total | 52.1 | 91.89 | | | | | |

TABLE 9-2 (Continued)
Oak Shrubland Reference Area

| Community | Mean Cover (%) | Range of Cover Values (%) |
|---|---|---|
| SUM OF SPECIES COVER | 56.7 | 42-71 |
| Total Woody Cover | 47.7 | 34-69 |
| Total Herbaceous Cover | 2.4 | 0- 8 |
| | | |
| Lichens | 0.0 | --- |
| Mosses | 0.1 | 0-1 |
| Litter | 93.6 | 55-100 |
| Rock | 3.6 | 0-33 |
| Bare Soil | 2.9 | 0-19 |

Evaluation of the herb layer and the ground layer as a single unit. The values in this section add to 100 percent for each quadrat.

| | | |
|---|---|---|
| Total Vegetation | 48-5 | 38-65 |
| Rock/Litter | 48.7 | 31-61 |
| Bare Soil | 2.9 | 0-19 |

| Number of Species per Square Meter | Mean ± S.D. ** | Range |
|---|---|---|
| Herb Species | 3.60 ± 2.11 | 10- 8 |
| Woody Species | 4.05 ± 1.15 | 2- 6 |
| Total Species | 7.65 ± 2.84 | 4-13 |

*Importance Value (I.V.) = Relative Cover ± Relative Frequency
** ± Values equal the standard deviation (S.D.)

TABLE 9-3
Oak Shrubland Reference Area
Cover, Frequency and Density Summaries for Shryb Species
Based on Data From 15 cm x 15m Line-Strip Transects. (1981 Data.)

| Species | Height Class* | Mean Cover (%) | Relative Cover (%) | Freuqency (%) | (no. individuals per hectar) By Height Class | Total ± S.D. |
|---|---|---|---|---|---|---|
| Amelanchier utahensis | Total | 0.7 | 7.77 | 100.0 | | 4987±3436 |
| | I | | | | 3407 | |
| | II | | | | 800 | |
| | III | | | | 533 | |
| | IV | | | | 237 | |
| Artemisia tridentata | Total | 0.1 | 0.11 | 33.3 | | 48± 204 |
| | I | | | | 48 | |
| Cercocarpus montanus | Total | 0.1 | 1.11 | 53.3 | | 1067±1629 |
| | I | | | | 681 | |
| | II | | | | 356 | |
| | III | | | | 30 | |
| Prunus virginiana | Total | | | 6.7 | | 104± 402 |
| | I | | | | 74 | |
| | II | | | | 30 | |
| Purshia tridentata | Total | 0.1 | 1.11 | 33.3 | | 341± 671 |
| | I | | | | 341 | |

TABLE 9-3 (Continued)
Oak Shrubland Reference Area

| Species | Height Class* | Mean Cover (%) | Relative | | (no. individuals per hectare) | |
|---|---|---|---|---|---|---|
| | | | Cover (%) | Freuqency (%) | By Height Class | Total ± S.D. |
| Quercus gambelii | Total | 6.3 | 69.92 | 100.0 | | 23067±8587 |
| | I | | | | 14933 | |
| | II | | | | 5111 | |
| | III | | | | 2104 | |
| | IV | | | | 919 | |
| Rosa woodsii | Total | 0.3 | 3.33 | 86.7 | | 3615±3633 |
| | I | | | | 3230 | |
| | II | | | | 370 | |
| | III | | | | 15 | |
| Symphoricarpos oreophilus | Total | 1.5 | 16.65 | 100.0 | | 14726±8098 |
| | I | | | | 14044 | |
| | II | | | | 681 | |
| TOTAL | | | | | | 47946±8776 |

19,411/AC

*Height Class I = 0.25m-0.75m
II = 0.76m-1.50m
III = 1.51m-2.25m
IV = 2.25m+

# Table 9-4

## OAK SHRUBLAND

Reference Area. Mean production ± the standard deviation (S.D.). Based on the data from 40 1m$^2$ quadrats. 1981 data.

| Species | Mean±S.D. (grams/m$^2$) | Mean±S.D. (lbs/acre) | Percent Total Biomass |
|---|---|---|---|
| PERENNIAL GRASSES AND SEDGES | | | |
| Agropyron trachycaulum | 0.764±1.879 | 7 ± 17 | 6.42 |
| Bromus anomalus | 0.006±0.028 | 1 ± 1 | 0.05 |
| Bromus ciliatus | 0.010±0.063 | 1 ± 1 | 0.08 |
| Carex geyeri | 0.051±0.321 | 1 ± 3 | 0.43 |
| Carex sp. | 0.652±1.429 | 6 ± 13 | 5.48 |
| Elymus salinus | 0.707±1.742 | 6 ± 16 | 5.94 |
| Poa pratensis | 0.618±1.831 | 6 ± 16 | 5.19 |
| Poa sp. | 0.245±0.890 | 2 ± 8 | 2.06 |
| Stipa lettermannii | 0.206±0.596 | 2 ± 5 | 1.73 |
| Sub-Total | 3.259±4.030 | 29 ± 36 | |
| ANNUAL FORBS | 0.011±0.043 | 1 ± 1 | 0.09 |
| PERENNIAL FORBS | 5.542±5.085 | 49 ± 45 | 46.56 |
| SEMI-SHRUBS | | | |
| Gutierrezia sarothrae | 0.049±0.311 | 1 ± 3 | 0.41 |
| Mahonia repens | 2.528±4.447 | 23 ± 40 | 21.24 |
| Pachystima myrsinites | 0.514±0.772 | 5 ± 7 | 4.32 |
| Sub-Total | 3.091±4.351 | 28 ± 39 | |
| TOTAL PRODUCTION | 11.903±8.736 | 106 ± 78 | |

### 9.3.2.2 Mountain Grassland (Reference Area)

The mountain grassland type is the fifth most abundant type within within the mapped area. It covers 166 acres (10.2 percent of the area) and occurs on high, dry slopes. The major species include Salina wildrye (Elymus salinus) and Indian ricegrass (Oryzopsis hymenoides).

#### Cover, Frequency, Species Diversity

Table 9-6 summarizes the data deriving these parameters for the mountain grassland reference area. The dominant species within this vegetation type is salina wildrye. Approximately 86 percent of the cover is provided by perennial grasses and sedges. In terms of cover and frequency, major shrub species within this type are mountain mahogany (Cercocarpus montanus) and a species of wild buckwheat (Eriogonum corymbosum).

The total number of individual shrubs per hectare was 4633. Total number of stems per hectare was 17,678. The majority of shrubs occurs within the shortest height class (Table 9-7).

#### Productivity

Salina wildrye is the most productive species (Table 9-8). Approximately 92 percent of the total biomass is attributable to this species. Tall shrub components were not included in the production measurements. Mean total production was 68.4 grams per square meter (611 pounds per acre).

#### Sample Adequacy

Sample adequacy was attained for vegetation cover, herb production and shrub density in the mountain grassland reference area (Table 9-5).

TABLE 9-5
Evaluation of Sample Adequacy for Reference Areas
Gordon Creek No. 2 Mine

| Community | Sample Size (n) | Level of Mean±Standard Deviation | Confidence (%) | d | t (two-tailed) | Sample Size ($n_{ade}$) |
|---|---|---|---|---|---|---|
| VEGETATION COVER | | | | | | |
| Mountain Grassland | 25 | 19.92 ± 3.32 | 90 | 0.1 | 1.645 | 8 |
| Oak Shrubland | 20 | 48.45 ± 7.83 | 80 | 0.1 | 1.282 | 5 |
| HERBACEOUS LAYER PRODUCTION (grams/m$^2$) | | | | | | |
| Mountain Grassland | 22 | 68.397±18.944 | 90 | 0.1 | 1.645 | 21 |
| Oak Shrubland | 40 | 11.903± 8.736 | 80 | 0.1 | 1.282 | 89 |
| DENSITY (No. Ind./Plot) | | | | | | |
| Mountain Grassland | | | | | | |
| Shrubs | | | | | | |
| Stems | 40 | 20.85 ±12.03 | 90 | 0.1 | 1.645 | 91 |
| Individuals | 40 | 79.60 ±50.19 | 90 | 0.1 | 1.645 | 107 |
| Oak Shrubland | 15 | 216.13±39.49 | 15 | 0.1 | 1.282 | 6 |

TABLE 9-6
Mountain Grassland Community Reference Area
Cover, Frequency and Species Diversity Summaries for Herb Layer Components
Based on Date from 20 $1m^2$ Quadrats. (1981 Data)

| Community | Mean Cover (%) | Relative Cover (%) | Range of Cover Values | Percent Frequency | Relative Frequency (%) | I.V.* | Rank |
|---|---|---|---|---|---|---|---|
| PERENNIAL GRASSES AND SEDGES | | | | | | | |
| Agropyron spicatum | 0.1 | 0.48 | 0-1 | 4.0 | 1.11 | 1.59 | 13 |
| Agropyron trachycaulum | 0.4 | 1.94 | 0-5 | 16.0 | 4.44 | 6.38 | 8 |
| Carex sp. | 0.1 | 0.19 | 0-1 | 4.0 | 1.11 | 1.30 | 15 |
| Elymus salinus | 16.7 | 80.99 | 9-26 | 100.0 | 27.78 | 108.77 | 1 |
| Poa fendleriana | 0.4 | 1.94 | 0-4 | 24.0 | 6.67 | 8.61 | 5 |
| Stipa lettermanii | 0.1 | 0.19 | 0-1 | 4.0 | 1.11 | 1.30 | 15 |
| Sub-Total | 17.6 | 85.73 | | | | | |
| | | | | | | | |
| Aster sp. | 0.1 | 0.01 | 0-1 | 4.0 | 1.11 | 1.11 | 21 |
| Caulanthus crassicaulis | 0.1 | 0.19 | 0-1 | 4.0 | 1.11 | 1.30 | 15 |
| Eriogonum umbellatum | 0.1 | 0.48 | 0-2 | 8.0 | 2.22 | 2.70 | 10 |
| Erysimum asperum | 0.1 | 0.19 | 0-1 | 4.0 | 1.11 | 1.30 | 15 |
| Haplopappus nuttallii | 0.1 | 0.19 | 0-1 | 8.0 | 2.22 | 2.41 | 11 |
| Hymenoxys richardsonii | 0.2 | 0.97 | 0-3 | 8.0 | 2.22 | 3.19 | 9 |
| Penstemon sp. | 0.1 | 0.19 | 0-1 | 8.0 | 2.22 | 2.41 | 11 |
| Physaria floribunda | 0.1 | 0.19 | 0-1 | 4.0 | 1.11 | 1.30 | 15 |
| Sisymbrium linifolium | 0.1 | 0.01 | 0-1 | 32.0 | 8.89 | 8.89 | 3 |
| Stanleya viridiflora | 0.3 | 1.45 | 0.3 | 20.0 | 5.56 | 7.01 | 7 |
| Sub-Total | 0.7 | 3.85 | | | | | |

TABLE 9-6 (Continued)
Mountain Grassland Community Reference Area

| Community | Mean Cover (%) | Relative Cover (%) | Range of Cover Values | Percent Frequency | Relative Frequency (%) | I.V.* | Rank |
|---|---|---|---|---|---|---|---|
| SEMI SHRUBS | | | | | | | |
| Atremisia frigida | 0.1 | 0.18 | 0-1 | 4.0 | 1.11 | 1.30 | 15 |
| Guitierrezia sarothrae | 0.6 | 2.91 | 0-6 | 20.0 | 5.56 | 8.47 | 6 |
| Opuntia fragilis | 0.1 | 0.01 | 0-1 | 4.0 | 1.11 | 1.11 | 21 |
| Sub-Total | 0.6 | 3.10 | | | | | |
| SHRUBS | | | | | | | |
| Atremisia tridentata | 0.1 | 0.01 | 0-1 | 4.0 | 1.11 | 1.11 | 21 |
| Cercocarpus montanus | 1.4 | 6.79 | 0-9 | 36.0 | 10.00 | 16.79 | 2 |
| Eriogonum corymbosum | 0.1 | 0.01 | 0-1 | 32.0 | 8.89 | 8.89 | 3 |
| Purshia tridentata | 0.1 | 0.01 | 0-1 | 4.0 | 1.11 | 1.11 | 21 |
| Quercus gambelii | 0.1 | 0.48 | 0-3 | 4.0 | 1.11 | 1.59 | 13 |
| Sub-Total | 1.5 | 7.27 | | | | | |
| SUM OF SPECIES COVER | 20.4 | | 14-27 | | | | |
| Total Woody Cover | 1.5 | | 0-19 | | | | |
| Total Herbaceous Cover | 18.6 | | 11.26 | | | | |
| Lichens (Crustose)± | 3.1 | | 0-10 | | | | |
| Mosses | 0.1 | | 0-1 | | | | |
| Litter | 53.1 | | 22-81 | | | | |
| Rock | 23.9 | | 2-70 | | | | |
| Bare Soil | 23.0 | | 8-46 | | | | |

TABLE 9-6 (Continued)
Mountain Grassland Community Reference Area

| Community | Mean Cover (%) | Relative Cover (%) | Range of Cover Values | Percent Frequency | Relative Frequency (%) | I.V.* | Rank |
|---|---|---|---|---|---|---|---|
| Evaluation of the herb layer and ground layer as a single unit. The values in this section add to 100 percent for each quadrat. | | | | | | | |
| Total Vegetation | 19.9 | 12-26 | | | | | |
| Litter/Rock | 57.1 | 36-74 | | | | | |
| Bare Soil | 23.0 | 8-46 | | | | | |

| Number of Species per Square Meter | Mean ± S.D.** | Range |
|---|---|---|
| Herb Species | 2.51±1.05 | 1-5 |
| Woody Species | 1.08±1.04 | 0-4 |
| Total Species | 3.60±1.71 | 1-7 |

*Importance Value (I.V.) = Relative Cover = Relative Frequency
** ±Values equal the standard deviation (S.D.).

TABLE 9-7
Mountain Grassland Community Reference Area
Cover, Frequency and Density Summaries for Shrub Species
Based on Data from 40 cm x 15m Line-Strip Transects (1981 Data)

| Species | Height Class* (%) | Mean Cover (%) | Relative Cover (%) | Frequency | Density (Ind./Hectare) By Height Class | Density (Ind./Hectare) Total ± S.D. | Density (Stems/Hectare) By Height Class | Density (Stems/Hectare) Total ± S.D. |
|---|---|---|---|---|---|---|---|---|
| Amelanchier utahensis | Total | 0.1 | 6.45 | 30.0 | | 294±667 | | 717±2380 |
| | I | | | | 283 | | 589 | |
| | II | | | | 6 | | 89 | |
| | III | | | | 6 | | 39 | |
| Artemisis tridentata | Total | 0.1 | 2.58 | 17.5 | | 50±118 | | 61± 142 |
| | I | | | | 50 | | 61 | |
| Cercocarpus montanus | Total | 0.8 | 51.61 | 92.5 | | 2383±1911 | | 13928±11249 |
| | I | | | | 1844 | | 11833 | |
| | II | | | | 411 | | 1906 | |
| | III | | | | 128 | | 189 | |
| Eriogonum corymbosum | Total | 0.3 | 19.35 | 67.5 | | 828±918 | | 978±1211 |
| | I | | | | 828 | | 978 | |
| Opuntia fragilis | Total | 0.1 | 0.1 | 12.5 | | 144±560 | | 144±500 |
| | I | | | | 144 | | 144 | |

TABLE 9-7 (Continued)
Mountain Grassland Community Reference Area

| Species | Height Class* (%) | Mean Cover (%) | Relative Cover (%) | Frequency | Density (Ind./Hectare) By Height Class | Density (Ind./Hectare) Total ± S.D. | Density (Stems/Hectare) By Height Class | Density (Stems/Hectare) Total ± S.D. |
|---|---|---|---|---|---|---|---|---|
| Pinus edulis | Total | 0.1 | 0.1 | 2.5 | | 6± 36 | | 6± 36 |
| | I | | | | 6 | | 6 | |
| Purshia tridentata | Total | 0.3 | 19.35 | 60.0 | | 628±987 | | 1433±1773 |
| | I | | | | 628 | | 1433 | |
| Quercus gambelii | Total | 0.1 | 0.01 | 2.5 | | 28±176 | | 33±211 |
| | I | | | | 28 | | 33 | |
| Symphoricarpos oreophilus | Total | 0.1 | 0.65 | 15.0 | | 272±976 | | 378±1178 |
| | I | | | | 272 | | 378 | |
| TOTAL | | | | | | 4633±2673 | | 17678±11153 |

* Height Class I = 0.25m-0.75m
II = 0.76m-1.50m
III = 1.51m-2.25m
IV = 2.25m+

1875/Ac

Table 9-8

MOUNTAIN GRASSLAND COMMUNITY

Reference Area. Mean production ± the standard deviation (S.D.). Based on the data from 20 $1m^2$ quadrats. 1981 data.

| Species | Mean±S.D. (grams/$m^2$) | Mean±S.D. (lbs/acre) | Percent Total Biomass |
|---|---|---|---|
| PERENNIAL GRASSES AND SEDGES | | | |
| *Agropyron trachycaulum* | 2.311± 9.810 | 21 ± 88 | 3.38 |
| *Elymus salinus* | 63.011±21.275 | 562 ±190 | 92.13 |
| *Oryzopsis hymenoides* | 0.232± 1.056 | 2 ± 9 | 0.34 |
| *Poa fendleriana* | 0.457± 1.443 | 4 ± 13 | 0.67 |
| Sub-Total | 66.011±19.868 | 589 ±177 | |
| PERENNIAL FORBS | 1.303± 2.554 | 12 ± 23 | 1.91 |
| SEMI-SHRUBS | | | |
| *Gutierrezia sarothrae* | 1.009± 2.756 | 9 ± 25 | 0.11 |
| *Mahonia repens* | 0.074± 0.347 | 1 ± 3 | 0.11 |
| Sub-Total | 1.083± 2.750 | 10 ± 25 | |
| TOTAL PRODUCTION | 68.397±18.944 | 611 ±169 | |

### 9.3.2.3 Aspen Woodland

The aspen woodland type occurring primarily on moist north-facing slopes, covers approximately 440 acres (27 percent), and is the most extensive vegetation type on the permit area. The major tree species is quaking aspen (Populus tremuloides).

### 9.3.2.4 Mixed Coniferous Forest

The mixed coniferous forest type occurs on north-facing slopes and covers approximately 247 acres (15.2 percent) within the study area. It is the second most common forest type and fourth in extent of all mapped types. Major species include douglas fir (Pseudotsuga menziesee), white fir (Abies concolor), sub-alpine fir (Abies lasiocarpa), Engelmann spruce (Picea engelmannii), and Colorado blue spruce (Picea pungens). On high ridges, both bristle cone pine (Pinus aristata) and limber pine (Pinus flexilis) occur.

### 9.3.2.5 Cherry Thicket

The cherry thicket type is limited in extent and covers only 15 acres (0.9) percent of the area. It occurs in the southwest quarter of Section 12 (Plate 9-1) on the steep slopes above Beaver Creek. The major species is choke cherry (Prunus virginiana). This species tends to occur throughout the upland mixed shrub types and only in limited areas does it grow in dense homogeneous.

### 9.3.2.6 Willow Thicket

The willow thicket type occurs along major stream courses such as Beaver Creek. The type is characterized by dense stands of willows (Salix ssp.)., and very moist to wet growing conditions. The type covers approximately 15 acres (0.9 percent) within the mapped area.

9.3.2.7 Riparian Community

The riparian community type also occurs along stream courses. However, it tends to have a somewhat different species composition. Both trees and shrubs characterize the type. Major species include cottonwood (Populus fremontii), red osier dogwood (Cornus stolonifera), mountain maple (Acer glabrum), and serviceberry (Amelanchier ssp.). The trees occur as scattered individuals. This type is limited in extent and covers only 12 acres (0.8 percent).

9.3.2.8 Mixed Mountain Shrubland

The mixed mountain shrubland type occurs on steep upland slopes and is characterized by a mixture of species. Major species include Gambles oak, mountain snowberry, serviceberry, choke cherry, and mountain mahogany. This type covers approximately 48 acres which is equivalent to 2.9 percent of the mapped area.

9.3.2.9 Manzanita Shrubland

The manzanita shrubland type occurs on exposed hillsides and is the most restricted type within the mapped area. It covers only 1.4 acres which is approximately 0.1 percent of the area. Major species include manzanita (Arctostaphylos patula) and mountain lover (Pachystima myrsinites).

9.3.2.10 Big Sagebrush Shrubland

The big sagebrush shrubland type is the second most prevalent shrubland type, covering 305 acres (18.7 percent of the area). It occurs on steep, dry upland slopes. Major shrub species include mountain big sagebrush (Artemisia tridentata ssp. vaseyana) and antelope bitterbrush (Purshia tridentata). The major grass species in salina wildrye.

9.2.3.11 Bottomland Sagebrush Shrubland

The bottomland sagebrush type occurs in lowland areas along Beaver Creek, and occupies only 20 acres (1.2 percent) within the mapped area. The major species is big sagebrush (*Artemisia tridentata* ssp. *tridentata*). The major difference between the big sagebrush shrubland and bottomland sagebrush shrubland types is the subspecies of big sagebrush which occurs as the dominant species. The subspecies *tridentata* grows to a much greater height than does the subspecies *vaseyana*.

9.3.2.12 Wet Sedge Meadow

The wet sedge meadow type is restricted in extent and covers 15 acres (0.9 percent) within the mapped area. It occurs along the upper portions of Beaver Creek and is usually found in association with abandoned beaver ponds. The major species are sedges (*Carex* spp.) and other semi-aquatic species.

9.3.2.13 Open Water

The open water type includes ponds which occur within the mapped area. The total area occupied by ponds is only 2.1 acres which is approximately 0.1 percent of the area.

9.3.2.14 Disturbed Areas

The disturbed areas within the mapped area primarily include those areas which are currently being used for mining activities. The total extent of this type is approximately 34 acres (2.1 percent of the area).

Sample Adequacy

Sample adequacy was attained for vegetation cover and herb vegetation cover and herb production in the bunchgrass reference area. Refer to Table 9-5.

9.3.3 Species List

The plant list resulting from the floristic survey is presented in Table 9-9. The table is arranged in alphabetical order by plant family. Species are identified in the table according to their common name, scientific name, growth form, and occurrence in (1) douglas fir forest, (2) sagebrush-grassland, (3) oak shrubland, and (4) wetland communities.

The list includes 88 species, 71 general and 31 families. Species identification was from Cronquist et al (1972, 1977), Welsh and Moore (1973), McDougall (1973), and Weber (1976).

TABLE 9-9
Plant Species Observed
Gordon Creek No. Mine Permit Area
Carbon County, Utah

| Common Name | Family Scientific Name | Growth Form | Wetland | Sagebrush Grassland | Oak Shrubland | Douglas Fir |
|---|---|---|---|---|---|---|
| MAPLE FAMILY | ACERACEAE | | | | | |
| Rocky Mountain Maple | Acer glabrum | Tree | | | | x |
| Big Tooth Maple | Acer grandidentatum | Tree | | | | x |
| AMARANTH FAMILY | AMARANTHACEAE | | | | | |
| Prostrate Pigweed | Amaranthus graecizans | Forb | | x | | |
| BARBERRY FAMILY | BERBERIDACEAE | | | | | |
| Oregon Grape | Mahonia repens | Shrub | | x | x | x |
| BORAGE FAMILY | BORAGINACEAE | | | | | |
| Catseye | Crypthantha abata | Forb | | x | | |
| Houndstongue | Cynoglossum officinale | Forb | | x | x | |
| Stickseed | Lappula occidentalis | Forb | | x | x | x |
| HONEYSUCKLE FAMILY | CAPRIFOLIACEAE | | | | | |
| Elderberry | Sambucux coerulea | Shrub | | | | x |
| Snowberry | Symphoricarpos vaccinoides | Shrub | | | x | x |
| PINK FAMILY | CARYOPHYLLACEAE | | | | | |
| Catchfly | Silene menziesii | Forb | | | | x |
| Chickweed | Stellaria jamesiana | Forb | | | | x |

TABLE 9-9 (Continued)
Plant Species Observed

| Common Name | Family<br>Scientific Name | Growth Form | Wetland | Sagebrush Grassland | Oak Shrubland | Douglas Fir |
|---|---|---|---|---|---|---|
| GOOSEFOOT FAMILY | CHENOPODIACEAE | | | | | |
| Goosefoot | Chenpodium fremontii | Forb | | | | x |
| Goosefoot | Chenpodium pratericola | Forb | | | | x |
| Russian Thistle | Salsola kali | Forb | | x | | |
| SUNFLOWER FAMILY | COMPOSITAE | | | | | |
| Yarrow | Achillea millifolium | Forb | | x | x | x |
| Fringed Sagewort | Artemisia frigida | Shrub | | x | | |
| Louisiana Sagewort | Artemisia ludiviciana | Shrub | | | x | |
| Big Sagebrush | Artemisia tridentata | Shrub | | x | | |
| White Rubber Rabbitbrush | Chrysothamnus nauseosus var. albucaulis | Shrub | | x | x | |
| Mountain Low Rabbitbrush | Chrysothamnus viscidiflorus var. lanceolatus | Shrub | | x | x | |
| Wavyleaf Thistle | Cirsium undulatum | Forb | | x | x | |
| Smokeweed | Gutierrezia sarothrae | Shrub | | x | x | |
| Orange Sneeze Weed | Helenium hoopesii | Form | | | | x |
| | Machaeranthera canescens | Forb | | x | x | |
| | Machaeranthera linearis | Forb | | x | x | |
| Rag Weed Groundsel | Senecio ambrosioides | Forb | | | | x |
| Decumbent Goldenrod | Solidago decumbens | Forb | | | | x |
| Nuttall Horse Brush | Tetradymia nuttallii | Shrub | | x | | |
| Showy Goldeneye | Viguiera multiflora | Forb | | | | x |

TABLE 9-9 (Continued)
Plant Species Observed

| Common Name | Family Scientific Name | Growth Form | Wetland | Sagebrush Grassland | Oak Shrubland | Douglas Fir |
|---|---|---|---|---|---|---|
| DOGWOOD FAMILY | CORNACEAE | | | | | |
| Red Osier Dogwood | Cornus stolonifera | Tree | | | | x |
| MUSTARD FAMILY | CRUCIFERAE | | | | | |
| Black Mustard | Brassica nigra | Forb | | | | x |
| Tansy Mustard | Descurainia sophia | Forb | | x | x | x |
| Plain Wall Flower | Erysimum asperum | Forb | | | | x |
| Hedge Mustard | Sisymbrium sp. | Forb | | | x | |
| CYPRESS FAMILY | CUPRESSACEAE | | | | | |
| Rocky Mountain Juniper | Juniperus scopulorum | Tree | | | x | x |
| SEDGE FAMILY | CYPERACEAE | | | | | |
| Sedge | Carex sp. | Graminoid | | x | | x |
| OLEASTER FAMILY | ELEAGNACEAE | | | | | |
| Buffalo Berry | Shepherdia rotundifolia | Shrub | | | | x |
| BEECH FAMILY | FAGACEAE | | | | | |
| Gamble's Oak | Quercus gambelii | Tree | | | x | |

TABLE 9-9 (Continued)
Plant Species Observed

| Common Name | Family Scientific Name | Growth Form | Wetland | Sagebrush Grassland | Oak Shrubland | Douglas Fir |
|---|---|---|---|---|---|---|
| PINE FAMILY | PINACEAE | | | | | |
| Pinion Pine | Pinus edulis | Tree | | | x | |
| Douglas Fir | Pseuditsuga menzeisii | Tree | | | x | |
| PHLOX FAMILY | POLEMONIACEAE | | | | | |
| Longleaf Phlox | Phlox lonifolia | Forb | | | | x |
| BUCKWHEAT FAMILY | POLYGONACEAE | | | | | |
| Winged Wild Buckwheat | Eriogonum alatum | Shrub | | x | | |
| Corymed Wild Buckwheat | Eriogonum microthecum var. foliosum | Shrub | | x | | |
| Prostrate Knotweed | Polygonum aviculare | Forb | | x | | |
| BUTTERCUP FAMILY | RANUNCULACEAE | | | | | |
| Red Baneberry | Actaea rubra | Forb | | | x | |
| Colorado Columbine | Aquilegia caerulea | Forb | | | | x |
| Western Virgin's Bower | Clematis ligusticifolia | Forb | | | | x |
| Rocky Mountain Virgin's Bower | Clematis pseudoalpina | Forb | | | | x |
| Nelson Larkspur | Delphinium nelsonii | Forb | | | | x |
| Fendler Meadowrue | Thalictrum fendleri | Forb | | | | x |

TABLE 9-9 (Continued)
Plant Species Observed

| Common Name | Family Scientific Name | Growth Form | Wetland | Sagebrush Grassland | Oak Shrubland | Douglas Fir |
|---|---|---|---|---|---|---|
| ROSE FAMILY | ROSACEAE | | | | | |
| Utah Serviceberry | Amelanchier utahensis | Shrub | | | x | x |
| Alder-Leaf Mountain Mahogany | Cercocarpus montanus | Shrub | | | x | |
| Wild Strawberry | Fragerla americana | Forb | | | | x |
| Ninebark | Physocarpus capitatus | Shrub | | | | x |
| Choke Cherry | Prunus virginiana | Tree | | | | x |
| Antelope Bitterbrush | Purshia tridentata | Shrub | | x | x | |
| Nootka Rose | Rosa nutkana | Shrub | | | | x |
| Woods Rose | Rosa woodsii | Shrub | | | | x |
| WILLOW FAMILY | SALICAECEAE | | | | | |
| Aspen | Populus tremuloides | Tree | x | | | x |
| Blue Willow | Salix subcoerulea | Shrub | x | | | x |
| Willow | Salix sp. | Shrub | x | | | x |
| SAXIFRAGE FAMILY | SAXIFRAGAECEAE | | | | | |
| Wax Currant | Ribes cereum | Shrub | | | x | x |
| Sticky Currant | Ribes viscossissimum | Shrub | | | | x |
| FIGWORT FAMILY | SCROPHULARIACEAE | | | | | |
| Watson Penstemon | Penstemon watsoni | Forb | | | | x |
| Penstemon | Penstemon sp. | Forb | | | | x |
| Lanceleaf Figwort | Scrophularia lanceolata | Forb | | | | x |

TABLE 9-9 (Continued)
Plant Species Observed

| Common Name | Family<br>Scientific Name | Growth Form | Wetland | Sagebrush Grassland | Oak Shrubland | Douglas Fir |
|---|---|---|---|---|---|---|
| POTATO FAMILY<br>Cutleaf Nightshade | SOLANACEAE<br>*Solanum triflorum* | Forb | | x | | |
| NETTLE FAMILY<br>Nettle | URTICACEAE<br>*Urtica breweri* | Forb | | x | x | x |
| VIOLET FAMILY<br>Violet | VIOLACEAE<br>*Viola sp.* | Forb | | | | x |

### 9.3.4 Total Acres in Plan Area, Acreage by Vegetation Type and Acreages of Types Affected

There are approximately 1630 acres within the lease area. A list of approximate acres of each vegetation type is given in Table 9-1. The total area of disturbance is approximately 34 acres. Of this total, approximately ten acres of disturbance occurs as a result of current mining operations. This area occurs on a south facing exposure and most likely supported a mosaic of mountain grassland and oak shrubland vegetation types.

## 9.4 Threatened or Endangered Species

Currently, eight species are listed as endangered of threatened in Utah. None of these threatened or endangered species, as defined and identified by the U.S. Department of the Interior, Fish and Wildlife Service (USDA, 1980) were observed in the Gordon Creek No. 2 Mine lease area. None of these species are known to occur in Carbon County.

No species are currently proposed as endangered or threatened in Utah (USDI, 1980). One hundred and sixty-three (163) plant taxa are currently under review (USDI, 1980). Of these species, two (Eriogonum corymbosum var. davidsii and Eriogonum lancifolium) are known to occur in Carbon County (USDA, 1979). Both species occur on the Mancos shale formation in salt desert shrub vegetation types at elevations of 4900 to 5700 feet. These vegetation types do not occur in the Gordon Creek No. 2 Mine area.

## 9.5 Effects of Mining Operations on Vegetation

Based on the current mine plans, all anticipated surface disturbance and effects on vegetation have already taken place.

## 9.6 Mitigation and Management Plans

As noted previously, the Gordon Creek No. 2 Mine is an existing operation. Therefore, mitigation and management measures have been designed to prevent additional impacts related to continued mining activities and to facilitate rapid return of the site to productive use after decommissioning.

The relatively small-scale disturbance associated with the mining operation will be mitigated upon completion of the project by reclaiming the disturbed sites with an approved seed mix. The plant mix has been selected to offer a diverse assemblage of herbaceous and woody species that are adapted to on-site conditions and are of known value for cover, forage, or both. The comprehensive reclamation procedure is fully described in Section 3.5, Reclamation Plan.

In an effort to protect newly seeded areas, no grazing will be allowed on reseeded areas for at least two growing seasons after planting.

## 9.7 Revegetation Methods

Seeding and planting of disturbed areas shall be conducted during the first normal period for favorable planting conditions after final preparation. When necessary to effectively control erosion, any disturbed area shall be seeded, as contemporaneously as practicable. Refer to Section 3.5.5.2 (Temporarily Disturbed Areas).

The disturbed areas will be regraded to rather steep slopes which will exclude most methods of machine planting. Therefore, areas to be planted will be "roughened" by raking (or other means) to help hold the seeds in place. The proper seed mixture will then be spread either by hand or machine. Mulch will be applied over the entire area.

The revegetated area will be monitored and, if success appears unlikely, alterations will be made with concurrence of the land owner until revegetation success is achieved.

## 9.8 Revegetation Monitoring

Revegetation monitoring will consist of visual inspections of the vegetated area for the first few years after planting. If the vegetation on any areas does not appear to be re-establishing an acceptable cover, additional soil tests will be taken. If nutrients or soil additives are found to be deficient, needed amendments will be added and the area replanted.

Any areas showing excessive erosion (greater than nine-inch rills or gullies) will also be repaired with additional topsoil and/or regraded and replanted.

Vegetation monitoring for bond release will follow the same procedures as those utilized during the baseline vegetation survey and 1981 sampling described in detail under Section 9.2. These methods include random quadrats to determine ground cover and randomly located 1.0 $m^2$ circular quadrats to measure productivity.

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# SECTION 9
# VEGETATION RESOURCES
# GORDON CREEK No. 7 MINE

## 9.1a Scope

The vegetation resource data information was prepared by Native Plants, Inc. in Salt Lake City, Utah. The study area, Gordon Creek No. 7 Mine , is located approximately 15 miles northwest of Price in Carbon County, Utah.

The objectives of the study were to prepare a vegetation map of the permit area, and qualitatively and quantitatively describe the vegetation within the disturbance and study area. The study also included a site wide examination to identify any threatened or endangered species which may be present on the lease area.

## 9.2a Methodology

### 9.2a.1 Floristics

A floristic survey was conducted at the same time as the 1983 quantitative vegetation sampling. The purpose of the floristic survey was to determine a list the plant species present within the lease area including any threatened or endangered species. This was accomplished by a walking reconnaissance of the proposed disturbance area noting species occurrence and their distribution in the various communities. Plant identification was aided by the use of numerous reference (Cronquist et. al, 1972; Judd, 1962; McDougall, 1973; Parker, n.d.; Tidestrom, 1925; Weber, 1976; and Welsh and Moore, 1973).

### 9.2a.2 Vegetation Map

The vegetation map of the Gordon Creek No. 7 Mine area was prepared using a combination of air photo interpretation and field checking. Black-and-white and color infrared aerial photographs (at a scale of 1:12,000, approximately) were used to map the location an extent of the various vegetation types. The photo interpretation was augmented by some field checking although the higher elevations were inaccessible at the time of the field visit due to flooding and mud slides. Community types were delineated based on two or more dominant species.

The vegetation types were also quantified in terms of acreage and percent of the study area (Table 9-1a). The final map was prepared on a topographic mylar base at a scale of 1:600 (1 inch = 500 feet). See Plate 9-1a. The aerial extent of the mapped plant community types was determined by weighing the various communities from the 1:6000 vegetation map.

### 9.2a.3 Reference Areas

Data from the reference area proposed for the existing Gordon Creek No. 2 Mine will not be used as the standard for revegetation success in the No. 7 Mine disturbed area. Instead, Beaver Creek will use the baseline data presented in the sections to follow.

The Gordon Creek No. 2 Mine area, which will use data from the reference areas as the standard for revegetation, is shown on Plate 9-1 as the "Affected Area". The "Modified Affected Area" on Plate 9-1 is the No. 7 Mine disturbed area which will use the baseline data in the following sections. Both reference areas have been identified on the ground with 4' stakes at each corner.

TABLE 9-1a

Aerial Extent and Percent of Total Area
Each Vegetation Type
Gordon Creek No. 7 Mine Area

| Mapping Unit | Acres | Percent of Total Area |
|---|---|---|
| Aspen Woodland | 93.9 | 14 |
| Mixed Coniferous Forest | 145.1 | 21 |
| Oak Shrubland | 116.3 | 17 |
| Mixed Mountain Shrubland | 48.0 | 7 |
| Sagebrush Shrubland | 177.1 | 26 |
| Mountain Grassland | 87.5 | 13 |
| Disturbed Area | 7.5 | 1 |
| TOTAL | 677.3 | 100 |

### 9.2a.4 Vegetation Cover and Productivity

The vegetation types most affected by mining operations are oak shrubland, mixed conifer, and aspen. Cover and production data were gathered from the oak and conifer. The aspen area was not sampled because of the small area which it represents.

#### 9.2a.4.1 Cover

During 1983, cover data were collected using a quadrat approach. Individual 1.0$m^2$ quadrats were randomly located in the oak shrubland and 1/4$m^2$ quadrats in the mixed conifer. Random sampling was accomplished by using pairs of random coordinates. The first number of the pair was the measured distance along one side (long axis) of the disturbance area, and the second number was the paced distance perpendicular to the tape at the position of the first number. Random sampling locations within each of the reference area are shown on Plate 9-2a. In each quadrat, total vegetation cover (canopy cover) including shrub canopy, cover by bare soil, and cover by litter and rock were visually estimated. For each quadrat these three components added to 100 percent. Canopy cover for each species and cover by litter, rock, bare soil, and cryptograms in the ground layer were also visually estimated. Because of overlap, these components added to more than 100 percent. Cover data were summarized by calculating means values for each species and each component.

#### 9.2a.4.2 Productivity

During 1983, production data were collected using a harvest method. Individual 1.0$m^2$ quadrats in the oak and 1/4$m^2$ in the conifer and were randomly located throughout each of the reference areas. Random locations were determined using pairs or random coordinates in the same manner used for locating cover quadrats. In each of the clipped quadrats plants were separated by life form. Shrubs were clipped only when they occurred as seedlings. Clipped samples were oven dried for 48 hours at 100°C and were weighed to the nearest milligram. Data were summarized by obtaining mean production values for each species or species group.

9.2a.5 Density

During 1983, density data for shrubs were obtained using a line-strip transect approach. Randomly located transects 15 m by 3 m were used to obtain shrub density data in the oak shrubland.

Within each of the shrub line-strip transects, individual shrubs were tallied on the basis of height class in order to obtain some measure of community structure. For individuals with multiple stems (i.e. oak) separate counts were made for the number of stems per individual. Total density was calculated both on the basis of the number of individuals per hectare as well as the number of stems per hectare. Random sampling locations for the line-strip transects are shown on the mylar map. Density for the mixed conifer type was obtained using the point quarter method (Cottom and Curtis, 1856).

9.2a.6 Data Analysis

9.2a.6.1 Definitions

See Section 9.2.6.1 of the Gordon Creek No. 2 Mine Permanent Program Permit to Mine Application.

## 9.3a Existing Vegetation Resources

### 9.3a.1 General Site Description

The Gordon Creek No. 7 Mine area is located along the eastern edge of the Wasatch Plateau in Carbon County, Utah. The elevation range is about 8,300 ft. to 9.200 ft.

Topographically, the study area consists of steep slopes on the face of the plateau and along drainages, flat surfaces on terraces of the floodplains in valley bottoms, and relatively gentle terrain on top of the plateau. The area is underlain by nearly flat sedimentary rocks of the Tertio-Cretaceous North Horn Formation and and the Lower Tertiary Flagstaff Formation.

The disturbance area is approximately one percent of the total lease area. The disturbance area is located on relatively steep slopes (50 percent) with north and south aspects. In the Spring of 1983 several seeps appeared in the area that previously had not been present. Two natural mud slides also occurred during the Spring of 1983 on the north facing slope and several sloughages occurred along the existing road.

### 9.3a.2 Vegetation Types

The vegetation map for the Gordon Creek No. 7 Mine area depicts six mapping units. The vegetation has been divided into two forest types (Aspen Woodlands and Mixed Coniferous Forests), three shrubland types (oak Shrublands, Mixed Mountain Shrublands, and Sagebrush shrublands), a grassland type (Mountain Grassland and Wet Sedge Meadow) and disturbed areas. Each of the mapping units is briefly described in the discussion which follows.

### 9.3a.2.1 Oak Shrubland

The oak shrubland type covers 122 acres within the mapped area. It is the third most abundant of all the mapped types. Oak shrublands occur on steep slopes which tend to be drier and have more shallow soil than the slopes which support aspen woodlands and mixed coniferous forests. These slopes tend to be more south and west facing, however, the oak shrublands are not limited to these aspects. Major shrub species include Gambles oak (*Quercus gambelii*) and mountain snowberry (*Symphoricarpos oreophilus*). The major species is Thickleaf peavine (*Lathyrus lanszwertii*).

#### Cover, Frequency, Species Diversity

Table 9-2a summarizes cover and species frequency in the oak shrubland disturbance area. The major grass species in the type is western wheatgrass, and the most common forb is peavine and beardtongue (*Penstemon sp.*). Gambles oak and mountain snowberry contribute approximately 70 percent of the cover within this type. Total cover was 82 percent which is very high compared to the reference area (49 percent). This is probably due to the unusual amount of precipitation in 1982 and 1983. The dominant shrub species in terms of density is Gambles oak, which has a total density of 8,178 stems per hectare (Table 9-3a). Snowberry had the next highest density of 3,089 plants per hectare. Total shrub density was 14,289 plants per hectare.

#### Productivity

Perennial forbs provide approximately 70 percent of the total biomass (Table 9-4a). Mean total production was 94.3 grams per square meter (841 pounds per acre). Tall shrub components were not included in the production measurements.

Because of the very steep slope on which the disturbance area is located, there is very limited utilization by domestic livestock. The particular vegetation type appears to be in excellent range condition due to the high water year. A list of species encountered on site is given in Table 9-5a. A summary of minimum sample size is given in Table 9-6a.

TABLE 9-2a

Oak Shrubland

Mean Cover and Frequency for 15, 1 $m^2$ Plots.

| Species | Mean Cover | Range | Percent Frequency |
|---|---|---|---|
| GRASSES | | | |
| Agropyron smithii | .4 | 0-4 | 13 |
| Bromus sp. | 1.6 | 0-8 | 40 |
| Bromus tectorum | 2.1 | 0-30 | 13 |
| Poa pratensis | 2.8 | 0-15 | 7 |
| Carex sp. | 1.3 | 0-6 | 40 |
| Subtotal | 8.3 | | |
| FORBS | | | |
| Achillea millifolium | 6.4 | 0-15 | 73 |
| Artemisia ludoviciana | 1.7 | 0-17 | 20 |
| Circium sp. | .1 | 0-2 | 7 |
| Galium Boreal | 1.2 | 0-8 | 27 |
| Lathyrus lanszwertii | 38.1 | 0-80 | 87 |
| Penstemon spp. | 10.2 | 0-30 | 80 |
| Smilacina Stellata | 1.3 | 0-20 | 7 |
| Viola adunca | .3 | 0-5 | 7 |
| Subtotal | 59.3 | | |
| SHRUBS | | | |
| Amelanchier utahensis | .7 | 0-10 | 7 |
| Mahonia repers | 3.7 | 0-15 | 53 |
| Prunus virginiana | 2.7 | 0-40 | 7 |

TABLE 9-2a (continued.)

| Species | Mean Cover | Range | Percent Frequency |
|---|---|---|---|
| *Quercus gambelii* | 48.3 | 0-85 | 93 |
| *Rosa woodsii* | 3.3 | 0-20 | 40 |
| *Symphoricarpos oreophilus* | 21.4 | 0-60 | 67 |
| Subtotal | 80.1 | | |
| Sum of Species Cover | 147.7 | | |

| | Mean Cover | Standard Deviation |
|---|---|---|
| Cryptogram | 0 | |
| Litter | 82.0 | 6.2 |
| Rock | 7.7 | 5.0 |
| Bareground | 9.3 | 3.2 |
| Cover based on 100 percent of each quadrat | | |
| Total Vegetation Cover | 81.8 | 6.7 |
| Litter | 12.3 | 5.1 |
| Rock | 3.0 | 2.9 |
| Bareground | 2.9 | 2.4 |

TABLE 9-3a.

Oak Shrubland

Shrub Density Taken from 15, 3 x 15 m Quadrat.

| Species | Height Class | Density (#/Hectare) | Standard Deviation | Percent Frequency |
|---|---|---|---|---|
| Total | | 1,289 | 1,342 | 80 |
| Amelanchier utahens | III | 616 | | |
| | IV | 460 | | |
| Cercocarpus monanus | III | 104 | 251 | 20 |
| Prunus virginiana | IV | 73 | 200 | 13 |
| Purshia tridentata | I | 429 | 507 | 67 |
| Quercus gambelii | Total | 8,178 | 1,511 | 100 |
| | I | 1,244 | | |
| | II | 622 | | |
| | III | 778 | | |
| | IV | 5,689 | | |
| Rosa woodsii | I | 3,089 | 1,311 | 100 |
| Symphoricarpos Oreophilus | I | 822 | 1,400 | 47 |
| TOTAL | | 14,289 | 1,511 | |

** Height Class

I = .25 m - .75 m
II = .76 m - 1.5 m
III = 1.6 m - 2.25 m
IV = 72.25 m

### 9.3a.2.2 Mountain Grassland

The mountain grassland covers 88 acres and occurs on high dry slopes. The major species include Salina Wildrye (*Elymus salinus*) and Indian ricegrass (*Oryzopsis hymenoides*).

### 9.3a.2.3 Aspen Woodland

The aspen woodland type occurs primarily on moist north-facing slopes and covers approximately 94 acres. The aspen woodland within the disturbance area covers approximately 1.7 acres. This area was not quantitatively sampled because of the small area which it occupies. The aspen community is on a steep, south-facing slope (50 percent). Choke cherry, snowberry, and serviceberry are co-dominants in this community. The forb layer consists primarily of peavine. Herbaceous growth again was lush in late-June, 1983 due to above average precipitation. A list of species encountered on site is provided in Table 9-7a.

### 9.3a.2.4 Mixed Coniferous Forest

The mixed coniferous forest type occurs on north-facing slopes and covers approximately 145 acres (15.2 percent within the study area). It is the second most common forest type and fourth in extent of all mapped types. Major species include Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), subalpine fir (*Abies lasiocarpa*), Englemann spruce (*Picea* engelmannii), aspen and Colorado blue spruce (*Picea* Pungens). On high ridges, both bristle cone pine (*Pinus aristata*) and limber pine (*Pinus flexilis*) occur.

The mixed coniferous forest within the disturbance area covers approximately 2.7 acres. The dominant species are sub-alpine fir mixed with aspen. Tree density was 645 individuals per acre (Table 9-8a). Fifty-seven (57) percent of the trees were aspen and the remainder were sub-alpine fir. The prevalence of aspen probably indicates a transitional change toward a fir community.

Understory cover and production were sparse as would be expected in a closed canopy community. At the time of sampling, sheep were in the area and much of the understory vegetation had been cropped. Also, due to the late-spring, many species were not fully developed.

Understory vegetation cover was 9.8 percent (Table 9-9a). Forbs contributed to 8.5 percent of the cover. Thickleaf peavine, meadowrue (Thalictrum chilensis) comprised the dominant understory vegetation.

Total production was 18.8 pounds per acre (Table 9-10a). The forb component contributed to 17.2 pounds of the total understory production. A list of species encountered on-site is given in Table 9-11a.

TABLE 9-4a

Oak Shrubland

Average Production Obtained from 40, $1m^2$ Clipped Quadrats.

| | Mean $(g \cdot m^2)$ | Standard Deviation | Mean (lbs./A) | Standard Deviation |
|---|---|---|---|---|
| Grasses and grass-like | 19.16 | 17.34 | 170.97 | 154.73 |
| Forb | 66.01 | 47.32 | 589.04 | 422.25 |
| Shrub | 9.14 | 10.66 | 81.56 | 95.12 |
| TOTAL | 94.30 | 48.11 | 841.47 | 429.30 |

Table 9-5a

Oak Shrubland Species List

| Scientific Name | Common Name |
|---|---|
| GRASSES | |
| Agropyron smithii | Western wheatgrass |
| Bromus Sp. | Brome |
| Bromus tectorum | Cheatgrass |
| Poa pratensis | Kentucky bluegrass |
| Poa secunda | Sandburg bluegrass |
| Carex geyeri | Elk sedge |
| Carex sp. | Sedge |
| FORBS | |
| Achillea millifolium | Yarrow |
| Artemisia ludoviciana | Locoweed |
| Clematis sp. | Clematis |
| Circium sp. | Thistle |
| Descusrainia pinnata | Pinnate tansymustard |
| Erysemum asperum | Wallflower |
| Fragaria virginiana | Strawberry |
| Galium boreale | Northern bedstraw |
| Gilia aggregata | Scarlet gilia |
| Helianthella uniflora | One Flower helianthella |
| Hymenoxys richardsonii | Pingue Hymenoxys |
| Lathtyrus lanszwertii | Thickleaf peavine |
| Penstemon sp. | Beardtongue |
| Phlox longifolia | Longleaf phlox |
| Senecio integerrimus | Lambstongue grounsel |
| Smilancina stellata | Solom Seal |
| Viola adunca | Hook violet |

Table 9-5a (Continued)
Oak Shrubland Species List

| Scientific Name | Common Name |
|---|---|
| SHRUBS | |
| Amelanchier utahensis | Utah serviceberry |
| Chrysothamnus viscidiflorus | Low rabbit brush |
| Cerocarpus montanus | True mountain mahogany |
| Eriogonum umbellatum | Sulfur eriogonum |
| Mahonia repens | Oregon grape |
| Prunus virginiana | Choke cherry |
| Purshia tridentata | Bitterbrush |
| Quercus gambelii | Gamble Oak |
| Rosa woodsii | Woods rose |
| Symphoricarpos oreophilus | Snowberry |

TABLE 9-6a

Evaluation of Sample Adequacy

Mixed Conifer & Oak Shrubland Disturbance Area

| Community | Sample Size | Mean | Standard Deviation | Percent Level of Confidence | t | Minimum Sample Required |
|---|---|---|---|---|---|---|
| VEGETATION COVER | | | | | | |
| Oak Shrubland | 15 | 81.8 | 6.7 | 80 | .1 | 1 |
| Mixed Conifer | 40 | 9.8 | 8.8 | 80 | .1 | 130 |
| PRODUCTIVITY 9(g/m$^2$) | | | | | | |
| Oak Shrubland | 40 | 94.3 | 48.1 | 80 | .1 | 43 |
| Mixed Conifer | 40 | 2.1 | 3.7 | 80 | .1 | 497 |
| DENSITY | | | | | | |
| Oak Shrubland (#4/45m$^2$) | 15 | 64.3 | 6.8 | 80 | .1 | 2 |
| Mixed Conifer (x of 4 points) | 10 | 2.4 | .6 | 80 | .1 | 10 |

TABLE 9-7a

List of Disturbed Species

Encountered in the Aspen Community

| Scientific Name | Common Name |
|---|---|
| GRASSES | |
| Bromus sp. | Brome |
| Poa partensis | Kentucky bluegrass |
| Poa reflexa | Nodding bluegrass |
| Poa secunda | Sandburg bluegrass |
| Carex geyeri | Elk sedge |
| Carex sp. | Sedge |
| FORBS | |
| Achiellea millifolium | Yarrow |
| Artemisia ludoviciana | Louisiana sage |
| Astragalus sp. | Locoweed |
| Clematis sp. | Clematis |
| Fragaria americana | Wild strawberry |
| Galium boreale | Bedstraw |
| Geranium sp. | Geranium |
| Helianthella uniflora | One flower helianthella |
| Helenium hoopsii | Orange sneezeweed |
| Lathyrus lanszwertii | Thickleaf peavine |
| Penstemon sp. | Beard tongue |
| Senecio sp. | Groundsel |
| Smilacina stellata | Solom seal |
| Stellaria sp. | Starwort |
| Thalictrum fendleri | Meadowrue |
| Viola adunca | Hook violet |

TABLE 9-7a (Continued)

List of Disturbed Species

Encountered in the Aspen Community

| Scientific Name | Common Name |
| --- | --- |
| SHRUBS AND TREES | |
| Amelanchier utahensis | Utah serviceberry |
| Juniperus osteosperma | Utah Juniper |
| Mahonia repens | Oregon grape |
| Pachistima myrsenitis | Mountain lover |
| Populus tremuloides | Quaking aspen |
| Prunus virginiana | Choke cherry |
| Quercus gambelii | Gamble Oak |
| Rosa woodsii | Woods rose |
| Symphoricarpos oreophilus | Snowberry |

TABLE 9-8a

Density of Aspen and Sub-Alpine Fir

Mixed Conifer Community

| Species | Average $ft^2$ | Individual per Acre |
|---|---|---|
| *Abis lasiocarpa* | 159.2 | 274 |
| *Populus tremuloides* | 117.4 | 371 |
| TOTAL | 67.6 | 645 |

9.3a.2.5 Mixed Mountain Shrubland

The mixed mountain shrubland type occurs on steep upland slopes and is characterized by a mixture of species. Major species include Gambles oak, mountain snowberry, service berry, choke cherry, and mountain mahogany. This type covers approximately 48 acres.

9.3a.2.6 Sagebrush Shrubland

The sagebrush type is the most prevalent shrubland type, covering 177 acres (18.7 percent of the area). It occurs on steep and dry upland slopes. Major shrub species include mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) and antelope bitterbrush (*Purshia tridentata*). The major grass species is salina wildrye.

9.3a.2.7 Disturbed Areas

The proposed disturbance area is approximately 7.5 acres, or one percent of the lease area.

TABLE 9-9a

Mixed Conifer Community Understory Vegetation

Mean Cover and Frequency Values

| Species | Mean Cover | Range | Percent Frequency |
|---|---|---|---|
| GRASSES | | | |
| Poa reflexa | .6 | 0-5 | 45 |
| Subtotal | .6 | | |
| FORBS | | | |
| Achillea millifolium | .2 | 0-1 | 20 |
| Fragaria americana | .2 | 0-5 | 10 |
| Galium boreale | .9 | 0-5 | 50 |
| Geranium sp. | .5 | 0-5 | 18 |
| Helenium hoopsii | .2 | 0-5 | 5 |
| Lathyrus lanszwertii | 1.9 | 0-40 | 25 |
| Mitella sp. | .8 | 0-13 | 25 |
| Osmorhiza chilensis | 1.2 | 0-10 | 35 |
| Ranunculus jovis | .3 | 0-3 | 18 |
| Taraxacum officinale | .1 | 0-1 | 13 |
| Thalictrum fendleri | 1.7 | 0-12 | 48 |
| Urtica sp. | .3 | 0-3 | 10 |
| Viola adunca | .2 | 0-2 | 13 |
| Subtotal | 8.5 | | |

TABLE 9-9a (Continued)

Mixed Conifer Community Understory Vegetation

Mean Cover and Frequency Values

| Species | Mean Cover | Range | Percent Frequency |
|---|---|---|---|
| SHRUBS AND TREES | | | |
| Abies lasiocarpa | .9 | 0-25 | 15 |
| Mahonia repens | .6 | 0-8 | 18 |
| Pachistima myrsinites | .1 | 0-3 | 3 |
| Physocarpus malvacius | .1 | 0-5 | 3 |
| Populus tremuloides | .1 | 0-4 | 5 |
| Subtotal | 1.8 | | |
| Sum of species cover | 10.9 | | |
| Cryptograms | .1 | | |
| Litter | 82.9 | | |
| Rock | 2.1 | | |
| Bareground | 9.3 | | |

Cover, based on 100 percent for each quadrat

| | |
|---|---|
| Total vegetation cover | 9.8 |
| Litter | 79.0 |
| Rock | 2.3 |
| Bareground | 8.6 |

TABLE 9-10a

MIXED CONIFER COMMUNITY

UNDERSTORY PRODUCTION VALUES

| | g/1/4m$^2$ | lbs/A |
|---|---|---|
| GRASS | .02 | .18 |
| FORB | 1.93 | 17.22 |
| SHRUB | .16 | 1.43 |
| TOTAL | 2.11 | 18.83 |

TABLE 9-11a (Continued)

Mixed Conifer Community

List of Species Encountered

| Scientific Name | Common Name |
|---|---|
| SHRUBS & TREES | |
| Abies lasiocarpa | Subalpine Fir |
| Acer glabrum | Rocky Mountain Maple |
| Mahonia repens | Oregon Grape |
| Pachystima myrsinites | Mountain Lover |
| Populus tremuloides | Quaking Aspen |
| Sambucus cerulea | Elderberry |
| Symphoricarpos oreophilus | Mountain Snowberry |

## 9.4a Threatened or Endangered Species

Currently, eight species are listed as endangered or threatened in Utah. None of these threatened or endangered species, as defined and identified by the U.S. Department of the Interior, Fish and Wildlife Service (USDI, 1980) were observed in the Gordon Creek No. 7 Mine area. None of these species are known to occur in Carbon County.

One hundred and sixty-three (163) plants taxa are currently under review (USDI, 1980). Of these, two (Eriogonum corymbosum var. davidsii and Eriogonum lancifolium) are known to occur in Carbon County (USDI, 1979). Both species occur on the Mancos shale formation in salt desert shrub vegetation types at elevations of 4900 to 5700 feet. These vegetations types do not occur in the Gordon Creek No. 7 Mine area.

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TABLE 9-12a

Similarity of Oak Shrubland Reference and Disturbance Area

Minimum Sample Size is Also Demonstrated

| | X | S | N | $N_{min}$ | X | S | N | $N_{min}$ | t-Value | t' |
|---|---|---|---|---|---|---|---|---|---|---|
| Cover | 81.8 | 6.7 | 15 | 7.1 | 48.5 | 7.8 | 20 | 5 | 13.54 | .8655 |
| Density (plants/45 $m^2$) | 64.3 | 6.8 | 15 | 1.8 | 216.1 | 39.5 | 15 | 6 | 14.67 | .8660 |
| Productivity ($g/m^2$) | 94.30 | 48.11 | 40 | 43 | 11.9 | 8.7 | 40 | 89 | | |
| Aspect | N-NE | | | | | | | | | |
| Slope | 53% | | | | | | | | | |

% Similarity: 55.6

$(1.345)^2 (6.7)^2$

.1(