TREATMENT PLANT COPY

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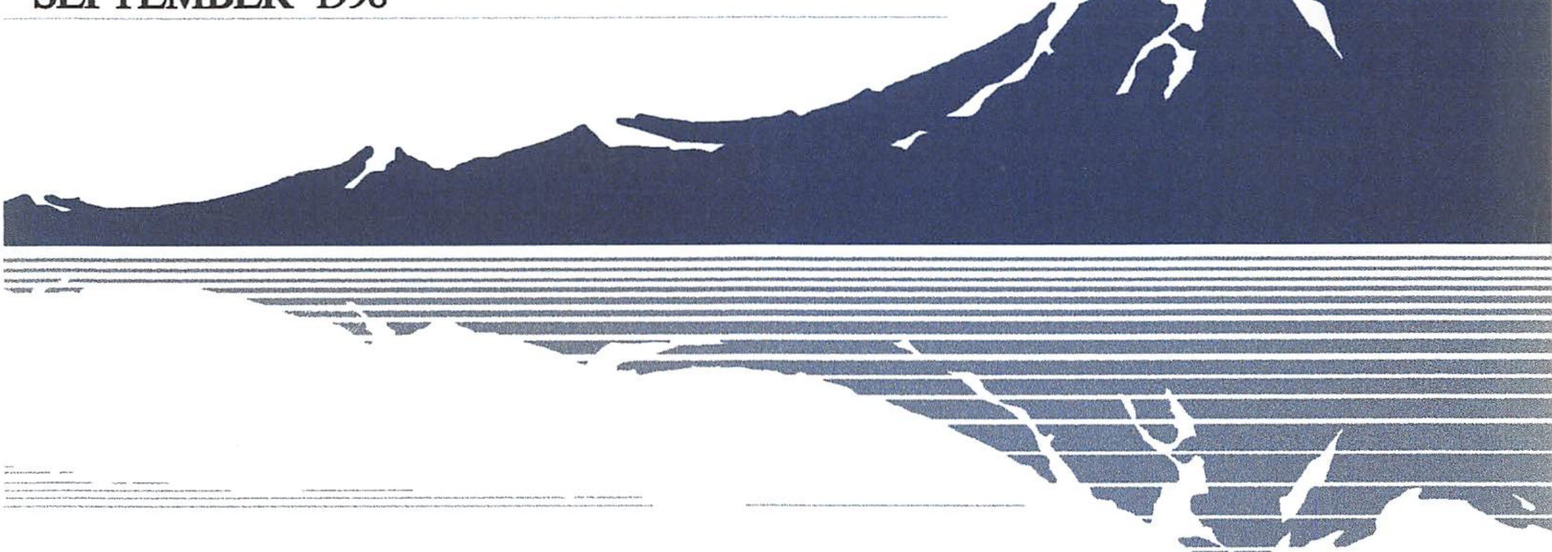
LONG TERM COMPLIANCE WORK PLAN FOR WASTEWATER TREATMENT AND DISPOSAL

BIG SKY, MONTANA

SEPTEMBER 1998



HKM ENGINEERING

TABLE OF CONTENTS

Page

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LIST OF FIGURES

LIST OF TABLES

<u>APPENDIX</u>

A) MAP OF COLLECTION SYSTEM

B) SOILS DATA AND DRILL LOGS ON GOLF COURSE

C) WATER QUALITY STANDARDS

D) DRILL HOLE GRADATIONS AT MICHENER CREEK SITE

E) NONDEGRADATION RULES

F) SURFACE WATER QUALITY DATA FROM 1976 AND 1994

G) GROUND WATER QUALITY DATA FROM 1972 AND 1994

H) WATER CONSERVATION ORDINANCES AND LETTERS

I) SEWER REPAIRS COMPLETED

J) SEWER FLOW MONITORING RESULTS

K) GOLF COURSE IRRIGATION AREA AND MONITORING DATA

L) GALLATIN RIVER STREAM FLOW RECORDS

M) CIRCULAR WQB-7 MONTANA NUMERIC WATER QUALITY STANDARDS

N) MEMORANDUM ON TREATMENT SYSTEM EVALUATION

O) SNOWMAKING PILOT TEST RESULTS - DELTA ENGINEERING AND SOIL PROFILE LOGS FROM POTENTIAL SITE

P) DRAFT DISCHARGE PERMIT

1.0 SUMMARY

1.1 EXECUTIVE SUMMARY

This Long Term Compliance Work Plan has been prepared as required by a compliance order issued by the Montana Department of Environmental Quality. The compliance order requires the Big Sky Water and Sewer District to evaluate the capacity of the wastewater collection and treatment facility and develop a plan for handling projected 20 year flows. Several options for wastewater treatment and disposal were evaluated. Evaluation criteria included compliance with the applicable State of Montana regulations, technical feasibility, and capital and annual costs.

Option "2C" (See Section 7.1.6) is the District's preferred wastewater management strategy for the next 20 years. As described in the work plan, Option 2C utilizes a combination of direct discharge and beneficial reuse to dispose of up to 207.8 million gallons per year of treated wastewater.

154.8 million gallons per year will be treated in a biological nutrient removal plant to remove nitrogen and phosphorous, filtered, and disinfected. The treated wastewater will be applied to the local golf course and discharged to the Gallatin River as follows:

- Spray irrigate 143.3 MG/year on the golf course.
- Discharge 11.5 MG/year to the Gallatin River in compliance with ARM 17.30.715 - Non-degradation requirements.

53 MG/year will receive pretreatment in an aerated storage pond and be supplied to a snowmaking system. The snowmaking system will be located on approximately 21.7 acres of private land located near the Big Sky ski area.

The estimated capital cost of Option 2C is approximately 11.14 million dollars, the estimated annual operation and maintenance cost is approximately $293,000. It is anticipated general obligation bonds or revenue bonds will be used to finance the design and construction of the improvements although the District Board has not finalized the financing method.

1.2 REGULATORY BACKGROUND

The Montana Department of Environmental Quality (previously Health & Environmental Services) issued a compliance order to the District on July 13,1993. The order required the District to submit both an interim action work plan and a long term compliance work plan. The order also placed a moratorium on new sewer connections that prevented any new construction activity. On August 31, 1995 the DEQ issued the "First Amendment to Compliance Order" that defined the conditions for lifting the moratorium.

The interim action work plan final version was submitted to the DEQ on December 31, 1995. The IAWP was approved, and construction contracts for several system improvements were awarded including:

1. Wastewater Filtration System
2. Expanded Golf Course Irrigation System
3. Expanded Irrigation Pump Station
4. Enlargement of Storage Pond Volume to 79.9 Million Gallons
5. Temporary Irrigation System on Horse pasture Land South of the Golf Course

All IAWP improvements are complete. The DEQ has rescinded the sewer connection moratorium as specified in the First Amendment.

2.0 INTRODUCTION

2.1 GENERAL

Big Sky, Montana is an unincorporated community located within the Gallatin Canyon. Big Sky is a resort community featuring a nationally recognized ski area. The area is a destination resort and therefore has a highly variable population. The development consists of two major housing areas, the Mountain Village located at the base of the ski hill and the Meadow Village located above the confluence of the South and Middle Forks of the West Fork of the Gallatin River.

HKM Associates was retained on August 26, 1992 to perform an analysis of the wastewater collection and treatment system at Big Sky. The analysis of the wastewater system is contained in this facilities plan, which has been prepared in accordance with the Facilities Plan/Environmental Review checklist contained in the Handbook of Procedures for State Revolving Loan Fund.

2.2 HISTORICAL BACKGROUND INFORMATION

Planning for the Big Sky Resort began in the late 1960's by Chet Huntley and Chrysler Realty Corporation. In August of 1969, Big Sky of Montana, Inc. was formed with a Certificate of Incorporation issued in Delaware.

Prior to 1965, land in the West Fork area was controlled by the Forest Service and private landowners. Three land exchanges between the U.S. Forest Service and Burlington Northern, Inc. occurred between 1967 and 1972. The land exchanges were intended to consolidate lands within the Gallatin and Beaverhead National Forests and Yellowstone National Park to promote more effective land management. In the three land exchanges Burlington Northern acquired, approximately 15,189 acres of which 11,523 acres were located in the West Fork area. Following the land exchange, 1,927 acres were then sold to Big Sky. Prior to the land exchanges, Big Sky had purchased 8,721 acres of land in the West Fork area from private individuals. The land purchases gave Big Sky of Montana ownership and control of 10,648 acres in the West Fork area. Big Sky also obtained Forest Service special use permits for a portion of the ski runs and lifts.

The first land exchange between the Forest Service and Burlington Northern was not opposed and was completed in 1967. The second and third land exchanges were quite controversial. The Regional Forester approved exchange #2 on June 26, 1970 and exchange #3 on December 9, 1970. The approval was appealed by a citizens group. The appeals were denied by the Chief Forester in October of 1971 and by the Secretary of Agriculture in 1972. The citizen group then sued the Secretary of Agriculture in federal district court. The district court decided in favor of the Secretary of Agriculture on May 23, 1972. The district courts decision was appealed to the Ninth Circuit Court of Appeals. In September 1973, the appellate court affirmed the district court decision.

In March of 1971, Big Sky of Montana, Inc. created and provided covenants for the Meadow Village Subdivision. The covenants require that "all improvements or structures designed for occupancy or use by humans shall be connected with the water and sewer facilities constructed or installed by Big Sky or a special improvement district. No private well, septic tank, leaching field or other private sewage treatment facility shall be used or installed in the subdivision." The protective covenants were referenced in the July 1, 1971 Environmental Impact Statement prepared by the Forest Service for Land Exchanges Number 2 and 3 between Burlington Northern, Inc. and the Forest Service.

In August 1971, the Gallatin County Special Improvement District No. 305 was created. The boundary for the District was essentially the Meadow Village area plus the wastewater treatment site. In April of 1973, the District was expanded to include the Mountain Village area.

In October of 1972, the Big Sky Owners Association, Inc. (BSOA) was issued a Certificate of Incorporation. The purposes of BSOA is stated in its Articles of Incorporation as summarized below are:

a) To manage, operate, and maintain the area described as Big Sky of Montana, Inc.

b) To buy, own, acquire, sell, lease, rent, encumber, and possess real and personal property to carry out the functions of the corporation.

c) Either directly or by agreement with third parties to provide municipal or quasi-municipal services and functions.

d) To make assessments, collect assessments, file liens for unpaid assessments, and prosecute foreclosures.

e) To administer and enforce all protective covenants.

In May 1976, Boyne Mountain Lodge, Inc. bought the controlling interest of Big Sky of Montana, Inc. Boyne Mountain Lodge, Inc. merged with Boyne Highlands, Inc. in May of 1978. The new corporation was named Boyne USA, Inc.

In May of 1982, the Westfork properties (Westfork Meadows Subdivision) dedicated its entire sewer system to RID 305. In return, the RID agreed to provide hook-ups in the subdivision sufficient for a peak daily flow of 48 thousand gallons per day.

In an August 1985 Montana District Court decision, a 1971 agreement between Westland Enterprise (Simkins/Taylor land) and Big Sky of Montana, Inc., (Boyne USA successor in interest) was interpreted. The court's decision was later upheld by the Montana Supreme Court in April 1989. The court ruled that the Simkins lands have rights to sewer capacity of up to 43 million gallons per year (or 3700 population equivalency), without a financial obligation to share in facility costs. In addition, the Court ruled that sewage originating from Simkins land would be entitled to free treatment for up to 1 million gallons per year until the year 2001. As of December 31, 1995, there were no sewer hook-ups to these properties.

In October 1991, Boyne USA, Inc. filed a complaint in the Montana Eighteenth Judicial District Court against RID 305 asking the court to declare that Boyne USA has no continuing obligation to pay all or part of the cost of expanding the wastewater collection and/or treatment facilities of RID 305. As of December 31, 1995, this litigation is ongoing.

In January 1992, RID 305 placed a moratorium on specified new sewer hook-ups to the system. The moratorium does not apply to the following:

- Original Platted Subdivisions

- Sweet Grass Hills
- Meadow Village
- Cascade

- Court required capacity for Westland Enterprises.
- Contractual arrangements with West Fork Meadows.
- Tracts involved in BSOA/Boyne pond agreement.
- All developments officially granted a hook-up prior to the moratorium.
- All undeveloped lands currently paying sewer assessments.

In March of 1993, a Memorandum of Understanding (MOU) was entered into by Boyne USA, RID 305, and BSOA. The MOU allowed and directed BSOA to take all steps necessary to create a County Water and Sewer District without effecting the position, rights, obligations or liabilities of the parties in the litigation between Boyne USA and RID 305. On July 26, 1993, the voters approved the creation of the Water and Sewer District 363.

Just prior to the vote to create the Water and Sewer District, the Montana Department of Health and Environmental Sciences (DHES) issued a Compliance Order to RID 305 which restricted RID 305 from issuing further permits to connect to the sewage system without prior approval from the DHES. In part, the Compliance Order stated "A building or facility that is not under construction or fully constructed at this time may only be connected to the existing Big Sky sewage system if:

(a) Respondents demonstrate to the Department that the connection will not result in biochemical oxygen demand loading to State Waters that exceed the Department approved Maximum Annual Load..."

On August 31, 1995, the DEQ issued its "First Amendment to Compliance Order". A second and third amendment have been issued on October 27 and December 1, 1995, respectively.

3.0 PLANNING AREA

In August of 1971, the Gallatin County Commissioners created by Resolution the Gallatin County Special Improvement District No. 305. At that time, the boundary for the District was essentially the Meadow Village area which is in Gallatin County. In April of 1973, the boundaries of RID 305 were expanded to include the Mountain Village area which is in Madison County. The expansion was created by joint resolution of both Madison and Gallatin Counties.

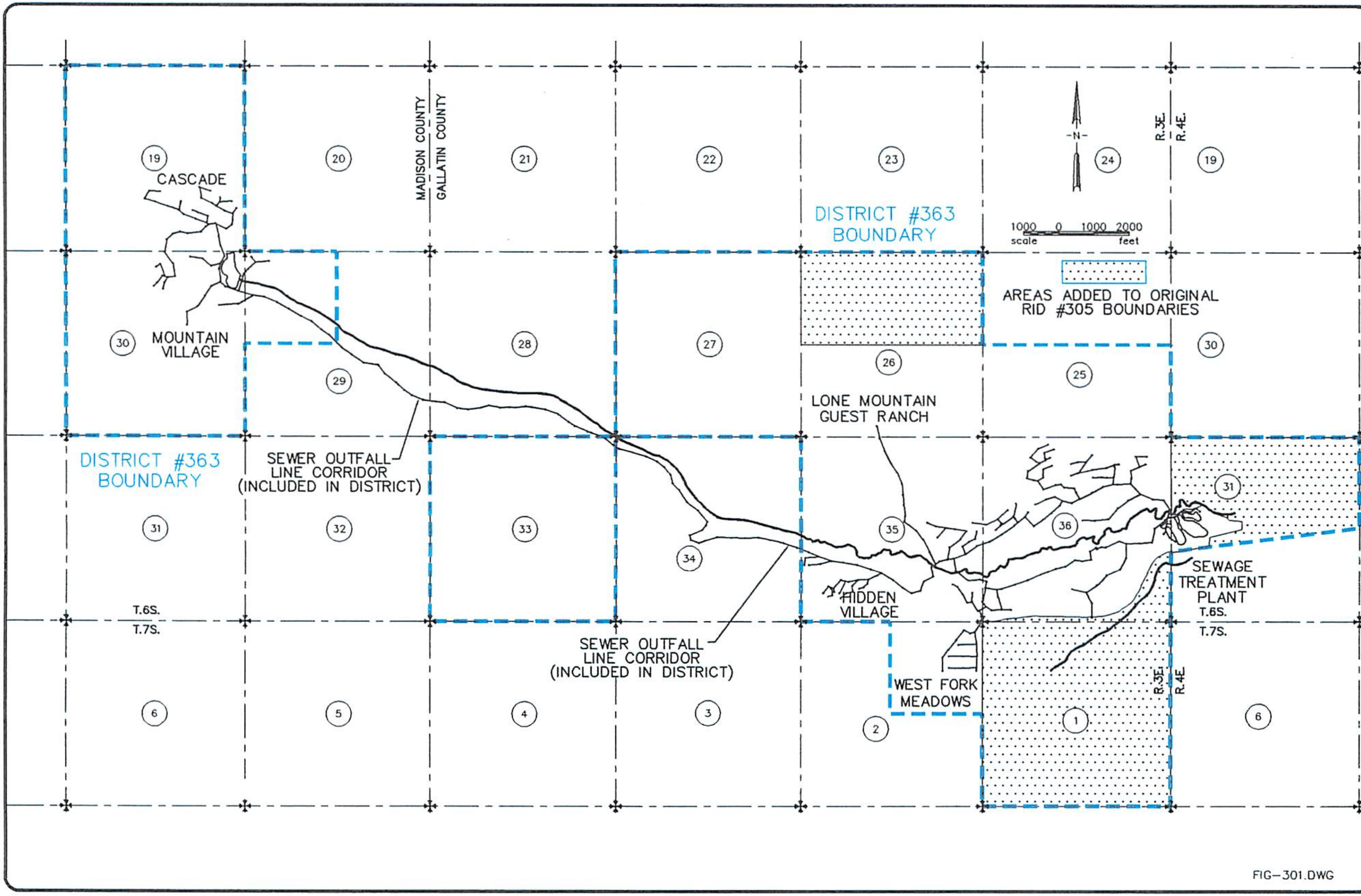
Water and Sewer District 363 was organized under Title 7, Chapter 13, Parts 22 and 23, MCA. The district's boundaries are located in both Madison and Gallatin Counties. A petition to create the district was presented to the County Commissioners of both Madison and Gallatin Counties. The County Commissioners of both Madison and Gallatin Counties conducted a public hearing and made changes in the proposed boundaries in response to public input, and subsequently gave a notice of election to create the district. In July of 1993, the voters approved the creation of the Big Sky County Water and Sewer District No. 363.

Figure 3.0-1 shows the boundaries of the District and also the boundaries of RID 305 that existed prior to the creation of the District. As indicated, the District has slightly expanded the previous RID boundary. The new planning area in the District consists of approximately 6,240 acres versus approximately 4,800 acres in the previous RID 305. The District expansion includes the area of the existing wastewater treatment lagoons. Through the public hearing process, the lower basin area along Highway 191 had the opportunity to be included in the District's boundaries. Lacking a consensus of support from the lower basin area, this area was not finally included within the District.

Land use and zoning at the resort is complicated by the fact that the DESIGNATED resort area lies in Madison and Gallatin Counties. The Meadow Village area lies in Gallatin County while the Mountain Village lies in Madison County. A draft land use plan was prepared in 1992 for Gallatin County by an Advisory Committee. The draft land use plan addressed development concepts for the area generally. The plan stopped short of formulating zoning ordinances and zoning maps. In 1993, a document was published by the Gallatin County Planning Office which proposed guidelines and design standards for hillside development, ridgeline development, view shed protection, and stream access and preservation in the Gallatin Canyon/Big Sky Planning District. No land use planning studies have been initiated for the Madison County portion of the resort area. Development in the resort area consists primarily of residential, commercial, and recreational areas. Commercial core areas are located at the Mountain Village base lodge area and the Meadow Village area.

State and county records were reviewed to determine the number of subdivisions approved by the Department within the District's boundaries, where the RID or District's sewage treatment system was relied upon for sewage treatment and disposal and upon which Department approval was granted. The District's records were specifically reviewed to determine the actual number of connections and Single Family Equivalents (SFE's) associated with each approved subdivision or other development. Table 3.0-1 lists the number of housing units which have sewer connections or which the District has legal commitments to provide sewer connections once they are developed based on Department approvals relying on the RID or district's sewage treatment system. The table also lists the number of SFE's associated with each subdivision or other development. The schedule used to calculate an SFE is shown in Table 3.0-2.

The total of SFE's resulting from all state approved subdivisions and developments including Westlands represents the minimum capacity to which the District is legally obligated to provide sewage treatment and disposal.



BIG SKY WASTEWATER FACILITY PLAN

WATER AND SEWER DISTRICT BOUNDARY

FIGURE 3.0-1

HKM ASSOCIATES
ENGINEERS · PLANNERS

4M357.102	MARCH 1994

AMENDED TABLE 3.0-1 LONG TERM COMPLIANCE WORK PLAN

Table 3.0-1 Number of Sewer Connection Commitments in the Planning Area — **As Adopted July 16, 1997**

PROPERTY	COMMITMENTS		CURRENTLY OCCUPIED		CONDO ASSOC. (SFE)
	TOTAL	SFE	TOTAL	SFE	
I. MEADOW VILLAGE AREA					
A. Homes (Lots)					
Meadow Village	249	412.8	119	197.3	
Sweetgrass Hills	90	165.0	34	62.4	
Pinewood Hills	5	9.4	5	9.4	
South Fork Phase I	25	42.5	0	0.0	
B. Condominiums (Units) [1]					
Silverbow (TR 1 &1A)	70	84.0	70	84.0	6.3
Yellowstone (TR 3 BLK 1)	42	48.6	42	48.6	6.3
Glacier (TR 7 BLK 2)	64	77.0	64	77.0	6.3
Broadwater (TR 9 BLK 5)	72	72.0	16	16.0	
Teton (TR 4 BLK 1)	40	69.3	3	5.2	
Park (TR 2 BLK 1)	29	38.9	29	38.9	3.7
Tract 5 BLK 2 [1]	22	29.0	0	0.0	
Tract 6 BLK 2 [1]	50	65.9	0	0.0	
Tract 8 BLK 6 [1]	64	84.3	0	0.0	
Tract 11 BLK 4 [1]	60	79.0	0	0.0	
Tract E	20	20.4	0	0.0	
Hidden Village [2]	184	314.0	142	242.0	4.7
Blue Grouse Phase I & II [3]	147	196.2	8	10.8	
Sweetgrass Tract 2	82	149.5	0	0.0	
C. Hotels and Motels					
Golden Eagle (rooms)	42	28.0	42	28.0	
Westfork Hotel (River Rock)	29	19.3	29	19.3	
Lone Mountain Ranch	--	39.2	--	39.2	
D. Commercial					
Meadow Village Minor #91 & COS 409 [4]	--	108.2		30.2	
Golf Course	--	5.4		5.4	
Tennis Courts (TR A-1) [5]	--	34.2	1	1.0	
Minor Sub-Camper Village	--	4.7		4.7	
SUBTOTAL FOR MEADOW VILLAGE AREA	1,386.00	2,196.8	604.0	919.4	27.3
IA. COMMITMENTS BY AGREEMENT/COURT ORDER					
A. Westfork Meadows [6]	--	448.0	--	157.6	--
B. Westland Projected Commitment [7]	--	1434.9	--	0	--
SUBTOTAL FOR PRIOR COMMITMENTS	-	1,882.9	-	157.6	-
IB. PENDING DEVELOPMENTS W/ PRIOR COMMITMENT FOR SERVICE					
A. Aspen Groves	89	142.4	--	--	--
B. South Fork- Phase II [8]	97	155.0	--	--	--
SUBTOTAL FOR PENDING DEVELOPMENTS	186.0	297.4	-	-	-
MEADOW VILLAGE AREA SUBTOTAL	1,572.0	4,377.1	604.0	1,077.0	27.3

Amended Table 3.0-1 Number of Sewer Connection Commitments in the Planning Area

PROPERTY	COMMITMENTS TOTAL	COMMITMENTS SFE	CURRENTLY OCCUPIED TOTAL	CURRENTLY OCCUPIED SFE	CONDO ASSOC. (SFE)
II. MOUNTAIN VILLAGE AREA					
A. Homes (Lots) Cascade	362	757.1	23	48.1	
B. Condominiums (Units) [1]					
Hill-Cascade	180	180.0	180	136.8	
Skycrest-Cascade	303	388.6	35	50.05	6.2
Tract 1-Cascade [1]	69	71.1	0	0	
Tract 2-Cascade [1]	108	111.2	0	0	
Tract 4-Cascade [1]	37	38.1	0	0	
Tract 5-Cascade [1]	338	348.1	0	0	
Tract 6-Cascade [1]	20	20.6	0	0	
Tract 7-Cascade (Fire Station)	–	6.8	1	1.84	
Tract 8-Cascade (Electrical Service Facility)	–	0.0	–	–	
Tract 9-Cascade (Water Storage Site)	–	0.0	–	–	
Tract 10-Cascade (Water Storage Site)	–	0.0	–	–	
Tract 12-Cascade [1]	–	31.0	0	0	
Areas 1-13-Cascade [10]	130.8	273.5	0	0	
Stillwater (Built Out)	63	67.0	63	67.0	
Beaverhead [9]	68	147.4	40	84.4	
Lake	135	156.5	45	57.95	
Arrowhead- Residential (Built Out)	24	52.0	24	52.0	
Arrowhead- Commercial (Built Out)	12	17.5	12	17.5	
Bighorn (Built Out)	70	108.6	70	108.6	
Shoshone (Built Out)	94	100.3	94	100.3	
C. Hotels and Motels					
Mountain Lodge- Condo A Rest./Bar (Cascade Tr. 3)	-	6.1	-	6.1	
Mountain Lodge- Condo B Lodge (Cascade Tr. 3)	84	49.5	84	49.5	
D. Employee Housing					
Dorm Space (156 beds)	85	39.0	85	39.0	
Married Housing	4	4.0	4	4.0	
E. Mountain Commercial Core (Built Out)	–		–		
Huntley Lodge- Guest Rooms (Built Out)	204	128.8	204	128.8	
Huntley Lodge- Commercial, Retail & Other	–	28.3	–	28.3	
Yellowstone Conference Center	–	39.55	–	39.55	
Mountain Mall	–	71.6	–	71.6	
Snowcrest Skiers Services	–	18.85	–	18.85	
Maintenance Shop	–	0.5	–	0.5	
Mtn. Commercial Core Subtotal	204	287.6	204	287.6	
MOUNTAIN VILLAGE AREA SUBTOTAL	2,594.8	3,549.2	1,168.0	1,398.3	6.2

SUMMARY TOTALS FOR ALL DEVELOPMENTS					
MEADOW VILLAGE AREA					
MEADOW VILLAGE	1,386.0	2,196.8	604.0	919.4	
CONDO ASSOCIATIONS		-		33.5	
COURT ORDER/AGREEMENT COMMITMENTS	-	1,882.9	-	157.6	
PENDING W/ PRIOR COMMITMENT	186.0	297.4	-	-	
TOTAL	1,572.0	4,377.1	604.0	1,110.5	-
MOUNTAIN VILLAGE AREA					
TOTAL	2,594.8	3,549.2	1,168.0	1,398.3	-
GRAND TOTAL OF LEGAL OBLIGATIONS	4,166.8	7,926.3	1,772.0	2,508.8	-

FOOT NOTES:

1 Condominium & Light Commercial tracts are estimated at 12 units per acre on undeveloped tracts at 1.03 SFE's per unit.

2 Hidden Village- added 72 SFE's assuming 40 condo units at 1.8 SFE's per unit (refer to minutes of August 7, 1996)

3 Blue Grouse Hills Phase I & II- added 27 units at 1.4 SFE's per unit= 37.8 SFE's, total 196.2 SFE's (refer to minutes of August 7, 1996).

4 Meadow Village Minor #91 includes the Meadow Village Commercial Center (13.8 SFE's); COS 409 includes Chase Montana Building (16.4 SFE's) added an undivided 78 SFE's (refer to minutes of August 7, 1996).

5 Tennis Courts (Tract A-1)- adjusted to 34.2 SFE's conditioned on use maintained as business/recreational (refer to minutes of August 7, 1996).

6 Westfork Meadows- adjusted to 448.0 SFE's, but conditioned on a flow commitment of 48,000 gpd peak flow per Sewer Dedication dated May 17, 1982 (refer to minutes of August 7, 1996).

7 Westlands flow commitment based on Supreme Court decision (Westland v. Boyne, April 27, 1989)- 43,000,000 gallons per year divided by a flow of 29,967 gallons per year per SFE.

8 South Fork Phase II- added to list of obligations for 155 SFE's for remainder of development in the NE ¼ of Section 2, assumes 1.7 SFE's per unit for Phase I & II.

9 Beaverhead- adjusted from 60 units to 68 units averaging 2.25 SFE's per unit, added 63 SFE's to exsitng 84.4 SFE's.

10 Areas 1-13- Covenants allow 2 single family units per acre, total of 64.522 acres assume 2.09 SFE's per residence.

TABLE 3.02

As Approved on July 15, 1997

SINGLE FAMILY EQUIVALENT UNIT CONVERSION SCHEDULE

PROPERTY USAGE[1]	SFEs PER UNIT[3]
Single Family Residences, Townhouses and Condominiums:[2,3]	
· Two bedrooms or less	1.00
· Each bedroom in excess of two	0.40
· Each bath, or portion thereof, in excess of two	0.20
· Private jacuzzi or hot tub, each	0.35
Studio Apartment/Condominiums: (single room less than 500 sq. ft. with single bathroom)	0.70
Hotel, Motel or Lodge, per rental room[2]	0.60
· Jacuzzi, spa or hot tub, each	0.75
· Swimming pool	2.00
· Banquet rooms, per seat	0.03
· Conference rooms, per seat	0.02
Employee Housing:	
· Condominium Type, per unit	1.00
· Dormitory Type, per bed	0.25
Snack Bars and Delicatessens:[4]	
· 500 sq. ft. or less	1.00
· Each sq. ft. in excess of 500 sq. ft.	0.003
Convenience Type Food Stores and Shoppers	1.00
Cafeteria, Lounges and Bars, per seat	0.07
Full Service Restaurants, per seat	0.07
Self-Service laundromat, per washing machine	1.30
Beauty Salon, Barber Shops, Hairdresser, per station	0.35
Fire Stations, Maint. Bldgs, Machine Shops, Warehouses and Garages, per 1,000 sq. ft.	0.15
Offices and Office Buildings, per 1,000 sq. ft.	0.75
Retail Stores, per 1,000 sq. ft.	0.50
Ski Areas, sum of SFE Units from other applicable use categories plus 85% of total hourly lift capacity times	0.001
Public Restrooms, per toilet unit	0.50
Non-Public Restrooms, per toilet unit	0.20
Health Spas/Fitness Centers, per 1,000 sq. ft.	1.50
Residential Swimming Pools w/controlled sewer connection, per 1,000 sq. ft. of pool area	
· Single Family	1.00
· Multi-Family	3.00
Churches, conference/meeting/banquet rooms, and similar facilities <u>without</u> in-house food serving capacities per	.40
Churches, conference/meeting/banquet rooms, and similar facilities <u>with</u> in-house food serving capacities per 1,000	.50
Day-care centers, per unit of child care capacity	.05
Ski Rental Shops, per 1,000 SF	1.0
Travel Trailer Parks	
· Without individual water & sewer hook-ups, per space	.25
· With individual waster & sewer hook-ups, per space	.30
Undesignated commercial space, per 1,000 SF	.60

FOOTNOTES TO SCHEDULE:

1If more than one use category is applicable to a particular building, the building will be divided into areas of similar use categories and the SFE Units for the building will be computed by adding the SFE units determinations for each use category area. For example, if a portion of a single family home is used as an office, the single family home will be divided into a "single family residence" area and an "office" area and the SFE units for the entire building will be the sum of the SFE units determined separately for the uses not specifically described in this table, such as condominium recreational facilities, pools, dormitory-style quarters, etc., the number of SFE units to be assigned shall be determined on a case-by-case basis by the Manager. No less than 1.0 SFE unit will be assigned any building or portion thereof that has a separate service line and/or that is to be billed individually for sewer service.

2For the purpose of SFE unit determinations, a "loft" area shall be equivalent to a minimum of one bedroom. More than 1.0 SFE unit may be assigned if warranted by the size and characteristics of the loft area. For the purpose of SFE unit determination, an area designated as a "den", "library", "study", "sewing room", or the like, shall be equivalent to a minimum of one bedroom if such area has an accompanying closet.

3For the purpose of the table: (a) a residential building or portion thereof shall be considered a duplex if it has more than one kitchen area, and (b) any portion of a residential building or unit that can be used independently of the remainder of the residential building or unit (e.g. lock-off unit shall be considered a separate residential building or unit).

4In computing area, the "total usable area" shall be used. "Total usable area" includes but is not limited to: kitchen areas, serving areas, washing areas, occupant areas, waiting rooms, store rooms, restrooms, lunch rooms, halls, entryways, show rooms, and retail areas

4.0 EXISTING CONDITIONS

4.1 ENVIRONMENTAL

4.1.1 Geology and Soils

The Big Sky area lies at the southern end of the Northern Rocky Mountain Physiographic Province. The mountains were formed by the Madison-Gallatin uplift, which is a broad anticlinal uplift and faulted block with exposures of Pre-Cambrian to Tertiary rock. The Gallatin River flows north along a structural low in the middle of the uplift, separating the Madison Range on the West from the Gallatin Range on the east (Montagne, 1971).

The Big Sky area is located within a northwest trending basin in the Madison Range. The major surface drainage of the Big Sky area is the West Fork, which is a tributary of the West Gallatin River. The West Fork basin is not only a topographic basin, but is also a geologic structural basin. That is, the underlying geologic units (which are sedimentary rocks which were originally deposited in horizontal layers) have been structurally folded into a basin, that roughly coincides with the topographic drainage basin of the West Fork. The geologic materials exposed at the surface in the basin are primarily fine-grained sedimentary rocks (claystones and shales) from the Cretaceous geologic period, or are relatively thin mantles of glacial, alluvial, colluvial, landslide, or other deposits from the Quaternary geologic period. There are also scattered intrusive volcanics throughout the basin.

West Fork Basin is bounded to the south by the Buck Creek anticline and the Andesite Anticline. It is bounded to the north by the Spanish Creek Fault, which is a northwest trending, high angle reverse fault. The rocks north of the fault are an uplifted block of relatively resistant crystalline rock which form the Spanish Peaks. Dudley Ridge, a prominent northwest trending hogback, forms the north flank of the basin both structurally and topographically. The sedimentary units that form Dudley Ridge dip steeply to the southwest.

The West Fork basin is bounded to the west by Lone Mountain, which is formed of multiple andesitic intrusions alternating with the sedimentary layers of the country rock. Fan, Cedar, and Pioneer Mountains to the southwest are similar to Lone Mountain.

The Quaternary (the most recent geologic time period) geology of the West Fork Basin was studied in some detail by Walsh (1971), Kewhew (1970), and Montagne (1971) prior to the Big Sky development. The specific area of the Big Sky Wastewater Treatment Facility was studied by Walsh (1971). The West Fork Basin was altered primarily by glaciation and extensive landsliding during the Quaternary.

The Big Sky Wastewater Treatment Facility is located near the trough of the West Fork basin on an outwash terrace that was deposited on the underlying sedimentary bedrock of the late Cretaceous geologic time period. The terrace is formed of alluvial deposits of glacial meltwater. The terrace deposits are primarily sand and gravel, but also include silt and clay at depth. The underlying bedrock is primarily claystones and shales, but may contain some thin sandstone interbeds. The bedrock dips gently to the southwest at the location of the Wastewater Treatment Facility.

The outwash terrace that is occupied by the Big Sky Wastewater Treatment Facility is bounded to the south by the South Fork (of the West Fork) and bounded to the north by the Middle Fork (of the West Fork). The site is located about 4000 feet above the confluence of these streams. The present day stream bed of the South Fork is incised into the underlying sedimentary rocks to an elevation well below the terrace deposit. The shale bedrock is exposed and easily visible in the stream cut bank of the South Fork.

Based on the relatively impervious nature of the upper-Cretaceous shales exposed near the surface, the surface streams and near-surface aquifers are probably completely isolated from the deeper aquifers in the vicinity of the Big Sky Wastewater Treatment Facility. The near-surface aquifers consist primarily of the coarser-grained Quaternary deposits such as stream alluvium and outwash deposits. Based on the surrounding private wells, small amounts of water can also be obtained from the near-surface (shallower than 150 feet), fine grained, sedimentary bedrock. The water from the near-surface bedrock probably comes from thin interbeds of slightly more pervious materials such as siltstones and sandstones.

As was previously described, the Big Sky Wastewater Treatment Facility is located on an outwash terrace that separates the South Fork (of the West Fork) and the Middle Fork (of the West Fork). The present day stream bed of the South Fork is incised into the underlying sedimentary rocks (shale) to an elevation well below the terrace deposit. By being incised below the terrace deposits, the stream and the stream alluvium of the South Fork is effectively decoupled from the gravelly terrace deposits. This means that other than the lateral seepage that may spill (seep) from the terrace deposits into the stream, the stream and the terrace are hydraulically unconnected. For example, the groundwater levels in the terrace would not be affected by rising and lowering surface flows in the South Fork. Incidentally, small damp areas and seepage zones can be observed in the South Fork stream cut near the contact of the terrace gravels and the underlying shale.

The stream bed of the Middle Fork is also incised 15 to 20 feet below the surface of the terrace deposits, and appears to be decoupled from the surface flows and stream alluvium. The underlying shale bedrock is exposed in a seepage area located just east of the aeration cells and southeast of Storage Cell Number 1. Assuming this is representative of the location of the base of the terrace deposits, groundwater would not flow from the stream alluvium into the terrace gravels even during relatively high flow events.

Since the outwash terrace that is occupied by the Big Sky Wastewater Treatment Facility appears to be decoupled from the adjacent streams, the only natural groundwater flows in the terrace deposits would be derived from precipitation falling on the immediate upslope vicinity (presently the golf course). It is suspected that the natural groundwater flows in the terrace materials are relatively minor amounts, and that the most significant flows are derived from infiltration of irrigation water on the golf course.

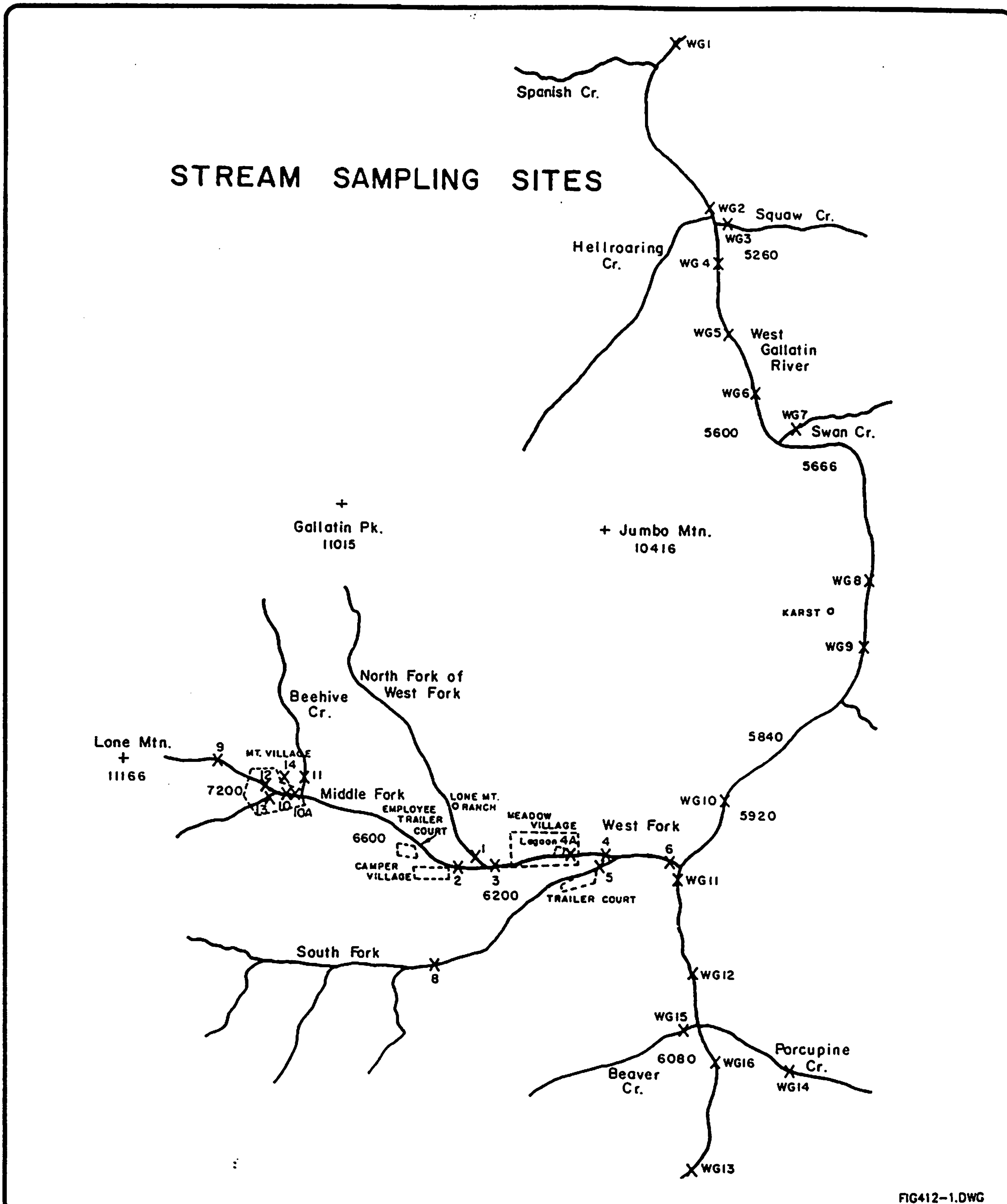
Most of the surface infiltration into the terrace deposits probably flows vertically to the underlying shale barrier, and then laterally to drain into the adjacent streams. If the suspected thin zones of interbedded siltstone and sandstone exist in the shale bedrock, a small amount of flow may infiltrate into interbeds where they outcrop beneath the terrace gravels. This is a potential pathway of contamination to the nearby shallow wells, although presently unconfirmed. The District currently has monitoring wells in place around the lagoons and regularly monitors the groundwater.

Soils data for the area was obtained from the U.S. Soil Conservation Service (SCS). The data is included in the appendix. Soils in the golf course area are primarily of the Libeg series. The soil is a well drained moderately permeable soil. To a depth of 7-inches, the soil is cobbly loam containing approximately 15 percent cobbles and 15 percent gravels. From 7 to 22 inches, the soil is very gravelly sandy clay loam with 45 percent gravels and 15 percent cobbles. From 22 to 45 inches, the soil is extremely cobbly sandy clay loam with 40 percent cobbles and 25 percent gravel.

4.1.2 Surface Water Quality and Flows

Surface Water. Two streams run in the vicinity of the existing treatment site. The Middle Fork of the West Fork of the Gallatin River runs directly north of the treatment site. The South Fork of the West Fork of the Gallatin River runs on the south side of the treatment site. Both streams converge downstream of Big Sky and are a contributory to the West Gallatin River.

While recent water quality data for the surface streams including the Gallatin River is limited, data collected during the early 1970's provides an indication of the water quality in the area (Stuart, et.al. 1976). The study by Stuart measured water quality for several parameters from 1971 through 1974. Figure 4.1.2-1 shows the stream sampling sites used in the 1976 study. Tables 4.1.2-1 and 4.1.2-2 summarize the data collected at Stations 4 and 4A on the West Fork and for Stations WG10 and WG11 located on the West Gallatin. A complete copy of the data from the 1976 study is included in the appendix (more recent water quality data are shown in Table 4.1.2-4).



BIG SKY WASTEWATER FACILITY PLAN

STREAM SAMPLING SITES

FIGURE 4.1.2-1

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4M357.102 | MARCH 1994

Table 4.1.2-1
Water Quality Data for West Fork
Sample Sites 4 and 4A

YEAR	NITRATE mg/l NO_3-N		AMMONIA mg/l NH_3-N		ORTHOPHOSPHATE mg/l PO_4^{-3}-P		FECAL/COLIFORM #/100ml
SITE #4	# SAMPLES	MEAN	# SAMPLES	MEAN	# SAMPLES	MEAN	MEAN
1971	14	0.06	11	0.02	13	0.01	
1972	13	0.04	12	<0.01	13	0.01	
1973	5	0.05	3	0.02	5	0.02	
1974	4	0.01	3	<0.01	4	0.04	1
SITE #4A							
1973	8	0.02	7	0.01	8	<0.01	4
1974	11	0.02	10	<0.01	11	<0.01	2

Table 4.1.2-2
Water Quality Data for West Gallatin
Sample Sites WG10 and WG11

	NITRATE mg/l NO_3-N		AMMONIA mg/l NH_3-N		ORTHOPHOSPHATE mg/l PO_4-P		FECAL COLIFORMS Organisms/100ml
YEAR	# SAMPLES	MEAN	# SAMPLES	MEAN	# SAMPLES	MEAN	Number/100 ml
WG11							
1970	7	0.03	8	<0.01	8	0.02	
1971	8	0.08	8	0.01	8	0.02	5
1972	13	0.01	12	0.02	12	0.02	9
1973	12	<0.01	9	0.05	12	0.02	5
1974	10	<0.01	9	0.01	10	0.05	7
WG10							
1970							
1971	9	0.01	9	0.01	9	0.01	15
1972	9	0.01	8	<0.01	9	0.02	27
1973							
1974							

A 1987 study (Kerin) listed the test results for the Middle Fork and South Fork given in Table 4.1.2-3.

Table 4.1.2-3 Water Quality Data for Middle Fork and South Fork		
LOCATION	NITRATE AS N (mg/l)	TOTAL PHOSPHORUS (mg/l)
Upstream of Plant on Middle Fork	0.09	0.018
Downstream of Plant on Middle Fork (150 yds. downstream at pumphouse)	0.05	0.019
Downstream of Plant on Middle Fork	0.08	0.013
South Fork Below Plant	0.02	0.011
South Fork Below Plant	0.02	0.021

Test results collected recently on the Middle Fork and Gallatin River are shown in Table 4.1.2-4.

The historical and recent data show that the surface water in the vicinity of Big Sky is of very high quality.

The mean monthly flows in the Gallatin River were obtained from the publication Water Resources Data for Montana, Water Year 1992. The gaging station for the Gallatin River flow measurements is located 0.3 miles downstream from Spanish Creek and covers a drainage area of 825 square miles. The published mean flows were adjusted to account for the smaller drainage area at Big Sky (557 square miles) than at the gaging station. The adjustment was made using the following equation obtained from Analysis of the Magnitude and Frequency of Floods and Peak Flow Gaging network in Montana:

$$\text{Ungaged Flow} = \left[\frac{\text{ungaged area}}{\text{gaged area}}\right]^{0.85} \times \text{gaged flow}$$

Table 4.1.2-5 shows the published and calculated mean flows.

Table 4.1.2-4 Water Quality Data for Middle Fork, South Fork and West Gallatin							
PARAMETER	DATE	SOUTH FORK	MIDDLE FORK ABOVE MEADOW	MIDDLE FORK BELOW MEADOW	MIDDLE FORK BELOW WWTP	GALLATIN RIVER ABOVE CONFLUENCE	GALLATIN RIVER BELOW CONFLUENCE RIVER
BOD_5 mg/l	8/28/92			1.0			
	9/10/92			2.0	2.0		
	9/15/92			2.0	2.0		
	1/26/94		1.0	2.0	1.0	1.0	
	2/23/94	<1.0	1.0	1.0	1.0	1.0	
	3/29/94	1.0	<1.0	2.0	1.0	1.0	<1.0
	4/25/94	1.0	1.0	<1.0	<1.0	<1.0	<1.0
	5/25/94	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total Suspended Solids-mg/l	1/26/94		2.0	5.0	12.0	<1.0	
	3/23/94	<1	1	2	26	3	
	3/2/94	3	2	36	13	11	20
	4/25/94	52	30	62	64	46	60
	5/25/94	188	38	42	37	112	64
Total Phosphorus-mg/l as P	3/23/87				0.01		
	8/28/92				0.11		
	9/10/92				0.12		
	9/15/92				0.08		

Table 4.1.2-4 (continued) Water Quality Data for Middle Fork, South Fork and West Gallatin							
PARAMETER	DATE	SOUTH FORK	MIDDLE FORK ABOVE MEADOW	MIDDLE FORK BELOW MEADOW	MIDDLE FORK BELOW WWTP	GALLATIN RIVER ABOVE CONFLUENCE	GALLATIN RIVER BELOW CONFLUENCE RIVER
	1/26/94		0.05	0.03	0.04	0.03	
	2/23/94	0.08	0.1	0.1	0.09	0.1	
	3/29/94	0.04	0.07	0.06	0.08	0.14	0.08
	4/25/94	0.14	0.10	0.09	0.09	0.08	0.10
	5/25/94	0.07	0.09	0.07	0.08	0.17	0.06
Nitrate & Nitrite as N	1/26/94		0.15	0.25	0.24	0.10	
	2/23/94	0.16	0.14	0.24	0.27	0.09	
	3/29/94	<0.05	0.08	0.22	0.21	<0.05	0.12
	4/25/94	0.12	0.09	0.10	0.10	0.11	0.12
	5/25/94	<0.05	0.05	0.06	0.05	0.07	<0.05
Ammonia-mg/l as N	1/26/94		<0.1	<0.1	<0.01	<0.1	
	2/23/94	<0.01	<0.1	<0.1	<0.01	<0.1	
	3/29/94	<0.1	<0.1	<0.1	<0.01		<0.1
Fecal Coliforms #/100ml	1/26/94		42	9		1	
	2/23/94	<1	18	7	4	4	
	3/16/94	<1	4	6	35	<1	3
	4/25/94	9	5	12	12	12	4
	5/25/94	<1	6	3	6	12	1

Table 4.1.2-5 Mean Flows in Gallatin River (cfs)					
Month	gaged site	ungaged site	Month	gaged site	ungaged site
January	306	219	July	1276	914
February	305	218	August	601	430
March	309	221	September	491	352
April	500	358	October	455	326
May	1765	1264	November	383	274
June	2908	2082	December	322	230

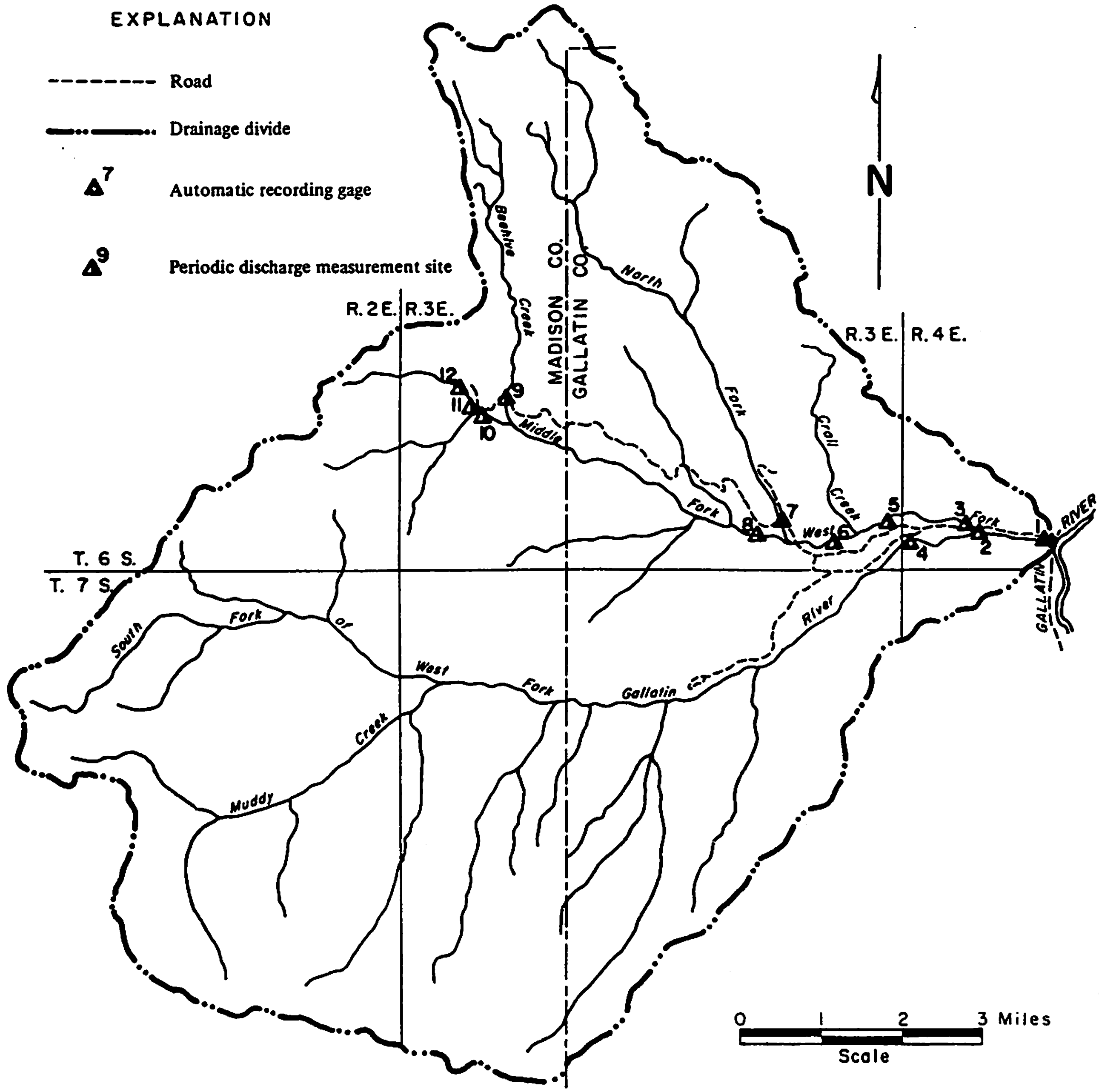
Limited data is available for streamflows in the Middle Fork and West Fork of the Gallatin River. A 1972 report by Van Voast lists flow measurements taken at 12 sites in the West Fork drainage during 1970 and 1971. The 1971 measuring sites are shown in Figure 4.1.2-2. Measured flows are listed in Table 4.1.2-6.

Table 4.1.2-6 Streamflows for West Fork Drainage					
LOCATION	DATE	DISCHARGE (cfs)	LOCATION	DATE	DISCHARGE (cfs)
Station 1 - West Fork Mainstem	8/2/70	111.33	Station 7 - N. Fork Gaging Station	8/10/70	8.03
	10/2/70	29.70		10/1/70	5.63
	10/31/70	26.98		10/31/7 0	4.43
	12/2/70	19.72		12/2/70	2.66
	1/3/71	8.88*		1/3/71	1.21
	2/2/71	18.52		2/2/71	1.97
	2/25/71	17.74		2/25/71	2.41
	3/25/71	12.25		3/25/71	1.23
	4/27/71	36.13		4/27/71	2.22
Station 2 - West Fork Below Dawes Bridge	8/2/70	105.29	Station 8 - Middle Fork .4 Mile Above North Fork Junction	10/31/7 0	5.70

Table 4.1.2-6(continued)
Streamflows for West Fork Drainage

LOCATION	DATE	DISCHARGE (cfs)	LOCATION	DATE	DISCHARGE (cfs)
				2/26/71	4.96
				3/26/71	3.40
				4/26/71	11.77
				5/25/71	57.90
Station 3 - North and Middle Forks at Culvert Under Road	8/2/70	47.12	Station 9 - Beehive Creek at Culvert	2/3/71	1.16
	10/31/70	13.08		2/26/71	.80
	12/2/70	12.36		3/26/71	.71
	2/2/71	9.64		4/28/71	1.03
	2/25/71	7.85	Station 10 - Middle Fork Below Upper Forks	2/3/71	1.93
	3/25/71	6.72		2/26/71	.90
	4/27/71	21.31		3/26/71	1.45
Station 4 - S. Fork Gaging Station	8/2/70	52.84		4/28/71	1.81
	10/2/70	20.50	Station 11 - North Fork of Middle Fork (upper forks) at Road	1/2/71	.98
	10/31/70	21.04		2/3/71	1.21
	12/1/70	6.50*		3/26/71	1.10
	1/3/71	7.08		4/28/71	1.35
	2/2/71	7.88	Station 12 - North Fork of Middle Fork (upper forks) at Road	1/2/71	.63
	2/25/71	11.86		2/3/71	.57
	3/25/71	6.61		2/26/71	.81
	4/27/71	16.66		3/26/71	.42
Station 5 - North and Middle Forks at Crail Ranch Bridge	12/2/70	9.44		4/28/71	.99
Station 6 - North and Middle Forks in Meadow Above Crail Creek	8/2/70	37.51	*Denotes probably poor accuracy		
	12/2/70	7.54			

Van Voast notes that during the 1971 period of lowest flow (March 25, 26) more than one-half the streamflow leaving the West Fork drainage originated in the South Fork subdrainage. A hydrologic budget developed in the Van Voast study indicates the average annual runoff from the West Fork watershed is 60,600 acre-feet (83.7 ft^3/s). The Middle Fork, North Fork, and West Fork mainstem drainages contribute 24,000 acre-feet (33.1 ft^3/s).



SOURCE: VAN VOAST, 1972

FIG412-2.DWG

BIG SKY WASTEWATER FACILITY PLAN

STREAM FLOW MEASURING SITES

FIGURE 4.1.2-2

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4.1.3 Groundwater

In order to monitor the groundwater condition around the lagoon, 7 monitoring wells were installed in 1987 (see Figure 4.1.3-1). The average values for 4 samples collected from April 8, 1987 to May 3, 1988 are shown in Table 4.1.3-1 (more recent groundwater data are shown in Table 4.1.3-4).

Table 4.1.3-1
Groundwater Summary

	WELL #1	WELL #2	WELL #3	WELL #4	WELL #5	WELL #6	WELL #7
Conductance umho/cm	516	508	506	589	549	337	429
Chloride mg/l	3.5	19	15	20	21	12	<1.25
Phosphorus mg/l	<0.03	<0.03	<0.04	<0.05	0.03	<0.02	<0.04
Ammonia mg/l	0.48	1.25	<0.10	<0.68	<0.22	0.2	<0.15
Nitrate + Nitrite mg/l	0.35	<0.14	0.38	1.08	<2.01	<0.08	<0.82

These values are generally higher than the adjacent surface water. One of the sources of groundwater in these terrace deposits has been seepage from the wastewater plant storage ponds and the irrigation of the golf course. The ponds were lined in the summers of 1996 and 1997. Therefore, the groundwater should no longer be influenced by seepage from the lagoons.

In addition to the data listed in Table 4.1.3-1, background ground water quality data is contained in a 1972 report titled Hydrology of the West Fork Drainage of the Gallatin River, Southwestern Montana, Prior to Commercial Recreational Development by Van Voast.

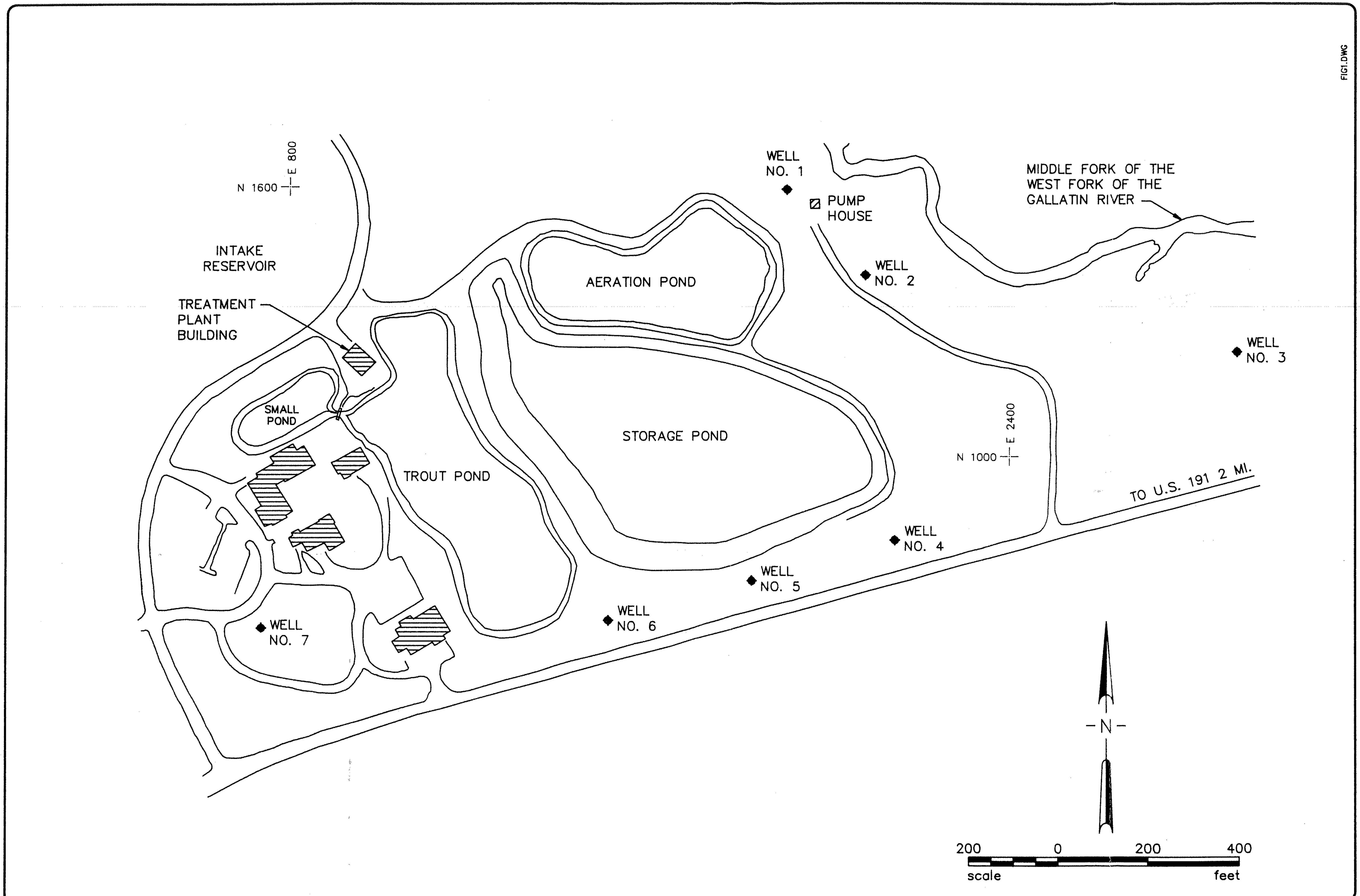

FIGURE 4.1.3-1

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BIG SKY WASTEWATER FACILITY PLAN
GROUNDWATER MONITORING WELL LOCATIONS

In the Van Voast study, wells and springs were sampled in the West Fork basin and along the Gallatin River upstream of the confluence with the Middle Fork. A copy of the location map and test data is included in Appendix G. Table 4.1.3-2 shows the background nitrate concentrations measured in 1970 for wells located in the vicinity of the golf course and the storage pond.

Table 4.1.3-2
Background Nitrate Concentrations
in Groundwater (Van Vast)

WELL #	WELL LOCATION	NO_3 -N (mg/l)
Cabin Wells		
1	06.04.31 dba	1.8
5	06.04.31 cab	2.9
17	06.04.31 dab	1.4
18		1.3
Test Wells		
4	06.03.36 caa	1.2
6	06.03.36 bdd	1.5

The Compliance Order issued by the DHES listed the nitrate plus nitrite test results shown in Table 4.1.3-3.

Table 4.1.3-3 Groundwater Data from Compliance Order		
MONITORING WELL	DATE	VALUE ppm NO_3+NO_2-N
1	4/8/87	1.04
5	4/8/87	4.6
4	5/12/87	3.9
5	5/12/87	3.36
7	5/12/87	1.00
1	5/3/88	0.81
3	5/3/88	0.85
7	5/3/88	1.33
1	5/10/89	10.4
3	5/10/89	1.07
5	5/10/89	4.00
7	5/10/89	1.92

Test results collected by the District from the 7 wells from January 1994 to May 1994 are shown in Table 4.1.3-4.

Table 4.1.3-4 1994 Groundwater Test Results (MG/L)							
	WELL #1	WELL #2	WELL #3	WELL #4	WELL #5	WELL #6	WELL #7
Nitrate + Nitrite as N							
01/26/94	1.24	3.83	<0.05	0.46	0.40		<0.05
03/02/94	<0.05	0.38	<0.05	<0.05	0.53		0.37
03/29/94	12.2	0.09	0.23	<0.05	<0.05		<0.05
04/25/94	9.68	0.10	0.06	<0.05	0.83		0.05
05/25/94	<0.05	0.30	<0.05	<0.05	0.61		<0.05
Ammonia N							
01/26/94	<0.1	0.3	5.0	<0.1	1.9		0.6
03/02/94	<0.1	0.4	0.9	5.4	<0.1		0.4
03/29/94	<0.1	0.6	<0.1	5.8	1.6		<0.1
04/25/94	<0.1	0.6	<0.1	5.6	2.5		<0.1
05/25/94	1.0	0.9	<0.1	5.7	2.0		<0.1
Total Phosphorus as P							
01/26/94	0.01	0.07	0.40	0.03	0.05		0.14
03/02/94	0.05	0.09	0.09	0.96	0.07		0.09
03/29/94	0.49	0.07	0.11	0.74	0.09		0.02
04/25/94	0.04	0.03	0.04	1.7	0.04		0.04
05/25/94	0.13	0.12	0.07	1.33	0.13		0.05
Fecal Coliforms #100 ML/S							
01/26/94	<1	4	100	2600		4	<1
03/02/94	<1		<1	1178	<1	<1	<1
03/16/94	<1	<1	<1	2100	<1	<1	<1
04/25/94	<1	<1.2	<1	170	5		<1.2
05/25/94	<1	<1	<1	5	<1		<1

4.1.4 Climate

The Big Sky area lies east of the Continental Divide and therefore storms and weather fronts moving from the Pacific Coast often lose much of their intensity and moisture west of the Divide. Areas east of the Continental Divide, such as Big Sky, are often influenced by dry cold air from Canada, and southerly, moist air moving up from the Gulf of Mexico. Storms and fronts from the Gulf of Mexico are strongest in the spring and early summer and produce much of the precipitation in the area.

Thunderstorms are common in late spring and summer. They may produce locally strong winds, hail, and high intensity storms.

Weather data from four weather stations were reviewed to determine typical precipitation statistics for the Big Sky area. Two of the stations are located in the vicinity of the Meadow Village. The third and fourth stations are in the vicinity of the Mountain Village. Station 0775 (Big Sky 3S) is located at a latitude of 45°13' and a longitude of 111°17' at an elevation of 6600 feet. Station 11D22 (Big Sky Meadow) is at latitude 45°16', longitude 111°19', and an elevation of 6350. Station 0775 is a precipitation station while Station 11D22 is a snow station. Stations 11D17 and MH17 are located in the vicinity of the Mountain Village at a latitude of 45°12' and a longitude of 111°25' at an elevation of 7700 feet. Station 11D17 is a snow station and MH17 is a precipitation station. Tables 4.1.4-1 and 4.1.4-2 summarize the data obtained from the two stations in the vicinity of the Meadow Village. Tables 4.1.4-3 and 4.1.4-4 summarized the data from the Mountain Village stations.

Table 4.1.4-1
Weather Data (Station 0775)* Meadow Village

MONTH	AVERAGE PREC. INCHES	MAXIMUM PREC. INCHES	MINIMUM PREC. INCHES	AVERAGE+ TEMP °F
January	1.22	2.97	0.11	17.9
February	0.97	1.87	0.13	21.6
March	1.37	3.76	0.30	28.9
April	1.39	2.80	0.25	38.0
May	2.48	5.46	0.66	45.8
June	2.84	9.28	0.60	54.8
July	1.65	4.05	0.17	59.5
August	1.58	3.98	0.21	58.0
September	1.77	3.89	0.06	50.0
October	1.29	2.85	0.00	41.1
November	1.25	2.56	0.44	25.9
December	1.32	3.76	0.33	18.7
TOTAL	19.13	---	---	

* 39 Years of Record 1953 - 1991
\+ 1985-1991 Data

Table 4.1.4-2 Snow Data (Station 11 D22)* Meadow Village					
MONTH	YEARS OF RECORD	AVERAGE DEPTH INCHES	MAXIMUM DEPTH INCHES	AVERAGE SWE-INCHES+	MAXIMUM SWE-INCHES
January	1	15	15	2.6	2.6
February	2	26	29	5.4	6.6
March	18/29++	32	42	8.7	12.8
April	18/29	31	43	10.1	16.0
May	17	9	34	3.3	11.5

* First of Month Measurements

\+ SWE - Snow Water Equivalent

++ 18 Years of Depth Records, 29 Years of SWE Records

Table 4.1.4-3 Weather Data (Station MH17)* Mountain Village			
MONTH	AVERAGE PREC. INCHES	MAXIMUM PREC. INCHES	MINIMUM PREC. INCHES
January	2.29	4.7	0.3
February	1.94	6.2	0.6
March	2.80	6.10	0.50
April	2.88	5.50	0.5
May	4.23	7.0	1.5
June	3.78	9.5	1.0
July	2.09	6.3	0.2
August	2.01	6.3	0.3
September	2.71	6.1	0.1
October	2.18	5.6	0.2
November	2.24	4.3	0.8
December	2.44	6.3	0.5
TOTAL	31.59		

* 31 years of record

Table 4.1.4-4 Snow Data (Station 11D17)* Mountain Village					
MONTH	YEARS OF RECORD	AVERAGE DEPTH INCHES	MAXIMUM DEPTH INCHES	AVERAGE+ SWE-INCHES	MAXIMUM SWE-INCHES
January	21	29	43	6.6	9.5
February	21	37	54	9.7	14.5
March	22/32++	46	64	13.2	19.8
April	22/32	53	74	16.4	24.2
May	22/32	43	69	16.3	25.3
June	1	10		4.5	

* First of Month Measurement
\+ SWE - Snow Water Equivalent
++ 22 Years of Depth Records, 32 Years of SWE Records

The DHES Circular WQB 2 - Design Standards for Wastewater Facilities, 1994 requires that designs for spray irrigation systems be based on the wettest year in ten. Table 4.1.4-5 and Table 4.1.4-6 show the monthly precipitation values calculated for a 10 year recurrence interval for annual precipitation at Station 0775 and Station MH17, respectively. The 10-year recurrence interval was calculated using the Weibull plotting distribution to determine the wettest year in ten. The monthly values are distributed based on the ratio of average monthly to average annual precipitation.

Table 4.1.4-5 Calculated Monthly Precipitation (Station 0775) Meadow Village (10 Year Recurrence Interval)					
MONTH	PREC. INCHES	MONTH	PREC. INCHES	MONTH	PREC. INCHES
January	1.70	May	3.46	September	2.47
February	1.35	June	3.96	October	1.80
March	1.91	July	2.30	November	1.74
April	1.94	August	2.20	December	1.84
				TOTAL	7.85

Table 4.1.4-6 Calculated Monthly Precipitation (Station MH17) Mountain Village (10 Year Recurrence Interval)					
MONTH	PREC. INCHES	MONTH	PREC. INCHES	MONTH	PREC. INCHES
January	3.07	May	5.68	September	3.64
February	2.60	June	5.07	October	2.92
March	3.76	July	2.80	November	3.00
April	3.86	August	2.70	December	3.27
				TOTAL	42.37

Winds in both the Meadow Village and Mountain Village are typically light to variable. During the fall and winter, winds in the Meadow Village have an average speed of approximately 3.3 miles per hour. Winds in the Mountain Village had an average speed of approximately 4 miles per hour. The mean resultant wind during the fall and winter of 1973-74 in the Meadow Village was reported at approximately 267° negative at 1.0 mph and at approximately 276° negative at 0.85 mph in the Mountain Village (Stuart, 1974).

4.1.5 Plants and Wildlife

The Gallatin River is part of the Missouri Headwaters drainage. The West Gallatin originates in Yellowstone National Park and flows north for about 100 miles to the town of Manhattan where it is joined by the East Gallatin. Once the East and West Gallatins come together, the river flows for about 10 miles before becoming part of the Missouri River. Based on the Pacific Northwest Rivers Study, high sport fishery values dominated the fishery assessment in the Gallatin River. The 30-mile stretch of the West Gallatin from the West Fork to Gallatin Gateway received a Class I rating in sport fishery value. A Class I rating signifies that fish production is based on natural reproduction and trout are abundant. The fishery assessment data for the reach between the West Fork of the Gallatin and Spanish Creek indicated a trout biomass of 275 pounds per 1000 feet with 1013 fishing days/year/mile.

The Montana Natural Heritage Program was contacted concerning potential sensitive species in an area comprising roughly a 5 mile rectangle surrounding Big Sky. In the areas under consideration for treatment systems, the only plant identified was Yellow Springbeauty which was located 0.33 miles east of the highway up Porcupine Creek. The plant was rated with a global rank of G5, state rank of S3. The rankings are defined below:

G5 Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery.

S3 Either very rare and local throughout its range, or found locally (even abundantly at some of its locations) in a restricted range, or vulnerable to extinction throughout its range because of other factors; in the range of 21 to 100 occurrences.

The plant is rated by the U.S. Forest Service as sensitive. The Federal status is C2 which is defined below:

C2 Notice of review; current information indicates that proposing to list as endangered or threatened is possibly appropriate, but substantial biological information is not on file to support an immediate ruling.

While the grizzly bear was also identified by Montana Natural Heritage Program as a sensitive species in the West Fork Drainage area, the recommended alternative would not have any impact on grizzly bears. Most alternatives under consideration would be located in or near areas that experience significant human activity and are unlikely to be part of the bear's normal range. The recommended alternative discussed in Section 8 of this report would not involve any construction or human activities in remote areas. Therefore, the potential for human/grizzly conflict resulting from this project is small.

A review of the Gallatin Forest Plan West Side Management map shows that the West Fork Basin is outside the Grizzly Bear recovery zone.

The Porcupine Creek drainage is one area considered as a potential spray irrigation site. The location under consideration falls within an area classified as MS2 (Grizzly Management situation). A MS2 area is described as follows by the Montana Fish Wildlife & Parks.

1. Population and habitat conditions. Current information indicates that the area lacks distinct population centers; highly suitable habitat does not generally occur, although some grizzly habitat components exist and grizzlies may be present occasionally. Habitat resources in Management Situation 2 either are unnecessary for survival and recovery of the species, or the need has not yet been determined but habitat resources may be necessary. Certain management actions are necessary. The status of such areas is subject to review and change according to demonstrated grizzly population and habitat needs. Major Federal activities may affect the conservation of the grizzly bear primarily in that they may contribute toward (a) human-caused bear mortalities or (b) long-term displacement where the zone of influence could affect habitat use in Management Situation 1.

2. Management direction. The grizzly bear is an important, but not the primary, use of the area. In some cases, habitat maintenance and improvement may be important management considerations. Minimization of grizzly-human conflict potential that could lead to human-caused mortalities is a high management priority. In this management situation, managers would accommodate demonstrated grizzly populations and/or grizzly habitat use in other land use activities if feasible, but not to the extent of exclusion of other uses. A feasible accommodation is one which is compatible with (does not make unobtainable) the major goals

and/or objectives of other uses. Management will at least maintain those habitat conditions which resulted in the area being stratified Management Situation 2. When grizzly population and/or grizzly habitat use and other land use needs are mutually exclusive, the other land use needs may prevail in management consideration. In cases where the need of the habitat resources for recovery has not yet been determined, other land uses may prevail to the extent that they do not result in irretrievable/irreversible resource commitments which would preclude the possibility of eventual restratification to Management Situation 1. If grizzly population and/or habitat use represents demonstrated needs that are so great (necessary to the normal needs or survival of the species or a segment of its population) that they should prevail in management considerations, then the area should be reclassified under Management Situation 1. Managers would control nuisance grizzlies.

4.1.6 Land Use - Gallatin County

In 1990 the Board of commissioners of Gallatin County created a Planning District and appointed an Advisory Committee to prepare a proposed plan and zoning ordinance for the District. In November 1992 the Advisory Committee published a draft Land Use Plan. The following excerpt is from the draft publication.

> The Gallatin Canyon/Big Sky Planning District, because of its location and mountainous terrain and its limited population, has a distinct land use pattern.
>
> The area is predominately forested, with the Forest Service having jurisdiction over a substantial portion of the District. This jurisdiction includes fire protection, garbage and waste disposal, the granting of grazing and logging permits, wildlife management, visitor accommodations and control, and range and forest maintenance. These forest lands are utilized for timber, water, wildlife, grazing, and recreation.
>
> The strongest defining features of the District are the steep, heavily timbered mountain slopes and the Gallatin River. The mountains constrain access, while providing ideal opportunities for recreation. The topography creates separate distinct identities for the different regions of the District.

Commercial activities in the Gallatin Canyon area are located alongside U.S. Highway 191. A substantial commercial area is located at the junction of U.S. Highway 191 and the Big Sky Spur Road. The commercial uses are mainly tourist-oriented facilities (bars, restaurants, mini-marts, fly fishing shops, antique shops, etc.).

Commercial activities in the Big Sky section of the District are limited to the Meadow Village Center and another commercial area adjacent to the Big Sky Spur Road. The commercial uses are resident and tourist oriented, and include restaurants, a general store, the post office, and real estate offices.

Residential areas in the Canyon are located along U.S. 191, and also in several subdivisions located in adjacent drainages such as Beaver Creek. There has been a minimal amount of development on hillsides that overlook the Gallatin River.

Residential areas in the Big Sky area range from condominium developments to large lots with single family homes. The condominium developments are mainly located in the center of the Meadow Village, with the single family residential areas radiating out from the area.

Agricultural usage within the planning area is limited primarily to grazing activities. Most of the acreage in agricultural use produces feed for livestock. In the Canyon, this forage crop is generally used for on-site grazing practice. Both the Forest Service and private landowners issue grazing permits to allow their land to be used as pasture by others. Other than limited grazing use, there are virtually no agricultural uses within the District.

Recreational opportunities in the District are abundant. Downhill and cross country skiing are both available. There are miles of multi-use trails. Hunting, fishing, camping, and back-packing are enjoyed by residents and visitors alike. A golf course is popular in the summer season.

Figure 4.1.6-1 and 4.1.6-2 are also from the draft land use plan and show the planning district boundary and the proposed land use map. The land use categories as defined in the draft planning document are explained below.

Commercial/ Office	Land use classification that permits offices and facilities for the buying and selling of commodities and services. The zoning ordinance will further categorize, such is tourist commercial, neighborhood commercial, recreational commercial, neighborhood office, and mixed use.
Natural Resource/ Open	Any parcel or area of land or water that is essentially unimproved and used for the preservation of natural resources, the managed space production of resources, outdoor recreation, buffer zones, view protection or public health and safety.
Low	This type of land use is characterized by a combination of open space land

Density	with very low density residential development. Clustered housing is encouraged to allow the maximum amount of open space to be preserved. Highly visible ridgelines and hillsides will be retained as open space. Development of land in this category is often limited by physical constraints, such as steep slopes. Development should occur carefully and will be evaluated on an individual basis. Development must be compatible with environmental considerations.
Residential	Land designated for buildings consisting only of dwelling units and accessory structures.
Light	Allows for uses not inconsistent with community needs, including, but not
Industrial	limited to, equipment storage, rental storage units, satellite dishes and receiving equipment, gravel pits, warehouses, sewage treatment ponds, cement mixing plants, bus storage, and utility use. The zoning ordinance will have specific regulations, such as siting requirements and conditional uses.
Institutional	Includes parks, schools and other community owned facilities.
Transfer Density	Environmentally sensitive and valuable lands which have been identified as in need of protection from development. These areas will be assigned a number of permitted dwelling units per acre (development rights) in the zoning ordinance. The development rights will then be transferred or conveyed to other parcels of land.

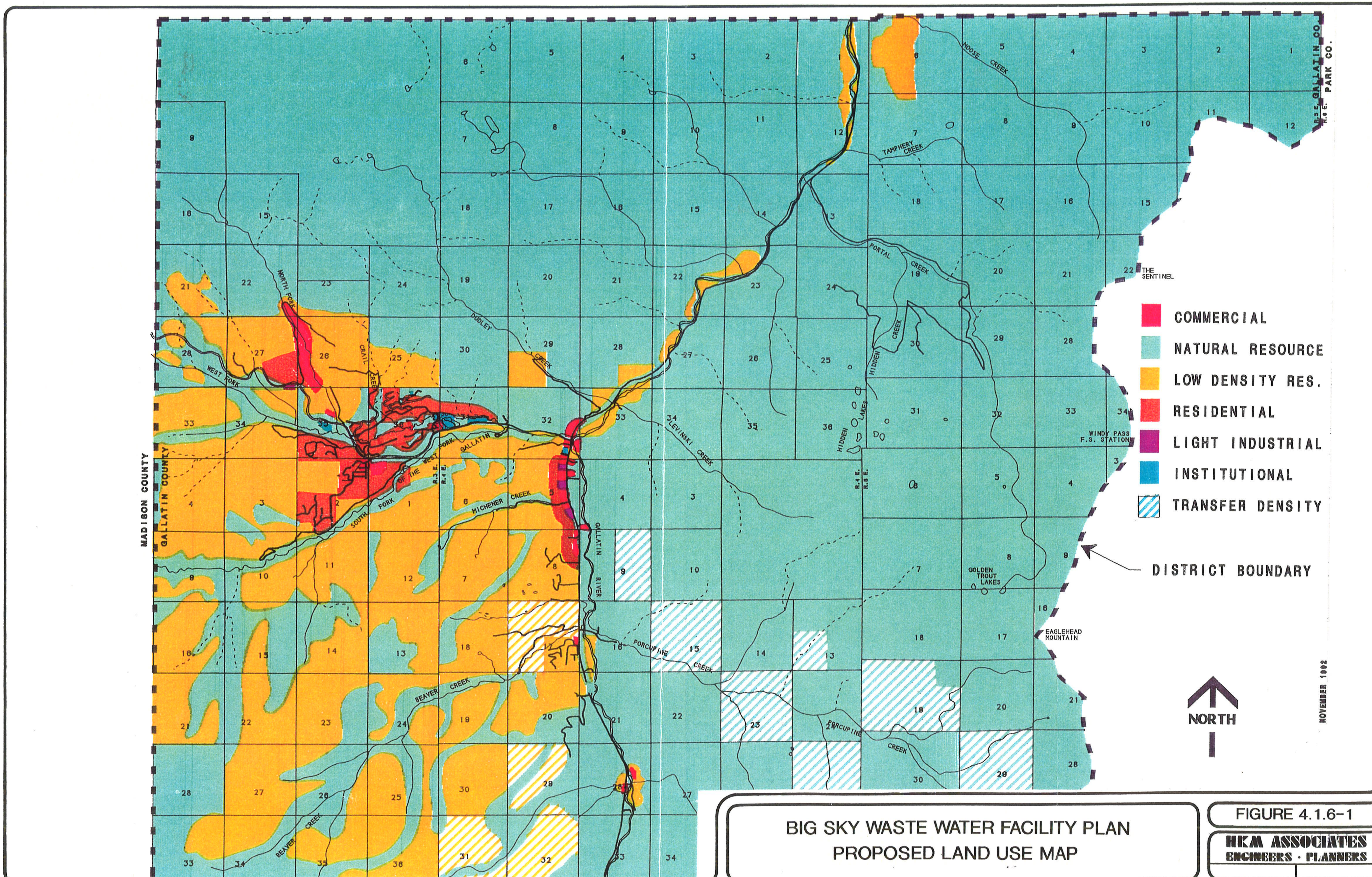

FIGURE 4.1.6-1

BIG SKY WASTE WATER FACILITY PLAN
PROPOSED LAND USE MAP

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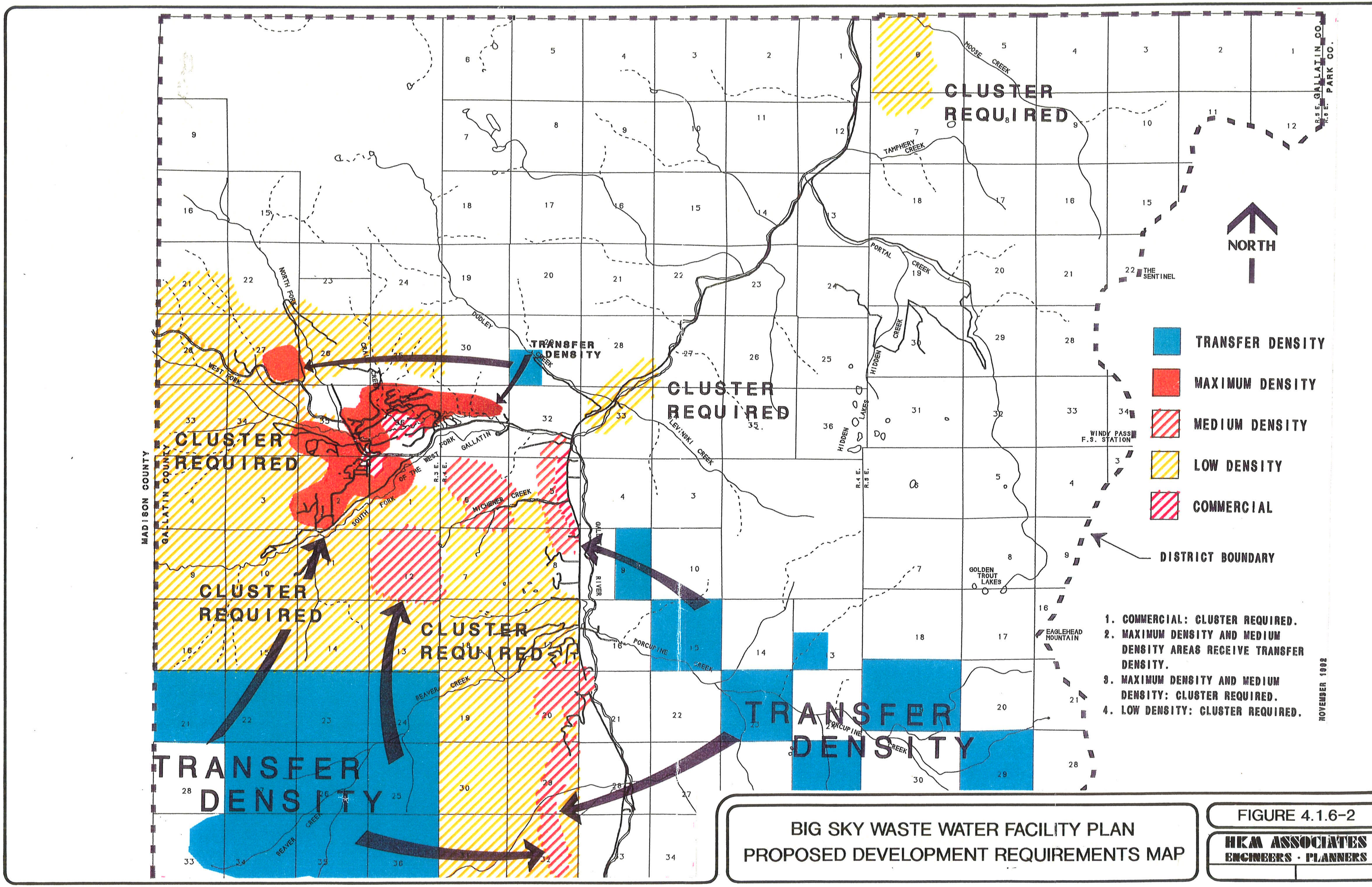

BIG SKY WASTE WATER FACILITY PLAN
PROPOSED DEVELOPMENT REQUIREMENTS MAP

FIGURE 4.1.6-2

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As discussed in Section 3, land use planning for the Gallatin County portion of the resort is an ongoing process. Figure 4.1.6-3 shows the land use planning for the Mountain Village area as shown in the original Big Sky Master Plan (Stuart, 1976). Figure 4.1.6-3 also shows the unique and critical areas delineated in the report Impacts of Large Recreational Developments Upon Semi-Primitive Environments: The Gallatin Canyon Synthesis Report (Stuart, 1976).

4.1.7 Flood Plain

The 100 year flood plain in the vicinity of the existing lagoons is shown in Figure 4.1.7-1. The flood data was obtained from the U.S. Forest Service Office in Bozeman, Montana.

4.1.8 Air Quality

No scientific studies of the air quality in the Big Sky area have been done since the early 1970's. At that time, no evidence of reduced air quality was noted except during periods of temperature inversions when a large number of trucks passed the air monitoring site during construction activities (Stuart, 1974).

The area is susceptible to temperature inversions as cold air flows downhill on windless nights to form cold-air lakes in the low lying basins. These temperature inversions tend to trap air pollutants in the low lying areas.

Even though no scientific studies have been done recently, the air quality is considered to be high. As stated in the Gallatin Canyon draft land use plan, one of the goals is to preserve the clean air and water in the area.

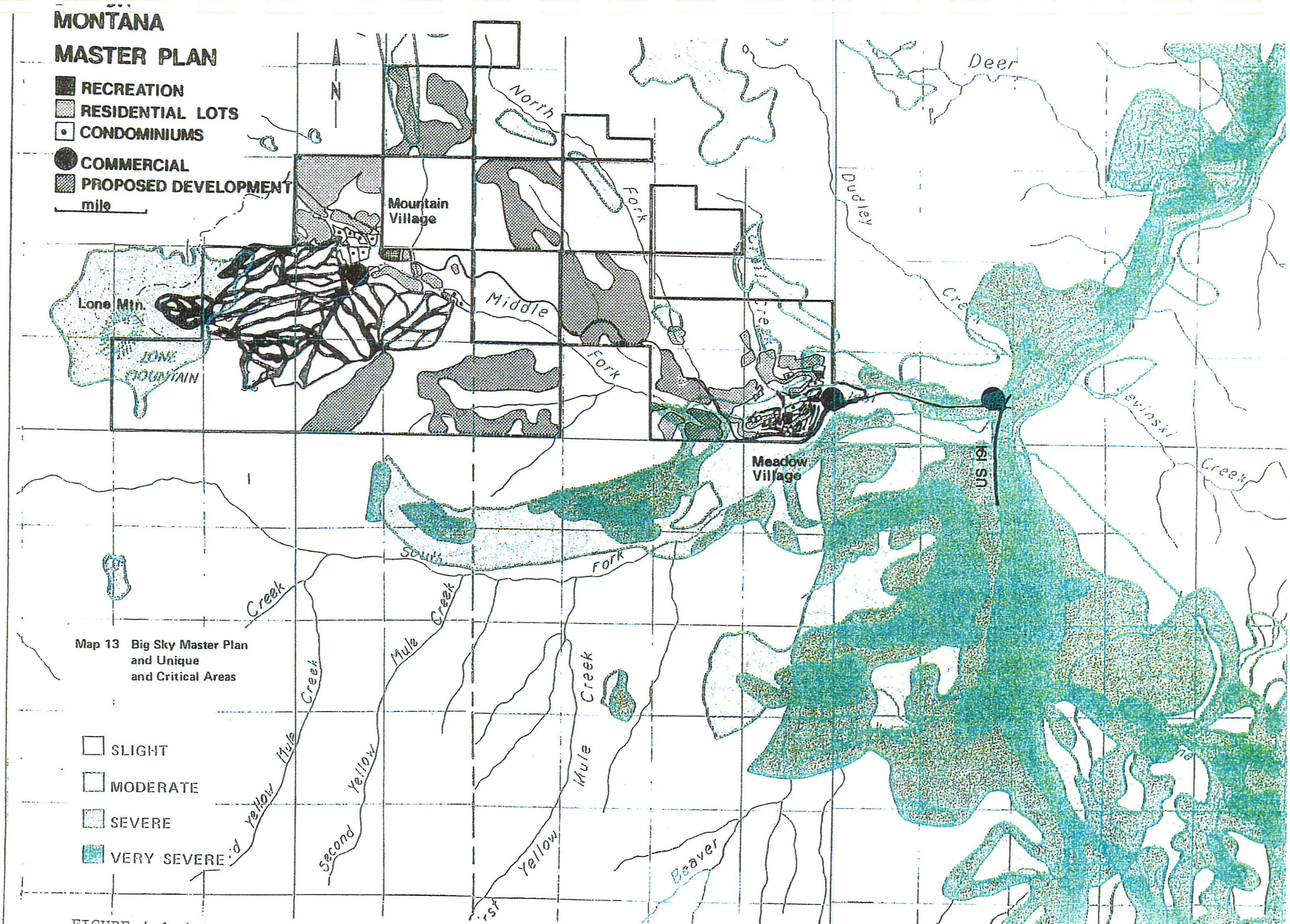
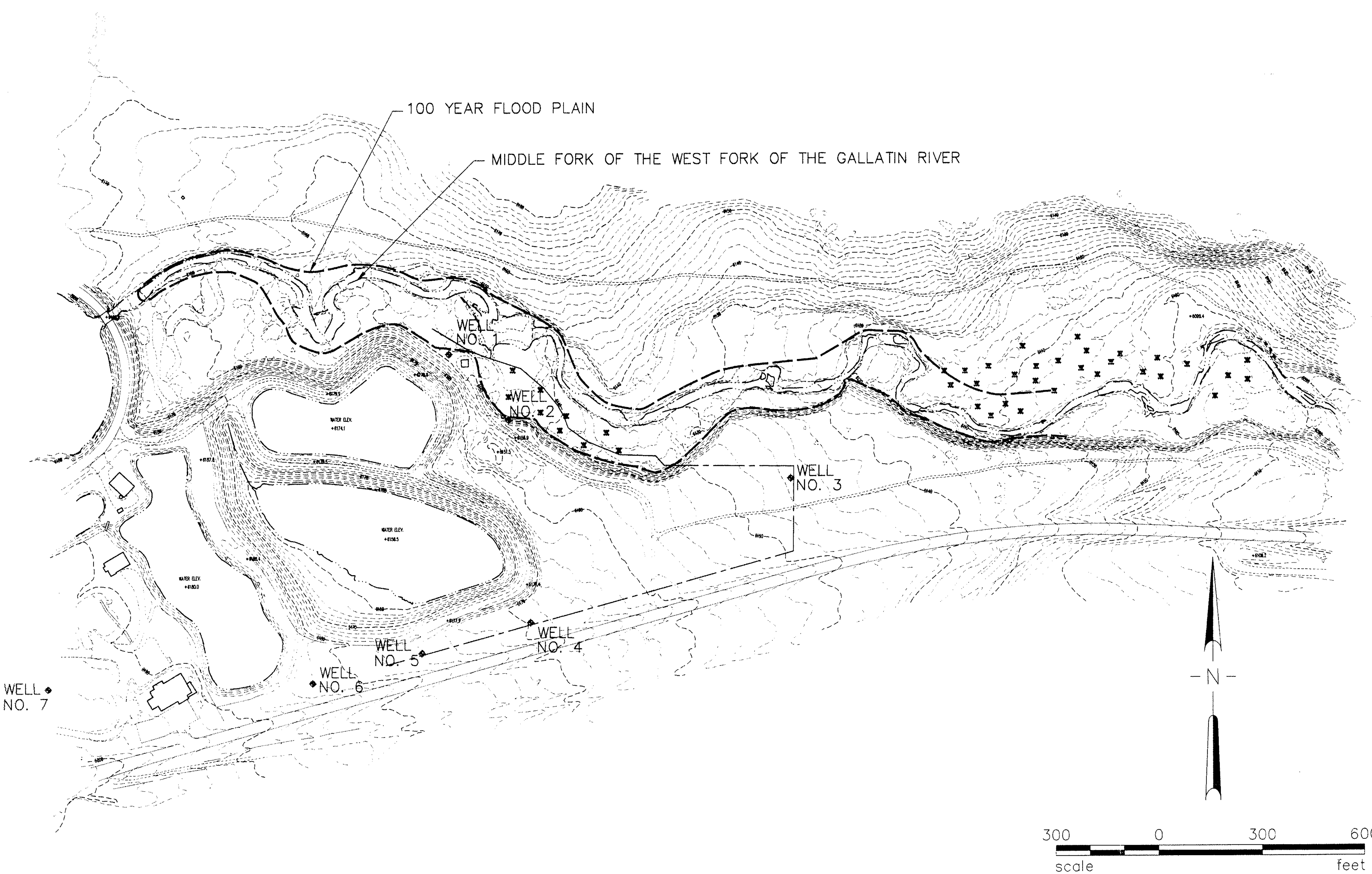


FIGURE 4.1.6-3
Land Use Planning Map (1976)



BIG SKY WASTEWATER FACILITY PLAN

100 YEAR FLOOD PLAIN

FIGURE 4.1.7-1

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4.2 POPULATION AND POPULATION CHARACTERISTICS

Because Big Sky is not incorporated, there is no census data available which deals strictly with the Big Sky area. In addition, due to the pattern of use at a resort it is difficult to correlate flows with a certain number of residents that would be accounted for in a census. In order to address this problem, the concept of a single family equivalent (SFE) has been used. The SFE establishes a standard basis for comparing different types of developments. Establishing the number of SFE's associated with each development takes into account the number of bedrooms, number of baths over two, hotel/motel units, swimming pools and hot tubs, and a full range of commercial operations. As shown in Table 3.0-1, there are currently 1928.7 SFE's that are currently contributing flow to the sewer system.

As census data is not available which deals strictly with the Big Sky resort area, it is difficult to define the social characteristics with much precision. The 1992 draft land use plan for Gallatin Canyon and Big Sky area contains results of a questionnaire mailed to members of the Big Sky Owners Association. Of 1500 questionnaires mailed, approximately 425 were returned. The results are summarized below in Table 4.2-1.

Table 4.2-1 Population Characteristics for Big Sky, Montana (From Draft Land Use Plan - 1992)	
Type of Dwelling Owned	
Condominium	51%
Single Family	49%
Number in Household	
1 person	9.4%
2 person	53.6%
3 person	11.9%
4 person	13.5%
5 person	8.3%
6 person	1.9%
7+ person	1.4%
Household Income	
100,000+	47.5%
80,000 - 100,000	11.2%
60,000 - 80,000	12.6%
40,000 - 60,000	18.1%
20,000 - 40,000	9.3%
<20,000	1.4%

4.3 WATER SUPPLY AND CONSUMPTION

Water for the Big Sky area is supplied by wells. Estimated water usage for 1991 and 1992 are shown in Table 4.3-1.

Table 4.3-1 Estimated Water Usage - Million Gallons						
MONTH	1991			1992		
	MEADOW VILLAGE	HIDDEN VILLAGE	MOUNTAIN VILLAGE	MEADOW VILLAGE	HIDDEN VILLAGE	MOUNTAIN VILLAGE
Jan	8.6	No-Meter	8.1	10.1	1.06	15.3
Feb	8.5	No-Meter	12.5	9.3	0.97	11.3
March	9.2	No-Meter	8.0	10.4	1.15	12.6
April	10.3	No-Meter	11.4	9.5	0.63	9.5
May	11.1	No-Meter	13.7	10.9	0.97	9.03
June	11.3	No-Meter	14.6	11.3	1.01	11.4
July	12.9	No-Meter	8.6	12.9	1.09	13.4
August	11.1	No-Meter	6.5	14.0	.079	12.5
September	7.6	No-Meter	11.7	10.0	0.85	12.4
October	6.6	0.91	11.3	8.7	0.93	11.2
November	4.6	No-Meter	8.9			
December	9.1	No-Meter	9.0			
TOTAL	110.9	9.1	124.4	107.2	9.4	118.7
TOTAL ANNUAL		244.4		235.4		

4.4 WASTEWATER FLOWS AND LOADS

The daily wastewater flow records furnished by Big Sky have been used to estimate the future daily flow into the treatment system. Flow records are available for the period October, 1986, to the present. Although data is available for 1992, there is some question as to the validity of this data since the flow meter may not have been functioning correctly. Therefore, data for the years 1988 through 1997, excluding 1992 has been used in this analysis.

A 1988 study entitled Addendum I Current Capacity Wastewater Treatment Plant for Big Sky Sewer District (Kerin 1988) indicated the Palmer Bowlus flume consistently gave flow readings approximately 10 percent higher than readings from a V-notch weir. As a result, the study recommended derating the Palmer Bowlus readings by 10 percent. A separate study in 1991 (TDH, 1991) concluded that it was just as likely that the V-notch weir was reading 10 percent low and recommended against derating the flow records. We concur with the 1991 study recommendation and have used the Palmer Bowlus records without any adjustments being made.

Table 4.4-1 was developed based on the actual flow records. A new flow meter and recorder was installed and calibrated on January 14, 1993.

Table 4.4-1
Wastewater Flows
Million Gallons Per Month

	1989	1990	1991	1993	1994	1995	1996	1997
January	5.3	5.9	5.8	7.2	7.07	8.14	5.87	8.55
February	5.9	6.4	6.5	7.3	6.99	7.79	7.21	7.87
March	7.0	7.8	7.8	9.2	9.82	9.03	7.38	10.15
April	7.4	10.7	5.1	6.9	7.84	9.12	8.78	9.27
May	11.8	7.9*	15.9	16.3	5.08	15.86	11.69	19.38
June	7.9	11.7	14.0	13.5	5.88	12.33	9.13	14.5
July	6.4	8.5	10.1	14.8	8.50	8.98	5.67	9.67
August	5.3	6.1	8.6	12.5	7.14	5.02	4.94	8.02
September	3.0	3.6	5.6	14.0	5.48	3.25	4.62	5.61
October	2.2	2.5	2.8	6.0	3.66	1.96	4.06	4.11
November	1.9	1.8	4.4	4.1	3.70	2.78	3.79	4.45
December	4.9	5.6	4.9+	5.2	7.51	3.64**	7.80	8.12
TOTAL ANNUAL	69.1	78.5	91.5	117.0	78.67	87.9**	79.9	109.71
AVG. DAY GALLONS	189,299	214,975	250,686	320,500	215,534	240,822**	219,013	300,575
AVG. MONTH	5.8	6.5	7.6	9.8	6.56	7.32	6.66	9.14
PEAK MONTH/ AVG. MONTH	2.05	1.79	2.08	1.66	1.50	2.17	1.76	2.12

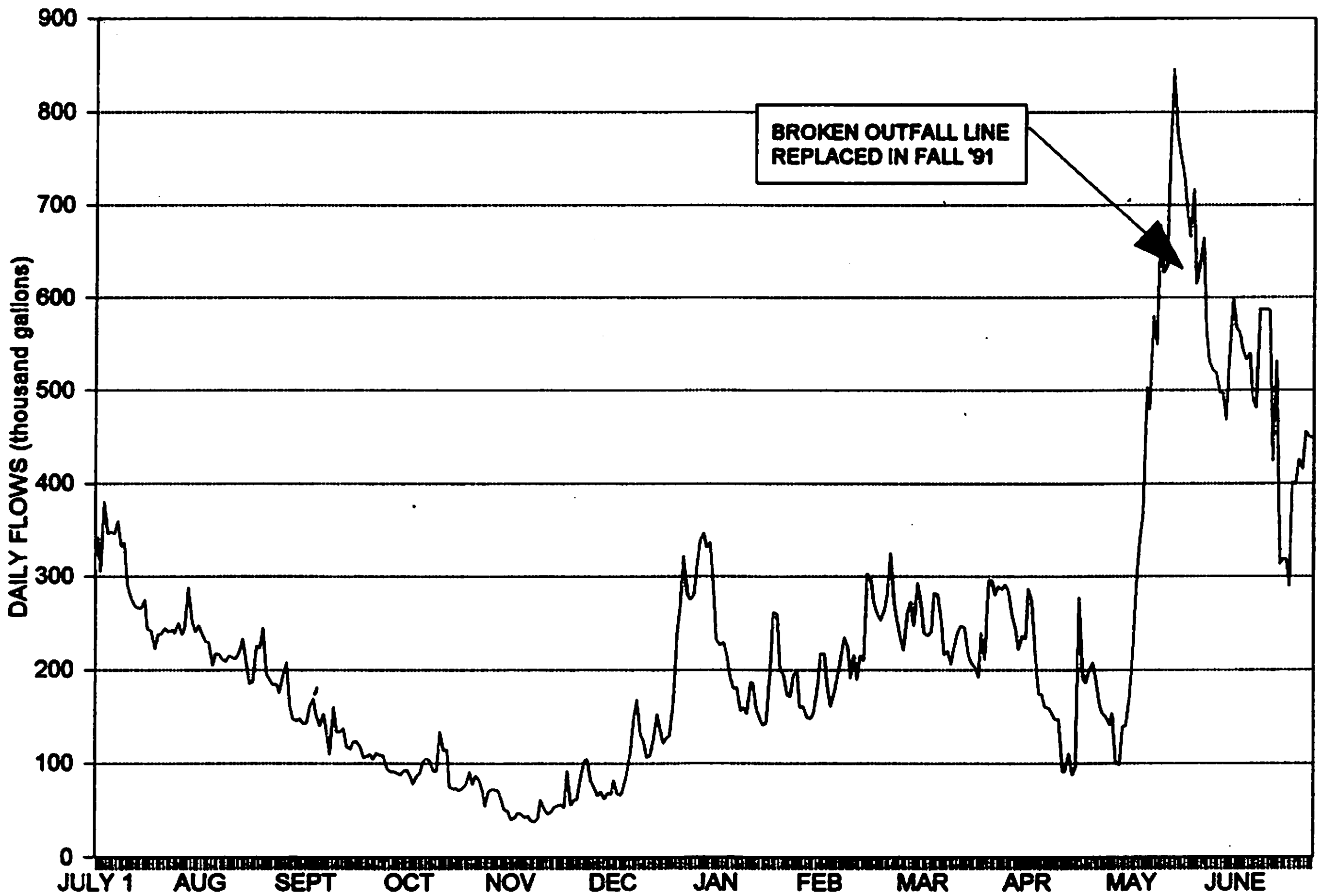
* From TDH Data
N/A Not Available
\+ Meter appears bad. Use average of 88, 89, 90
** Estimated

Figure 4.4-1 is a plot showing the daily flows from January 1, 1996 to December 31, 1996. The plot illustrates how the flow into the sewer system varies throughout the year and it also shows the peak daily flows that the system is currently receiving. From the plot of Figure 4.4-1, it is apparent that the peak day can be expected to occur during the periods of high skier activity or during the spring.

In order to determine trends over the years during the ski season and the spring, the plots of Figures 4.4-2 and 4.4-3 were developed. The plots given in Figure 4.4-2 are for the period November 15 to March 30 (the ski season) for three years beginning November 15, 1988. Figure 4.4-3 contains plots for the period from April 15 to June 30 for three years beginning in 1989.

Figure 4.4-2 illustrates that the peak day flow during the ski season typically occurs during the Christmas vacation period and is approximately 350,000 gallons per day. Figure 4.4-3 shows that the peak day during spring runoff will be approximately 600,000 gallons per day (neglecting the high flow in 1991 caused by a sewer line break). It is apparent from the figures that infiltration/inflow (I/I) constituted a substantial portion of the flow during the spring and summer in 1991. As discussed later in Section 4.8, the District made major repairs to the sewer system in 1993 in order to reduce the I/I flows.

Several studies have been completed regarding I/I at Big Sky. The 1986 facility plan, reported that through the 1985-1986 ski season I/I averaged 110 gpm (160,000 gpd). A 1988 study (Kerin, 1988) estimated the I/I ranged from 45 to 60 gpm from January 1988 to April 7, 1988. However, during this time period the I/I did increase to approximately 125 gpm when a plug on a sewer stub dislodged. After the plug was re-inserted the flow attributed to I/I decreased to 45 to 60 gpm (65,000 - 86,400 gpd). This 1988 report also indicated the I/I jumped to 148 gpm during a period of high snow melt. As discussed later in Section 4.8.1, repair work completed during the summer and fall of 1993 reduced the minimum night time flow to 42 gallons per minute from 56 gallons per minute measured in January and February 1993.

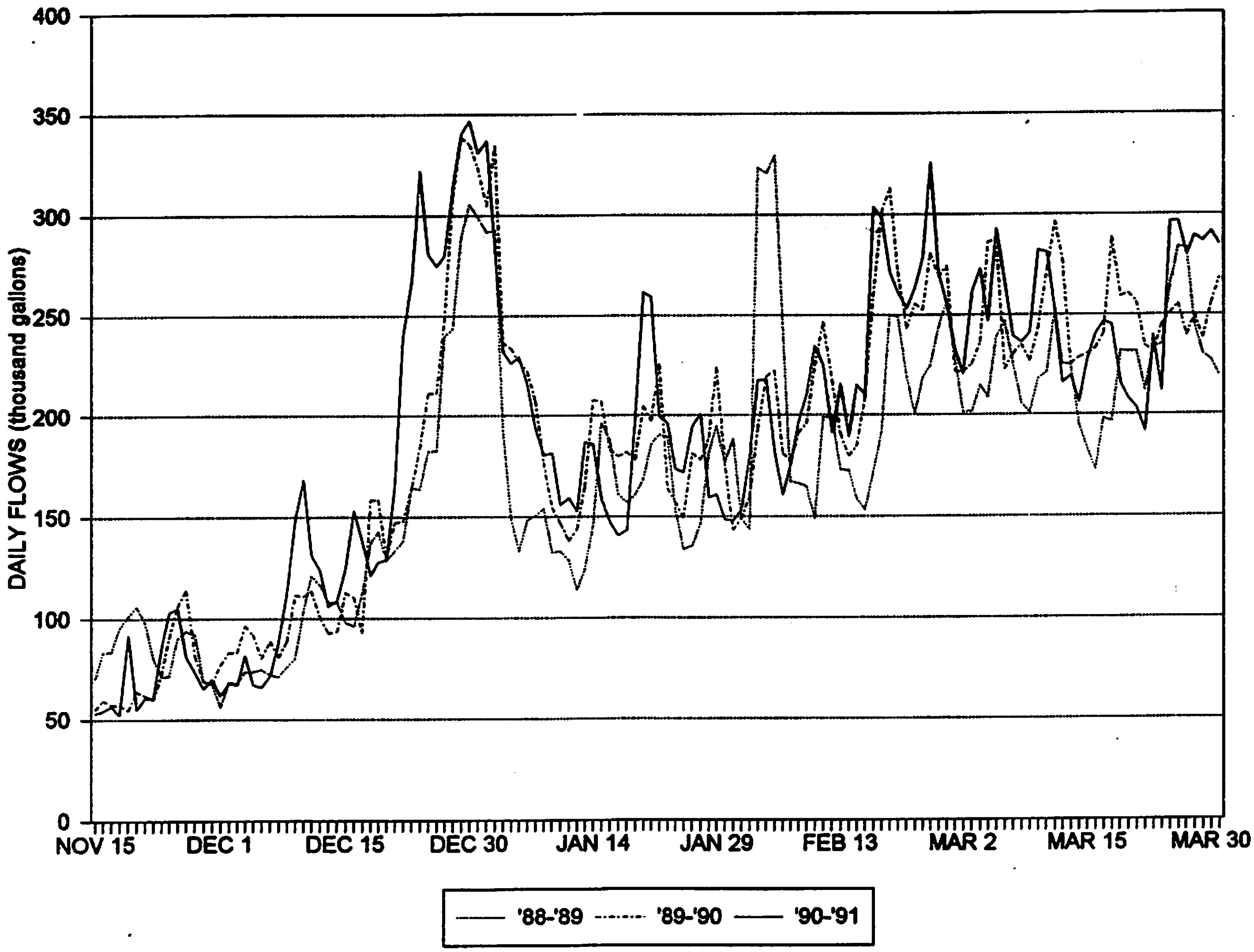


BIG SKY WASTEWATER FACILITY PLAN

DAILY FLOWS
JULY 1,1990 TO JUNE 30,1991

FIGURE 4.4–1

4M357.102 | JUNE 1993



BIG SKY WASTEWATER FACILITY PLAN

DAILY FLOWS
SKI SEASON

FIGURE 4.4-2

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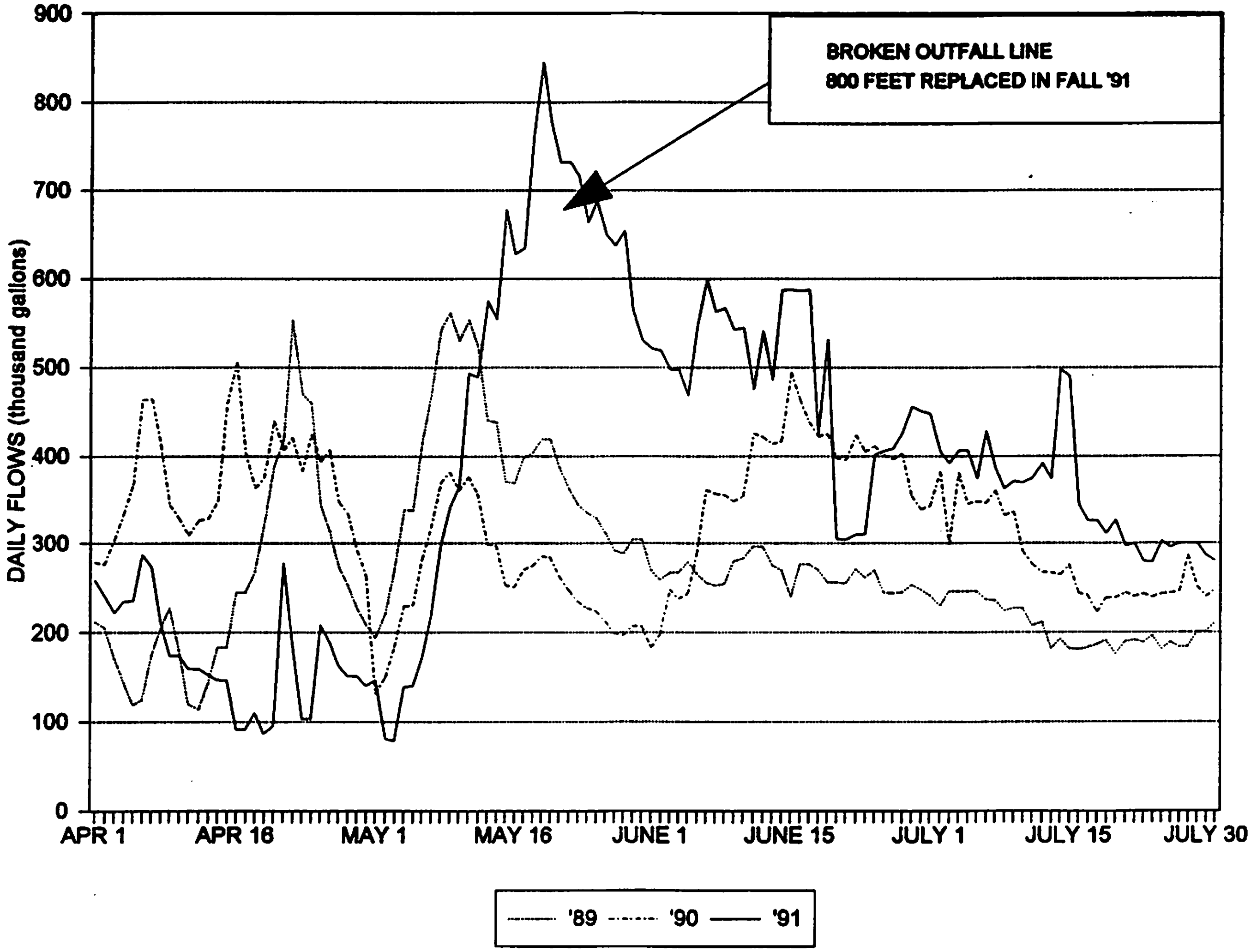

BIG SKY WASTEWATER FACILITY PLAN

DAILY FLOW
SPRING

FIGURE 4.4-3

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A month by month analysis of the 1993 flows was completed to separate the infiltration and domestic components of the flow. Table 4.4-2 lists the resulting flow components.

Table 4.4-2
Estimated Wastewater Flow Components (1993)
Million Gallons Per Month

MONTH	INFILTRATION	DOMESTIC	TOTAL
January	1.3	5.9	7.2
February	1.2	6.1	7.3
March	1.3	7.9	9.2
April	6.2	0.7	6.9
May	14.6	1.7	16.3
June	10.9	2.6	13.5
July	10.4	4.4	14.8
August	5.6	6.9	12.5
September	8.1	5.9	14.0
October	1.3	4.7	6.0
November	1.3	2.8	4.1
December	1.3	3.9	5.2
TOTALS MG/YR	63.5	53.5	117.0
AVERAGE - GPD	173,972	146,575	320,547

Based on the number of existing SFE's that contributed flow to the system in 1993 (1928.7 SFE's), the domestic portion of the flow equates to a flow of 76.0 gpd/SFE (27,739 gallons per year per SFE). It is emphasized that this calculation does not take into account the occupancy rate at the resort. If the occupancy rate increases, the total domestic flow would increase while the number of SFE's would remain fixed. This would result in an increase in the calculated value for the flow per SFE. The use and occupancy rate at the resort can vary significantly throughout the year. During the ski season the majority of condominiums and houses are occupied, while during the summer the occupancy rate drops significantly.

During the ski season, influent flow data is representative of a high strength waste. During the spring and summer, infiltration dilutes the waste concentration. Table 4.4-3 summarizes the monthly influent flow data from 1994 and 1995.

Table 4.4-3
Existing Wastewater Influent Data - Monthly Averages*

					pH**	
MONTH	BOD_5 mg/l	TSS mg/l	TKN mg/l-N	ALKALINITY	MAXIMUM	MINIMUM
January	395	347	18	245		
February	430	407	32	277	7.3	7.1
March	388	328	47	270	7.7	7.3
April	182	73	28	250	7.6	7.2
May	117	123	8.9	183	7.7	7.4
June	138	95	25	182	8.1	6.8
July	220	175	1.2	250	7.1	7.0
August	330	240	60	253	7.6	7.0
September	370					
October	225					
November	194					
December	367					
AVERAGE	280	223	27.5	239		
MAXIMUM MONTH	430	407	60	277		
MINIMUM MONTH	117	73	1.2	182		
PEAK DAY	560	530	60	320		

* Based on weekly samples in 1994 and 1995
** Daily maximum and minimum

4.5 EFFLUENT LIMITATIONS

The existing wastewater treatment facility was intended to store treated wastewater over the winter and then irrigate the golf course with the stored water during the summer. Consequently, a discharge permit was not required.

In planning for an expansion of the wastewater treatment facility, there are three alternatives for the ultimate disposal of the treated wastewater. (1) The treated water or a portion of the treated water could be discharged into a surface stream; (2) a land application system such as spray irrigation, rapid infiltration basin or snowmaking could be used; or, (3) an underground injection well could be used.

Standards pertaining to the required quality of state waters are contained in the Montana State Water Quality Act and the implementing rules found in the Administrative Rules of Montana (ARM). The rules classify state waters based on present and future "most beneficial uses" and formulate standards of water purity. The West Gallatin River in the vicinity of Big Sky is classified as "B-1". Waters classified B-1 are suitable for drinking, culinary and food processing purposes after conventional treatment, and bathing, swimming and recreation.

The surface water quality standards are contained in ARM 16.20.601 through ARM 16.20.642. ARM 16.20.618 establishes the water quality standards for B-1 waters. Section 16.20.618 states:

> 16.20.618 B-1 Classification (1) Waters classified B-1 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
>
> (2) No person may violate the following specific water quality standards for waters classified B-1:
>
> (a) During periods when the daily maximum water temperature is greater than 60°F, the geometric mean number of organisms in the fecal coliform group must not exceed 200 per 100 milliliters, nor are 10 percent of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters.
>
> (b) Dissolved oxygen concentration must not be reduced below the levels given in department circular WQB-7.

(c) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

(d) The maximum allowable increase above naturally occurring turbidity is 5 nephelometric turbidity units except as permitted in ARM 16.20.633.

(e) A 1°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 66°F; within the naturally occurring range of 66°F to 66.5°F, no discharge is allowed which will cause the water temperature to exceed 67°F; and where the naturally occurring water temperature is 66.5°F or greater, the maximum allowable increase in water temperature is 0.5°F. A 2°F-per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F, and a 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F. This applies to all waters in the state classified B-1 except for Prickly Pear Creek from McClellan Creek to the Montana Highway No. 433 crossing where a 2°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 65°F; within the naturally occurring range of 65°F to 66.5°F, no discharge is allowed which will cause the water temperature to exceed 67°F; and where the naturally occurring water temperature is 66.5°F or greater, the maximum allowable increase in water temperature is 0.5°F.

(f) No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) True color must not be increased more than five units above naturally occurring color.

(h)(i) Concentrations of carcinogenic, bioconcentrating, toxic or harmful parameters which would remain in the water after conventional water treatment may not exceed the applicable standards set forth in department circular WQB-7.

(ii) Discharges issued permits under ARM Title 16, Chapter 20, Subchapter 9, shall conform with ARM Title 16, Chapter 20, Subchapter 7, the nondegradation rules, and may not cause receiving water concentrations to exceed the applicable standards specified in department circular WQB-7 when stream flows equal or exceed the design flows specified in ARM 16.20.631(4).

(iii) If site-specific criteria are developed using the procedures given in the Water Quality Standards Handbook (US EPA, Dec. 1983), and provided that other routes of exposure to toxic parameters by aquatic life are addressed, the criteria so developed shall be used as water quality standards for the affected waters and as the basis for permit limits instead of the applicable standards in department circular WQB-7.

(iv) In accordance with 75-5-306(1), MCA, it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water as long as the minimum treatment requirements, adopted pursuant to 75-5-305, MCA, are met.

(3) The board hereby adopts and incorporates by reference the following:

(a) Department circular WQB-7, entitled "Montana Numeric Water Quality Standards" (1994 edition), which establishes standards for toxic, carcinogenic, bioconcentrating, and harmful parameters in water; and

(b) The Water Quality Standards Handbook (US EPA, Dec. 1983) which sets forth procedures for development of site-specific criteria.

The Water Quality Act also adopts a nondegradation policy which is intended to protect the water quality of streams that have a higher water quality than the established water quality standards. As indicated above in ARM 16.20.618(2)(h)(ii) the nondegradation rules are incorporated into the water quality standards. The nondegradation policy is described in Section 75-5-303 MCA; and states:

75-5-303. Nondegradation policy.

(1) Existing uses of state waters and the level of water quality necessary to protect those uses must be maintained and protected.

(2) Unless authorized by the department under subsection (3), the quality of high-quality waters must be maintained.

(3) The department may not authorized degradation of high-quality waters unless it has been affirmatively demonstrated by a preponderance of evidence to the department that:

(a) degradation is necessary because there are no economically, environmentally, and technologically feasible modifications to the proposed project that would result in no degradation;

(b) the proposed project will result in important economic or social development and that the benefit of the development and exceeds the costs to society of allowing degradation of high-quality water;

(c) existing and anticipated use of state waters will be fully protected; and

(d) the least degrading water quality protection practices determined by the department to be economically, environmentally, and technologically feasible will be fully implemented by the applicant prior to and during the proposed activity.

(4) The department shall issue a preliminary decision either denying or authorizing degradation and shall provide public notice and a 30-day comment period prior to issuing a final decision. The department's preliminary and final decisions must include:

(a) a statement of the basis for the decision; and

(b) a detailed description of all conditions applied to any authorization to degrade state waters, including, when applicable, monitoring requirements, required water protection practices, reporting requirements, effluent limits, designation of mixing zones, the limits of degradation authorized, and methods of determining compliance with the authorization for degradation.

(5) An interested person wishing to challenge a final department decision may request a hearing before the board within 30 days of the final department decision. The contested case procedures of Title 2, Chapter 4, Part 6, apply to a hearing under this section.

(6) Periodically, but not more often than every 5 years, the department may review authorizations to degrade state waters. Following the review, the department may, after timely notice and opportunity for hearing, modify the authorization if the department determines that an economically, environmentally, and technologically feasible modification to the development exists. The decision by the department to modify an authorization may be appealed to the board.

(7) the board shall adopt rules to implement his section.

Senate Bill 401, adopted by the 1993 legislature, made several amendments to the Water Quality Act. Specifically, the law required the Board of Health and Environmental Sciences to adopt administrative rules specifying the level of protection or treatment required if degradation is allowed. In the Water Quality Act, degradation is defined as "a change in water quality that lowers the quality of high-quality water for a parameter Section 75-5-103(4) MCA. The term does not include those changes in water quality determined to be non-significant pursuant to Section 75-5-301(5)(6) MCA". In addition, SB 401 allows a mixing zone where water quality standards may be exceeded subject to conditions imposed by the Department.

The Water Quality Division has published rules for implementing the new statutory changes contained in the Nondegradation Policy (Section 75-5-303 MCA) and for the determination of mixing zones. A copy of the policies are included as Appendix E. The proposed rules state that for a new or increased source that may affect the quality of high-quality waters, the department shall determine whether the resulting change in water quality is non-significant.

The criteria for determining non-significant changes in water quality are published in (ARM) 16.20.712. This proposed rules states in pertinent part as follows:

(1) The following criteria will be used to determine whether certain activities or classes of activities will result in non-significant changes in existing water quality due to their low potential to affect human health or the environment. These criteria consider the quantity and strength of the pollutant, the length of time the changes will occur, and the character of the pollutant. Except as provided in (2) below, changes in existing surface or ground water quality resulting from the activities that meet all the criteria listed below are non-significant, and are not required to undergo review under 75-5-303, MCA:

(a) activities that would increase or decrease the mean monthly flow of a surface water by less than 15% or the 7-day 10 year low flow by less than 10%;

(b) discharges containing carcinogenic parameters or parameters with a bioconcentration factor greater than 300 at concentrations less than or equal to the concentrations of those parameters in the receiving water;

(c) discharges containing toxic parameters or nutrients, except as specified in (d) and (e) below, which will not cause changes that equal or exceed the trigger values in department circular WQB-7. Whenever the change exceeds the trigger value, the change is not significant if the resulting concentration outside of a mixing zone designated by the department does not exceed 15% of the lowest applicable standard;

(d) changes in the concentration of nitrogen in ground water which will not cause degradation of surface water if the sum of the predicted concentrations of nitrate at the boundary of an applicable mixing zone will not exceed the following values:

(i) 7.5 mg/l for nitrate sources other than domestic sewage;

(ii) 5.0 mg/l for domestic sewage effluent discharged from a conventional septic system;

(iii) 7.5 mg/l for domestic sewage effluent discharged from a septic system using level two treatment; as defined in ARM 16.20.707; or

(iv) 7.5 mg/l for domestic sewage effluent discharged from a conventional septic system in areas where the groundwater nitrate level exceeds 5.0 primarily from sources other than human waste.

For the purposes of this subsection (d), the word "nitrate" means nitrate as nitrogen.

(e) changes in concentration of total inorganic phosphorus in ground water if water quality protection practices approved by the department have been fully implemented and if an evaluation of the phosphorus adsorptive capacity of the soils in the area of the activity indicates that phosphorus will be removed for a period of 50 years prior to a discharge to any surface waters;

(f) changes in the quality of water for any harmful parameter for which water quality standards have been adopted other than nitrogen, phosphorous, and carcinogenic, bioconcentrating, or toxic parameters, in either surface or ground water, if the changes outside of a mixing zone designated by the department are less than 10% of the applicable standard and the existing water quality level is less than 40% of the standard;

(g) changes in the quality of water for any parameter for which there are only narrative water quality standards if the changes will not have a measurable effect on any existing or anticipated use or cause measurable changes in aquatic life or ecological integrity.

(2) Not withstanding compliance with the criteria of (1) above, the department may determine that the change in water quality resulting from an activity which meets the criteria in (1) above is degradation based upon the following:

(a) cumulative impacts or synergistic effects;
(b) secondary byproducts of decomposition or chemical transformation;
(c) substantive information derived from public input;
(d) changes in flow;
(e) changes in the loading of parameters;
(f) new information regarding the effects of a parameter; or
(g) any other information deemed relevant by the department and that relates to the criteria in (1) above.

(3) The department may determine that a change in water quality resulting from an activity or category of activities is nonsignificant based on information submitted by an applicant that demonstrates conformance with the guidance found in 75-5-301(5)(c), MCA.

Of the above criteria, the most relevant for Big Sky is the criteria listed in ARM 16.20.712(1)(c) and (1)(d). These sections relate to the concentration of nitrogen (and many other parameters) that can be discharged while the resulting change in water quality is still deemed as non-significant. The trigger value for nitrate plus nitrite in a surface discharge, contained in Circular WQB-7, is 0.01 mg/l NO_3+NO_2 as nitrogen. Therefore, a surface discharge that would cause the nitrate plus nitrite concentration to increase by 0.01 mg/l would be a significant discharge. With a ground water discharge, the nitrate plus nitrite concentration outside of the mixing zone could not exceed 5.0 mg/l in order to be deemed non-significant.

ARM 16.20.712(1)(g) concerns changes in water quality for which there are only narrative standards. The narrative standards are contained in ARM 16.20.618 and 16.20.631 through 16.20.635.

The impact of each of the nondegradation criteria on a surface water discharge is evaluated in Chapter 7.

Under the nondegradation rules, a spray irrigation system designed for agronomic uptake rate of nutrients is classified as an activity that causes a non-significant change in water quality.

Disposal by deep well injection would be regulated by the EPA under the Federal Underground Injection Control Program (UIC). The regulations are contained in the Code of Federal Regulations (CFR) under 40 CFR 144. Under the UIC program, the injection of treated wastewater is allowed if the wastewater is treated to meet Federal Primary Drinking Water Standards. The Montana Department of Environmental Quality has indicated that an underground injection system would also be required to meet Montana Nondegradation requirements.

4.6 WASTEWATER COLLECTION SYSTEM

The collection system was built over a four-year period from 1971 to 1974. The system serves both the Mountain Village area and the Meadow Village. A 4-1/2 mile long sewer line transports the sewage flow from the Mountain Village area to the Meadow Village area and the treatment plant. A map of the collection system is included as Appendix A.

The system consists of the sizes and lengths of pipe given in Table 4.6-1 (Kerin, 1986).

Table 4.6-1
Collection System Characteristics

SUBSYSTEM	LENGTH OF SEWER (L.F.)	PIPE SIZE (Inches Diameter)	INCH-DIAMETER-MILES
I. Meadow Village			
1. Collectors			
a. Dull Knife/Crazy Horse/Two Gun-White Calf	3,569	8	5.408
	(1)	4	0.040
	5,205	8	7.887
b. Rain-In-Face/Crazy Horse/Bobtail Horse	(7)	4	0.260
	1,902	8	2.882
c. Spotted Elk	(11)	4	0.420
	4,290	8	6.500
d. Lone Mountain Guest Ranch	2,645	8	4.008
e. Crow King/Chief Joseph	2,552	10	4.833
f. Two Moons/Black Otter/Curley Bear	5,456	8	8.267
	(25)	4	0.950
	3,133	8	4.747
g. Yellowtail	(11)	4	0.420
	5,881	8	8.911
h. West Fork Meadows	150	6	0.110
	(35)	4	1.320
	629	8	0.953
i. 1. Mobile Home Village West	282	21	1.123
	680	8	1.030
2. Mobile Home Village East	282	22	1.177
	3,512	8	5.321
j. Hidden Village	556	6	0.632
	(94)	4	3.650
	2,617	8	3.965
k. Chief Joseph	144	16	0.436
l. Commercial Areas	481	8	0.729
	323	6	0.367
	(3)	4	0.400
	998	24	4.536
	1,519	8	2.302
m. Outfall	994	8	1.506
n. Looking Glass/Lone Walker	1,582	8	2.340
o. Sweet Grass Hills Subsystem			
p. Two Gun White Calf			

2. Interceptors			
a. Little Coyote (MT Hwy #64-MH7)	1,239	16	3.755
	1,395	14	3.699
	1,299	12	2.952
	4,258	10	8.064
	1,030	8	1.561
	(43)	4	1.620
b. Black Otter/Curley Bear/Two Moons	2,552	10	4.833
	5,456	8	8.267
c. Black Otter	1,626	10	3.080
		Subtotal	125.261
( ) Number of 4" Services			
II. Mountain Village			
1. Collectors			
a. Sitting Bull	118	10	0.223
	4,301	8	6.517
b. Custer Lake Condos	1,560	16	4.727
	630	10	1.193
c. Low Dog/Commercial Core	1,880	8	2.848
d. Black Eagle	987	8	1.495
e. White Otter/Sioux	3,482	8	5.276
f. Washakie/Cheyenne/Lone Mountain	3,428	8	5.194
g. Heavy Runner	1,606	8	2.433
h. Turkey Leg	961	8	1.456
2. Interceptor-Low Dog to Montana Highway #64	3,514	18	11.980
	1,123	16	3.403
	1,200	14	3.182
	7,899	12	17.952
	11,010	10	20.852
		Subtotal	88.731
		TOTAL	213.992

4.7 WASTEWATER TREATMENT SYSTEM

4.7.1 Introduction

The original wastewater facility at Big Sky was constructed in 1972-1973 with modifications being made in 1981-1982 and 1997. The 1997 modifications expanded and lined the storage ponds, added a coagulation sedimentation/filtration system, and expanded the golf course irrigation system. The present facility (Figure 4.7.1-1) consists of an influent metering flume, one 8.2 MG aeration pond, two storage ponds of 19.6 MG and 60.1 MG, a recirculation pump station, a chlorine contact tank, and a golf course irrigation system.

The original treatment facility was intended to store all of the treated wastewater and use it for irrigation of the golf course in the summer months. Consequently, the facility has never obtained a discharge permit.

Over the years there have been several agreements made with property owners regarding reserving treatment capacity in the sewage treatment plant. An agreement was made with Westland's Inc. to provide treatment of sewage generated by the development of the Westland property. Through litigation the court required that sufficient wastewater treatment capacity be available to handle 43 million gallons per year of flow from an additional 3700 people when needed. In addition, an agreement was made with Westfork Properties, Inc. in May of 1982 to provide sufficient capacity in the sanitary collection and treatment system for an additional peak daily flow of 48,000 gallons for a population of 800 people.

4.7.2 Aeration Pond

The existing aeration pond is an 8.2 MG hypalon lined pond. The effective volume, when the bottom two feet is reserved for sludge storage, is 7.4 MG. Based solely on the DHES requirement of maintaining a minimum of 15 days hydraulic detention time, the pond has adequate capacity to treat a flow of approximately 500,000 gallons per day. However, maintaining a minimum 15 day detention time in itself does not ensure adequate treatment is being obtained. Treatment efficiency is also highly dependent on the wastewater temperature and the available oxygen supply. Treatment efficiency slows in the winter, as microbial activity decreases, which corresponds to the highest use periods at the resort. At winter flow rates (0.24 MGD) the expected BOD_5 removal efficiency in the aeration pond would be approximately 80 percent. Discharge standards for lagoons are normally set at 30 mg/l BOD_5. As indicated in Table 4.7.2-1, BOD_5 levels in the storage pond are frequently above 30 mg/l.

BIG SKY WASTEWATER FACILITY PLAN
EXISTING TREATMENT SYSTEM

FIGURE 4.7.1-1

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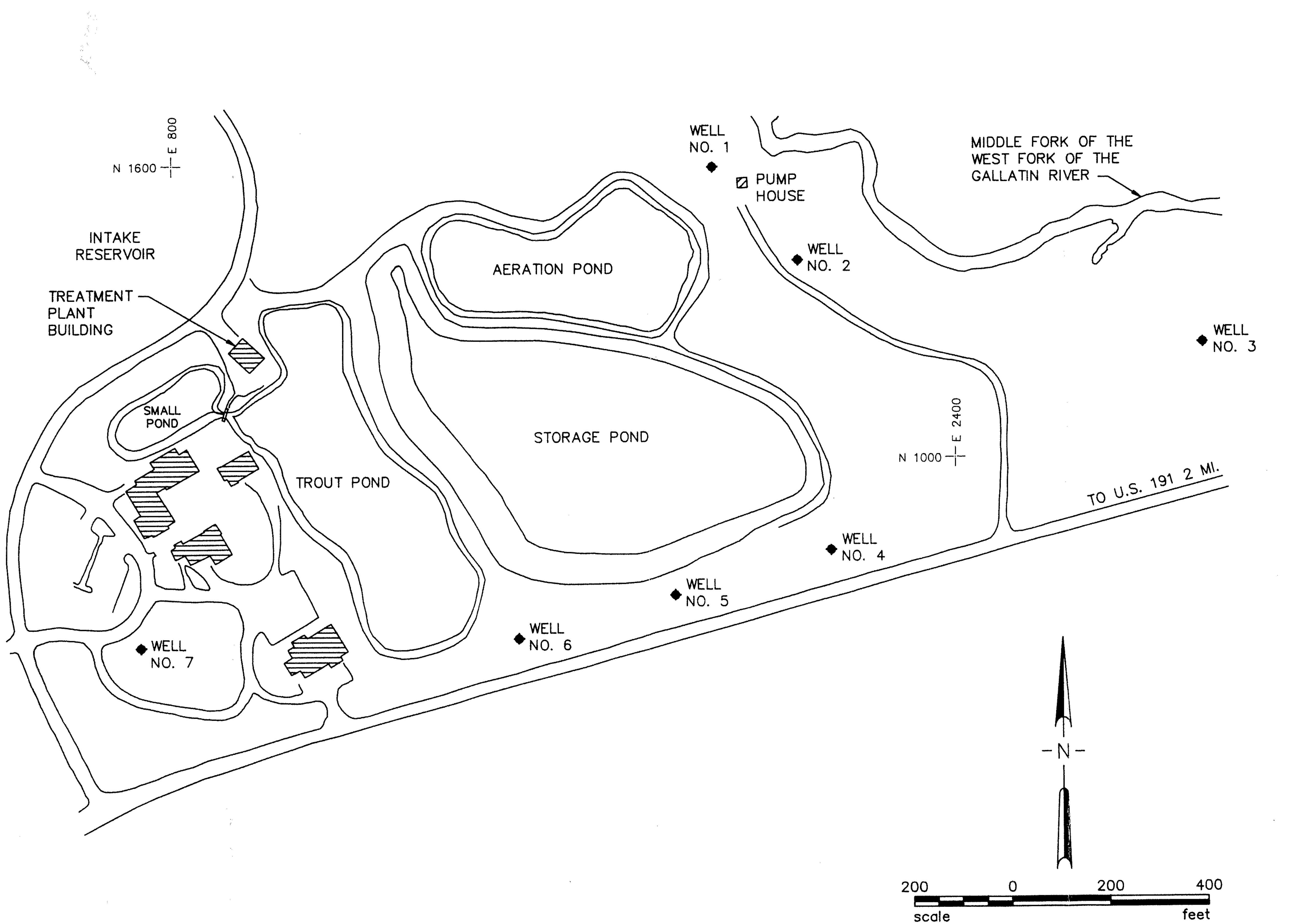


Table 4.7.2-1 Treatment Levels - 1995			
MONTH	INFLUENT BOD_5-mg/l	AERATION POND EFFLUENT BOD_5 - mg/l	STORAGE POND BOD_5 - mg/l
January-1995	395	130	54
February	430	170	78
March	388	140	80
April	182	106	90
May	117	44	47
June	138	25	21
July	220	72	14
August	330	121	63

In the summer of 1995 the aeration cell was split into 2 cells with the addition of a baffle curtain. Six 5 HP floating aerators were installed in the first aeration cell and two 5 HP floating aerators were installed in the second cell. Additional data on the aeration improvements completed during the summer of 1995 is contained in the December, 1994 Interim Action Work Plan for Wastewater Treatment and Disposal at Big Sky, Montana (HKM) (See pages 1-5).

4.7.3 Filtration System

In order to improve the quality of water used to irrigate the golf course, a coagulational/ flocculation/sedimentation and filtration system was installed in the fall of 1997. Three filter trains were installed to provide a total filter area of 225 square feet. The filters have the capacity to treat a daily flow of 0.74 MGD based on a filtration rate of 2.5 gallons per minute per square foot and a 22 hour day. A 22 hour day is utilized to allow time for backwashing. It is anticipated that the filtration rate can be increased to 3 to 4 gpm/ft^2 once an advanced treatment plant is constructed. Figure 4.7.3-1 shows the layout of the filtration system.

Water is pumped to the filters using constant speed pumps at the existing recirculation pump station. A flow control valve on the filter inlet regulates the influent flow. During the backwash cycle, the recirculation pumps shut off automatically.

A flocculation chamber and tube settler is used for pre-treatment before the filters.

The chemical feed system consists of liquid alum for coagulation/flocculation and a polymer addition for a filter aid. A 7,500 gallon liquid alum tank is located in a separate chemical feed room

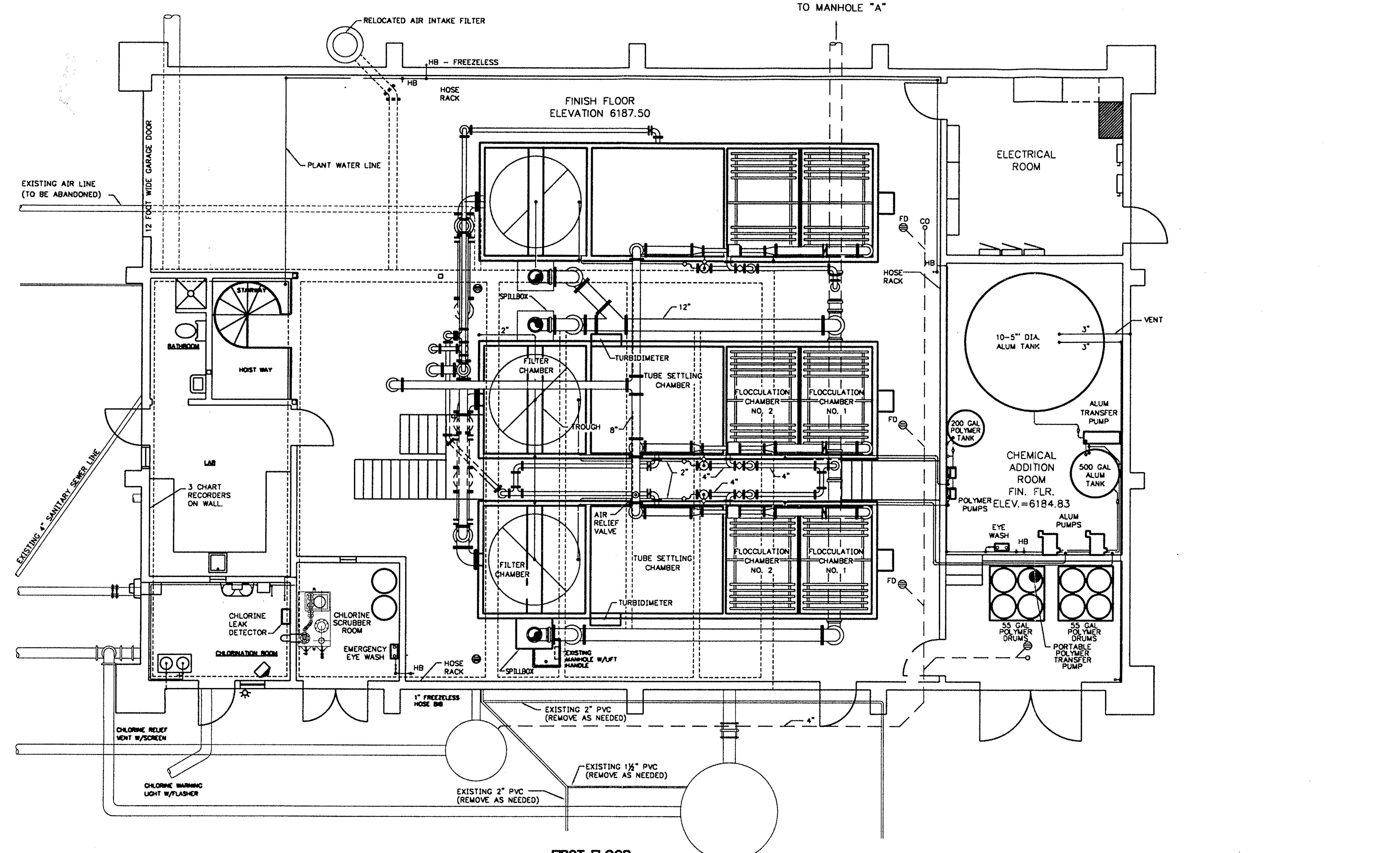
An air/water backwash system is utilized to clean the filters. Backwash pumps are designed to provide a backwash rate of 15 gpm/ft^2. Water from the chlorine contact chamber is used to backwash the filters.

4.7.4 Storage Ponds

During the summers of 1996 and 1997 the storage ponds were enlarged and lined. The storage ponds have capacities of 19.6 MG and 60.1 MG (79.7 MG total).

Pond 1 stores effluent from the aerated lagoon. A recirculation pump station pumps water from pond 1 to the filtration system. After being filtered and chlorinated, the water flows to pond 3 where it is stored for summer irrigation. Transfer piping is also provided between ponds 1 and 3.

In past litigation covering the Westland, Inc. property, it was apparently agreed that the storage capacity of the facility should be a minimum of 225 days, although 240 days may be more appropriate based on weather data. The data from 1972 to 1989 indicates the average snow depth in the Meadow Village at the first of May is 9 inches with a snow-water-equivalent of 3.3 inches. In 1982 through 1984 the snow depth ranged from 31 inches to 14 inches in the Meadow Village on the first of May. Given this data, it is unlikely that irrigation of the golf course could be routinely started before the first of June. Irrigation normally continues until the first part of October. With irrigation from June through September, a storage time of 240 days is required.



FIRST FLOOR PLAN VIEW

SCALE: 1/8"=1'-0"

BIG SKY WASTEWATER FACILITY PLAN

EXISTING FILTRATION SYSTEM

FIGURE 4.7.3-1

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4M357.102 | OCT. 1997

FIG4731.DWG

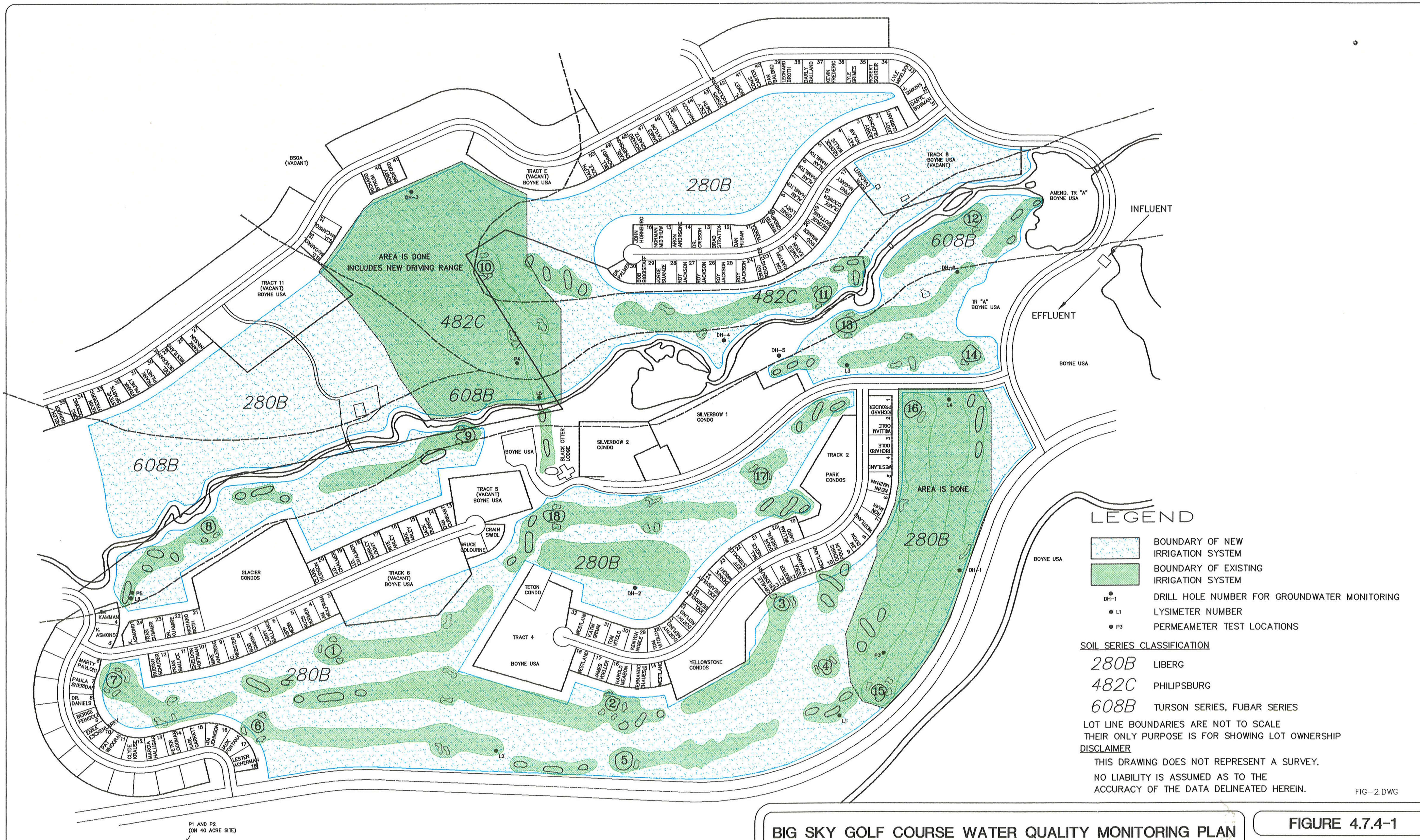
At the 1997 average annual flow rate of 0.30 MGD, the existing storage ponds provide 265 days of storage.

4.7.5 Irrigation

The golf course irrigation system was expanded in the summer of 1997 to cover approximately 185 acres. The expansion was completed as part of the Interim Action Work Plan. Figure 4.7.4-1 shows the limits of the expanded irrigation system. The figure also shows the location of monitoring wells and lysimeters that were installed in the spring of 1995. Monitoring data from 1996 and 1997 is included in Appendix K.

Four pumps are available to pump to the golf course. Pumps 1 and 2 are Aurora Model 5x6x11C and have a rated capacity of 1250 gallons per minute at 365 feet of head. Pump 3 is an Aurora Model 5x6x17 with a rated capacity of 1500 gallons per minute at a head of 196 feet. The three pumps are all variable frequency drive pumps that will maintain a constant discharge pressure regardless of the flow demands. Pump 2 can act as a backup pump to either pump 1 or pump 3.

The fourth pump is a small capacity jockey pump designed to meet small demands and to maintain line pressure when the irrigation system is not in operation. The golf course fairways are seeded to Kentucky Blue Grass and the greens are seeded with Penncross and Penneale bent grasses. The Montana Irrigation Guide lists a consumptive use of 20.28 inches for turf grass based on a weather station at the Belgrade airport and a consumptive use of 19.43 inches for pasture grasses based on a weather station at Ennis. These weather stations are at elevations of 4451 feet and 4953 feet respectively. The Meadow Village at Big Sky is at an elevation of approximately 6200 feet and it is reasonable to assume the crop consumptive use will be lower than would be found in the lower valleys.



BIG SKY GOLF COURSE WATER QUALITY MONITORING PLAN

GOLF COURSE IRRIGATION AREA AND MONITORING LOCATIONS

FIGURE 4.7.4-1

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4M357.102 | DECEMBER 1997

Evapotranspiration (ET) is the combination of evaporation from plant and soil surfaces and transpiration through plant tissues into the atmosphere. ET and consumptive use have slightly different definitions but are approximately the same and both terms are used interchangeably throughout this document. The net irrigation requirement (NIR) of a crop is equal to ET minus effective precipitation. Effective precipitation is that part of the total precipitation during the growing season which is available to meet the consumptive use requirements of a crop. The gross irrigation requirement makes an allowance for evaporation in the irrigation process.

A recently published document, which updates Wyoming's irrigation guide, gives an annual consumptive use of 16.24 inches for turf grass at Lake Yellowstone (elevation 7762). It was assumed that Lake Yellowstone's consumptive use estimates are more representative of Meadow Village and Mountain Village than either Belgrade or Ennis and were used herein. Local precipitation data from Meadow Village and Mountain Village were used to estimate irrigation requirements and total water use at both sites.

The Wyoming irrigation guide used 35 years of climatic data at Lake Yellowstone to estimate monthly turf grass ET estimates. The 35 years of monthly data were ranked and probabilities were calculated using the Weibull plotting positions method. The 10% and 90% values were calculated to represent the driest, warmest year in 10 years and the wettest, coolest year in 10 years, respectively. The same ET estimates from Lake Yellowstone were used for both Meadow Village and Mountain Village.

Hydraulic Loading. As discussed previously in Section 4.1.1, the existing lagoon site and the golf course area are located on an outwash terrace consisting primarily of sand and gravel, but also includes silt and clay at depth. The terrace deposits are approximately 13 to 20 feet thick and are underlain by bedrock which is primarily claystone and shale. The bedrock is relatively impervious. Because of this bedrock, the irrigation capacity of the golf course will be limited by evaporation, precipitation, crop uptake and the horizontal permeability of the soil. Deep percolation past the root zone may surface at the stream cuts bordering the golf course.

On June 26 and 27, 1995 six monitor wells were installed at various locations on the golf course. Drill logs showing the completion of each monitor well are included in Appendix B.

Three ring permeameter tests were conducted on the golf course on August 28 and 29, 1995. The test locations are shown on the map of the golf course irrigation area in Appendix K. Procedures outlined in the USBR Drainage Manual were followed while conducting the ring permeameter tests. Results show that permeabilities varied greatly, depending on location and the type of soil. The test near hole 8's tee box (P5) indicated a permeability of over 17 inches per hour, while across the creek between hole 10 and the driving range (P4), a permeability of 0.33 inches per hour was obtained. The varying geology of the site and the variety of soils at the locations creates this phenomenon. Near hole 8, rock terraces descend onto the golf course site, resulting in high permeability rates. The driving range and hole 10 are located on an alluvial fan created by the Crail Creek drainage. Depositions of thin layers of fine clays creates a low permeability in this location. The third test (P3) was conducted between holes 14 and 15. Permeability rates were about 3.5 inches per hour.

In order to correlate the permeameter test results with soil types, the soil types and location determined by the Soil Conservation Service (Appendix B) were plotted on the map of the golf course (Appendix K).

From the soils map it is apparent that the majority of the golf course consists of a soil designated 280B. The 280B soil is a Libeg series which is a well drained, moderately permeable soil. The permeameter test P3 was conducted in the 280B soil and showed a test result of 3.5 inches per hour. In addition to the test on the golf course, two additional permeameter tests were conducted on similar soils south of the golf course. The two additional permeameter tests showed results of 1.19 inches per hour and 3.98 inches per hour.

In addition to the 280B soil on the golf course, a small section, at test location P4, is designated as a 482C soil. This soil is a Philipsburg series that has a clay layer, at depths of 14 to 27 inches, that limits the percolation rate. The permeameter test (P4) confirmed the lower percolation rate (0.33 inches per hour) in the Philipsburg soil.

The third type of soil on the golf course is designated as 608B. This soil borders the stream and is a Turson series soil. The soil permeability is classified as moderate in the upper part and rapid in the lower part. Permeameter test P5 was conducted in this soil and showed a permeability of 17 inches per hour.

The weighted average of the soil type area and minimum permeability observed in the soil type were utilized in calculating the hydraulic capacity of the golf course. Of the total area, 135.02 acres was assumed to have a minimum permeability of 1.19 inches/hour and 49.75 acres was assumed to have a minimum permeability of 0.33 inches/hour. This distribution results in a weighted average of 0.96 inches per hour. The EPA recommends using a design percolation rate between 4 and 10% of the minimum soil permeability. Therefore, in calculating the hydraulic capacity, a percolation rate of 0.038 inches per hour has been utilized.

Table 4.7.4-1 illustrates the capacity calculations based on the wettest year in 10 precipitation values. Table 4.7.4-1 calculates the golf course capacity based both on soil permeability and nitrogen limits. Column 5 shows the hydraulic capacity based on soil permeability and Column 7 shows the hydraulic capacity based on nitrogen loading. A nitrogen concentration of 5 mg/l in the applied effluent has been assumed based on the construction of a nutrient removal wastewater plant.

While Table 4.7.4-1 indicates a large volume of water could be disposed of on the golf course, the actual capacity will be limited by the site geology rather than soil permeability or nitrogen loading. The soil in the golf course area consists of approximately 1 to 1.5 feet of clay loam topsoil overlaying poorly graded gravel with clay, sand, cobbles and occasional boulders. A clay shale layer is encountered below the gravel at depths ranging from 13 to 18 feet. The shale layer limits the vertical flow of water and therefore the capacity of the golf course to accept water is limited by the horizontal flow of water. Published test well data (Van Voast, 1972) indicates the horizontal permeability of the gravel layer is approximately 270 feet per day.

Calculations shown in Table 4.7.4-2 show the actual gross irrigation requirement of the golf course in the wettest year in 10 is 53.3 million gallons. Therefore, irrigation applications in excess of 53.3 million gallons will percolate past the root zone into the underlying gravels. The underlying gravels must have enough hydraulic permeability to drain the area to prevent excessive groundwater mounding.

Calculations indicate the golf course site has the capacity to drain approximately 90 million gallons during a 137 day irrigation season. When the actual gross irrigation requirement of 53.3 MG is added to deep percolation volume of 90.0 MG the total volume of treated wastewater that can be applied to the golf course is 143.3 MG.

It needs to be emphasized that limited data is available for calculating groundwater flow patterns. Therefore, the volume that can be drained from the site as deep percolation could vary. Conservative estimates of the hydraulic conductivity, porosity, and mound height were used in the calculations so it is felt the volume that can be drained is reasonable. However, we do recommend that groundwater levels in the monitoring wells continue to be recorded to facilitate the development of a groundwater computer model.

The golf course manager has indicated he typically fertilizes twice per year at an annual nitrogen loading of 100 pounds nitrogen per acre per year. As discussed above, Kentucky Bluegrass has a nitrogen uptake rate of approximately 150 to 200 pounds per acre per year. Therefore, one-half to three quarters of the nitrogen requirement is being supplied by a commercial fertilizer. lysimeters installed on the golf course can be monitored to ensure that nitrogen leaching into the groundwater is minimized.

Soil analyses have been performed on the golf course since 1982. Recent data from 1989, 1990, 1993 are shown in Table 4.7.4-4. Data from 1982 is also shown for comparison.

TABLE 4.7.4-1

GOLF COURSE IRRIGATION SYSTEM CAPACITY
FUTURE TREATMENT PLANT & EXPANDED GOLF COURSE IRR. SYSTEM
(Effluent applied at 5 mg/l

1		2	3	4	5	6	7	8	8	9	10
Month	Days	ET (cm)	Pr (cm)	Pw (cm)	Lw(p) (cm)	U (kg/ha)	Lw(n) (cm)	HLR (cm)	HLR (in)	Acres Irrigated	Irr (MG)
JAN		0.0	4.3	0.0	0.0	0.0	0.0	0.0	0.0	185	0
FEB		0.0	3.4	0.0	0.0	0.0	0.0	0.0	0.0	185	0
MAR		0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0	185	0
APR		0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0	185	0
MAY	12	1.9	8.8	12.8	5.9	7.6	18.9	5.9	2.3	185	12
JUN	30	7.6	10.0	32.1	29.7	31.0	77.4	29.7	11.7	185	59
JUL	31	10.6	5.8	33.2	37.9	43.2	108.0	37.9	14.9	185	75
AUG	31	9.2	5.6	33.2	36.7	37.4	93.5	36.7	14.5	185	73
SEP	30	3.6	6.3	32.1	29.4	14.7	36.8	29.4	11.6	185	58
OCT	3	0.0	4.6	3.2	0.0	0.0	0.0	0.0	0.0	185	0
NOV		0.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	185	0
DEC		0.0	4.7	0.0	0.0	0.0	0.0	0.0	0.0	185	0
SEASON	137	32.8	67.7	146.6	139.7	133.9	334.7	139.7	55.0	185	276

1 Growing season
2 Coolest year in 10 monthly ET value from 35 years of data at Lake Yellowstone
3 Wettest year in 10 total precipitation
4 Percolation rate (11 hr/day avg. irr. over season based on 4% of weighted soil permeability = 0.04 * 0.96 in/hr)
5 Hydraulic loading rate based on soil permeability
6 Nitrogen uptake per month. (Based on 150 lbs/ac/yr (134 kg/ha/yr), proportioned to monthly ET)
7 Hydraulic loading rate based on nitrogen limits of percolation water (model assumes 5 mg/l in applied water and NO nitrates deep percolated)
8 Design hydraulic loading rate (lesser of columns 5 and 7)
9 Acreage to be irrigated
10 Allowable irrigation volume (hydraulic loading) applied to the ground surface (calculated from depth in column 8 and acreage in column 9)

TABLE 4.7.4-2

GOLF COURSE IRRIGATION CAPACITY (COOL YEAR)

MONTH	10% PROBABILITY COOL YEAR** LAWN GRASS ET* (INCHES)	MEADOW VILLAGE WETTEST YEAR IN 10 TOTAL PRECIPITATION (INCHES)	WETTEST YR IN 1 EFFECTIVE *** PRECIPITATION (INCHES)	WETTEST YR IN 1 NET IRR. REQ'T (INCHES)	(using 70% irrigation application efficiency) WETTEST YR IN 10 GROSS IRR. REQ'T (INCHES)	WETTEST YR IN 10 GROSS IRR. REQ'T (FT)	GOLF COURSE IRRIGATED AREA (ACRES)	TOTAL**** POTENTIAL WATER USE (AC-FT)	TOTAL**** POTENTIAL WATER USE (MG)
MAY	0.73	3.46	1.48	0.00	0.00	0.00	185	0	0.00
JUN	2.99	3.96	1.90	1.10	1.57	0.13	185	24	7.88
JUL	4.17	2.30	1.25	2.91	4.16	0.35	185	64	20.90
AUG	3.61	2.20	1.17	2.44	3.49	0.29	185	54	17.52
SEP	1.42	2.47	1.15	0.27	0.39	0.03	185	6	1.97
SEASON	14.37	14.39	6.95	7.42	10.60	0.88	185	163	53.26

* ET VALUES FROM WYOMING IRRIGATION GUIDE @ LAKE YELLOWSTONE, WY (Calculated from Weibull plotting positions method)

** The ET in any given month can be expected to equal or exceed the given values 9 out of every 10 years (ie. There is a 90% probability that the monthly ET will equal or exceed the given values).

*** EFFECTIVE PRECIPITATION FROM SCS TR-21: Pe=f(D)[1.25(Pt)^0.824-2.93]*10^(0.000955ETc)

where:

f(D)=function to account for depth of soil moisture depletion other than 75 mm, (d) and =0.77 for a (d)= 1.00 inches

Pt = Total monthly precipitation (mm)

ETc = monthly ET (mm)

**** Seasonal ET and Gross Irrigation Requirements do not equal the sum of the monthly values because of the probability analyses used herein.
The 90% values for seasonal ET and Gross Irr. Req'ts apply to seasonal values and do not assume that the 90% monthly values occur in consecutive months of the same year.

Table 4.7.4-4 Soil Analysis on Golf Course (Nutrient Results in MG/L)							
DATE	CEC	pH	SOLUBLE SALTS	EXCHANGE-ABLE CA	EXCHANGE-ABLE MG	EXCHANGE-ABLE NA	AVAILABLE PO_4
9/17/93	12.4	7.9	0.24	2046	218	12	10
	11.8	7.9	0.28	1792	287	18	9
	6.2	7.7	0.14	833	205	12	3
	9.2	7.1	0.50	1578	104	28	65
6/20/90	17.9	7.4	0.17	3053	263	28	29
	9.1	6.9	0.19	1438	179	27	79
	5.6	7.1	0.11	866	111	26	86
8/16/89	8.6	7.0	0.20	1290	188	51	66
	10.2	7.3	0.21	1583	191	62	48
	8.7	7.1	0.23	1302	179	69	66
	8.6	7.1	0.24	1337	173	44	66
	8.4	7.1	0.26	1278	182	44	68
6/4/82	7.6	6.8		1200	160	22	84
	5.7	6.6		900	110	21	68
	8.9	6.7		1500	130	19	77
	21.1	6.7		3300	420	18	66

These sixteen soil samples were taken from scattered locations in four different years over a period of twelve years. Except for green 8, which was sampled three of the four years there is no consistency in sample locations. This makes it difficult to draw conclusions about soil chemical changes over time. The available data indicates that, of the parameters measured, most are within the normal ranges for agricultural soil. The pH soluble salts and exchangeable sodium are all at low levels.

The available PO_4 in almost all samples is high enough that typical phosphorus application is, for the most part, unwarranted. According to the laboratory report, however, routine applications of 0.5 lb/acre of P_2O_5 would not be detrimental to the turf. Based on the Montana Irrigation Fertilizer Guide, grass has a phosphorus requirement of approximately 30 to 40 pounds per acre. Assuming a phosphorus removal plant is constructed, phosphorus level applied would be approximately 3 to 5 pounds per acre. Therefore, the high existing soil phosphorus levels will gradually be reduced.

4.7.6 Disinfection

Before the treated wastewater is used for golf course irrigation, chlorine is added for disinfection. Chlorine is applied at the inlet of the chlorine contact chamber.

The chlorine contact chamber is located in the existing treatment plant building and consists of a 4-pass-baffled chamber. The contact chamber has a volume of approximately 25,920 gallons. The state design criteria require that 15 minutes of contact time be provided at the peak hourly flow. Therefore, the contact chamber has the capacity to disinfect a peak hourly flow of 1,728 gallons per minute (2.49 MGD).

4.8 INFILTRATION AND INFLOW

4.8.1 General

Infiltration is defined as water that enters a sewer system and service connections from the ground, through defective pipes, pipe joints, connections, manholes, or other means. Infiltration may be due to either a high groundwater or rainfall. The magnitude of groundwater infiltration depends on groundwater levels, which fluctuate throughout the year. At Big Sky, groundwater infiltration is the main source of infiltration and is severe during spring runoff.

Inflow is defined as water discharged into a sewer system and service connections from sources such as roof drains, cellar, yard and area drains, foundation drains, cooling water discharges, and manhole covers. As inflow is characterized by a direct connection or discharge to the sewer system, inflow will result in a rapid flow increase during a storm event.

Typically, the EPA considers wastewater flows over 120 gallons per capita per day as excessive (EPA, 1984). Another technical source uses a flow quantity with units of gallons per day per inch diameter per mile of sewer. In one study with 128 cities reporting, 59% had infiltration allowances of 500 gpd/inch-diameter-mile or greater (ASCE No. 60). Infiltration allowances ranged from 50 to 1,500 gpd/inch-diameter-mile. A value of 200 gpd/inch-diameter-mile is typically used for acceptance tests on new sewers.

Since the population at the resort is highly variable, it is difficult to correlate a flow with a specific population. Therefore, a better estimate of the severity of the I/I problem can be obtained by looking at the flow per inch-diameter-mile. As previously shown in Table 4.4-2, infiltration/inflow averages 173,972 gallons per day. Based on the collection system containing 213.99 inch-diameter-miles, the annual average infiltration equates to 812.9 gpd/inch-diameter-mile.

The I/I in the collection system varies throughout the year and is the most severe during the spring and early summer snow melt period. Figure 4.8-1 shows a graph of the weekly maximum and minimum instantaneous flows for the spring of 1993. As the figure indicates, during the winter of 1993 the minimum flow was approximately 56 gallons per minute. However, during April and May the minimum flow rises to approximately 186 gallons per minute and 406 gallons per minute respectively. During the same time frame, the domestic flows show a downward trend starting at the end of February. This indicates that the domestic sewage component of the flow is decreasing while at the same time the I/I portion of the flow is increasing.

Extensive repair work was performed on the collection system during 1993 and 1994. As a result of the repair work minimum night time flows were reduced to approximately 42 gallons per minute from the 56 gallons per minute measured in January and February 1993.

The first step in the infiltration/inflow analysis for Big Sky was an analysis of the wastewater flows on a system wide basis. This analysis documented the severity of the I/I problem. The second step in the I/I analysis involved checking flows in individual drainage areas to locate sources of high I/I. The District personnel conducted flow monitoring on the individual drainage zones during the Spring of 1995. The flow monitoring results are included in Appendix J.

4.8.2 System Wide Analysis

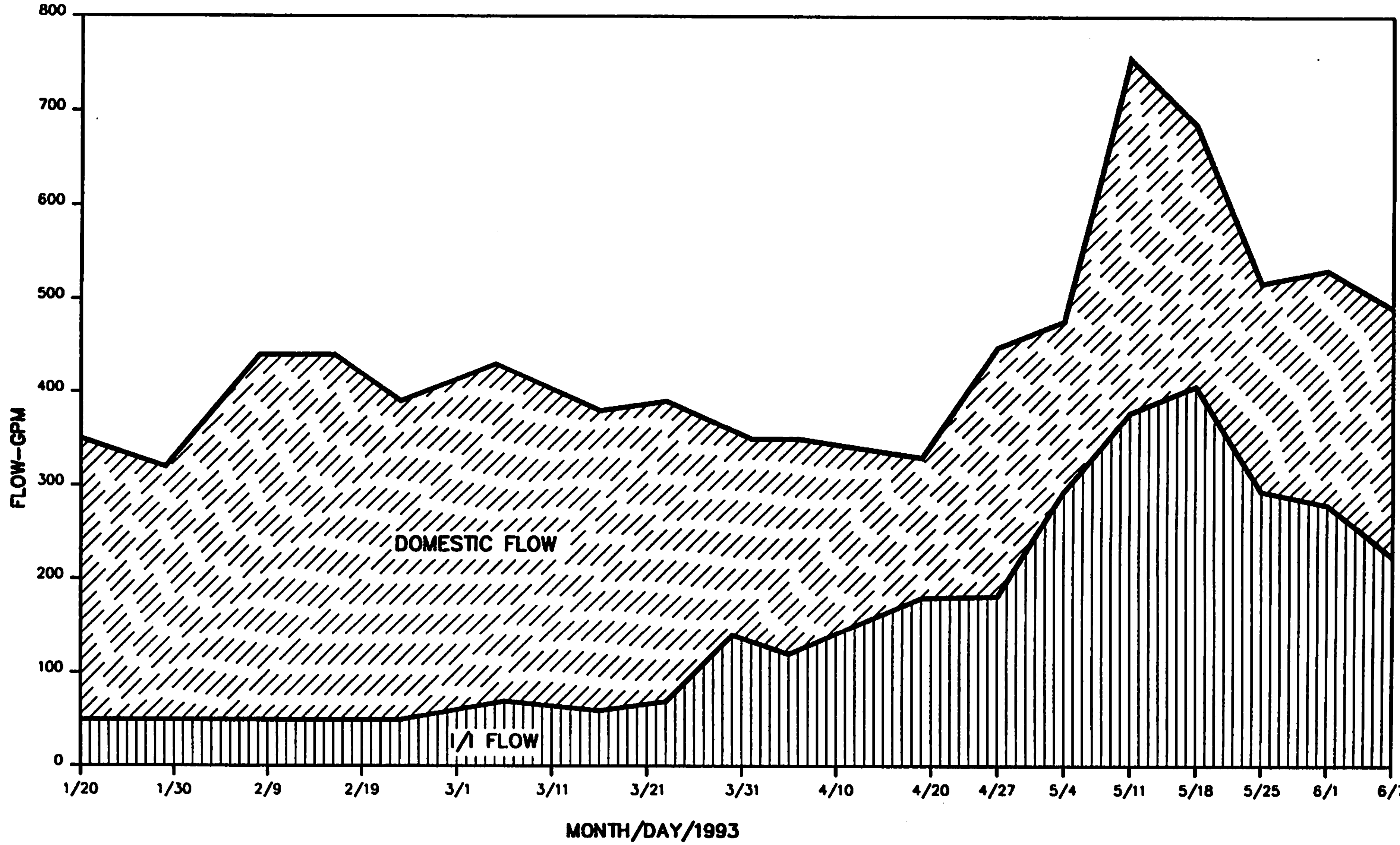
The wastewater treatment plant flow records from January 1993 through December 1993 were reviewed to determine the monthly flow patterns at Big Sky. The 1993 monthly flows were then compared to the monthly flows from 1987 through 1991 (Refer to Table 4.4-1). Data from 1992 is not included due to inaccurate meter readings. A new meter was installed in January 1993.

Due to the seasonal nature of the resort, it is necessary to evaluate the data during the ski season and also during a non-ski season period. Figure 4.8.2-1 shows the January, February and March flows from 1987 through 1995 (excluding 1992). As the figure indicates the flows decreased from 1987 to 1989. From 1989 the flows have shown an increase. To determine if the flow increase during the 1993 ski season was due to infiltration or increased usage, the ratio of total flow during January through March to skier days was checked. Table 4.8.2-1 shows the data used to develop the gallons per skier day ratio.

Table 4.8.2-1
Ratio of Gallons Per Skier Day

YEAR	TOTAL FLOW JANUARY-MARCH GALLONS	NUMBER OF SKIER DAYS	GALLONS/SKIER DAY
1988	24,097,550	162,814	148.0
1989	18,293,820	168,000	108.9
1990	20,003,010	192,000	104.1
1991	20,061,470	212,000	94.6
1993	23,787,123	225,300	105.6
1994	23,880,000	218,000	109.5
1995	24,960,000	239,400	104.3

The data indicates that the flow increase, during the winter, from 1988 is due primarily to the increase in usage. The data also reflects the decrease in gallons per skier day achieved since 1988.



BIG SKY WASTEWATER TREATMENT PLANT

INSTANTANEOUS WEEKLY MAXIMUM AND MINIMUM FLOWS

FIGURE 4.8-1

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4M357.102 | MARCH 1994

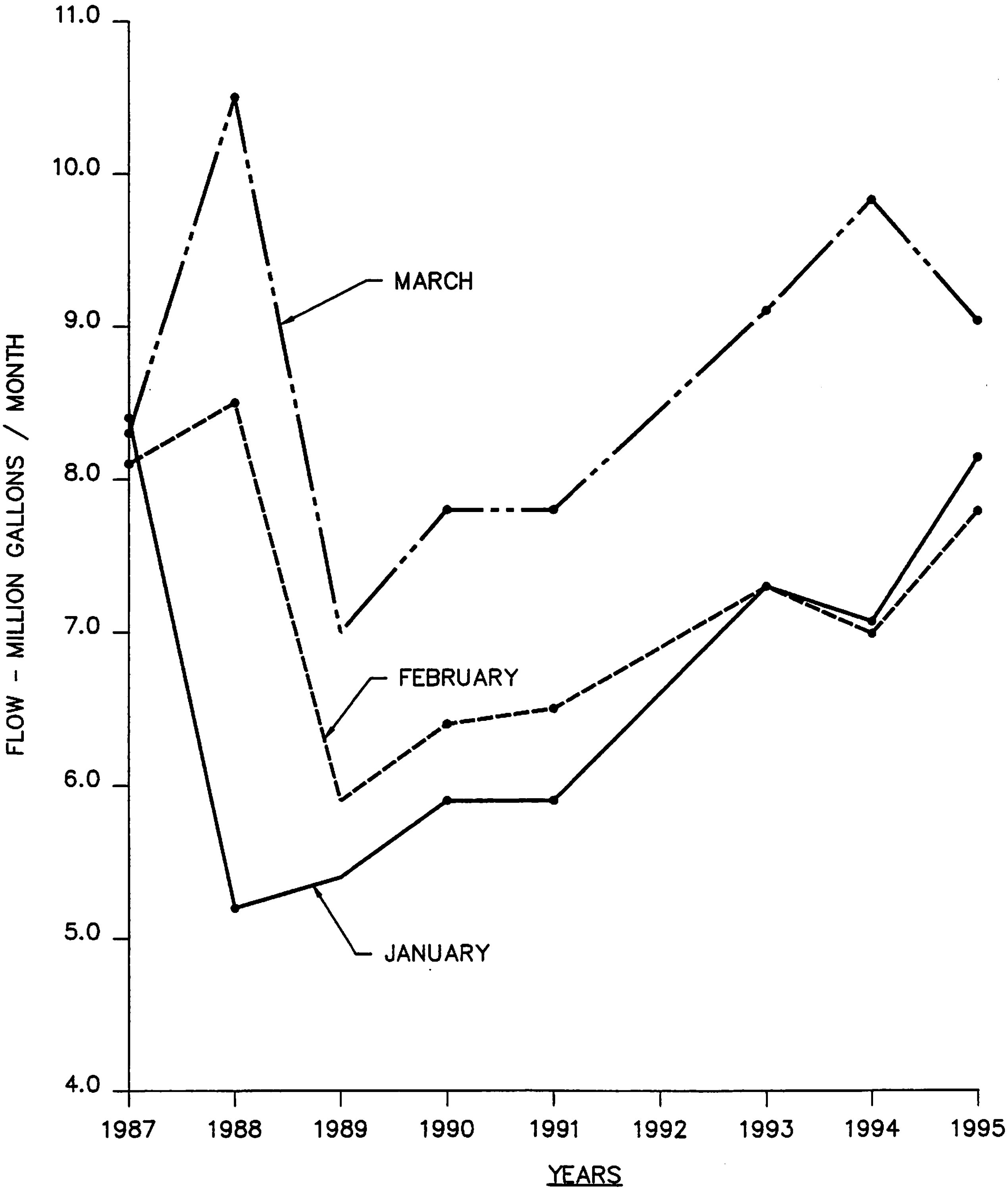

FIG4-821.DWG

BIG SKY WASTEWATER TREATMENT PLANT

INFILTRATION / INFLOW ANALYSIS
JANUARY - MARCH FLOWS

FIGURE 4.8.2-1

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4M357.102 | DEC 1995

Figure 4.8.2-2 is a graph of the flows recorded on January 22 and 23, 1993. This time period reflects the flows during the ski season, when groundwater infiltration is low. The average flow for the two days was 249,557 gallons per day (173.3 gpm). The minimum flow observed during the two days was 56 gpm. It can be assumed that the minimum night time flow is made up of two components: (1) groundwater infiltration and (2) night time domestic flow. An estimate of the infiltration component was made by looking at the flow reduction achieved after repairs were made in 1993 and estimates of infiltration from the television inspection in 1993. Repair work completed during the summer of 1993 reduced the minimum flow observed during the fall of 1993 to approximately 42 gpm, a reduction of 14 gpm. From the television inspection, it is estimated an additional flow of 12 gpm can be attributed to infiltration. Therefore, the infiltration component of flow during low groundwater periods of January, February, March, October, November, and December is estimated to be 30 gpm.

During the non ski season, when groundwater levels and I/I flows are high, the domestic portion of the minimum nighttime flows are insignificant in comparison to the I/I flow. Therefore, the infiltration component of flow was assumed to be represented by the minimum flow observed. Figure 4.8.2-3 is a graph of the flows recorded on June 3rd and 4th, 1993 and 1995. This time period represents the non-ski season during high groundwater conditions.

While the percentage of infiltration in the system is high compared to the domestic portion of the flow, it must be remembered that the area served is rather unique. The collection system covers a large area but serves a relatively small population. The collection system is comprised of a variety of pipe sizes with a total of 213.99 inch•diameter•miles of pipe. The infiltration acceptance standard for newly installed sewer line is 200 gallons per day per inch•diameter•mile of pipe (Montana Public Works Standard). Therefore, even with a newly installed system, meeting state standards, the allowable infiltration volume would be 42,798 gallons per day or 1,301,800 gallons per month (15.6 MG/YR). It would be expected that as the collection system ages, infiltration would increase. It is not uncommon to see infiltration allowances of up to 500 gpd per inch·diameter·mile. (ASCE No. 60). An infiltration allowance of 500 gpd/inch·diameter·mile would result in a monthly infiltration volume of 3,254,431 gallons (39.0 MG/YR). Comparing the infiltration flows previously in Table 4.4-2 to the typical infiltration allowances discussed above, it is apparent that the infiltration flows in October through March are well within acceptable limits. In contrast the infiltration flows in April through September are well above acceptable limits.

4.8.3 Drainage Area Analysis

The analysis of individual drainage areas was limited to instantaneous flow measurements during the early morning hours of November 11, 12, and 13, 1993. The flows measured for each drainage area are shown below in Table 4.8.3-1. Table 4.8.3-1 also shows the flows that were measured during 1986.

Table 4.8.3-1
Infiltration by Drainage Area

	MH NUMBER	1985 FLOWS FLOW GPM (DATE)	1986 FLOWS FLOW GPM (DATE)	1986 FLOWS FLOW GPM (DATE)	1993 FLOWS FLOW GPM (DATE)
MOUNTAIN SYSTEM					
Sky Crest	292	1 (12/85)			0 (11/93)
Stillwater	313	13.3 (4/86)	12.6 (7/86)		5 (11/93)
Turkey Leg	296	1.5 (12/85)	1.5 (4/86)		0 (11/93)
Sitting Bull	300	0 (12/85)	5 (4/86)	0.5 (7/86)	2 (11/93)
Low Dog	Flume				6 (11/93)
OUTFALL LINE	112	151 (4/86)			31 11/93)
HIDDEN VILLAGE	131	2.5 (12/85)	5.3 (4/86)	4.1 (7/86)	2 (11/93)
MEADOW SYSTEM					
Yellowtail	15	19.3 (12/85)	19.3 (4/86)	38.1 (7/86)	13 (11/93)
Westfork Meadows	51	1 (12/85)	0.5 (4/86)	0.5 (7/86)	<1 (11/93)
Sweet Grass Hills	91	0 (1/86)			<1 (11/93)
Spotted Elk	80	1 (12/85)	0.5 (4/86)		1 (11/93)
WASTEWATER PLANT		107-116 (12/85)			44 (11/93)

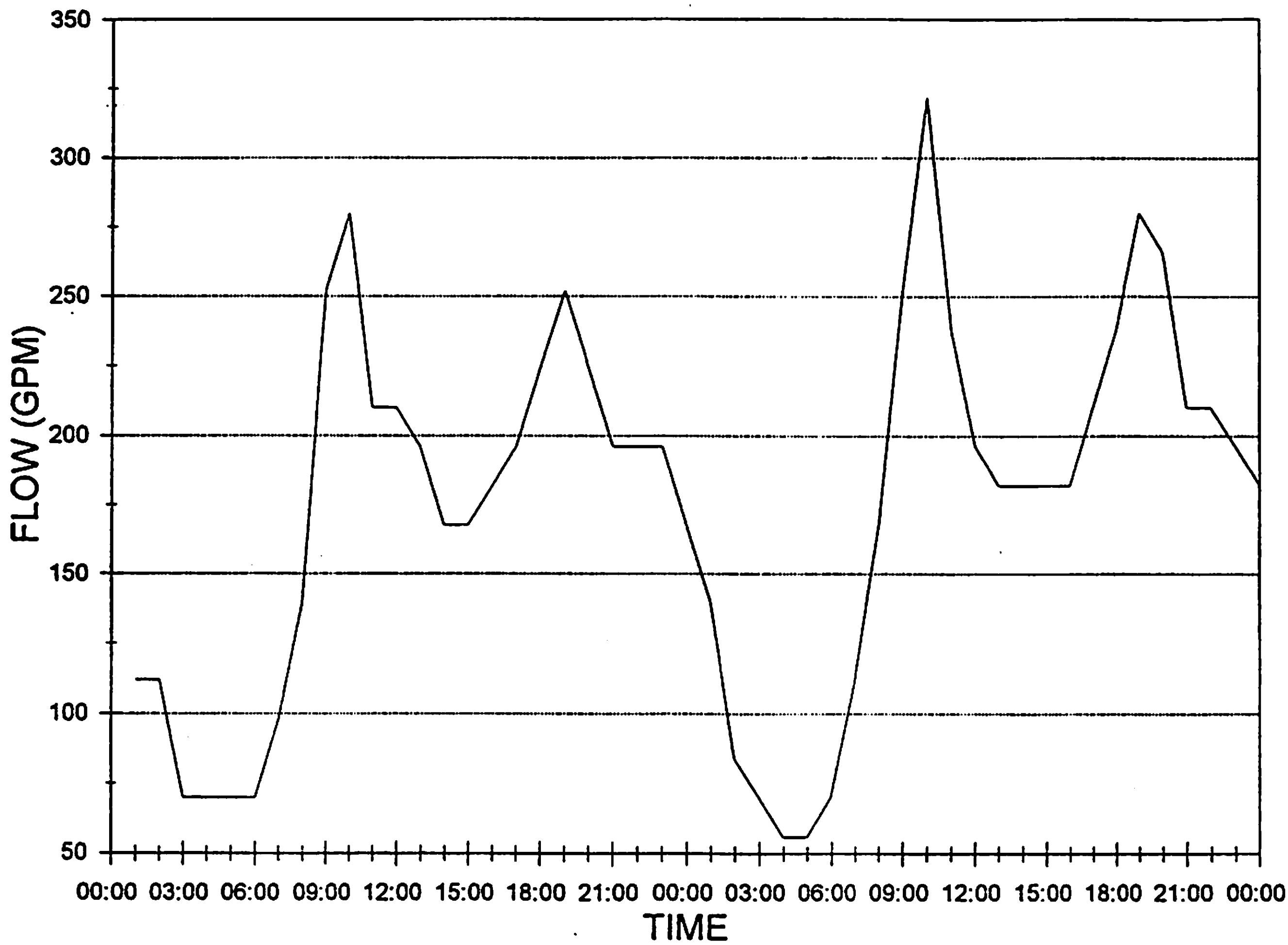

FIG4-822.DWG

BIG SKY WASTEWATER TREATMENT PLANT

TREATMENT PLANT FLOW
JANUARY 22 & 23, 1993

FIGURE 4.8.2-2

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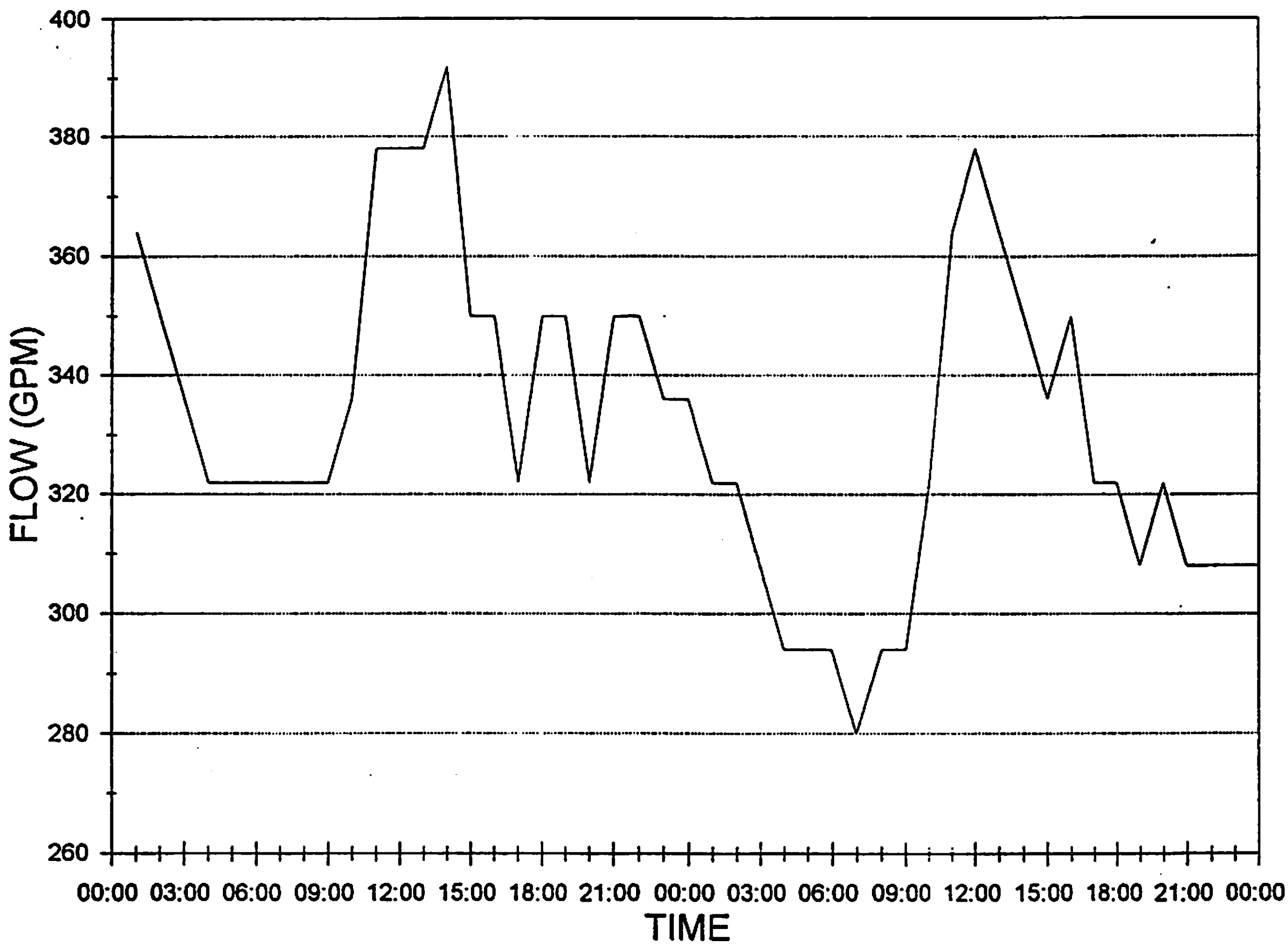

FIG4-823.DWG

BIG SKY WASTEWATER TREATMENT PLANT

TREATMENT PLANT FLOW
JUNE 3 & 4, 1993

FIGURE 4.8.2-3

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The previous table indicates that flows from most of the drainage areas have decreased. However, it is emphasized that the 1993 flow measurements were taken in November when groundwater levels were down. The flows from the individual drainage areas should be measured again during May and June to isolate areas of high infiltration.

From the spot flow measurements, it appears that the Yellowtail line is contributing approximately 13 gpm in infiltration flow. It also appears that the outfall line may have some infiltration. The measured flow at the bottom of the line was 31.0 gpm while the measured flow at the top was 6.0 gpm. While the difference in flows may not be entirely infiltration, it is expected that a portion of the 25 gpm flow difference is groundwater infiltration.

5.0 FUTURE CONDITIONS

5.1 POPULATION PROJECTION

As discussed in Section 4.2 the population of Big Sky is difficult to estimate because of the highly variable influx of people on weekends and holidays. In order to estimate the future growth rate of development at Big Sky, the historical growth rate was determined. Table 5.1-1 shows the number of new unit building permits that have been issued from 1986 through 1992.

Table 5.1-1
New Unit Building Permits Issued
Big Sky

	EXISTING 1985	'86	'87	'88	'89	'90	'91	'92
BIG SKY TOTAL	1263	25	28	10	110	24	26	49
% GROWTH		2.0	2.2	0.8	8.3	1.7	1.8	3.3
ADJUSTED GROWTH			3.0	3.0	3.0	3.0	3.0	3.0

Note: Adjusted growth is the average growth for the six years 1987 - 1992. This assumes a large complex such as Shoshone Lodge (94 units) is constructed once every six years.

The Draft Land Use Plan for the Gallatin Canyon/Big Sky Planning and Zoning District reported that past studies have estimated population growth in the "primary service area" as follows:

YEAR	POPULATION	% CHANGE
1986	1269	
1987	1307	2.99
1988	1346	2.98
1989	1386	2.97
1990	1428	3.0
1991	1428	3.0

The draft land use plan also reported recent annual growth rates of 3.9% for electric meter installations, 14.6% for residential telephones and 17.6% for business telephones.

While historically the growth rate has been approximately 3%, it is assumed that the sewer hook-up moratorium imposed by the Water Quality Division in July 1993 has created a back log of housing demand that will result in increased construction when this moratorium is lifted.

As indicated previously in Section 2.2, past court decisions have ruled that Westland Enterprise have rights to 43 million gallons per year of sewer capacity. At the projected flow rates, a flow of 43 million gallons per year equates to 1435.3 SFE's (refer to Table 3.0-1). The partners in the Westland Properties have indicated that they plan to develop a hotel or commercial space equivalent to approximately 500 to 700 SFE's timed to come on line shortly after the treatment plant is constructed (Simkins, 1995). It was also indicated that their remaining 935 SFE's would likely be developed in increments of 45 to 90 SFE's per year.

Boyne USA has also recently started construction on the Summit Hotel in the Mountain Village. It is anticipated that the Hotel will be connected to the sanitary sewer in the Fall of 1999. The hotel will constitute an additional load of 214.65 SFE's.

After the sewer hook-up moratorium was eased during the summer of 1996 several new construction projects were started. In July of 1997 the District completed an inventory of all currently occupied SFE's (Table 3.0-1). The inventory showed that the District provided sewer service to 2,508 SFE's. In addition as shown in Table 3.0-1 the District has a legal obligation to provide sewer service to an additional 5,417.5 SFE's (total legal commitment 7,926.3 SFE's).

Table 5.1-2 shows the projected SFE's connected to the sewer system in yearly increments to the year 2000. Thereafter, 5 year increments are shown based on a 3 percent growth rate. It is noted that the 3 percent growth rate includes the 45 to 90 SFE's per year that the Westlands have indicated they plan to develop. As noted in Chapter 3.0, the District has legal commitments to provide treatment capacity to 7,926.3 SFE's (includes court allocated commitments for Westlands).

Table 5.1-2 Projected Single family Equivalents			
YEAR	SFE	YEAR	SFE
1998 1999 2000 2005	2563.4 2902.1 2989.1 3465.1	2010 2015 2020 2025 2030	4017.0 4656.9 5398.2 6258.4 7255.2

5.2 WASTEWATER FLOW

5.2.1 Conservation Measures

Reducing the amount of wastewater that must be treated can be a viable and cost effective method of reducing treatment costs. Reducing water use and hence wastewater generally involves three aspects; 1) public education on the importance and impacts of water conservation and 2) use of improved plumbing fixtures such as low flow shower heads and low flush toilets, and 3) a price structure designed to discourage excess water use.

Requiring the use of low flow plumbing fixtures in all new construction will help reduce wastewater flows. The amount of wastewater reduction that can be achieved by improved plumbing fixtures has been reported to range from a low of approximately 3 percent to a high of 26.5 percent.

A study conducted in Seattle, Washington showed a decline in per capita water use of 6.4 and 2.1 percent from a complete installation of low-flow showerheads and toilet displacement devices respectively. A study in the North Marion, California District reported a 3.6% reduction in indoor water use as a result of installing low flow shower heads and toilet tank displacement devices (Nelson). The Contra Costa Water District showed reductions of 9.7 percent for low-flow shower heads and 3.9 percent for toilet displacement devices (Whitcomb, 1991). Water use reduction of 14.6% and 26.5% were reported for apartment buildings in Houston after the installation of low flush toilets (Langendoen, 1992).

In planning for future flow rates, water conservation measures are assumed to reduce the flow from existing users by 5% and by 10% from new users.

The Water and Sewer District has developed a building ordinance to ensure water conservation measures are used in new construction. Unlike federal policy which exempt commercial establishments from water conservation fixtures, the District ordinance will require low flow fixtures for both residential and commercial construction. A copy of the ordinance 94-1002 is included in Appendix H.

Through the public education efforts of the District, several of the major system users have indicated they have already changed to low flow showers and low flush toilets (Appendix H).

The District has also adopted Resolution 94-01 (Appendix H) which deals with eliminating inflow sources.

The District has made efforts to inform the public of the need to conserve water. A copy of the notice sent to all homeowners is included in Appendix H. It is recommended that additional notices be sent at regular intervals throughout the year to remind users of the importance of water conservation.

5.2.2 Flow Projections

The projection of future flow rate is based on the current domestic flow rate and the assumption that the flow rate will increase proportional to the growth rate. A design year of 2020 has been used which will provide approximately 20 years of plant life once the plant is completed. The following assumptions were used to project the 20-year design flow rate:

- 1993 is used as the base year for the domestic flow and number of SFE's.
- The domestic flow is 53.5 MG per year.
- The flow per SFE is 53.5 MGY/1928.7 = 27,739 gallons/year/SFE
- Conservation measures can reduce the current domestic flow per SFE by 5%.
- Conservation measures can reduce future domestic flow rates per SFE by 10%.
- Domestic flow rates will increase in proportion to increased growth at the resort.
- Projected new SFE's = 5398.2-1928.7 = 3469.5

- The average occupancy rate at the resort will increase 20% from current levels during the 20-year design period.
- Projected flow rate for existing SFE's = (27,739) (.95)(1.20) = 31,622 gpy/SFE's
- Projected flow rate for new SFE's = (27,739)(.90)(1.20) = 29,958 gpy/SFE

Using these assumptions, the domestic flow contribution for the year 2020 can be calculated as shown below:

20-year Domestic Flow = (1928.7)(31,622)+(3469.5)(29,958) = 164.9 MGY

Infiltration and Inflow (I/I) will also enter the collection system and must be treated. In 1993, I/I constituted over half of the flow measured at the lagoons. In order to reduce the I/I volume, the water and sewer district has instituted an aggressive repair program. During the 1993 and 1994, approximately 28,300 feet of sewer line was inspected with a television camera and repairs were made at many locations where infiltration was occurring (Appendix I). While the springtime flow decreased substantially in 1994, it returned to the historic high levels again during 1995. The low I/I flows observed in the spring of 1994 may have been the result of the low snowpack and short runoff period rather than improvements in the collection system. Flows in 1996 were generally lower than those in 1995 but high springtime flows again occurred during April through June of 1996. In 1997 high springtime flows were once again observed with a high monthly flow of 19.38 million gallons per month in May. In 1997 higher flows were also recorded during the fall and winter. The higher flows could be attributed to either higher usage or differences in meter readings.(A new flow meter was installed in September 1996)

We recommend the District continue to try and locate sources of infiltration; however due to the uncertainty of the actual I/I flow reductions that can be achieved, it is recommended that the current level of I/I flow be included in the design flow. As indicated above the District has made considerable efforts to reduce the volume of I/I flows. The current volume of I/I flow is estimated to range from 30 million gallons per year to 40 million gallons per year. The I/I range was estimated by subtracting the domestic flow contribution (2508.8 SFE's x 27,739 gallons/year/SFE) from the 1997 annual flow of 109.71 million gallons. The I/I flow was also estimated by assuming that the actual domestic flow during May through August was equal to the total plan flow in September, October, and November;

when I/I flow is minimal. The estimated domestic flow of 4.72 MG/month was then subtracted from the plant flows recorded in May through August. The result was an estimated I/I flow of 32.7 million gallons per year.

For planning it is recommended that an I/I flow allowance of 42.9 million gallons per year be included in the design flow. This allows for future I/I flows that may develop as the collection system expands.

Based on the preceding discussions the projected annual average flows are shown in Table 5.2-1.

Table 5.2-1
Projected Annual Flows

YEAR	WESTLAND SFE'S	TOTAL SFE	DOMESTIC FLOW MG/YR	I/I FLOW MG/YR	TOTAL FLOW MG/YR	AVG. DAY MGD
2000	545	2989.1	92.8	41.2	134.0	0.367
2005	770	3465.1	107	41.6	148.6	0.407
2010	995	4017	123.6	42.0	165.6	0.454
2015	1220	4656.9	142.7	42.4	185.1	0.507
2020	1435.3	5398.2	164.9	42.9	207.8	0.569
2025	1435.3	6258.4	190.7	43.2	233.9	0.641

Table 5.2-2 shows the projected monthly flow distribution. Monthly flow rates were projected based on the historical flow percentages for each month from 1988 through 1995.

Table 5.2-2 Projected from Distribution					
MONTH	MONTHLY FLOW - MG	% OF TOTAL	MONTH	MONTHLY FLOW-MG	% OF TOTAL
January	15.52	7.47	July	21.36	10.28
February	17.33	8.34	August	16.94	8.15
March	21.51	10.35	September	12.3	5.92
April	19.72	9.49	October	7.06	3.40
May	29.86	14.37	November	7.40	3.56
June	24.83	11.95	December	13.96	6.72
			TOTAL	207.77	100.00

In order to plan and design a wastewater treatment plant it is necessary to determine the design peak day. The peak flows will be a combination of domestic flows and infiltration flows. Prior to the repair work completed in 1993 and 1994, the peak day flows were due primarily to the amount of infiltration in the system. As growth occurs and infiltration is reduced the domestic component of the flow will make up a greater percentage of the flow.

The average day flow during the 1994-1995 ski season (December through March) was 0.268 MGD. During the same time period the peak day flow was 0.417 MGD. This results in a peak day to average day ratio of 1.55. When the average day winter flow and peak day winter flow are related to the number of SFE's available for occupancy (1928.7), the resulting flow rates are 139 gpd/SFE and 216 gpd/SFE.

When the water conservation and occupancy assumptions listed previously are factored in, the projected peak day winter flow is calculated as follows.

Peak Day Winter Flow =

[(1928.7)(139 gpd/SFE(.95)+(5399-1928.7)(139)(.90)](1.55)(1.20) = 1.28 MGD

The projected average day winter flow is calculated as follows:

Average winter flow = 1.28MGD/1.55 = 0.82 MGD

It is pointed out that a treatment and disposal system designed for the 20-year period would not have adequate capacity to treat flow from the subdivisions and developments that have already been approved through the State and local subdivision review process. It is not anticipated that all of the approved subdivisions would be fully developed during the 20-year design period but it must be assumed that at some future date, the District may have to provide treatment and disposal capacity to all the approved development. As shown previously in Table 3.0-1, the Water and Sewer District has an original commitment to provide service to 5746.0 SFE's. In addition to the 5746.0 SFE commitment, a court decision has mandated a capacity of 43 million gallons per year be available for the Westland property if the property is developed. In addition, a peak day capacity of 48,000 gpd must be available for the Westfork properties. The District has also agreed to provide service to 142.4 SFE's in the Aspen Grove Subdivision and 155 SFE's to South Fork Phase II. With the court decision and past agreement with Westfork properties, the district is legally obligated to provide treatment capacity to 7,926.3 SFE's.

At full build out of the existing treatment commitments and court mandated capacity, the annual flow is estimated as shown below:

Domestic flow (6043.4 SFE)	=	185.27	MG/year
Westland Capacity	=	43.0	MG/year
Westfork Capacity	=	6.04	MG/year
I/I	=	45.0	MG/year
TOTAL		279.31	MG/year

While it is not necessary to design for full build out now, the planning process must assume that at some future point it is likely all of the existing service commitments will have to be satisfied. As such, the treatment method, treatment plant site, and disposal method must be planned for a future flow of 279.31 MG/year. It is emphasized that increases in the amount of infiltration in the system would require additional storage and disposal sites. Likewise reductions in infiltration flows would reduce storage and disposal needs. Also, while a 20-year design period is normally used for treatment plants and pumping stations; pipelines and storage reservoirs can be expected to have a useful life of over 50 years. Due to the expense and difficulty of adding increased pipeline capacity, major transmission lines to storage reservoirs or disposal sites have been sized to provide adequate capacity for a flow of 279.3 MG/year.

5.3 WASTEWATER LOAD PROJECTIONS

Since the discharge into the Big Sky sewer system is primarily from domestic waste, service industries, and I/I, the load on the treatment facility should be typical of domestic waste. Big Sky does not foresee industrial development at any time in the future and the treatment facility should not have to treat industrial waste.

As shown previously in Table 4.4-3 the influent concentrations represent a high strength wastewater. On an annual basis the BOD_5 concentration averages 280 mg/l. However, during the ski season the average concentration during the maximum month was 430 mg/l, with a peak day concentration of 560 mg/l. Water conservation measures will tend to increase the existing concentrations. Therefore, a maximum month concentration of 480 mg/l BOD_5 and a peak day BOD_5 concentration of 625 mg/l were used for planning.

The existing BOD_5 and flow data for the winter months show a peaking factor of 1.56 for BOD_5 loading (flow x concentration). A peak loading factor of 1.56 was also used to project future peak BOD_5 and TSS loading rates.

5.4 DESIGN CONDITION SUMMARY

Table 5.4-1 summarizes the design criteria that have been developed in the previous sections of the report. The design criteria are based on the expected flow in the 20-year design period. However, as discussed previously in Section 5.2, the District is legally committed to provide treatment capacity in excess of the 20-year design values. Even though treatment and disposal capacity, for full build out may not be needed during the next 20 years, the alternatives must allow for the additional treatment and disposal commitments. Land disposal sites and storage sites have been identified based on the capacity required at full build out of the existing treatment commitments. Major transmission pipelines have been sized to have adequate capacity for the full build out of the existing legal commitments.

5.4.1 Sludge Disposal Requirements

Sludge generated must be disposed of in accordance with the recently adopted 503 regulations (40 CFR Part 503) as promulgated by the Environmental Protection Agency February 19, 1993. The 503 regulation consists of general requirements, pollutant limits, management practices, operational standards, and requirements that address frequency of monitoring, record keeping and reporting. The regulations cover land application, disposal and incineration of sewage sludge.

Table 5.4-1 20-Year Design Criteria	
Design Year	2020
Single Family Equivalents	5399
Flow:	
Annual	207.8 MG
Average Day (Annual)	0.569 MGD
Average Day (Winter – Ski Season)	0.82 MGD
Peak Day	1.28 MGD
Minimum Day	0.10 MGD
BOD_5:	
Average Day (Winter)	480 mg/l
Peak Day	625 mg/l
Average Loading (Winter)	3283 pounds/day
Peak Day Loading	5121 pounds/day
TSS:	
Average Day (Winter)	450 mg/l
Peak Day (Winter)	586 mg/l
Average Loading (Winter)	3077 pounds/day
Peak Day Loading (Winter)	4800 pounds/day
Phosphorus	15 mg/l
Total Nitrogen:	60 mg/l
Ammonia	40 mg/l
Organic Nitrogen	20 mg/l
Alkalinity	240 mg/l

Sewage sludge applied to land must meet one of two pollutant limits. The sludge must meet pollutant concentration limits in addition to ceiling limits. Ceiling limits are set for 10 pollutants shown in Table 5.4.1-1. Any sewage sludge that does not meet the ceiling concentration in Table 5.4.1-1 cannot be land applied.

Table 5.4.1-1 Ceiling Concentrations for Sludge Disposal	
POLLUTANT	CEILING CONCENTRATION mg/kg*
Arsenic	75
Cadmium	85
Chromium	3000
Copper	4300
Lead	840
Mercury	57
Molybdenum	75
Nickel	420
Selenium	100
Zinc	7500
*Dry Weight Basis	

In addition to the ceiling limits, sludge applied to agricultural land, or forest lands, must not exceed the cumulative loading rates or annual pollutant loading rates shown in Table 5.4.1-2.

The 503 regulations also specify management practices that must be followed in the land application process. The required management practices are summarized below.

- Sludge shall not be applied if it is likely to adversely affect a threatened or endangered species.

- Sludge shall not be applied to agricultural land, forest, a public contact site, or a reclamation site that is flooded, frozen, or snow-covered so that sludge enters a wetland or other waters of the United States.

Table 5.4.1-2 Cumulative and Annual Sludge Pollutant Loading Rates		
POLLUTANT	CUMULATIVE LOADING RATE Pounds/Acre	ANNUAL LOADING RATE POUNDS/ACRE/YEAR
Arsenic	36.6	1.78
Cadmium	34.8	1.69
Chromium	2,676.6	133.83
Copper	1,338.3	66.92
Lead	267.7	13.38
Mercury	15.2	0.76
Molybolenum	16.0	0.80
Nickel	374.7	18.74
Selenium	89.2	4.46
Zinc	2,498.2	124.9

- Sludge shall not be applied to agricultural land, forest, or a reclamation site that is 10 meters or less from waters of the United States.

- Sludge shall be applied to agricultural land, forest, a public contact site, or a reclamation site at a whole sludge application rate that is equal to or less than the agronomic rate.

The 503 regulations also specify operational standards for pathogen and vector attraction reduction. When sludge is applied to land, either Class A pathogen requirements or Class B pathogen requirements must be met. The regulations list six alternatives that allow a sludge to be classified as Class A and three alternatives for a sludge to be classified as Class B. Basically, Class A sludge requires treatment to a higher level so that the density of fecal coliforms in the sewage sludge is less than 1000 Most Probable Number per gram of total solids, or the density of Salmonella species in the sewage sludge shall be less than three most probable number per four grams of total solids. A Class B sewage sludge must have a fecal coliform density of less than 2,000,000 most probable number per gram of total solids or 2,000,000 Colony Forming Units per gram of total solids. A sewage sludge can also be classified as Class B if it is treated by a Process to Significantly Reduce Pathogens (PSRP). The PSRP include.

1. Aerobic digestion with a mean cell residence time of 40 days at 20 degrees celsius and 60 days at 15 degrees celsius.

2. Air drying for a minimum of three months. During two of the three months the ambient average daily temperature must be above zero degrees celsius.

3. Anaerobic digestion with a mean cell residence time of 15 days at 35 to 55 degrees celsius and 60 days at 20 degrees celsius.

4. Composting where the temperature of the sewage sludge is raised to 40 degrees celsius or higher and remains at 40 degrees celsius or higher for five days. For four hours during the five days, the temperature in the compost pile exceeds 55 degrees celsius.

When the sludge is Class B with respect to pathogens, restrictions are imposed on the site where sewage is applied.

The site restrictions imposed by the 503 sludge regulations for Class B sludge are listed below:

1. Food crops with harvested parts that touch the sewage sludge/soil mixture and are totally above the land surface shall not be harvested for 14 months after application of sewage sludge.

2. Food crops with harvested parts below the surface of the land shall not be harvested for 20 months after application of sewage sludge when the sewage sludge remains on the land surface for four months or longer prior to incorporation into the soil.

3. Food crops with harvested parts below the surface of the land shall not be harvested for 38 months after application of sewage sludge when the sewage sludge remains on the land surface for less than four months prior to incorporation into the soil.

4. Food crops, feed crops, and fiber crops shall not be harvested for 30 days after

application of sewage sludge.

5. Animals shall not be allowed to graze on the land for 30 days after application of sewage sludge.

6. Turf grown on land where sewage sludge is applied shall not be harvested for one year after application of the sewage sludge when the harvested turf is placed on either land with a high potential for public exposure or a lawn, unless otherwise specified by the permitting authority.

7. Public access to land with a high potential for public exposure shall be restricted for one year after application of sewage sludge.

8. Public access to land with a low potential for public exposure shall be restricted for 30 days after application of sewage sludge.

6.0 ANALYSIS OF POTENTIAL ALTERNATIVES

6.1 DISCHARGE TO SURFACE STREAM

During the 1995 legislative session, Senate Bills 330 and 331 were passed by the legislature. The Senate Bills amended the Montana Water Quality Act by revising, among other things, the water quality nondegradation provisions and nitrogen standards contained in the Montana Water Quality Act.

Specifically, Senate Bill 331 amended the Water Quality Act and added sections that establish conditions when standards more stringent than federal standards may be adopted. Senate Bill 331, as codified in Section 75-5-309 MCA states in pertinent parts as follows:

(1) In adopting rules to implement this chapter, the board may adopt rules that are more stringent than corresponding draft or final federal regulations, guidelines, or criteria if the board makes written findings, based on sound scientific or technical evidence in the record, which state that rules that are more stringent than corresponding federal regulations, guidelines, or criteria are necessary to protect the public health, beneficial use of water, or the environment of the State.

(2) The board's written findings must be accompanied by a board opinion referring to and evaluating the public health and environmental information and studies contained in the record that forms the basis for the board's conclusion.

Senate Bill 331 also added a subsection to Section 75-5-301 MCA which directs the Board to adopt site-specific standards of water quality for aquatic life. The site-specific standards must be developed in accordance with federal regulations, guidelines or criteria.

As discussed in Section 4.5 the treatment standards and nondegradation rules have now been adopted by the Board. Further, with passage of SB330, as codified in Section 75-5-303 MCA, it is possible to determine the level of treatment required for a direct discharge and the quantity of a pollutant that can be discharged for a given quality.

On August 3, 1998 the Big Sky County Water and Sewer District 363 applied to the Department of Environmental Quality (DEQ) for a permit to discharge treated effluent to the Gallatin River. A draft discharge permit has been published by the DEQ that limits the allowable discharge on a monthly basis. Effluent flows are limited to insure that requirements of ARM 17.30.715 CRITERIA FOR DETERMINING NON-SIGNIFICANT CHANGES IN WATER QUALITY are not exceeded. The effluent flow limitations are based on the monthly 7 day 10 year low flows (7Q10) in the Gallatin River. A copy of the draft discharge permit is included in Appendix P. Table 6.1-1 shows the monthly 7Q10 flow for the Gallatin River below the confluence of the West Fork of the Gallatin, and the allowable effluent volume in units of gallons per minute and million gallons per month.

Table 6.1-1

Draft Discharge Permit Discharge Volumes

Month	7Q10 Flows-cfs (gpm)	Effluent Volume - gpm	Effluent Volume Million Gallons/Month
January	155 (69,573)	140	6.22
February	162 (72,715)	145	5.87
March	166 (74,510)	150	6.66
April	180 (80,794)	160	6.99
May	332 (149,021)	300	13.33
June	586 (263,031)	525	22.77
July	340 (152,612)	305	13.65
August	258 (115,805)	230	10.36
September	244 (109,521)	220	9.48
October	220 (98,749)	195	8.83
November	174 (78,102)	155	6.76
December	152 (68,226)	135	6.10
Annual	202[1/]	144	117.05[2/]

1/ The annual 7Q10 will not equal the average of the monthly 7Q10.

2/ Sum of monthly discharges

The following discussion evaluates each of the criteria related to a surface water discharge contained in ARM 17.30.715 CRITERIA FOR DETERMINING NON-SIGNIFICANT CHANGES IN WATER

QUALITY. Discharges that cause changes in water quality that meet all the criteria listed below are considered "non-significant".

Criteria 1a: Activities that would increase or decrease the mean monthly flow of a surface water by less than 15% or the 7-day 10-year low flow by less than 10%.

Discussion: The mean monthly flows in the Gallatin River were obtained from the publication U.S. Geological Survey - Data Report MT 92-1 (See Appendix). The gaging station, for the Gallatin River flow measurements, is located 0.3 miles downstream from Spanish Creek and covers a drainage area of 825 square miles. The published mean flows were adjusted to account for the smaller drainage area at Big Sky (557 square miles) than at the gaging station. The adjustment was made using the following equation obtained from Analysis of the Magnitude and Frequency of Floods and Peak Flow Gaging Network in Montana USGS - Report 92-4048:

$$\text{Ungaged Flow} = (\text{ungaged area/gaged area})^{0.85} \times \text{gaged flow}$$

Table 6.1-2 shows the published and calculated mean flows.

Table 6.1-2
Mean Flows in Gallatin River (cfs)

MONTH	GAGED SITE	UNGAGED SITE	MONTH	GAGED SITE	UNGAGED SITE
January	306	219	July	1276	914
February	305	218	August	601	430
March	309	221	September	491	352
April	500	358	October	455	326
May	1765	1264	November	383	274
June	2908	2082	December	322	230

The minimum mean monthly flow occurs in February and is 218 cfs. Based on Criteria (1a), a discharge could increase the mean monthly flow to 250.7 cfs (218 x 1.15 = 250.7). The flow increase amounts to 32.7 cfs (21.1 MGD).

The monthly 7-day 10-year low flows for the Gallatin were determined by analyzed by downloading daily stream flow records from the USGS internet site. The minimum monthly 7Q10 flow of 152 cfs occurs in December. A 10% increase would result in a flow of 176.2 cfs or a flow increase of 15.2 cfs (9.82 million gallons per day).

Conclusion: Under Criteria (1a), a discharge of up to 9.82 MGD would be non-significant.

Criteria 1b: Discharges containing carcinogenic parameters or parameters with a bioconcentration factor greater than 300 at concentrations less than or equal to the concentrations of those parameters in the receiving water.

Discussion: Parameters considered carcinogenic and parameters with bioconcentration factors (BCF) greater than 300 are listed in Circular WQB-7 Montana Numeric Water Quality Standards (Appendix M). The list of chemical compounds considered carcinogenic or with bioconcentration factors greater than 300 is extensive with 108 chemicals or compounds listed as carcinogenic and 38 listed with a BCG greater than 300.

While the list of chemical compounds is extensive, the majority are pesticides, insecticides, herbicides, or industrial waste type compounds that are not likely to be in the wastewater at Big Sky given that the source water is groundwater and little if any industrial waste is produced at Big Sky. Many of the compounds are currently tested for in the source water under the State Drinking Water Act.

Some of the compounds are by-products of disinfection with chlorine. These disinfection by-products could be eliminated by utilizing ultra-violet disinfection for a surface water discharge.

Conclusion: As the source water at Big Sky is well water and there is no industrial discharge into the collection system, it is unlikely that any of the compounds listed under criteria 1b would be the controlling criteria for determining nonsignificance.

Criteria 1c: Discharges containing toxic parameters or nutrients...which will not cause changes that equal or exceed the trigger values in department Circular WQB-7. Whenever the change exceeds the trigger value the change is not significant if the resulting concentration outside the mixing zone does not exceed 15% of the lowest applicable standard.

Discussion: Again the list of toxic compounds is extensive but the majority are not likely to be present in the wastewater from Big Sky. Parameters likely to be of concern are chlorine, nitrate plus nitrite as nitrogen, and phosphorus.

Chlorine: The trigger value for total chlorine is 0.10 mg/l. The total chlorine residual could be controlled or eliminated by installing dechlorination equipment or by using an alternative disinfection process such as ultra-violet or ozonation. As discussed above, ultra-violet disinfection would also eliminate several disinfection by-products that result from chlorination.

Nitrate Plus Nitrite as Nitrogen: With the construction of a nutrient removal wastewater plant, the nitrate plus nitrite concentration in the effluent is expected to be 1.0 mg/l -N or less. The trigger value for nitrate plus nitrite is 0.01 mg/l -N for a surface discharge. With a minimum monthly 7-day 10-year low flow of 152 cfs in the Gallatin, the allowable discharge flow would be 0.992 MGD.

Phosphorus: The trigger value for inorganic phosphorus is 0.001 mg/l. The effluent phosphorus concentration from a wastewater treatment plant employing biological nutrient removal and filtration technology is expected to be 0.5 mg/l or less. Table 6.1-1 shows the allowable monthly discharges based on an effluent concentration of 0.5 mg/l and the monthly 7Q10 flows. While phosphorus appears to be the controlling parameter based on the trigger value, the second part of criteria (1c) must also be evaluated.

The second part of (1c) states the change is not significant if the resulting concentration outside the mixing zone does not exceed 15% of the lowest applicable standard. The applicable standard would be the aquatic life standard for which Circular 7 refers back to ARM 16.20.633 (1e) which prohibits a discharge that will create conditions which produce undesirable aquatic life.

As was discussed in an Application for Determination of Significance (HKM, 1993) filed with the Water Quality Bureau, the nitrogen to phosphorus ratio for the Gallatin River is approximately 3.27. Based on conversations with stream biologists, N/P ratios below 10 are indicative of nitrogen limited streams. Therefore, additional phosphorus discharge could occur without producing increased algae growth which would violate ARM 16.20.633 (1e).

Even with the trigger value of 0.001 mg/l increase in total in-stream phosphorous concentration, it would be possible to discharge the volumes shown previously in Table 6.1-1.

Conclusion: Of the parameters likely to be of concern under criteria 1c, phosphorus has the lowest trigger value. The allowable discharge, as published in the draft discharge permit and as shown above in table 6.1-1, varies on a monthly basis to reflect the varying stream flow. The total annual discharge limit is 117.05 million gallons.

Criteria 1d: (This criteria relates to a groundwater discharge and is not applicable to surface water discharges).

Criteria 1e: This criteria relates to a groundwater discharge and is not applicable to surface water discharges.

Criteria 1f: Changes in the quality of water for any harmful parameter for which water quality standards have been adopted other than nitrogen, phosphorous, and carcinogenic, bioconcentrating, or toxic parameters, in either surface or groundwater, are nonsignificant if the changes outside of a mixing zone designated by the department are less than 10% of the applicable standard and the existing water quality level is less than 40% of the standard.

Discussion: The following parameters or conditions are classified as harmful in Circular WQB 7:

PARAMETER	STANDARD ug/l[a]
Acenaphthene	20
p-chloro-m-Cresol	3,000
chlorobenzene	20
2-chlorophenol	0.1
color	<5 unit increase
2, 4 – Dichlorophenol	0.3
2, 4 – Dimethylphenol	400
Hexachlorocyclopentadiene	1
Iron	300
Manganese	50
Odor	Narrative
Ph	Narrative
Phenol	300
Sediment, settleable solids, soils, grease, or floating solids	Narrative
Temperature	Narrative
2, 4, 5 – Trichlorophenol	1
Turbidity	<5 nephelometric units

a) Human Health Standard unless otherwise noted.

While testing would have to be completed to verify the absence of the majority of the parameters listed above, it is felt that it is unlikely any of the standards would be exceeded with groundwater as a source water and with an advanced treatment plant.

Conclusion: The narrative standards for the parameters noted above are contained in ARM 16.20.618 and ARM 16.20.633. The quality of effluent from an advanced treatment plant would be well within the limits established ARM 16.20.618 and 16.20.633. However, some of the narrative standards are subjective and discussions and clarifications from the WQD will be required to ensure limits would not be exceeded and the discharge would still be deemed nonsignificant.

Criteria 1g: Changes in the quality of water for any parameter for which there are only narrative water quality standards if the changes will not have a measurable effect on any existing or anticipated use or cause measurable changes in aquatic life or ecological integrity.

Discussion: As mentioned above, the narrative standards apply to color, odor, pH, sediment, settleable solids, oils, grease, floating solids, temperature, and turbidity.

<u>Conclusion</u>: The treatment process proposed is an advanced process, including filtration, which is anticipated to meet the narrative limits for the parameters.

Criteria 2: Not-with-standing compliance with the criteria of (1) above, the department may determine that the change in water quality resulting from an activity which meets the criteria in (1) is degradation based upon the following:

(a) Cumulative impacts or synergistic effects

(b) Secondary by-products of decomposition or chemical transformation

(c) Substantive information derived from public input

(d) Changes in flow

(e) Changes in loading of parameters

(f) New information regarding the effects of a parameter; or

(g) Any other information deemed relevant by the department and that relates to the criteria in (1) above.

Discussion: The criteria in (2) above are non-specific and cannot be addressed in detail until a specific issue is raised by the Department.

In 1997 the State Legislature passed House Bill 546 which established a Total Maximum Daily Load Program (TMDL). Under House Bill 546, the Department of Environmental Quality(DEQ) is directed to monitor state waters to assess their quality and to develop Total Maximum Daily Loads (TMDLs) for those waters identified as threatened or impaired. The DEQ will use the monitoring results to revise the list of water bodies that are identified as threatened or impaired and to establish a priority ranking for TMDL development for those waters.

As of August 1998 TMDLs have not been established for the Gallatin River.

6.1.1 Summary

Each of the criteria for determining non-significant changes in water quality, as listed in ARM 17.30.715, have been evaluated in the preceding paragraphs. The evaluation indicates that a discharge of 117.05 MGY could take place while meeting all of the criteria for non-significance. The minimum discharge of 5.8 million gallons would occur in February and the maximum discharge of 22.7 million gallons would occur in June. The limiting criteria is the low trigger value for phosphorus. The discharge volume is based on an effluent phosphorus concentration of 0.5 mg/l. With both biological and chemical phosphorus removal it may be possible to reliably achieve phosphorus levels below 0.5 mg/l which would allow these discharge volumes to be increased.

As indicated, TMDLs have not yet been established for the Gallatin River. It is not possible to foresee, with any accuracy, what limits may be imposed by the DEQ or even if the Gallatin River will be included in the list of water bodies identified as threatened or impaired. However, it is important to note that under Section 4(10)(b) of HB546 the issuance of a discharge permit may not be precluded because a TMDL is pending.

6.2 LAND APPLICATION SYSTEMS

Land application systems offer alternative disposal methods that have minimal environmental effects. Land application can also provide a beneficial reuse of water in cases where irrigation water would otherwise have to be obtained from streams or wells. In this section of the report, two types of land disposal have been evaluated. Section 6.2.1 discusses the potential for utilizing rapid infiltration (RI) basins. Section 6.2.2 discusses spray irrigation sites.

6.2.1 Rapid Infiltration (RI) Basins

The first site evaluated consists of approximately 50 acres located south of the Big Sky turn off near Michener Creek. Figure 6.2.1-1 shows the location of the Michener Creek site.

The Michener Creek site sits on a gravel layer approximately 14 to 20 feet thick. Underlying the gravel, is a shale layer that is essentially impermeable. Flow applied to the site will percolate vertically to the shale layer and will then flow horizontally through the gravel layer to the Gallatin River. Snow melt and precipitation on the upper slopes causes the groundwater in the gravel layer to fluctuate throughout the year. During the spring and summer the groundwater level may rise to just below the ground surface. Test holes drilled in February of 1993 showed an aquifer thickness of approximately 4 to 6 feet over the shale layer. The drill holes identified the underlying soil as silty gravel (see Appendix D for gradation). Figure 6.2.1-2 shows a cross section of the geological conditions at the Michener Creek site. As the above discussion and Figure 6.2.1-2 indicate, the infiltration capacity of the site will be limited by the capacity of the gravel layer to transmit flow horizontally to the Gallatin River. The ponds would be located approximately 1500 feet from the Gallatin River and roughly 40 feet above the river surface. From the soils observed at the site, it does not appear that the site has adequate horizontal hydraulic conductivity to transmit the required volume of water to the river. As Figure 6.2.1-2 shows, exceeding the infiltration capacity of the site could lead to springs developing along the toe of the slope.

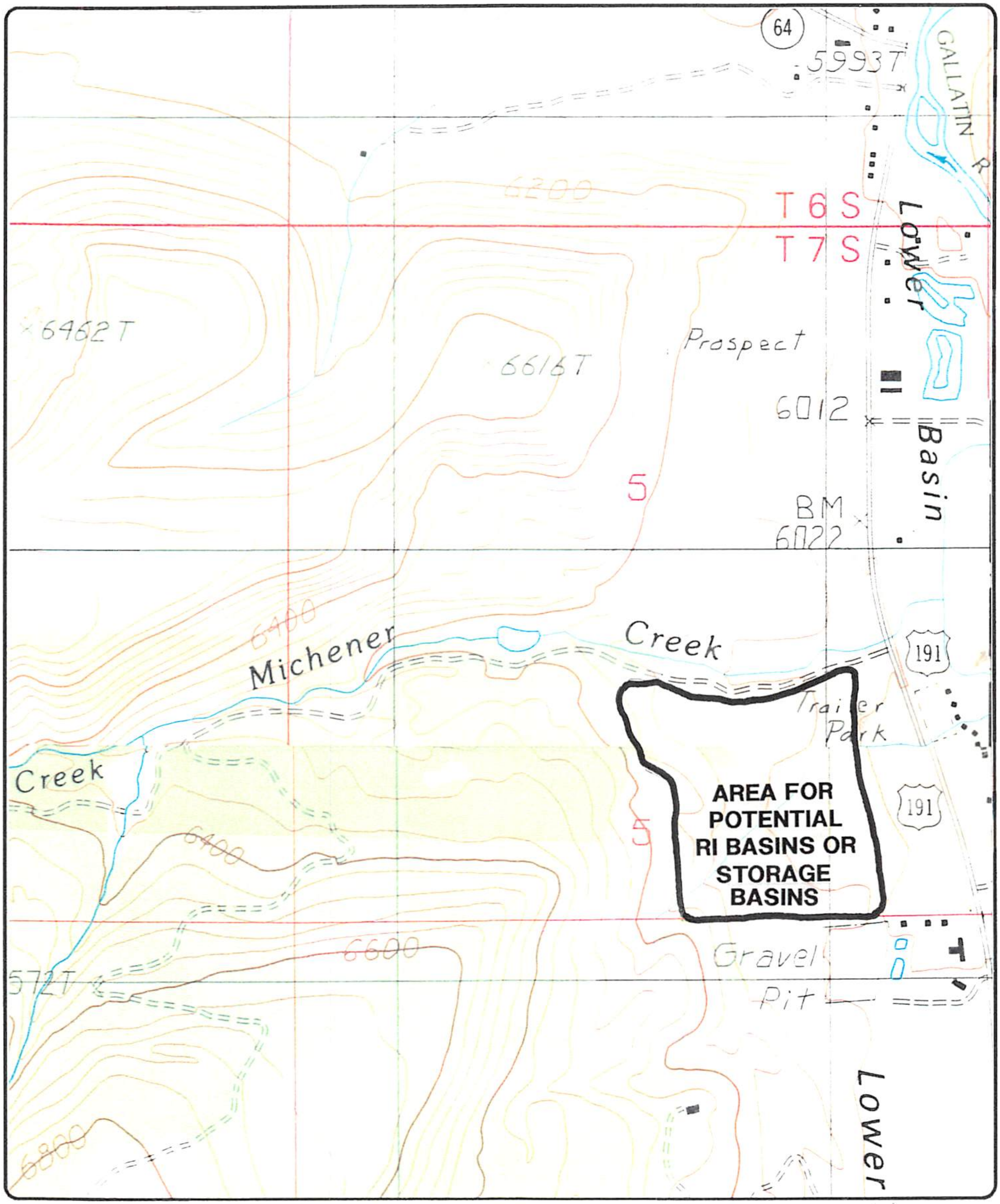
It is possible to mitigate the development of springs and to increase the infiltration capacity of the site by installing a groundwater drain system that would discharge into Michener Creek. The surface discharge would have to meet nondegradation requirements or a waiver would have to be obtained.

Two types of underdrain systems have been investigated. The first system involves placing a drain along the toe of the Michener Creek terrace to intercept groundwater as it flows toward the Gallatin River. This type of drain system maximizes phosphorus removal as the wastewater passes through the soil. The second type of underdrain system consists of a series of underdrain lines placed 5 to 10 feet below the bottom of the RI basins. This type of underdrain system maximizes the infiltration capacity of RI basins, however, phosphorus removal is reduced due to the shorter flow path through the soils.

Calculations indicate an underdrain placed at the toe of the slope would not increase the hydraulic capacity of the site enough. Therefore, this is not considered a viable alternative. The second option evaluated involved placing an underdrain system approximately 5 to 10 feet below the bottom of the I/P beds. Underdrains would be placed at approximately 40 foot intervals. With this type of underdrain system approximately 10 acres would be required for the infiltration basins based on the 20-year design flow and operating the basins from April through November. Freezing weather can hinder the operation of the basins during the winter. Storage cells would be required to store flows from

December through March.

With a conventional treatment plant (no phosphorus removal) preceding the RI basins, it is expected that the percolate collected in the underdrain system would have a phosphorous concentration of 2.0 to 2.5 mg/l-P and a total nitrogen concentration of 2 to 3 mg/l. Both the nitrogen and phosphorus level in the percolate would exceed the background levels in the Gallatin River. Since the percolate would not meet nondegradation criteria a waiver would have to be obtained. Obtaining a waiver would be difficult and would likely result in a 1½ to 2 year delay in the project. Therefore, constructing rapid infiltration basins on the Michener Creek site is not considered a viable alternative.



BIG SKY WASTEWATER FACILITY PLAN
MICHENER CREEK SITE

FIGURE 6.2.1-1

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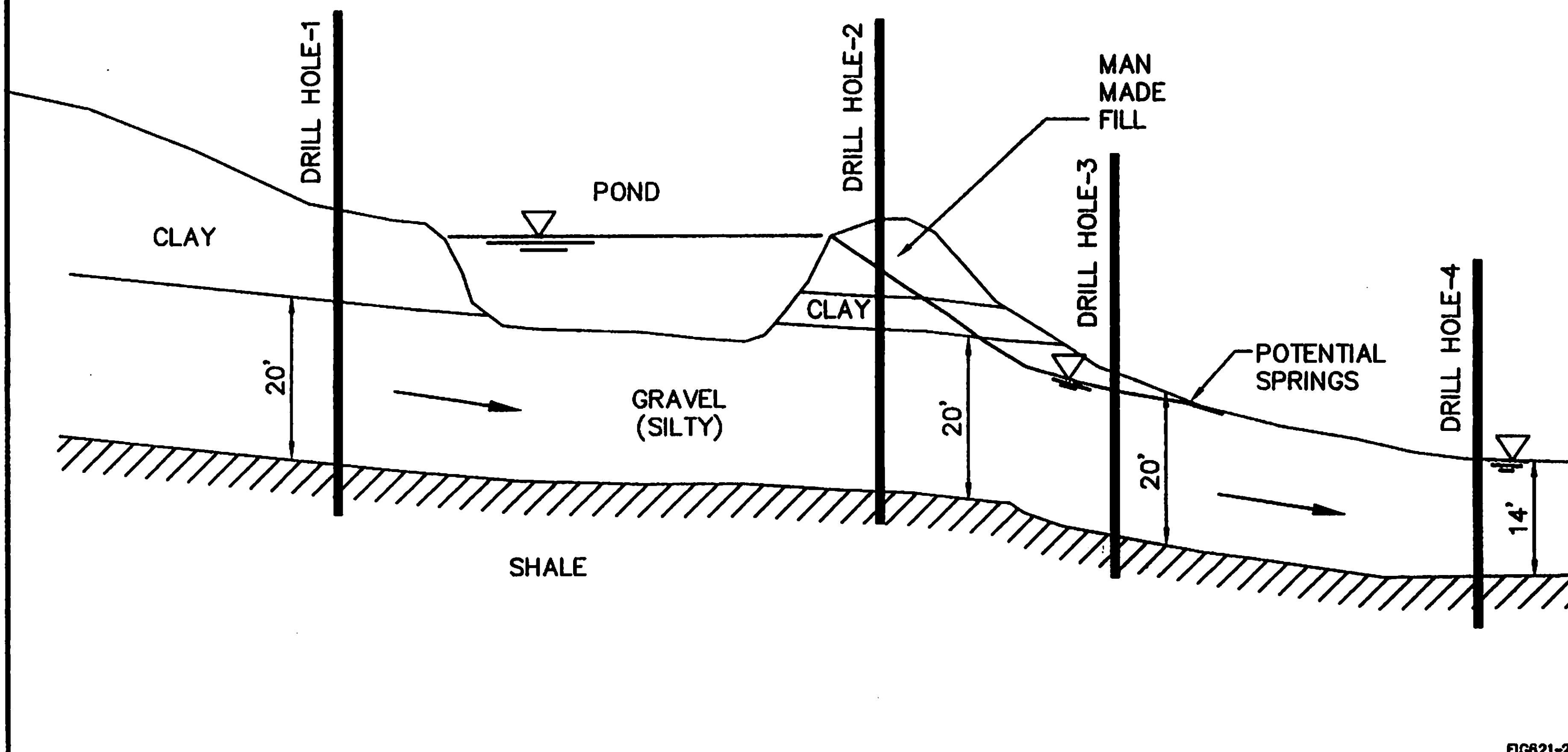

BIG SKY WASTEWATER FACILITY PLAN

GEOLOGICAL CONDITIONS
MICHENER CREEK SITE

FIGURE 6.2.1-2

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During the public meeting process conducted on August 31, 1993, there was some discussion regarding the option of continuing to use the storage ponds as infiltration ponds. The option had been proposed in which a mechanical plant would be constructed ahead of the storage ponds to remove the majority of pollutants. Then the leaking storage pond would be allowed to continue functioning as a quasi infiltration pond. This option was not considered as a viable option due to potential failure of the stream banks, inadequate infiltration capacity, and inadequate phosphorous adsorption capacity of the soils. The storage ponds were lined in 1996 and 1997.

In summary, it does not appear that the use of rapid infiltration basins is a feasible alternative unless a waiver of the nondegradation requirement is obtained. The Michener Creek site would require the use of an underdrain system to prevent springs from developing along the hillside. The underdrain system would require a surface discharge which would not meet surface water nondegradation requirements without further treatment. As other less degrading options are available, the use of rapid infiltration ponds on the Michener Creek site has not been evaluated further.

6.2.2 Spray Irrigation System

In a December 1993 report (HKM, 1993) the area around Big Sky was surveyed for sites suitable for land application. A simplified factor overlay methodology was used to eliminate areas from consideration based on three specific factors: 1) slope stability; 2) elevations over 8000 feet and 3) slopes greater than 30 percent.

The base maps for the overlay were USGS 7.5 minute quadrangles. The following six 7.5 minute quadrangles surrounding the Big Sky area were evaluated:

Lone Mountain
Gallatin Peak
Hidden Lake
Sphinx Mountain
Ousel Falls
Lone Indian Peak

The 1993 report concluded that in general the conditions in the Big Sky vicinity are poor for spray irrigation of effluent. Only three sites were found to be physically suitable. One of the sites is located southeast of Big Sky near the mouth of Porcupine Creek. This land was recently obtained by the Forest Service in a land trade between a private lumber company and the Forest Service. From past conversations with the Forest Service, gaining approval for a spray irrigation system on the Porcupine site seems unlikely.

For the Porcupine Creek site, it is estimated that an area of approximately 672 acres would be required for the 20 year design flow of 207.8 million gallons per year. When all of the legally committed treatment capacity is fulfilled the annual flow is estimated to be 279.31 million gallons per year. At an annual flow of 279.31 million gallons per year approximately 822 acres would be required. The land in the Porcupine Creek area would have to be acquired or leased. Discussion with the Forest Service indicates a special use permit would have to be obtained in order to use the site for spray irrigation. Our contact with the Forest Service has indicated that:

1) The Forest Service policy has been to not allow the application of sewage on their lands unless there are absolutely no available private lands. In general, they do not look favorably on that use of Forest Service land.

2) There would be a substantial public involvement period and environmental assessment. The net result is that there would be a long time period involved in acquiring these lands for spray irrigation. Local Forest Service personnel estimated that at least 3 years would be required before an answer could be given.

3. As the Porcupine Creek site is located in a Grizzly Bear Management Area (MS 2), additional study may be required to determine the effects of the spray irrigation on the grizzly bear.

Given the Forest Service policy and the time required for public involvement in a plan which utilizes approximately 820 acres of land in a Grizzly Bear Management area for irrigation, it is likely that it would be at least 3 years before a system design could begin. It is also possible that the Forest Service would deny the special use permit. For these reasons, the Porcupine Creek site was not evaluated further.

The second site is the drainage basins of the upper tributaries to the South Fork (Yellow Mule site).

The second site considered for spray irrigation is the Yellow Mule site located in the South Fork drainage. Figure 6.2.2-1 shows the location of the Yellow Mule site.

Two options were considered for irrigation on the Yellow Mule site. The first option involved continuing to treat the wastewater with an aerated lagoon and disposing of all the treated water in a three month period when there is a gross irrigation requirement. The existing lagoon would have to be upgraded to handle the projected organic loadings. By irrigating in a three month period when there is a gross irrigation requirement, surface runoff can be eliminated or minimized. The second option involves constructing an advanced nutrient removal treatment plant and irrigating on the golf course and the Yellow Mule site. As the Yellow Mule site falls just outside a grizzly bear management area, there was also a concern about potential impacts from the project.

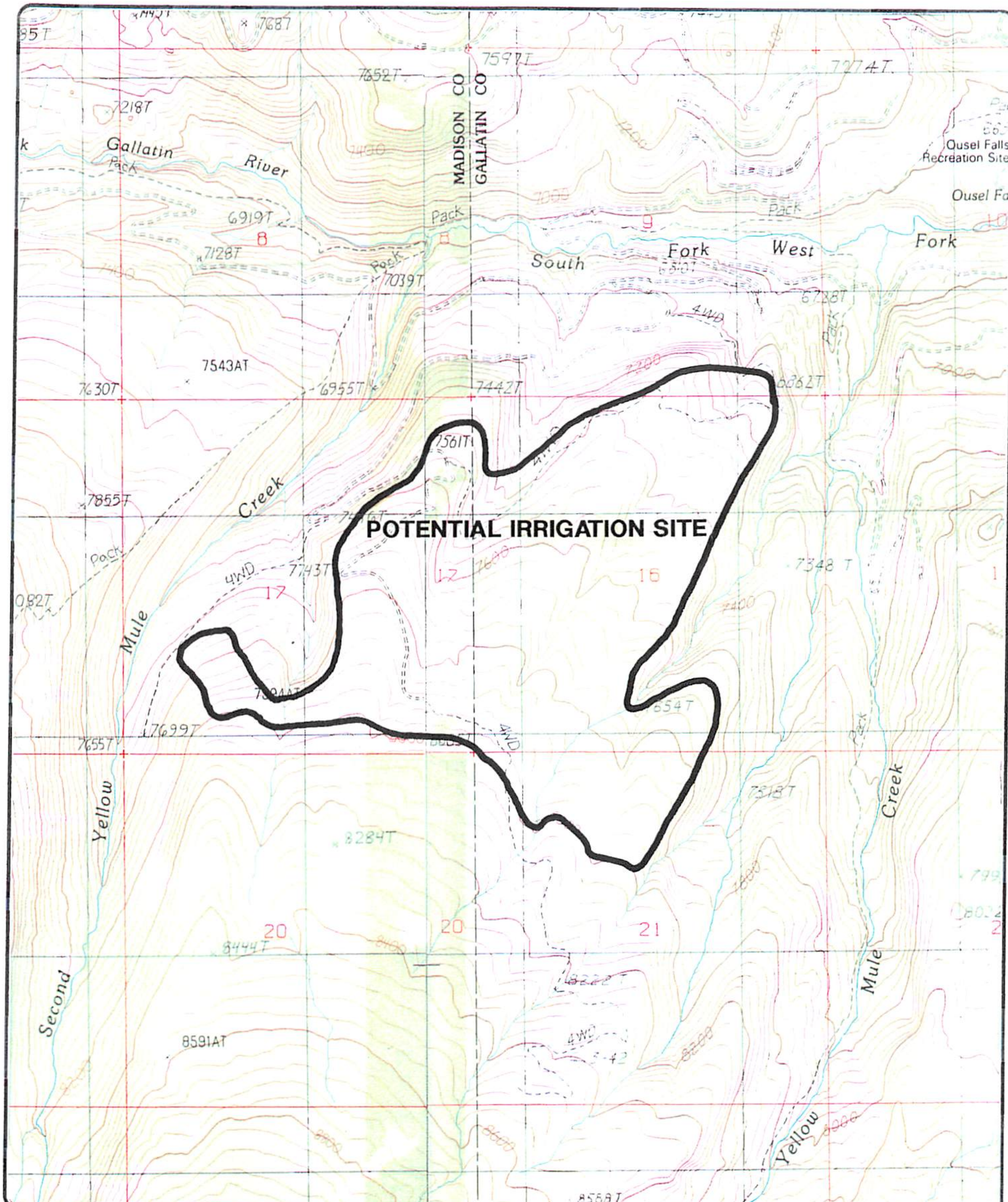
Spray irrigation at the Yellow Mule site was considered in detail in the draft wastewater facility plan submitted by the District in June 1994. Both treatment options were found to have high equivalent annual uniform costs. As the projected annual flow has increased since the 1994 facility plan, the costs for disposal at the Yellow Mule site would also increase. Since the detailed evaluation conducted in the June 1994 facility plan found that irrigation at the Yellow Mule site was not one of the preferred alternatives, it has not been evaluated further.

The other general area that is suitable for spray irrigation is the immediate vicinity of the Meadow Village. The golf course irrigation system was expanded during the summer of 1996 and 1997 as part of the Interim Action Work Plan. The irrigation capacity of the golf course was increased to approximately 143.3 million gallons per year.

The 1994 draft edition of the Montana Department of Health and Environmental Sciences Design Standards for Wastewater Facilities specifies the treatment requirements for irrigation of golf courses with reclaimed water. The regulations require that reclaimed water used for unrestricted golf courses "shall be at all times an adequately disinfected, oxidized, coagulated, clarified, filtered wastewater or a wastewater treated by a sequence of unit processes that will assure an equivalent degree of treatment and reliability." The regulations also require that the median number of coliform organisms in the effluent does not exceed 2.2 per 100 milliliters.

In addition to the draft State regulations, the EPA has recently published a document entitled

Guidelines for Water Reuse. The guidelines address all important aspects of water reuse, including recommended wastewater treatment processes, treatment reliability provisions, reclaimed water quality limits, monitoring frequencies, setback distances, and other controls for various water reuse applications. Table 6.2.2-1 shows a portion of the EPA guidelines.



BIG SKY WASTEWATER FACILITY PLAN

YELLOW MULE SITE

FIGURE 6.2.2-1

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Table 6.2.2-1
EPA Guidelines for Water Reuse
(Source: U.S. Environmental Protection Agency, 1992)

TYPES OF REUSE	TREATMENT	RECLAIMED WATER QUALITY	RECLAIMED WATER MONITORING	SETBACK DISTANCES	COMMENTS
Urban Reuse All types of landscape irrigation, (e.g., golf courses, parks, cemeteries) - also vehicle washing, toilet flushing, use in fire protection systems and commercial air conditions and other uses with similar access or exposure to the water.	• Secondary • Filtration • Disinfection	• pH = 6-9 • ≤ 10 mg/L BOD • ≤ 2 NTU • No detectable fecal coli/100 Ml • 1 mg/L Cl_2 residual (min.)	• pH = weekly • BOD = weekly •Turbidity = continuous • Coliform = daily • CL_2 residual = continuous	• 50 ft. (15 m) to potable water supply wells	• At controlled-access irrigation sites where design and operational measures significantly reduce the potential of public contact with reclaimed water, a lower lever of treatment, e.g. secondary treatment and disinfection to achieve 14 fecal coli/100 Ml, may be appropriate. • Chemical (coagulant and/or polymer) addition prior to filtration may be necessary to meet water quality recommendations. • The reclaimed water should not contain measurable levels of pathogens. • Reclaimed water should be clear, odorless, and contain no substances that are toxic upon ingestion. • A higher chlorine residual and/or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed. • A chorine residual of 0.5 mg/L or greater in the distribution system is recommended to reduce odors, slime, and bacterial regrowth.
Recreational Impoundments Incidental contact (e.g., fishing and boating) and full body contact with reclaimed water allowed	• Secondary • Filtration • Disinfection	• pH = 6-9 • ≤ 10 mg/L BOD • ≤ 2 NTU • No detectable fecal coli/100 Ml • 1 mg/L Cl_2 residual (min.)	• Ph = weekly • BOD = weekly • Turbidity = continuous • Coliform = daily • CL_2 residual = continuous	• 500 ft. (150 m) to potable water supply wells (minimum) if bottom not sealed.	• Dechlorination may be necessary to protect aquatic species of flora and fauna. • Reclaimed water should be non-irritating to skin and eyes. • Reclaimed water should be clear, odorless, and contain no substances that are toxic upon ingestion. • Nutrient removal may be necessary to avoid algae growth in impoundments. • Chemical (coagulant and/or polymer) addition prior to filtration may be necessary to meet water quality recommendations. • The reclaimed water should not contain measurable levels of pathogens. • A higher chlorine residual and/or a longer contact time may be necessary to assure that viruses and parasites are inactivated or destroyed. • Fish caught in impoundments can be consumed.

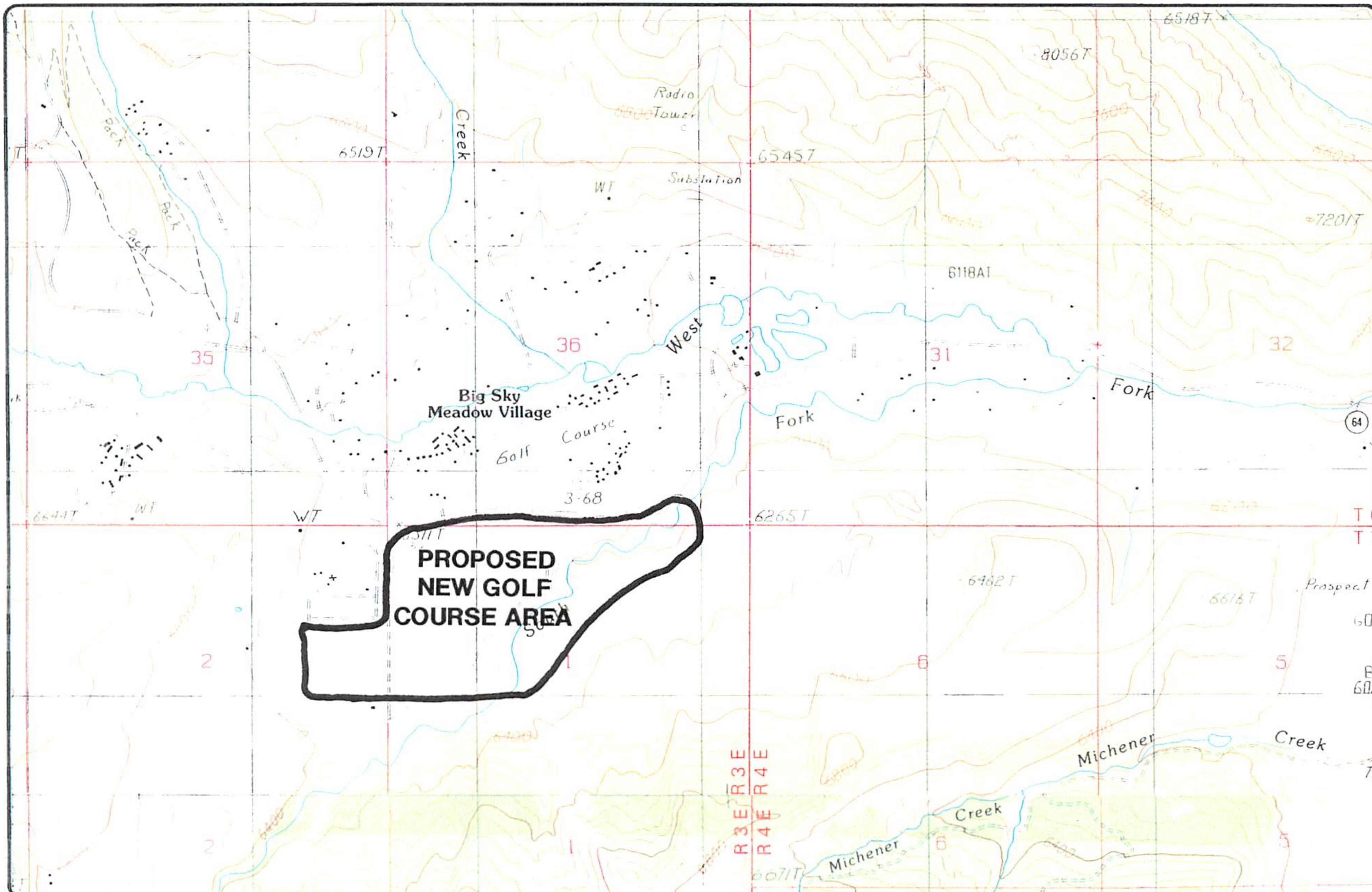
With the completion of the Interim Action Work Plan, the golf course is irrigated with water that has been treated in an aerated lagoon, filtered and disinfected.

Due to the close proximity of housing to the golf course, the level of exposure to treated wastewater is higher than would occur with the houses set back from the fairways. Normally a buffer zone would be provided between the irrigated lands and homes along the golf course. The irrigation system installed prior to the system expansion in 1996-1997 did not provide a buffer zone. The system expansion completed in 1996-1997 generally provided a 50-foot buffer zone between the irrigation heads and the property lines. However, due to irrigation requirements of the fairways and greens the 50-foot buffer zone could not be maintained in all locations.

Exposure to bacteria and enteric viruses can occur by several routes including: consumption of contaminated water, creation of aerosols from irrigation, or handling items such as golf balls that have come into contact with contaminated water. While treatment in a lagoon with disinfection may achieve a reduction in enteric viruses of approximately 98 to 99 percent, the number remaining may still approach 500,000 per liter. In contrast, tertiary treatment utilizing coagulation, filtration, and disinfection following a secondary plant can reduce enteric virus levels to approximately 170 per liter (USGA, 1994).

The existing golf course can continue to be used as a spray irrigation site. However, we recommend that the wastewater be treated to meet current requirements shown in Table 6.2.2-1 for golf course irrigation. As discussed in Section 4.7.4, the golf course has an irrigation capacity of approximately 143.3 million gallons per year during a cool wet year.

As indicated previously three general sites were investigated for spray irrigation (1) the Porcupine Creek area, (2) the Yellow Mule area and (3) the Meadow Village area. The existing golf course is in the Meadow Village area and has recently been expanded as part of Interim Action Work Plan. In addition to expanding the irrigation system on the existing golf course, the District has considered developing another golf course as a land application site. Figure 6.2.2-2 shows the approximate location of the proposed new golf course. It is estimated that the new golf course would provide approximately 250 acres of land for irrigation.



BIG SKY WASTEWATER FACILITY PLAN

PROPOSED NEW GOLF COURSE AREA

FIGURE 6.2.2-2

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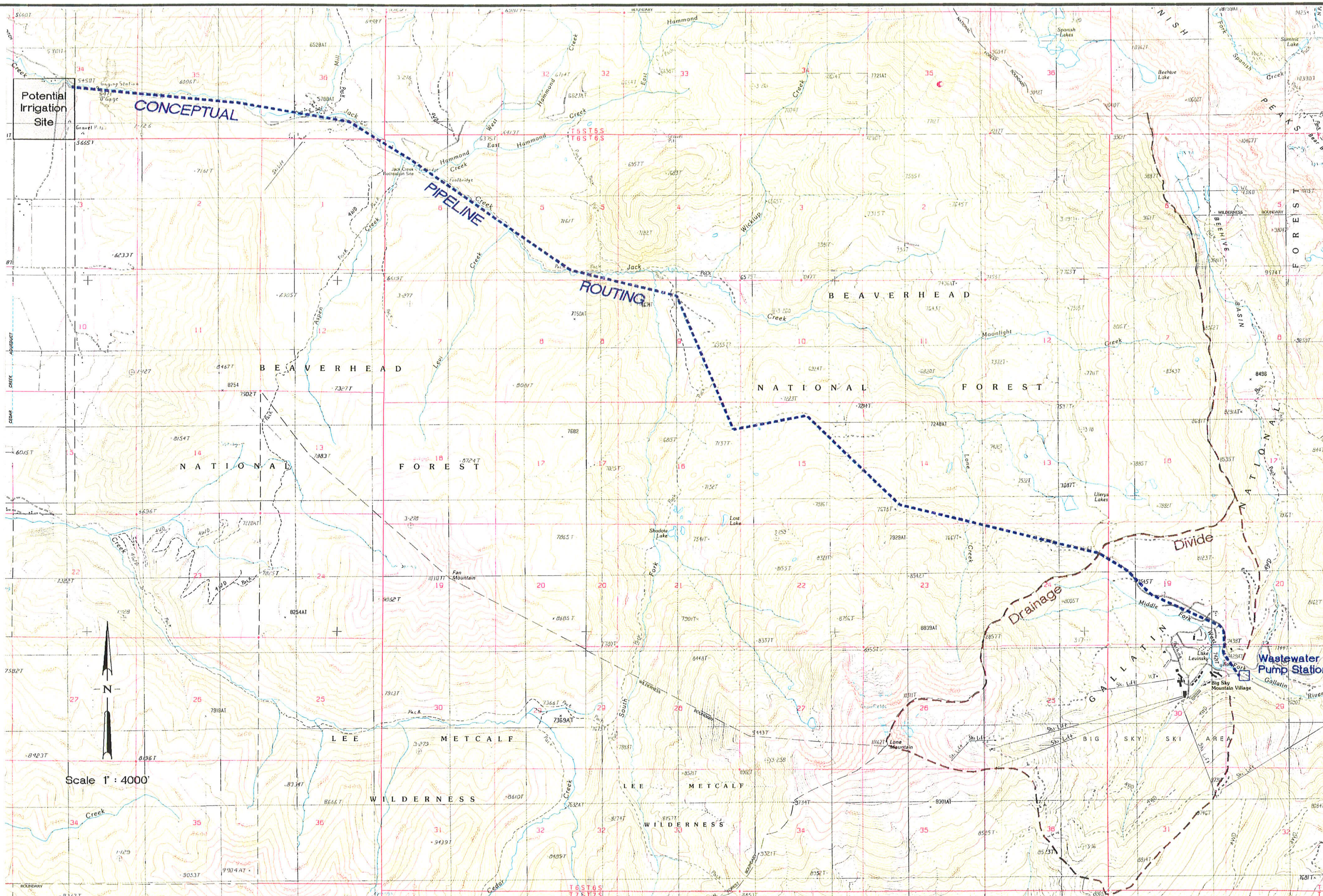
Two ring permeameter tests were conducted on the site proposed for the new golf course. Procedures outlined in the USBR Drainage Manual were followed while conducting the ring permeameter tests. The permeabilities ranged from 1.5 inches per hour to 3.98 inches per hour. While the surface permeabilities indicate a relatively permeable soil, the actual capacity of the golf course will be limited by the underlying shale layer. The actual capacity will depend on the final layout, but it is estimated the new golf course will provide the capacity to dispose of an additional 125 to 170 million gallons per year.

6.2.3 Jack Creek Disposal

As discussed in the previous section, suitable sites for spray irrigation in the vicinity of Big Sky are limited. Lands suitable for irrigation are also highly valued for residential and/or commercial development. Typically, the most favorable location for a spray irrigation system is on agricultural land where the landowner benefits from increased crop production and the potential for human contact with the irrigation water is minimized. Wastewater used for irrigation of agricultural land does not require the high level of treatment needed for the irrigation of a golf course where the potential for human contact is high. The nearest agricultural land that has suitable site characteristics is near the mouth of Jack Creek in the Madison Valley. Disposal of wastewater near the mouth of Jack Creek is included as Option 2C described in Section 7.1.7.

Disposal of water from the Mountain Village by irrigation on a site near the mouth of Jack Creek has been evaluated to determine the economic viability of this option. Figure 6.2.3-1 shows the area considered for spray irrigation. Figure 6.2.3-1 also shows a conceptual pipeline route. The route shown is only for cost estimation purposes to test the economic viability of the option. Property ownership and geological conditions along the route shown have not been determined at this time. Geotechnical, environmental conditions, and right-of-way acquisition may require alignment changes if this disposal option is selected.

In this option, wastewater from the Mountain Village would be intercepted in the existing sewer line just below Lake Levinsky at an elevation of approximately 7400 feet. The raw wastewater would be pumped in a 12-inch cement lined ductile-iron line to the drainage divide which is at an elevation of



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BIG SKY WASTEWATER FACILITY PLAN
JACK CREEK PIPELINE ROUTING

FIGURE 6.2.3-1

approximately 7820 feet. The pump station would consist of three, 550 gpm, 100 horsepower pumps; each would provide 50 percent of the estimated peak hour flows of 1100 gallons per minute. The pump station discharge pressure would be approximately 215 psi. An overflow to the existing gravity collection system would be provided to handle flows in excess of peak hour flows and to act as an emergency overflow during power outages. An emergency generator would not be provided for the lift station.

From the divide, wastewater would flow by gravity to the mouth of Jack Creek in a 12-inch line. An aerated lagoon located near the mouth of Jack Creek would provide treatment before spray irrigation of the effluent. The lagoon would be sized to treat the projected average day winter flow from the Mountain Village (0.54 MGD). The projected average BOD_5 load from the Mountain Village is 2,178 pounds per day. A 3-cell aerated lagoon would be used with a total detention time of 23.5 days. An area of approximately 5 acres would be required for the aerated lagoon.

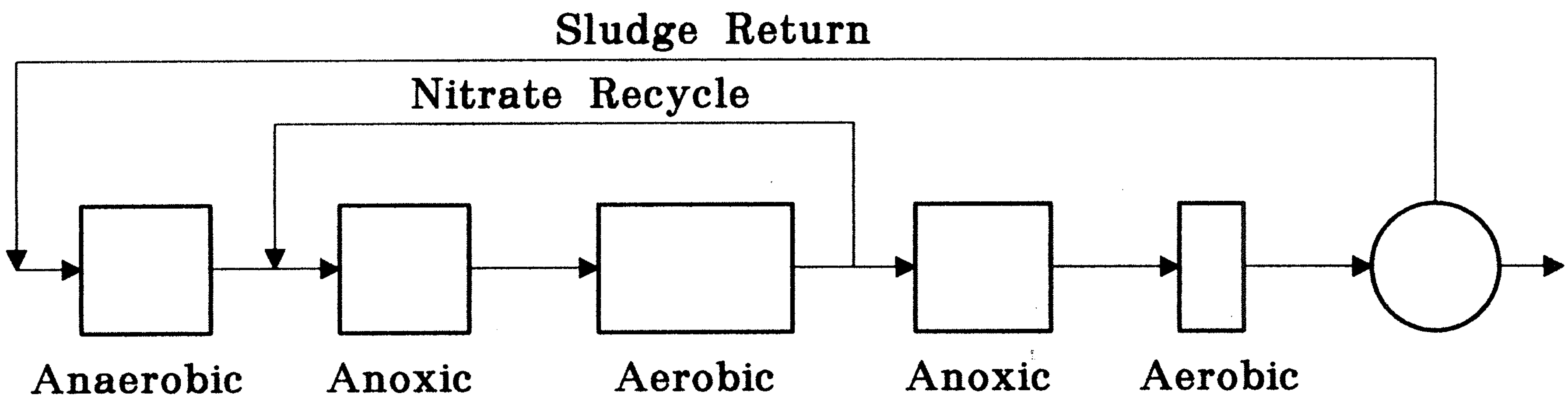
An 11 acre storage pond with a depth of 20-feet would be required to store treated water during the non-irrigation season. The storage pond size has been estimated based on providing 200 days of storage. The storage volume is estimated on the annual average flow rate for the Mountain Village (0.28 MGD) rather than the average winter flow rate. A storage volume of 56.5 million gallons would be required.

A minimum of 50 acres would be required for irrigation. However, in order to provide reserve capacity and utilize standard equipment, a quarter section (160 acres) should be leased for irrigation with a 1300 foot center pivot.

6.3 TREATMENT PLANTS

6.3.1 Oxidation Ditch

The oxidation ditch is a biological process that is capable of both phosphorus and nitrogen removal. The type of oxidation ditch proposed for Big Sky is a 5 stage, modified Bardenpho system. A simplified process flow diagram for the Bardenpho system is shown in Figure 6.3.1-1.



BIG SKY WASTEWATER FACILITY PLAN

MODIFIED BARDENPHO
PROCESS FLOW DIAGRAM

FIGURE 6.3.1-1

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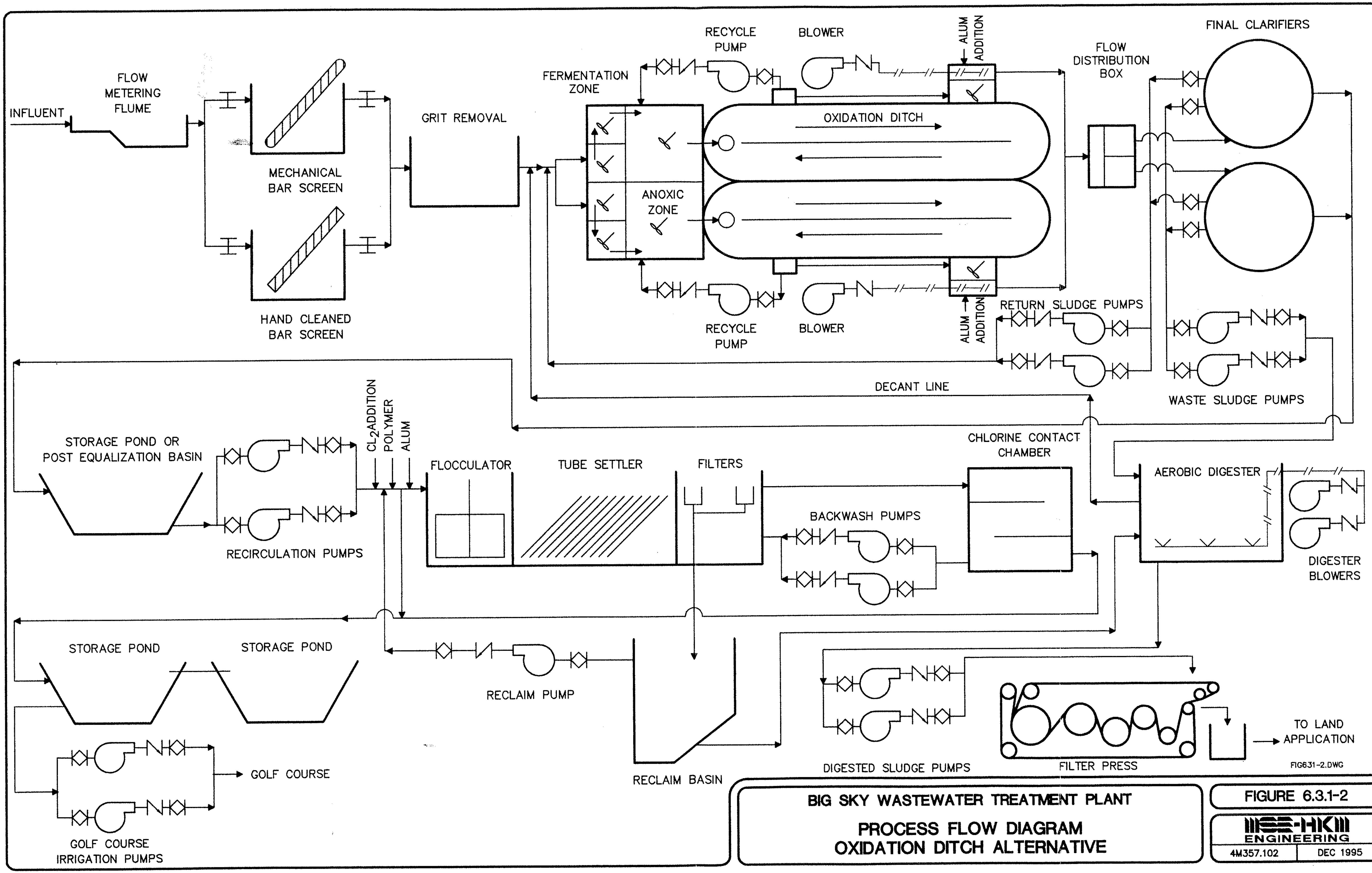
In the first anaerobic stage, return activated sludge is mixed with the incoming raw sewage. Under these conditions, acetate and other fermentation by-products are formed that are readily assimilated by phosphorus storing organisms. These conditions tend to select for a population of phosphorus-storing organisms. Any sulfate present may be reduced to sulfide and hydrogen sulfide and may require odor control measures be implemented.

From the first anaerobic stage, sewage flows to the first anoxic stage where it is mixed with recycled sludge from the nitrification stage. In the first anoxic stage, nitrate produced in the nitrification stage is reduced to nitrogen gas and is removed from the process. In order to achieve the desired level of nutrient removal, it is necessary to provide an anoxic cycle in which the contents of the reactor basin are mixed without the addition of air. Therefore, each basin would contain a mixer assembly which would accomplish mixing without the addition of oxygen

In the first aeration stage, an aerobic environment is provided to meet the oxygen demands for BOD_5 removal to oxidize ammonia to nitrate, and oxidize any sulfide carrying over from the upstream stages. It is also in this stage that biological phosphorus uptake occurs.

In the second anoxic stage nitrate produced in the aerobic stage is reduced to nitrogen gas. The second anoxic stage removes the remaining nitrate that was not removed in the first anoxic stage. The second anoxic stage also assures that nitrate recycle to the first anaerobic stage (via the return activated sludge) is prevented.

The final aerobic stage, also called the reaeration stage, oxidizes any traces of ammonia produced in the second anoxic stage. The final aerobic stage also allows any phosphorus released in the anoxic stage to be reabsorbed prior to the final clarifier. The reaeration phase also causes nitrogen gas produced in the second anoxic stage to be released prior to discharge to the final clarifier. A detailed process flow diagram for the oxidation ditch process is shown in Figure 6.3.1-2.



BIG SKY WASTEWATER TREATMENT PLANT

PROCESS FLOW DIAGRAM
OXIDATION DITCH ALTERNATIVE

FIGURE 6.3.1-2

As shown in Figure 6.3.1.2, the oxidation ditch process would consist of the following components:

- Pretreatment
  - Bar Screen
  - Grit removal
- Oxidation ditch process (modified Bardenpho)
- Final clarifiers
- Return sludge pumping
- Waste sludge pumping
- Chemical addition equipment
- Effluent Filters (Existing)
  - Coagulation and Flocculation
  - Tube Settlers
  - Filters
  - Backwash pumps
- Backwash reclaim basin
- Disinfection
- Odor Control System
- Solids Handling System

Following the oxidation ditch, the treated wastewater flows into the secondary clarifier for settling. Biological solids are separated from the wastewater and returned to the treatment basins. The clarified effluent is discharged to the existing filtration system to remove any residual suspended solids. The filter system provides a total surface area of 225 square feet in three filters so one can be taken offline for maintenance. The filtration rate will be 2.5 gpm/ft^2 with two filters in operation.

Prior to the effluent filters, the influent will be coagulated using alum and polymer. Tube settlers will be used to settle the particles formed in the coagulation process. The alum addition will also remove residual phosphorus remaining after the biological treatment step. Backwash water from the filters will be returned to a backwash reclaim basin. Decant water from the reclaim basin will be recycled to the filters.

6.3.2 Sequencing Batch Reactor

A sequencing batch reactor (SBR) is a biological treatment process that combines the biological reactor and the final clarifier into a single basin. It is also capable of removing both phosphorous and nitrogen. The SBR is a fill and draw process in which discrete treatment cycles occur in a single basin. The process allows a substantial amount of operational flexibility as the cycle times and volumes can be varied to accomplish nutrient removal. As shown in Figure 6.3.2-1, the specific treatment cycles include:

- Fill (raw wastewater is fed to the reactor),
- React (aeration/mixing of the contents),
- Settle (quiescent settling),
- Decant (withdrawal of treatment wastewater),
- Idle (removal of sludge from basin).

The process flow diagram for the SBR system is shown in Figure 6.3.2-2. As shown the treatment system would consist of the following components:

- Pretreatment
  - Bar Screen
  - Grit Removal
- SBR Basin and Equipment
- Filter and Backwash System (existing)
- Chemical Addition Equipment
- Sludge Pumps
- Disinfection (existing)
- Solids Handling System

The proposed SBR system consists of three basins each approximately 50 feet square with a maximum water depth of approximately 19.0 feet. Two of the basins would be equipped with full aeration and decant equipment. The third basin would function as a standby equalization basin should one of the functioning basins be down for maintenance. Minimal aeration and mixing would be provided in the standby basin. While it is possible to use a single SBR basin and a large equalization basin, two complete functioning basins are recommended.

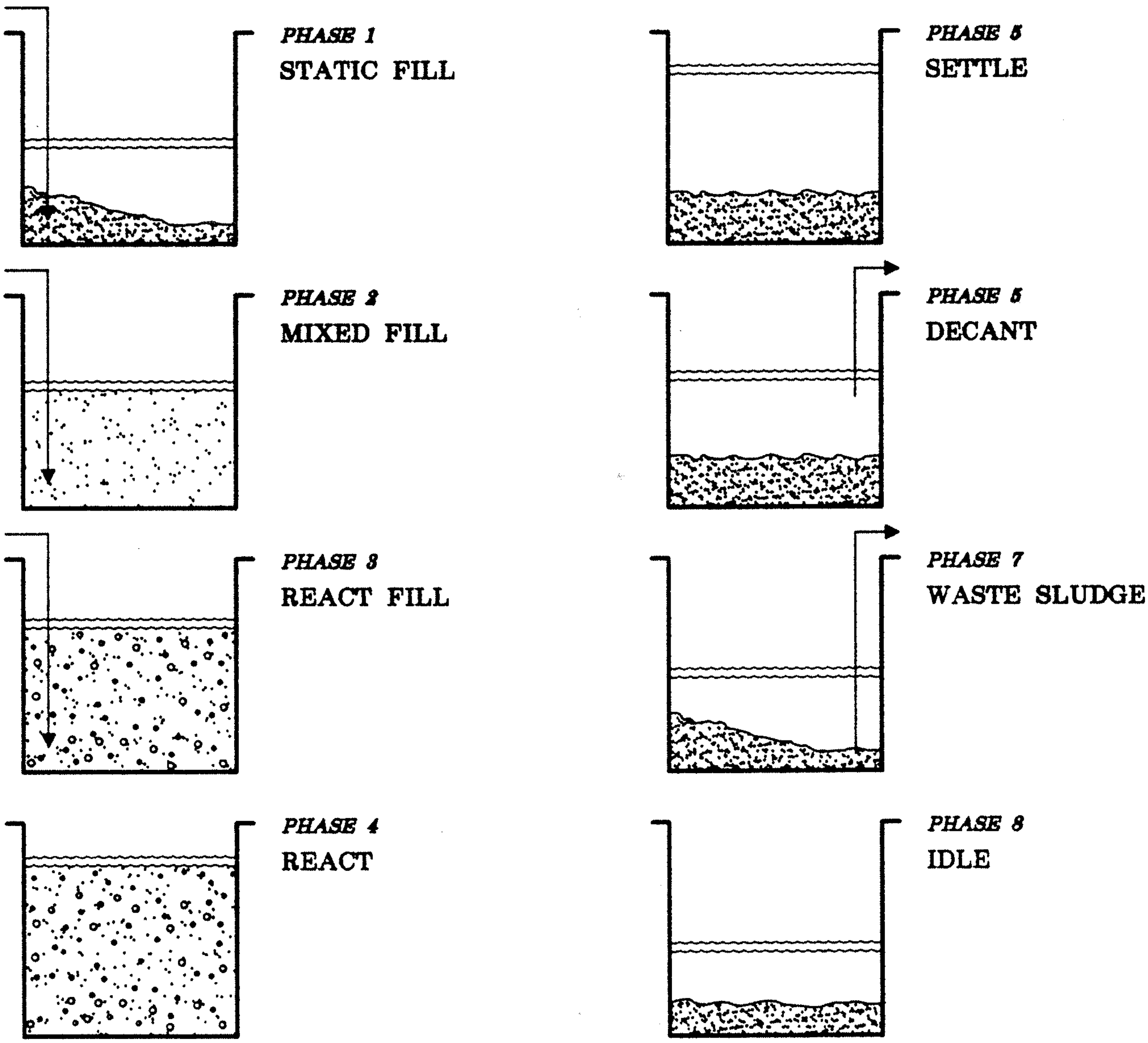


FIG632-1.DWG

BIG SKY WASTEWATER FACILITY PLAN

CYCLES FOR SBR

FIGURE 6.3.2-1

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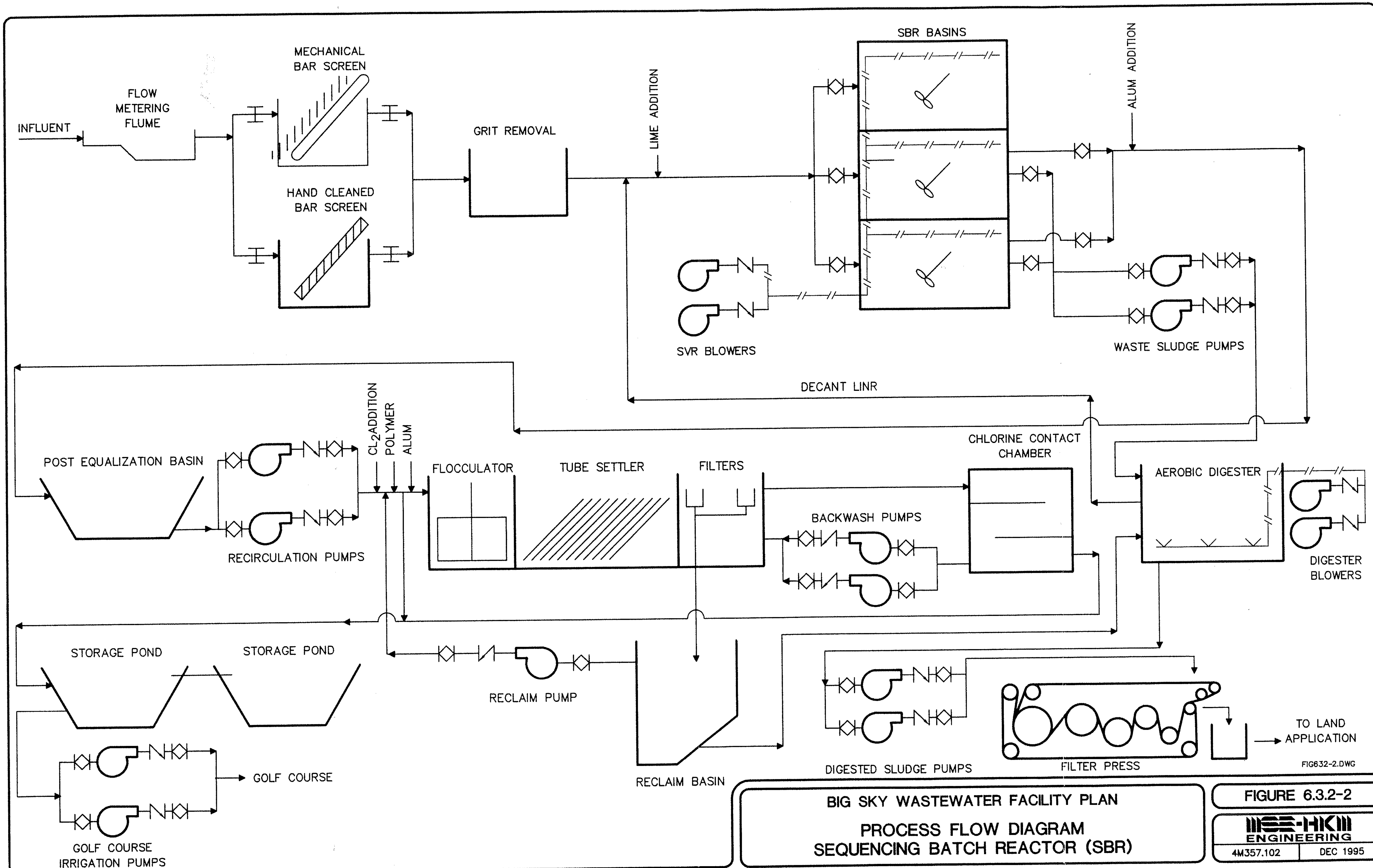

BIG SKY WASTEWATER FACILITY PLAN

PROCESS FLOW DIAGRAM
SEQUENCING BATCH REACTOR (SBR)

FIGURE 6.3.2-2

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Aeration would be required to meet both the carbonaceous and nitrogen oxygen demand. It is estimated that three (3) one hundred (100) horsepower blowers would be required to supply the oxygen demands.

6.3.3 Solids Handling

Sludge generated by the biological treatment system and filtration system will be stabilized and disposed in accordance with the federal sludge regulations (40 CFR Parts 257, 403, 503). Potential solids stabilization options include the following:

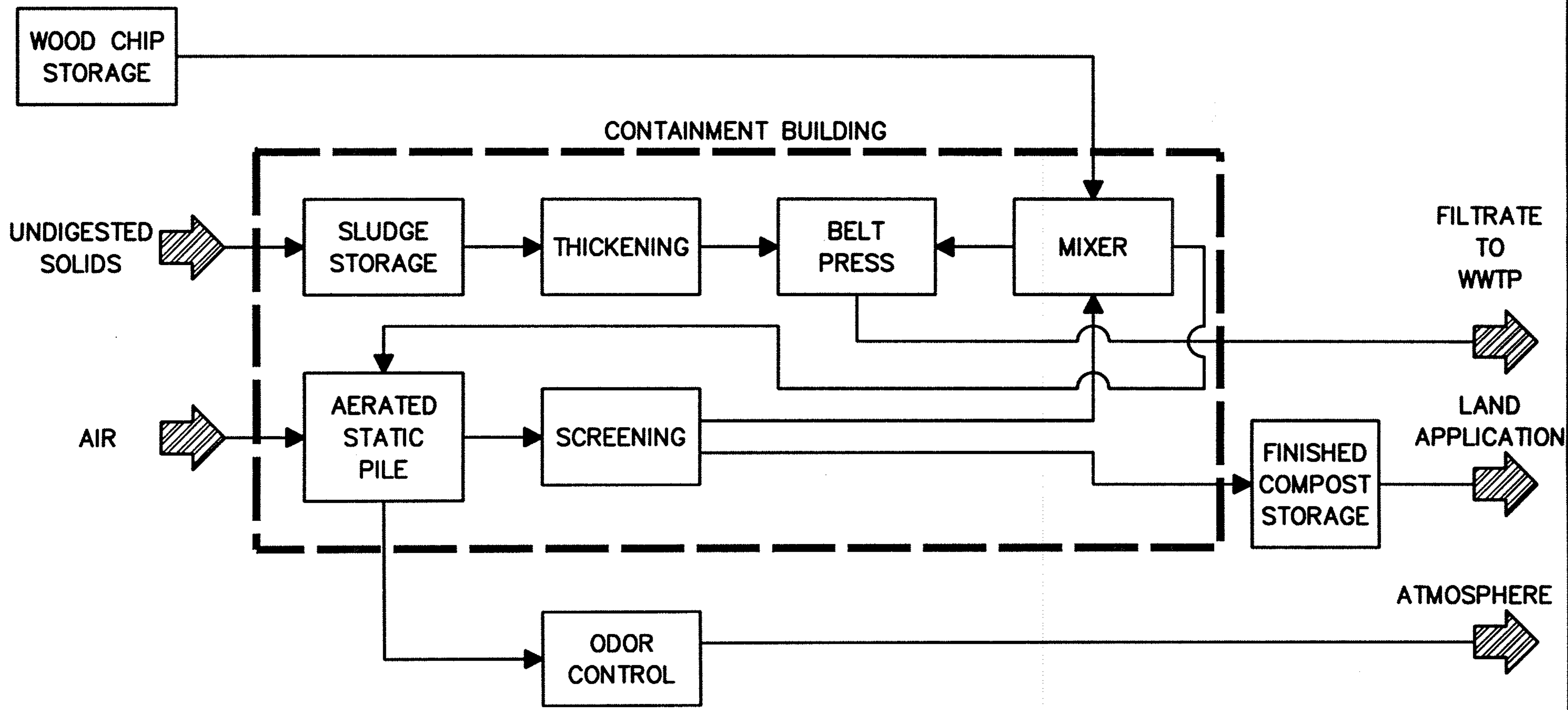
- Composting,
- Anaerobic digestion,
- Aerobic digestion,
- Lime Stabilization, and
- Thermophillic Digestion (ATAD)

6.3.3.1 Composting

Composting is a demonstrated method for stabilizing municipal wastewater sludges. The finished product is an excellent soil amendment and safe to handle. This creates numerous opportunities for disposal in and around the local community and allows the expense of remote hauling to be avoided. Because available sludge land application sites are expected to diminish over the longer term, composting has the potential to be cost effective over the long term.

A typical composting operation process diagram is shown in Figure 6.3.3-1. As shown, the undigested solids are initially thickened and dewatered to remove free water and reduce the quantity and cost of bulking agent. Next, the raw compost is prepared by mixing the dewatered sludge and a bulking agent such as wood chips or sawdust to increase the porosity and reduce the water content of the compost. The mixing can be accomplished manually or in a mixing bin or pug mill designed for this purpose.

The compost is then placed in lifts atop an air suction header. Aeration of the pile is accomplished by



BIG SKY WASTEWATER FACILITY PLAN

COMPOSTING SIMPLIFIED PROCESS FLOW DIAGRAM

FIGURE 6.3.3.1

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FIG-6331.DWG

drawing air into the pile. The off gas is discharged to an odor control scrubber. With the proper aeration rate, moisture, pH, and nutrient levels, the composting process will onset rapidly and generate the high temperatures (130°F - 175°F) necessary to inactivate pathogens. Approximately 20 to 22 days of aeration are necessary to obtain complete stabilization. Finished compost would be stockpiled during the winter months. The solids dewatering and compost piles would be enclosed for odor control purposes and protection from winter weather.

6.3.3.2 Anaerobic and Aerobic Digestion

Anaerobic and aerobic digestion are proven processes with wide application. Anaerobic digestion is more common in larger facilities while aerobic digestion is commonly used in plants under 5 MGD. Table 6.3.1-1 provides a comparison of the advantages and disadvantages of each process. As phosphorous is released from the biological sludge under anaerobic conditions, aerobic digestion is the more appropriate digestion technology. Additional advantages of aerobic digestion include ease of operation, lower odor potential, and the lower phosphorous concentration in the digester supernatant.

With an aerobic digestion process, two aerobic digesters would be constructed to provide redundancy in the system. The digesters would provide a mean cell residence time of approximately 60 days in accordance with the 503 regulations for Class B sludge. A mixer would be required to keep the contents of the digester in suspension.. In addition, each basin would contain a decant system to allow supernatant withdrawal.

From the aerobic digesters, sludge would be transferred to a belt filter press for final dewatering. It is anticipated that a sludge cake of 16% to 20% dry solids will be achieved in the belt filter press. The belt filter press will be housed in a separate building with chemical feed equipment. An odor control system will be installed in the building. Solids from the belt filter press will be hauled to agricultural land or to a landfill for final disposal. In the summer months, the sludge would be land applied. In the winter months, the sludge would be landfilled.

Table 6.3.1-1 Comparison of Anaerobic vs. Aerobic Digestion		
PROCESS	ADVANTAGES	DISADVANTAGES
Anaerobic digestion	Good VSS destruction (40 to 60%) Net operational costs can be low if gas (methane) is used Broad applicability Solids residue suitable for agricultural uses Good pathogen reduction Reduced total sludge mass Low net energy requirements	Requires skilled operators May experience foaming Methane formers are slow growing, hence "acid digester" sometimes occurs Recovers slowly from upset Supernatant strong in COD, BOD, SS, and NH_3 Cleaning is difficult (scum and grit) Can generate nuisance odors resulting from anaerobic nature of process High initial cost Potential for struvite (mineral deposit) Safety issues concerned with flammable gas Waste gas flare may be objectionable
Aerobic digestion	Low initial cost, particularly for small plants Supernatant less objectionable than anaerobic Simple operational control Broad applicability Low odor potential with proper design and operation Reduces total sludge mass	High energy costs Generally lower VSS destruction than anaerobic Reduced pH and alkalinity May experience foaming Potential for pathogen spread through aerosol drift Sludge is typically difficult to dewater by mechanical means Cold temperatures adversely affect performance

6.3.3.3 Lime Stabilization

The lime stabilization process uses an elevated pH to achieve pathogen inactivation and control odors. Large quantities of lime are mixed with the sludge until a pH of at least 12.0 can be maintained for a minimum of 2 hours. The lime stabilized sludge can be mechanically dewatered and either land applied or disposed in a landfill. This process was eliminated from further consideration for the following reasons:

1. No reduction in solids quantity is accomplished. The quantity is actually significantly increased versus other treatment schemes.

2. This process is not demonstrated in Montana.

3. Lack of disposal options for the sludge considering the potential for continued biological decomposition over time.

6.3.3.4 Thermophillic Digestion

An additional process, Autothermal, Thermophilic Aerobic Digestion (ATAD), has been used in Europe but few plants are operating in the U.S. Of the five alternatives, anaerobic digestion and aerobic digestion are considered as viable alternatives for Big Sky. The ATAD process was eliminated as a possible stabilization process primarily due to the lack of operating plants in the U.S. Even with the plants operating in Europe, there was a lack of data for the system performance in stabilizing sludge produced from activated sludge systems with low food-to-mass ratio. There is also a high potential for odor problems with the ATAD process. An ATAD system in St. George, Utah shut down immediately after start-up in order to install odor control equipment

6.3.4 Solids Handling Cost Evaluations

As previously discussed in Section 6.3.3, both composting and aerobic digestion appear to be good solids management options for Big Sky. In this section, the estimated costs for composting and aerobic digestion are developed separately from other portions of the project and compared.

The estimated capital cost for a new composting facility is $2,200,000. A cost breakdown is presented in Table 6.3.4-1. Major facilities include sludge storage, thickening, and dewatering, composting, finished compost storage and wood chip storage. The cost also includes an 11,000 square foot building for the sludge processing and composting operations. Storage of finished compost and raw wood chips would be outside.

The estimated operation and maintenance cost for the composting facility is $183,000 per year. A breakdown of these costs is shown in Table 6.3.4-3. The estimate includes labor costs for facility operation and maintenance and consumables such as parts, chemicals, and electricity. Approximately 3200 cubic yards of wood chips will be necessary to manufacture the compost. It should be noted that at the current price of $7.50 per cubic yard, the wood chips represent only 13 percent of the O&M cost. Due to the large quantities of chips needed, future increases in the chip cost could significantly increase composting O&M costs.

The estimated capital cost for a conventional aerobic digestor facility is $2,486,000. A cost breakdown is provided in Table 6.3.4-2. Included in this estimate are all equipment and facilities necessary to digest, dewater, transport, and land apply the sludge. A 1500 square foot building is provided for the belt presses, chemical feed system and digester motor control center. No costs for land purchase are included. The estimated operation and maintenance cost for this facility is slightly lower than the composting facility at $113,000 per year. A breakdown of these costs is shown in Table 6.3.4-3. This estimate includes labor costs for facility operation and maintenance including the land application operation. No cost for land application site purchase or leasing are included in these estimates. If a dedicated site must be purchased or leased, or if landfill tipping fees significantly increase (winter disposal) the costs of this option could increase significantly beyond the indicated costs.

A simple present worth analysis was used to determine the lowest cost option. A 20 year life and 8.25 percent discount rate were used as specified by the State Water Quality Bureau. As shown in Table 6.3.4-4, the conventional solids management approach is slightly more economical having a present worth of 3.7 million dollars versus 4.1 million dollars for the composting facility. The difference in cost is about 10 percent that, given the accuracy of the cost estimates, may not be significant at this stage of the project.

The conventional solids management scheme consisting of aerobic digestors, dewatering, and land application (winter landfilling) is the preferred option. This option is recommended on the basis of its competitive cost and the lower land requirement than composting. Should a suitable land site become available at a reasonable cost, composting could be reconsidered at such time.

TABLE 6.3.4-1 OPINION OF PROBABLE COST-COMPOSTING				
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
Sludge Tank	Ea.	1	112,000	112,000
Thickeners	Ea.	2	30,000	60,000
Belt Press	Ea.	2	275,000	550,000
Press Conveyors	Ea.	2	40,000	80,000
Pug Mill	Ea.	2	25,000	50,000
Pug Mill Conveyors	Ea.	1	50,000	50,000
Wood Chip Bin	Ea.	1	75,000	75,000
Placement Conveyor	Ea.	1	75,000	75,000
Shaker Screen	Ea.	1	25,000	25,000
Compost Bin	Ea.	1	7,500	7,500
Pile Aeration System	L.S.	1	50,000	50,000
Chemical Feed Equipment	L.S.	1	20,000	20,000
Sludge Transfer Pumps	Ea.	6	20,000	120,000
Return Pump Station	L.S.	1	25,000	25,000
Raw chip and Fin. Compost Conveyor Systems	L.S.	2	100,000	200,000
Odor Control Enclosures	L.S.	4	10,000	40,000
Belt Press Water System	L.S.	1	10,000	10,000
Compost Building	S.F.	10,800	75	810,000
Front End Loader	L.S.	1	100,000	100,000
Crane Hoist	L.S.	2	10,000	20,000
Stairs/Platforms	L.S.	1	50,000	50,000
Process Piping	L.S.	1	86,000	86,000
Electrical	L.S.	1	84,000	84,000
Instrument and Control	L.S.	1	77,000	77,000
Dump Truck	L.S.	1	75,000	75,000
Testing/Staking	L.S.	1	15,000	15,000
Site Grubbing	Acres	1.5	1,000	1,500
Excavation	Yard	4,142	3.62	15,000
Backfill/Compaction	Yard	4,142	3.00	12,400
Asphalt	Ton	1,183	69	81,600
Containment Walls	Yard	120	350.00	42,000
Rain Water Sump	L.S.	1	25,000	25,000
Fencing	L.F.	1,200	13.00	15,600
Landscaping	L.S.	1	20,000	20,000
Land Cost	Acre	1.5	35,000	52,500
Access Road	Foot	300	10	3,000
			SUBTOTAL	1,662,000
			15% CONTINGENCY	249,000
			SUBTOTAL	1,911,000
			ENGINEERING & LEGAL @ 15%	287,000
			TOTAL	2,200,000.

TABLE 6.3.4-2 OPINION OF PROBABLE COST CONVENTIONAL DEWATERING & DISPOSAL				
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL
Aerobic Digestors	Ea.	2	185,000	370,000
Belt Filter Presses	Ea.	2	275,000	550,000
Biosolids Transport and Application Equipment	L.S.	1	435,000	435,000
Chemical Feed Equipment	L.S.	1	20,000	20,000
Sludge Conveyor	L.S.	1	40,000	40,000
Drop Off Box	L.S.	1	7,500	7,500
Belt Press Wash Water System	L.S.	1	10,000	10,000
Filter Press Building	S.F.	1,500	75.00	113,000
Odor Enclosures	Ea.	2	10,000	20,000
Crane Hoist	Ea.	1	10,000	10,000
Stairs Platforms	L.S.	1	25,000	25,000
Process Piping	L.S.	1	120,000	120,000
Electrical	L.S.	1	60,000	60,000
Instrumentation and Control	L.S.	1	56,000	56,000
Site Work for Filter Press Building	L.S.	1	20,000	20,000
Return Flow Pump Station	L.S.	1	25,000	25,000
			SUBTOTAL	1,879,000
			15% CONTINGENCY	282,000
			SUBTOTAL	2,162,000
			ENGINEERING & LEGAL	324,000
			TOTAL	2,486,000

TABLE 6.3.4-3 ESTIMATED ANNUAL O&M COSTS FOR SOLIDS HANDLING OPTIONS					
OPERATION COST $/yr.		MAINTENANCE COST $/yr.	CONSUMABLES $/yr.	ADMINISTRATIVE & LAB $/yr.	TOTAL $/yr.
Composting	46,000	95,000	37,000	5,000	183,000
Conventional	23,000	72,000	14,000	5,000	113,000

TABLE 6.3.4-4 PRESENT VALUE ANALYSIS OF SOLIDS HANDLING OPTIONS			
OPTION	CONSTRUCTION COST (Million $)	ANNUAL COST (Thousand $)	PRESENT VALUE (8¼% 20 yr) (million $)
Composting	2.2	183	4.1
Conventional	2.5	113	3.7

6.4 SNOWMAKING

The process of snowmaking, as a method of wastewater treatment, is a relatively new technology that has been used successfully at several municipal and industrial sites. The snowmaking process is based on the concept of purifying water through a freeze-crystallization process. Wastewater is sprayed through atomizing nozzles under high pressure and compressed air is added for atomization, projection and nucleation of the wastewater. As the droplets freeze, the contaminants are physically separated from the water but remain trapped within the center of the frozen droplet. Nutrients, such as phosphorus, are precipitated in insoluble form and will not re-dissolve into the melting snow. Nutrients and remaining organics agglomerate to the precipitating salts and are retained in the soil matrix for uptake by plants in the spring and summer.

During the spring of 1997, the District conducted a pilot test of the snowmaking process to gather data to evaluate its feasibility for this project. The pilot test consisted of spraying approximately 500,000 gallons of water into two adjacent test sites. The test sites were located east of the existing storage ponds. Each test site was approximately 100 feet by 100 feet. A berm was constructed around each test area to contain runoff. One site was lined with a geomembrane to contain the meltwater. The other site was unlined and the meltwater was allowed to infiltrate into the ground. Monitoring wells were located upgradient and downgradient of the test sites to allow any impacts to the groundwater to be evaluated.

Water from storage pond 1 was sprayed onto the test site from March 5, 1997 to March 16, 1997. The snowpack and meltwater were sampled until May 23, 1997. Table 6.4-1 shows the test results.

As the results show, the spraying process achieves almost a complete elimination of fecal coliform organisms. Total Kjeldahl nitrogen and ammonia nitrogen levels in the meltwater were reduced to average concentrations of 2.62 mg/l-n and 1.12 mg/l-n respectively. Prior to April 2, 1997 the test results for total Kjeldahl nitrogen were in error (Inter-mountain Laboratories, Inc., 1997). However, based on the ammonia concentrations in the applied water it is expected that the actual TKN of the applied water would be approximately 70 to 90 mg/l-N. Based on the pilot test results and test results reported from other locations, snowmaking appears to be a viable treatment and disposal alternative. The executive summary and results section of the pilot test report is included in Appendix O (Delta Engineering, 1997).

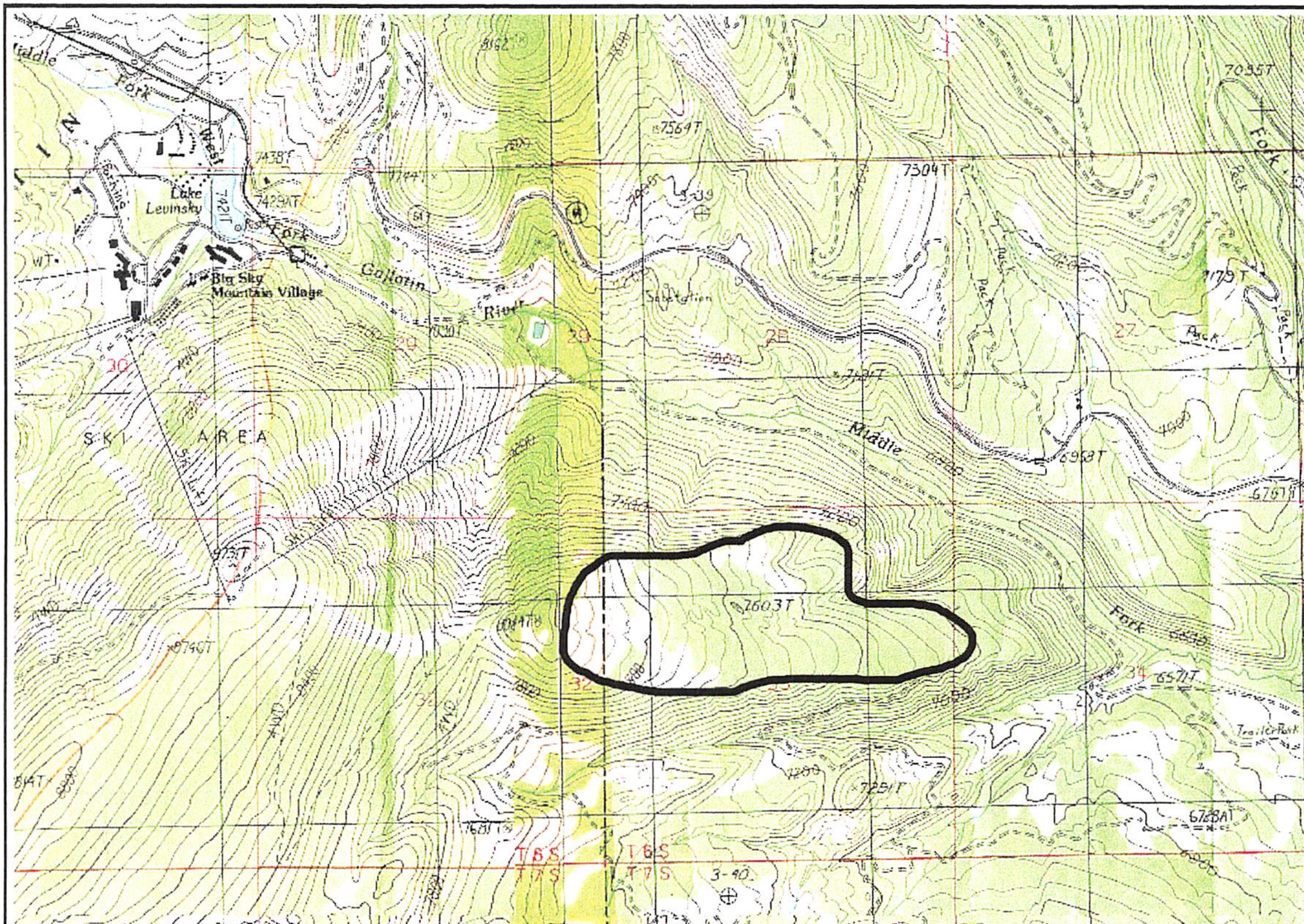
Two alternatives were evaluated for the snowmaking process. In the first alternative, wastewater from the Mountain Village would be diverted, pretreated in a small aerated lagoon and used in the snowmaking process at a site located in the ski area vicinity (Option 2D). This option would utilize the freeze crystallization snowmaking process patented by Delta Engineering for additional treatment. Three separate areas were considered for the snowmaking operation. The first area considered lies in Sections 32 and 33, Township 6 South, Range 3 East. Figure 6.4-1 shows the area. The remaining two areas considered for snowmaking are discussed in section 6.4.1. The first area is a gently sloping ridge with a northeast exposure at an elevation of approximately 7600 feet. The forest has been clearcut and has regrowth of 8-15 foot lodgepole pine. Access is limited due to the timber. The moderately deep soils are glacial till/colluvial in origin overlying jointed sandstone. Textures are typically sandy with stones and rock fragments increasing with depth.. Depth to bedrock is quite variable as is obvious in road cuts along the eastern margin of the area, but appears to typically be at least 36 inches below the surface. No bedrock outcrops were observed.

Two backhoe pits were dug to bedrock in November 1997 (see Figures 6.4-2 and 6.4-3). The typical soil profile consists of sandy loam or fine sandy loam textures with fragments increasing

TABLE 6.4.1

SNOWMAKING PILOT TEST RESULTS

PHASE I: SNOWMAKING												
Applied Water	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	ALKALINITY	CONDUCTIVITY	
6-Mar-97	13000	22	37	4.4	7.8	0.34	7.5	40	*	270	690	
7-Mar-97	9500	30	36	4.3	7.4	ND	7.3	41	*	270	710	
9-Mar-97	6400	21	31	4.1	2.5	ND	7.5	42	*	270	690	
11-Mar-97	6200	26	28	4.9	6.7	ND	7.8	43	*	260	650	
13-Mar-97	7400	8	34	4.6	7.4	ND	7.5	44	*	260	670	
16-Mar-97	500	17	25	3.7	6.4	0.063	7.6	45	*	160	380	
AVERAGE	7167	21	32	4	6	0	8	43	*	248	632	
nowpack "Fresh	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	ALKALINITY	CONDUCTIVITY	
5-Mar-97	12	37	33	2.2	7.1	ND	9.1	28	*	260	600	
7-Mar-97	ND	38	27	0.7	7.3	0.1	9.5	19	*	210	520	
9-Mar-97	ND	48	35	3.8	8.2	ND	9.1	31	*	240	540	
11-Mar-97	ND	100	7	0.42	3.8	0.11	9.8	4.4	*	100	150	
13-Mar-97	ND	36	39	3.8	6.4	ND	9	53	*	260	600	
16-Mar-97	ND	88	38	2.0	7.2	ND	9.1	7.2	*	69	140	
AVERAGE		58	30	2	7	0.11	9.3	24	*	190	425	
Snowpack "Aged	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	ALKALINITY	CONDUCTIVITY	
5-Mar-97	ND	44	34	1.9	6.6	ND	9.2	34	*	230	570	
7-Mar-97	ND	42	44	1.6	7.7	ND	9.3	34	*	220	490	
9-Mar-97	ND	21	51	2.7	7.5	ND	9.5	27	*	210	480	
11-Mar-97	ND	42	32	2.2	8.9	ND	9.5	34	*	200	450	
13-Mar-97	ND	18	50	2.9	4.5	ND	9.6	21	*	170	460	
16-Mar-97	ND	37	17	3.2	8.1	ND	9.4	75	*	230	550	
AVERAGE		34	38	2	7		9.4	38		210	500	
												SULFATE
PHASE II: INTERIM BETWEEN SNOWMAKING AND SNOWMELT												25
												40
Snowpack "Aged	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	ALKALINITY	CONDUCTIVITY	25
20-Mar-97	ND	48	35	3.70	6.7	ND	9.3	20	*	180	480	ND
25-Mar-97	ND	72	33	2.60	4.3	ND	9.2	94	*	310	88	ND
2-Apr-97	96	90	66	2.10	4.0	0.04	8.9	17.54	*	220	610	ND
16-Apr-97	94	75	29	9.80	9.3	0.05	9.3	7.4	13.12	80	120	ND
24-Apr-97	ND	90	10	3.00	6.3	0.01	8.7	3.07	4.57	85	130	30
1-May-97	ND	78	5	0.99	5.5	0.01	9.3	1.38	3.08	62	99	
12-May-97	ND	63	12	1.90	3.4	0.02	9.5	0.88	2.9	60	70	
AVERAGE		74	27	3.44	5.6	0.03	9.2	20.61	5.92	142	228	SULFATE
PHASE III: SNOWMELT												ND
												ND
Snowmelt	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	ALKALINITY	CONDUCTIVITY	ND
24-Apr-97	ND	28	7	2.4	4.2	0.04	7.7	0.78	1.31	50	140	ND
28-Apr-97	ND	ND	11	3.4	4.3	0.04	8.1	4.25	5.65	90	210	ND
30-Apr-97	ND	8	1	2.4	4.3	0.02	7.6	0.83	2.5	44	100	ND
5-May-97	ND	ND	19	1.6	2.2	0.02	7.6	0.89	2.9	70	130	ND
6-May-97	ND	ND	8	3.0	4.7	0.02	7.9	0.78	2.16	70	140	ND
7-May-97	1	9	7	2.6	3.9	0.02	7.7	0.96	2.36	50	120	ND
9-May-97	ND	23	6	3.0	3.3	0.02	7.9	0.94	2.12	100	180	ND
12-May-97	ND	10	7	3.4	3.6	0.02	7.9	1.27	2.23	80	170	ND
14-May-97	ND	34	8	3.0	3.4	0.03	8.4	0.93	3.17	120	200	ND
16-May-97	ND	ND	6	3.4	3.3	0.02	8.7	0.63	1.85	100	180	ND
19-May-97	ND	6	10	3.4	4.0	0.01	8.0	0.89	2.26	100	170	
21-May-97	ND	8	9	2.6	3.3	0.01	8.1	0.63	2.48	80	140	
23-May-97	ND	84	12	3.5	4.0	0.01	8.2	0.84	3.06	110	170	
AVERAGE		23	9	2.9	3.7	0.02	8.0	1.12	2.62	82	158	
ALL VALUES IN MG/L UNLESS NOTED												



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BIG SKY WASTEWATER FACILITY PLAN
POTENTIAL SNOWMAKING SITE

FIGURE 6.4-1

MSE-HKM ENGINEERING	LOG OF EXPLORATION HOLE BP-4	FIGURE 6.4-2
		Page 1 of 1

Project No.: 4M357.102
Project: BIG SKY SNOW MAKING
Location: BIG SKY, MT
Drill Date: 11/12/97
Drill Method: BACKHOE PIT

Surface Elev.:
Drill Hole Location: AREA 2
Total Depth: 6.67
Water Level (Date): DRY (11/12/97)
Field Logged by: R. WAPLES

SAMPLES	RECOVERY	W (%)	N	DEPTH (feet)	LITHOLOGY	GEOLOGIC DESCRIPTION
				0		LOAM to SANDY LOAM, (L-SL); yellow-brown, weak grade, crumb structure, platy, friable, no plasticity, slightly sticky, no lime, moderate to moderately rapid permeability, glacial till frozen to 12"
				.83		FINE SANDY LOAM to SANDY LOAM with moderate gravel and cobbles, (FSL-SL); yellow-brown, massive structure, friable, no plasticity, slightly sticky, no lime, moderate to moderately rapid permeability, glacial till roots to 48", angular stone fragments increase with depth
				1.67		FINE SANDY LOAM, (FSL); yellow-brown, massive structure, not sticky, friable, no plasticity, no lime, rapid permeability, colluvium, residual
				4.67		FINE SANDY LOAM, (FSL); yellow-brown, massive structure, not sticky, friable, no plasticity, no lime, rapid permeability, colluvium, glacial till 50% fragments at 56" 56" to 80" up to 80% stone fragments, jointed fractured sandstone at 80" some andesite stones in profile
				5		
				6.67		TOTAL PIT DEPTH OF 6.67 FEET Sample #1 taken from 0.0 to 10.0" Sample #2 taken from 24.0 to 48.0"
				10		

MSE-HKM ENGINEERING	LOG OF EXPLORATION HOLE BP-5	FIGURE 6.4-3
		Page 1 of 1

Project No.: 4M357.102
Project: BIG SKY SNOW MAKING
Location: BIG SKY, MT
Drill Date: 11/12/97
Drill Method: BACKHOE PIT

Surface Elev.:
Drill Hole Location: AREA 2
Total Depth: 5.0
Water Level (Date): DRY (11/12/97)
Field Logged by: R. WAPLES

SAMPLES	RECOVERY	M (%)	N	DEPTH (feet)	LITHOLOGY	GEOLOGIC DESCRIPTION
				0		SANDY LOAM, (SL); yellow-brown, weak grade, crumb structure, platy, friable, no plasticity, slightly sticky, no lime, moderately rapid permeability, glacial till frozen to 12" roots to 50"
				.33		SANDY LOAM to LOAM with gravel, cobbles and stones, (SL-L); yellow-brown, massive structure, no plasticity, slightly sticky, no lime, moderately rapid permeability, glacial 10% - 20% fragements, stones above 36"
				3.0		LOAM with cobbles and stones, (L); very dark gray, massive structure, no plasticity, slightly sticky, no lime, moderately rapid permeability, volcanic deposit, andesite stones and sand, 80% stones
				5.0 5		jointed sandstone, depth to bedrock is probably quite variable, andesite layer not contiguous TOTAL PIT DEPTH OF 5.0 FEET Sample #3 taken from 0.0 to 10.0" Sample #4 taken from 36.0 to 60.0"
				10		

with depth. Below 24 inches stone fragments increase to 50% or greater by volume. Jointed bedrock seems to lie between 48 and 72 inches. Backhoe pit 5 has a layer of andesite fragments at 36 inches but it is not contiguous throughout the area. Roots are common into and through the andesite layers. Although very shallow clay shale derived soils are typical at lower elevations, none were observed in the study area.

Additional backhoe pits should be excavated during the design phase to delineate the areas with greatest depth to bedrock.

Two ring permeameter tests were run to determine the infiltration rates of the surface soil. Because the soil was frozen to a depth of approximately 12 inches, the tests were run below the frost rather than on the surface. The sandy loam and fine sandy loam glacial till soils tend to liquefy when saturated and do not pass water as rapidly as the textures would indicate. Test 1 had an infiltration rate of 0.5 inches per hour and test 2 had a rate of 0.25 inches per hour. The tests were run in below freezing temperatures and test 2, especially, suffered from freezing water and soil. The tests were run for approximately 4 hours to simulate flow under saturated conditions, and the test rates are for the last hour of the tests. An infiltration rate of 0.5 inches per hour is probably more representative of the soil than 0.25 inches per hour. Depending on the location, rates will probably vary between 0.50 and 1.0 inch per hour.

In summary, the test results indicate that there is adequate permeability in these soils to infiltrate several inches of water per day. Although bedrock is present at relatively shallow, if variable depth, it lies in non-contiguous layers many of which are jointed. This should allow water to deep percolate rather than immediately surfacing downslope. The sloping nature of the area (2-4%) will require that berms be placed to retard runoff and facilitate infiltration.

After the area with greatest depth to bedrock has been delineated, additional ring permeameter tests on representative surface textures should be completed during the system design.

In this option the old pond located just east of the base of the Mad Wolf ski lift would be expanded and improved to provide pre-treatment and storage prior to the snowmaking operation. The existing 2.5 MG pond would be lined and an aeration system installed. An new 10 MG pond would provide storage during periods when conditions are not suitable for snowmaking. A pumping system would draw wastewater from the storage pond and deliver it via a 10-inch ductile iron line to the snowmaking site.

The second snowmaking alternative would use a conventional advanced biological treatment plant for treatment and then utilize a portion of the existing snowmaking system at the ski area for disposal of the treated wastewater (Options 1C, , 2A).

A key question regarding the snowmaking option is the applicability of the MPDES permit process to the snowmaking option. The state administers the permit program under the Montana Pollutant Discharge Elimination System (MPDES) which is expressly designed for the issuance of permits for the discharge of pollutants from point sources to state waters.

The District submitted a letter to the Montana Department of Health & Environmental Sciences (Jamison, 1994) which presents the District's opinion that a discharge permit would not be required for the snowmaking operation. It is the District's opinion that the snowmaking operation is neither a point source nor a discharge to state waters under the definitions contained in the Water Quality Act and ARM 16.20.1304. The District believes that any runoff from the snowmaking operation is functionally the same as agricultural return flows or storm runoff which do not require discharge permits. The District understands however, that monitoring reports would still be prepared and submitted to the WQD.

6.4.1 Alternative Snowmaking Site

At the request of the major landowner in the area, two additional sites were selected for study. Site A1 lies near the Middle Fork of the Gallatin River in the NE1/4 of Section 29. Site A2 lies south of A1 approximately one mile in the SE1/4 of Section 32. Backhoe pits and ring permeameter tests were completed on each site to characterize the physical and hydraulic properties of the soils. Figures 6.4-4 and 6.4-5 show the site locations. Soil logs and test data are shown in Figures 6.4-6 through 6.4-12.

SITE A1

This site lies at an elevation of approximately 7100 feet on a south-facing slope. Two intermittent streams that are tributaries to the Middle Fork drain the area and the river borders the site to the south. The general slopes are 6-15%, but the most desirable portion of the site (BP-3 and BP-4) is a small draw with 3-5% slopes. The soils are deep glacial tills with varying degrees of stoniness. The vegetation is small Lodgepole pine regrowth. The soil is mapped as MacFarlane stony sandy loam. The profile studied (BP A1 1-4) are somewhat heavier textures than the typical profile description.

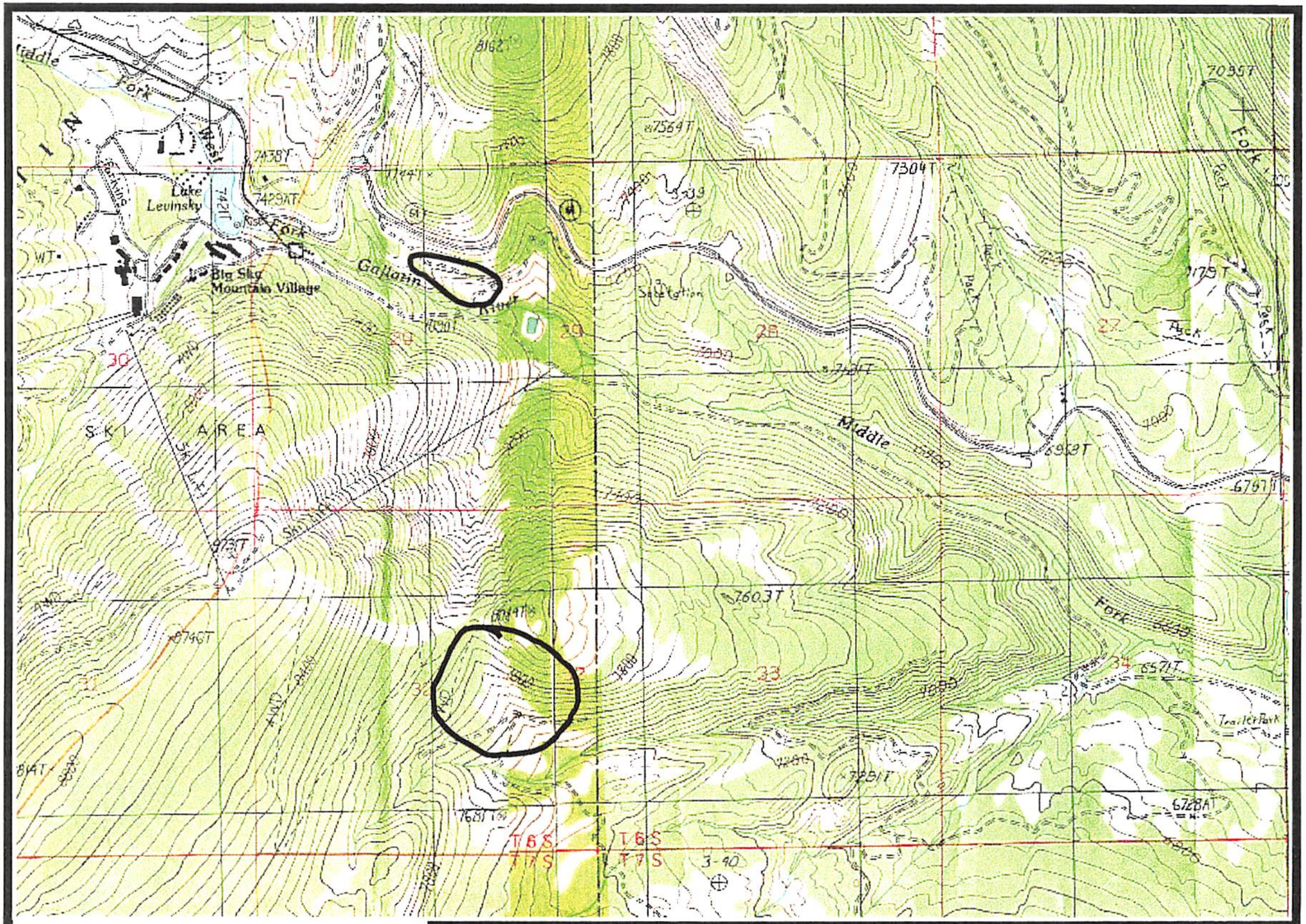
Four backhoe pits were dug and three ring permeameter tests were completed in the general area (see Figure 6.4-5 and 6.4-6 through 6.4-9). Of the area studied, the most suitable portion is the 7.2 acres in the western portion of the study area.

A water seep lies immediately east of BP-1. The soil profile showed many large mottles below a 24-inch depth indicating a long-term fluncuating water table. The soil was saturated and unstable throughout the profile with water f lowing into the hole at about 3 feet. The eastern portion of the area is not suitable due to slopes and high water table.

The other three backhoe pits have medium textured soils, reasonable slopes and no water table (see soil logs). No bedrock or other restrictive layers that would inhibit hydraulic conductivity were encountered.

Three ring permeameter tests were completed. They are located at BP-2, 3 and 4. The soils were moist due to recent snow melt, but the test sites were pre-soaked to approximate saturated flow conditions. The results are shown in Table 6.4-2

TABLE 6.4-2 INFILTRATION RATES AT SITE A1		
TEST #	LOCATION	FINAL INFILTRATION RATE
A1-1	BP-2	10 INCHES PER HOUR
A1-2	BP-3	12 INCHES PER HOUR
A1-3	BP-4	10 INCHES PER HOUR



PROPOSED SNOWMAKING AREAS

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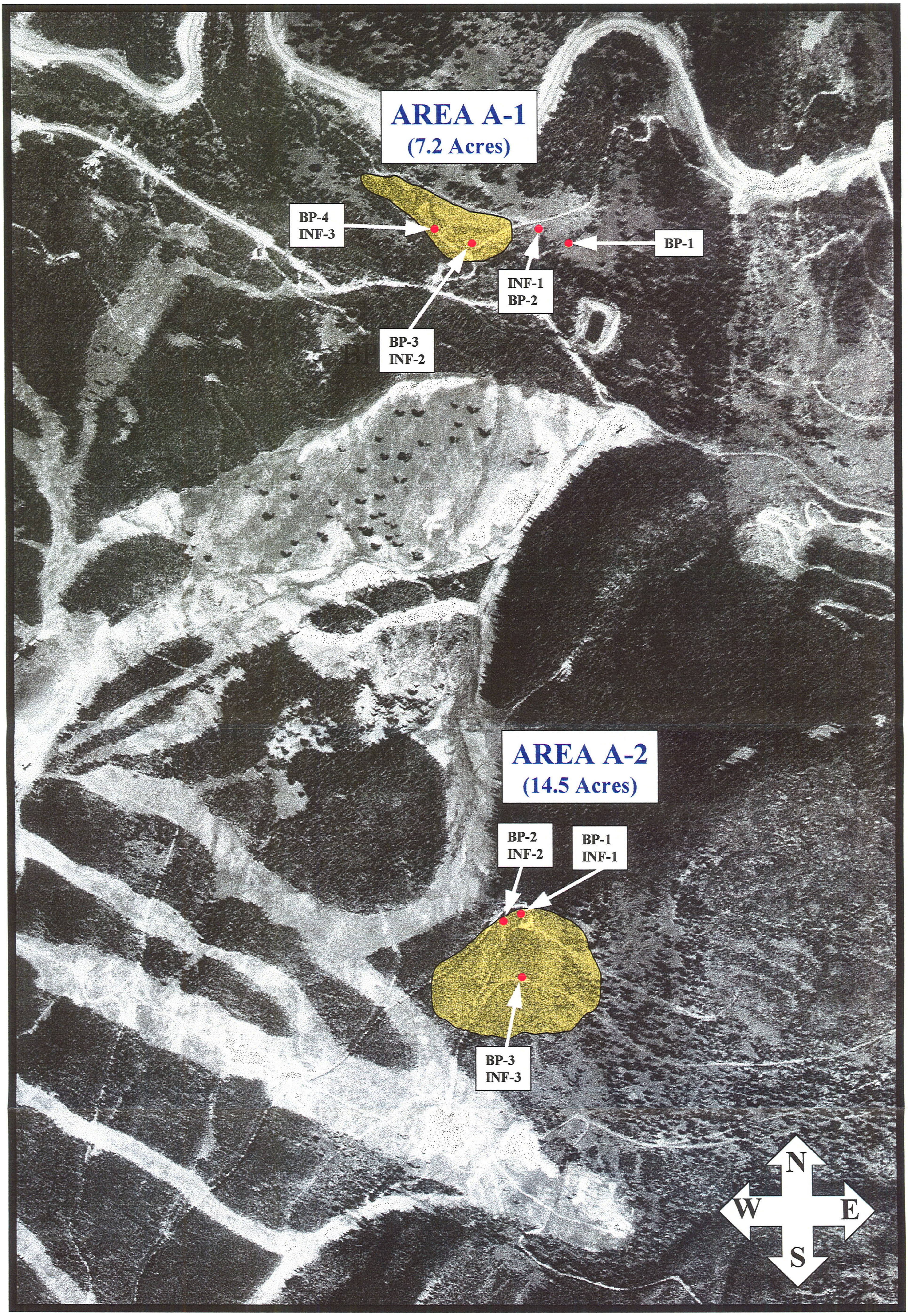
USGS MAP OF ALTERNATIVE SNOWMAKING SITES

FIGURE 6.4-4



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BIG SKY WASTEWATER FACILITY PLAN
POTENTIAL SNOWMAKING SITES A-1 AND A-2

FIGURE 6.4-5

MSE–HKM ENGINEERING	LOG OF EXPLORATION HOLE A1–1	FIGURE 6.4 – 6
		Page 1 of 1

Project No. : 4M357.102
Project : BIG SKY SNOW MAKING
Location : BIG SKY, MT
Drill Date : 6/8/98
Drill Method : BACKHOE PIT

Surface Elev. : 7100.0
Drill Hole Location : AREA A-1
Total Depth : 7.0
Water Level (Date) : 3.0 (6/8/98)
Field Logged by : R. WAPLES

SAMPLES	RECOVERY	M (%)	N	DEPTH (feet)	LITHOLOGY	GEOLOGIC DESCRIPTION
				0		CLAY LOAM, (CL); dark gray-brown, crumb structure, friable, slightly sticky and plastic, moderately slow permeability, glacial till, outwash, wet, moderate stones – boulders
				1.0		SILT LOAM to LOAM, (SIL – L); dark gray-brown, sub-angular blocky structure, friable, slightly sticky, slightly plastic, moderate permeability, glacial till, outwash, wet, moderate stones – boulders, large mottles
				3.33		GRAVELLY LOAM, (GL); dark gray brown, structurally massive, friable, sliughtly sticky, slightly plastic, moderate permeability, glacial till, outwash, more than 50% stones – boulders Hole unstable due to water seeping into hole. Water seep to east of pit
				5		
				7.0		TOTAL PIT DEPTH OF 7.0 FEET Slope 6 – 8% Clear cut Re-growth of lodgepole pine Sample #1 taken from 0.0 to .83 feet Sample #2 taken from 3.33 to 5.0 feet
				10		
				15		

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LOG OF EXPLORATION HOLE A1–2

FIGURE 6.4 – 7

Project No. : 4M357.102
Project : BIG SKY SNOW MAKING
Location : BIG SKY, MT
Drill Date : 6/8/98
Drill Method : BACKHOE PIT

Surface Elev. :
Drill Hole Location :
Total Depth : 9.33
Water Level (Date) : DRY (6/8/98)
Field Logged by : R. WAPLES

SAMPLES	RECOVERY	N (%)	N	DEPTH (feet)	LITHOLOGY	GEOLOGIC DESCRIPTION
				0		LOAM to CLAY LOAM; (L – CL); gray brown, weak sub-angular blocky, friable, slightly sticky, slightly plastic, moderate permeability, glacial till, outwash, slight stones, cobbles on surface roots to 3.0 feet
				.50		GRAVELLY SILTY CLAY LOAM, (GrSCL); brown, weak sub-angular blocky structure, friable, slightly sticky, slightly plastic, moderate permeability, glacial till, outwash, moist
				1.67		GRAVELLY SILTY CLAY LOAM, (GrSICL); structurally massive, friable, slightly sticky, slightly plastic, moderate permeability, glacial till, outwash, moist fragments upto 12" in diameter increasing with depth 30 – 50% fragments
				5.0 (5)		GRAVELLY CLAY LOAM to CLAY, (GrCL – C); structurally massive, firm, plastic and sticky, slow permeability, glacial till, outwash, stones, fragments, cobbles, boulders increase with depth
				9.33		TOTAL PIT DEPTH OF 9.33 FEET
				10		No bedrock or water table, soil moist due to snow melt Slope 6 – 8% Clear cut Re-growth of lodgepole pine Sample #3 taken from 0.0 to .50 feet Sample #4 taken from .50 to 1.67 feet
				15		

MSE–HKM ENGINEERING	# LOG OF EXPLORATION HOLE A1–3	FIGURE 6.4 – 8
		Page 1 of 1

Project No. : 4M357.102
Project : BIG SKY SNOW MAKING
Location : BIG SKY, MT
Drill Date : 6/8/98
Drill Method : BACKHOE PIT

Surface Elev. :
Drill Hole Location :
Total Depth : 7.17
Water Level (Date) : DRY (6/8/98)
Field Logged by : R. WAPLES

SAMPLES	RECOVERY	M (%)	N	DEPTH (feet)	LITHOLOGY	GEOLOGIC DESCRIPTION
				0		LOAM to SILT LOAM; (L–SIL); gray brown, granular, friable, slightly sticky, slightly plastic, moderate permeability, glacial till, outwash, moist roots to 3.33 feet
				.50		GRAVELLY LOAM to SILTY CLAY LOAM, (GrL–SICL); brown, weak sub-angular blocky structure, slightly sticky, slightly plastic, moderate permeability, glacial till, outwash, moist, 20% stones
				2.5		GRAVELLY SILTY CLAY LOAM, (GrSICL); structurally massive, slightly sticky, slightly plastic, moderate permeability, glacial till, outwash, 10 – 20% stones, fragments
				5		
				7.17		TOTAL PIT DEPTH OF 7.17 FEET No bedrock or water table Slope 3 – 6% Clear cut Re-growth of lodgepole pine Pit is located on the side slope of draw Sample #5 taken from 0.0 to .50 feet Sample #6 taken from .50 to 2.50 feet
				10		
				15		

MSE-HKM ENGINEERING	LOG OF EXPLORATION HOLE A1-4	FIGURE 6.4 - 9
		Page 1 of 1

Project No.: 4M357.102
Project: BIG SKY SNOW MAKING
Location: BIG SKY, MT
Drill Date: 6/8/98
Drill Method: BACKHOE PIT

Surface Elev.:
Drill Hole Location:
Total Depth: 10.0
Water Level (Date): DRY (6/8/98)
Field Logged by: R. WAPLES

SAMPLES	RECOVERY	M (%)	N	DEPTH (feet)	LITHOLOGY	GEOLOGIC DESCRIPTION
				0		CHANNERY LOAM; gray brown, granular structure, friable, non-plastic, slightly sticky, moderate permeability, glacial till, outwash less soil development with increasing elevation, roots to 4.0 feet 30% fragments, moist
				.50		CLAY LOAM to LOAM, (CL-L); red brown, weak sub-angular blocky structure, friable, slightly sticky, slightly plastic, moderate permeability, glacial till, outwash 10% stones, fragments, soils very consistent below 20" depth, moist
				1.67		CLAY LOAM, (CL); red brown, structurally massive, friable, slightly sticky, slightly plastic, moderate permeability, glacial till, outwash, 10% stones, fragments, moist
				3.33		CLAY LOAM, (CL); red brown, structurally massive, friable, slightly sticky, slightly plastic, moderate permeability, glacial till, outwash, 10% stones, fragments, moist
				5		
				7.50		CLAY LOAM, (CL); red brown, structurally massive, friable, slightly sticky, slightly plastic, moderate permeability, glacial till, outwash, 10% stones, fragments, moist
				10.0 10		TOTAL PIT DEPTH OF 10.0 FEET Slope 3 - 5% Clear cut Re-growth of lodgepole pine Pit is in the upper reach of a small draw Sample #7 taken from 0.0 to .50 feet Sample #8 taken from .50 to 1.67 feet
				15		

SITE A2

This site lies at an elevation of approximately 7800 feet (800 feet above the Middle Fork) and is one mile south of the river. The selected site lies along a ridge with south facing slopes. A shallow draw runs to the northeast, which would allow the runoff to be concentrated and diked. The slopes are 3-5% along the ridge and up to 15% or more on the slopes. The vegetation is a stand of thinned Lodgepole pine.

The soils are deep glacial till soils mapped by NRCS as Shaddow very flaggy loam. As in area A-1 the soils tend to be of medium texture. No bedrock or other restrictive layers, or water table was encountered in the soils investigation except as noted in BP2A-2. Three backhoe pits were dug in the 14.5-acre site (see Figure 6.4-5). The logs are shown in Figures 6.4-10 through 6.4-12..

The till derived soil profiles in this area are very heterogeneous till soils. Soil textures vary from sand to clay loams and rock fragments compose from 0 to more than 80% of the soil volume. However, contiguous bedrock was not encountered. Hole depths varied from 88 to 100 inches depending on the degree of rockiness and the stability of the pit walls. All soils were moist to wet due to snow melt and recent rain and snow, but no water tables were encountered.

All of the pits indicate that the soils are suitable as snow making sites. The glacial tills typically have extremely variable permeability rates depending on the soil texture. Pit 1 displayed a layer of dense gray clay at about 88 inches, but this layer was not found in either of the other two backhoe pits. Since this layer seems to occur within the top ten feet only at the top of the study area it is of minor concern for water percolation.

Three ring permeameter tests were run, one at each backhoe pit location (see Figures 6.4-10 through 6.4-12. The infiltration rates were all acceptable. See Table 6.4-3

MSE-HKM ENGINEERING	LOG OF EXPLORATION HOLE A2-1	FIGURE 6.4 - 10
		Page 1 of 1

Project No. : 4M357.102
Project : BIG SKY SNOW MAKING
Location : BIG SKY, MT
Drill Date : 6/8/98
Drill Method : BACKHOE PIT

Surface Elev. : 7800.0
Drill Hole Location : Area A2
Total Depth : 7.50
Water Level (Date) : DRY (6/8/98)
Field Logged by : R. WAPLES

SAMPLES	RECOVERY	N (%)	N	DEPTH (feet)	LITHOLOGY	GEOLOGIC DESCRIPTION
				0		LOAM to SILT LOAM; (L-SIL); gray brown, weak sub-angular blocky structure, friable, slightly plastic, moderate permeability, glacial till, very irregular boundary, very heterogeneous profile, 20% fragments
				.83		CLAY LOAM, (CL); olive, structurally massive, friable, slightly sticky, moderately slow permeability, glacial till, very heterogeneous
				3.0		CHANNERY CLAY LOAM to CLAY; olive and pink, structurally massive, plastic, slightly sticky, slow permeability, glacial till, blocky shale fragments increasing with depth - not contiguous, 0 - 30% fragments
				4.5		CHANNERY CLAY LOAM to CLAY; pink, structurally massive, plastic, slightly sticky, slow permeability, glacial till, increasing blocky sandstone, shale fragments (20 - 50%)
				5		
				7.5		TOTAL PIT DEPTH OF 7.50 FEET
				10		
				15		

TOTAL PIT DEPTH OF 7.50 FEET

No bedrock or water table encountered
Pit is in the top of a saddle in re-growth of lodgepole pine

Sample #2A-1 taken from 0.0 to .83 feet
Sample #2A-2 taken from .83 to 3.0 feet

MSE–HKM ENGINEERING	LOG OF EXPLORATION HOLE A2–2	FIGURE 6.4 – 11
		Page 1 of 1

Project No. : 4M357.102
Project : BIG SKY SNOW MAKING
Location : BIG SKY, MT
Drill Date : 6/8/98
Drill Method : BACKHOE PIT

Surface Elev. : 7800.0
Drill Hole Location : Area A2
Total Depth : 7.33
Water Level (Date) : DRY (6/8/98)
Field Logged by : R. WAPLES

SAMPLES	RECOVERY	W (%)	N	DEPTH (feet)	LITHOLOGY	GEOLOGIC DESCRIPTION
				0 – .25 – 1.0		CLAY LOAM; (CL); olive, weak sub-angular blocky structure, hard, slightly plastic, slightly sticky, moderately slow permeability, glacial till, fill due to logging road construction
				1.0 – 2.0		LOAM, (L); brown, weak granular structure, friable, slightly plastic, slightly sticky, moderately slow permeability, glacial till, original A horizon, very wet due to snow melt
				2.0 – 3.0		VERY CHANNERY LOAM; olive, friable, slightly plastic, slightly sticky, moderate permeability, very heteogeneous in texture, blocky black shale fragments, glacial till
				3.0		SILTY CLAY LOAM to CLAY LOAM, (SICL – CL); olive, structurally massive, slightly plastic, slightly sticky, moderately slow permeability, glacial till
				5		SILTY CLAY LOAM to CLAY LOAM, (SICL – CL); olive, structurally massive, friable, slightly plastic, slightly sticky, modertely slow permeability, glacial till, extremely heteogeneous
				7.33		At 7.33 feet, gray clay, very hard, slowly permeable
						TOTAL PIT DEPTH OF 7.33 FEET
						Pit is located on a side slope (3 – 8%) Re-growth lodgepole pine
						Sample #2A-3 taken from .25 to 1.0 feet Sample #2A-4 taken from 1.0 to 2.5 feet
				10		
				15		

MSE–HKM ENGINEERING	LOG OF EXPLORATION HOLE A2–3	FIGURE 6.4 – 12
		Page 1 of 1

Project No. : 4M357.102
Project : BIG SKY SNOW MAKING
Location : BIG SKY, MT
Drill Date : 6/8/98
Drill Method : BACKHOE PIT

Surface Elev. :
Drill Hole Location :
Total Depth : 9.17
Water Level (Date) : DRY (6/8/98)
Field Logged by : R. WAPLES

SAMPLES	RECOVERY	W (%)	N	DEPTH (feet)	LITHOLOGY	GEOLOGIC DESCRIPTION
				0		LOAM to SILT LOAM; (L-SIL); brown, weak granular structure, friable, slightly plastic, slightly sticky, moderate permeability, glacial till, moist to wet fromsnow melt
				.67		LOAM to SILT LOAM; (L-SIL); olive, structurally massive, friable, slightly plastic, slightly sticky, moderate permeability, glacial till, moist to wet
				2.08		CHANNERY CLAY LOAM to CLAY; olive, structurally massive, firm, plastic, slightly sticky, moderately slow to slow permeability, glacial till
				5		
				5.83		STONEY, CHANNERY CLAY LOAM to CLAY; olive, structurally massive, plastic, slightly sticky, moderately slow to slow permeability, glacial till, up to 80% stones and fragments
				6.67		SANDY CLAY LOAM, (SCL); olive, structurally massive, friable, slightly plastic, slightly sticky, moderate permeability, glacial till, stones throughout
				9.17		TOTAL PIT DEPTH OF 9.17 FEET
				10		Pit is located is on side slope in lodgepole pine re-growth adjacent to logging road Sample #2A-5 taken from 0.0 to .67 feet Sample #2A-6 taken from .67 to 2.08 feet
				15		

TABLE 6.4-3 INFILTRATION RATE AT SITE A2		
TEST #	LOCATION	FINAL INFILTRATION RATE
A2-1	BP, A2-1	8 INCHES PER HOUR
A2-2	BP, A2-2	7 INCHES PER HOUR
A2-3	BP, A3-3	9 INCHES PER HOUR

Summary

Both sites, A1 and A2, should be acceptable for stockpiling snow. Ideally, the manufactured snow would be kept within the small drainages that are found on each site to minimize dike construction. However, the till soils typically have enough clay content for dike construction. Soil compaction would be required because some of the soils tend to become unstable under saturated conditions. If site A1 is expanded to include the upper reaches of the draw, a buffer zone must be established to assure that the adjacent large highway fill is not destabilized.

In general, the snow making sites should be kept on the gentlest slopes possible to minimize run-off and maximize sort infiltration. In addition, slumping may occur on steep deeply saturated slopes.

6.5 DEEP WELL INJECTION

The possibility of discharging treated effluent through well bore injection is discussed in this section. Fluid injection through well bores has been a standard practice used in the petroleum industry. Since the early 1900's, produced water associated with oil and gas production has been returned to a producing formation. The classical use of water injection has been for water flooding an oil reservoir to increase ultimate oil recovery. Produce water can be injected to maintain reservoir pressure or to attenuate pressure decline. In either of these two standard and accepted practices, fluids are being withdrawn and the pressure fluid flow regime can be considered as pseudo steady state with somewhat predictable performance. However, in the case where a fluid is injected through well bores into a formation without fluid withdrawals, predictions as to fluid movement and resulting pressure behavior is very uncertain due to the uncertainty of establishing boundary conditions.

Predicting the flow and pressure behavior for fluid injection cases requires that the target formation be described in terms of 3-dimensional reservoir flow characteristics and the formation boundary conditions. The West Fork basin is bounded to the north by a SE-NW trending thrust fault zone with Pre-Cambrian basement rocks to the north and younger rocks on south or basin side. The aerial extent of potential target zones within the basin is not known. Therefore, an extensive geologic study would be required as a first step in analyzing the feasibility of treated effluent discharge into well bores.

6.6 ADVANCED TREATMENT ALTERNATIVES

In order to allow increased discharges to the Gallatin while still meeting nondegradation criteria an advanced treatment system may be required following the secondary treatment plant. The alternatives discussed below are treatment methods that would follow the biological treatment plant. The advanced treatment alternative would treat only the water that could not be disposed of by spray irrigation or through snowmaking.

6.6.1 Ion Exchange

One alternative for advanced treatment is an ion exchange system. The operative principle in the ion exchange process is the transfer of an ion in solution for an ion fixed to the surface of a resin. As the exchange process continues, the resin become exhausted, i.e. the fixed ions have all been exchanged for ions in the solution. Therefore the resin must be regenerated. Sodium chloride (salt) is used to regenerate the resin.

The regeneration process involves pumping a concentrated salt solution (brine) through the resin. The brine disposal problem is the major drawback to the ion exchange process. It is estimated that approximately 14,000 gallons per day of concentrated brine solution would be produced each day and approximately 1600 pounds of salt would be required each day. Since this quantity of brine solution could not be disposed of in any economical manner the ion exchange process is ruled out as a viable treatment alternative.

6.6.2 Reverse Osmosis

Reverse osmosis is a process in which water is separated from the dissolved salts in the solution by filtering through a semipermeable membrane at high pressure. The pressure must be great enough to overcome the natural osmotic pressure that tends to cause water in a diluted solution to migrate toward a more concentrated solution. The reverse osmosis process is highly effective in removing the majority of ions in water supplies. Table 6.5.2-1 shows typical removal levels for the reverse osmosis process.

Reverse osmosis plants are normally used to treat brackish well water or sea water to drinking water standards. Only recently has it been used to reclaim municipal wastewater for reuse. Because of the lack of widespread use of the RO process to treat municipal wastewater, a pilot plant study would be required to ensure adequate pretreatment is provided, and the proper membranes are selected to reduce problems with biofouling of the membranes.

The major problem foreseen with the RO system is a fouling or plugging of the membranes. Fouling results in declining production from the membranes and the need for higher operating pressures. Membrane fouling can occur from the growth of microorganisms or the deposition of calcium salts on the membrane surface. While biofouling can be alleviated to a limited degree by the selection of the membrane material and chlorination, biofouling cannot be eliminated.

Due to the membrane fouling typical in RO systems, an in-place cleaning system is used. The frequency of cleaning could vary and a pilot study would be needed to accurately estimate the cleaning requirements. Even with cleaning, it is expected the membranes would have to be replaced every 2 to 3 years.

Before the construction of a reverse osmosis plant, a pilot study should be conducted to evaluate the type of membrane, the effect of chlorination, and the need for prefilters in front of the RO members.

Unlike the ion exchange system, the concentrated reject water would still be suitable for spray irrigation after being blended with water in the storage ponds. In a RO system, water recovery is defined as the percent of feed water recovered as treated water. It is expected that the water recovery would be approximately 80 percent. The reverse osmosis option would involve constructing an RO plant that would treat water that is in excess of the irrigation capacity.

Following treatment in a RO system, the permeate would be discharged to the West Gallatin River. This would require the construction of an outfall line to the river.

As discussed previously, the limiting discharge criteria under the nondegradation rules is the low trigger value for inorganic phosphorus. The reverse osmosis process is highly effective in removing phosphorus as shown in Table 6.6.2-1. Therefore, reverse osmosis is a viable option for increasing the volume of water that could be discharged under the nondegradation rules.

The reverse osmosis process is a relatively new process for wastewater treatment. We would recommend pilot testing before utilizing the RO process at Big Sky.

Table 6.5.2-1
Typical Removal Efficiency for Reverse Osmosis Process (Weber, 1972)

SOLUTE	PERCENT REJECTION MAXIMUM	PERCENT REJECTION MINIMUM	AVERAGE
Calcium, CA^{2+}	99.7	96.3	>99
Magnesium, Mg^{2+}	99.9	93	>99
Sodium, Na^{+}	97	88	
Potassium, K^{+}	97	83	
Iron, Fe^{2+} and Fe^{3+}	~100	99.9	~100
Manganese, Mn^{2+}	~100		~100
Aluminum, Al^{3+}	99.9	97.3	>99
Chromium, Cr^{6+} pH 2.6			92.6
4.2			97.2
7.6			98.6
Ammonia, NH_4^{+}	95	77	
Bicarbonate, HCO_3^{-}			80-98
Sulfate, SO_4^{2-}	~100	99+	>99
Chloride, Cl^{-}	97	86	
Nitrate, NO_3^{-}	86	58	
Fluoride, F^{-}	98	88	
Boron (at pH5)	60	38	
Silica (at pH5)	95	80	
Orthophosphate, PO_4^{3-}	~100		>99
Polyphosphate	~100		>99
Total dissolved solids (TDS)	99	89	
COD-secondary effluent	97	94	
BOD-secondary effluent	94	81	
Color			~100
Turbidity			~100

6.7 REGIONALIZATION

There are several subdivisions in the Big Sky vicinity, not included in the District, that have recently been approved or are going through the review process. A regional wastewater system could be developed to include the nearby subdivisions, however, it would require the District to expand its boundaries to include the subdivisions. In addition to the proposed subdivisions, the lower basin area could be included in the service area.

Subdivisions that are currently proposed or recently developed in the Big Sky vicinity were identified in a draft environmental assessment prepared by the Department of Health and Environmental Sciences on December 13, 1994. The subdivisions included:

Cascade Subdivision Phase 1.
Diamond Hitch Phase 1
Aspen Grove Subdivision
Snowshoe Subdivision
Elk Ridge Estates

Since the draft environmental assessment, construction of the Lone Moose Meadows Subdivision has been started.

The Cascade Subdivision and Aspen Grove Subdivision are located within the District and will be connected to the collection system when the long range plan is approved and implemented.

Plans for the Snowshoe Subdivision have been reviewed and approved and approved by the WQD. Snowshoe is proposing lagoons and spray irrigation for effluent disposal. The subdivision will also be conducting pilot testing of a mechanical package plant which would allow additional development if the pilot testing is successful. Snowshoe is located approximately 3½ miles from the District wastewater plant and would require pumping to the District plant. It is estimated the pipeline and pumping costs would be approximately 2 to 3 million dollars. With a total development of approximately 32 lots, the cost per lot would be $62,500 to $94,000. When the cost is amortized over a 20 year period the average annual cost per lot would be $6,365 to $9,600. These costs would clearly be excessive and would preclude any development. The Elk Ridge Estates is planned for 25 single family dwellings on relatively large tracts, ranging from 19.8 to 40 acres in size. The low density of this development favors the use of individual on-site treatment and disposal systems. Extending collection lines to such low density development would be cost prohibitive.

The Lone Moose Meadows Subdivision is currently under construction in Section 28, T.6S., R.3E. The subdivision is not in the District boundary but the sewer outfall line from the Mountain Village runs just to the south to the subdivisions southern boundary. The pre-application plan indicates a total of 540 units.

During the public meeting process, both support and opposition have been expressed toward including the lower basin area in the District boundary. People favoring increased development of the lower basin area have expressed support for including the lower basin in the sewer district, while people wishing to maintain the current development level have expressed opposition to the district. As mentioned, the lower basin area currently uses septic tanks and drainfields for sewage treatment. Consequently, extensive development in the lower basin area will be limited by the land required for drainfields. Since the groundwater in the lower basin area can rise to within 3 to 4 feet of the ground surface, the extensive use of drainfields is questionable.

6.8 NO ACTION

The no-action alternative would simply allow the existing facility to continue operating as is. This alternative is not considered a viable alternative. The aerated lagoon and filtration system does not provide the level of treatment recommended for irrigation of unrestricted golf courses. In addition, the current system does not have the capacity to treat or dispose of the 20-year projected flows.

7.0 EVALUATION OF VIABLE ALTERNATIVES

7.0.1 INTRODUCTION

On July 13, 1993 the Department of Health and Environmental Sciences issued a compliance order that required the District to submit an Interim Action Work Plan and a Long-Term Compliance Work Plan that would establish treatment requirements necessary for meeting the District's service obligations. On August 31, 1995, the Department of Environmental Quality (DEQ), previously the Department of Health and Environmental Sciences, issued its "First Amendment to Compliance Order". A second and third amendment have been issued on October 27 and December 1, 1995, respectively.

While the First Amendment to Compliance Order substantially changed the content requirements for the Interim and Long-Term Work Plans, both the initial and first amended Compliance Orders clearly required the District to submit two separate documents for Department review and action.

Sections V.(4) & (5) of the Compliance Orders, establish the submission dates for the Interim and Long-Term Work Plans. Through issuance of the Second Amendment to the Compliance Order, the Revised Interim Action Work Plan was to be submitted to DEQ on December 31, 1995; and the Revised Long-Term Compliance Work Plan was to be submitted by December 31, 1995. The Revised Interim Work Plan was submitted on November 1, 1995. Three construction contracts were signed for separate portions of work required under the Revised Interim Action Work Plan in June and July 1996. The work completed included the expansion of the existing golf course irrigation system, the enlargement and lining of the storage ponds, and the installation of a filtration system.

A Draft Long Term Compliance work was submitted to the Department of Environmental Quality (DEQ) on January 2, 1996. Review comments were received from the Department of Environmental Quality on August 29, 1996. A revised draft of the LTCWP was submitted in December 1997 to address the comments received and to evaluate two new alternatives. The submission of this document reflects changes in the snowmaking sites and the receipt of the draft surface water discharge permit.

In this chapter, several different treatment options are evaluated in terms of cost, environmental impacts, and reliability. The options are designed to meet the projected 20-year needs of the District. The alternatives would all provide adequate treatment, storage, and disposal for the service obligations projected to occur during the next 20 years providing capacity for 207.8 million gallons per year. If all 7926.3 SFE's that the District is legally obligated to serve were developed, the projected flow would be 279.31 million gallons per year but this is not expected to occur during the current planning horizon..

7.1 COST COMPARISON

The cost effectiveness analysis presented in this section is based on equivalent uniform annual costs (EUAC). The EUAC is an expression of a series of expenditures, made at various intervals over a period of time, as a uniform annual amount. The capital cost and the annual O&M cost of each alternative is included in the computation of the EUAC. As required by the Water Quality Division, an interest rate of 8¼% has been utilized in computing the annual cost of capital.

Inflation has not been included in the cost analysis. It has been assumed that prices will tend to change over time by approximately the same percentage for all alternatives. Differences in EUAC costs among alternatives are of most importance at this stage of the planning process.

The cost of land for the spray irrigation option at the mouth of Jack Creek has not been included on the assumption that irrigable land would be obtained by a long term, no-cost lease arrangement. The cost of land required for the storage basin and the aeration basin has been included on the assumption that the land would have to be purchased.

Several treatment and discharge options were discussed in Chapter 6. Appendix N contains an evaluation of treatment alternatives which compares process reliability, operator skill level required, plant aesthetics, expandability, and future regulatory flexibility. The oxidation ditch ranked ahead of the SBR and was chosen by the District as the selected treatment alternative. Therefore, a detailed cost estimate for the SBR process has not been completed.

The primary issues for the Big Sky wastewater system are the methods and options available for storing and disposing of the treated wastewater. In Chapter 6 disposal options considered included:

- direct discharge to the Gallatin,
- irrigation on the golf course(s),
- irrigation of agricultural land near the Mouth of Jack Creek, and
- snowmaking.

Constructing two treatment plants; one at the Mountain Village and one at the Meadow Village, was also considered as an option.

Each option results in different storage requirements. Table 7.1-1 shows the various options and corresponding storage requirements. The storage volumes shown include a safety factor of 25% to allow for flow variations different than have been projected or other unforeseen events that may increase the storage requirements. A cost analysis is presented for each of the options shown below. A summary of the system components and capacities for each option is shown at the end of this section in Table 7.1.8-2.

Table 7.1-1
Treatment & Disposal Options Versus Required Storage

Option #	Discharge Options	Storage Required
	ONE TREATMENT PLANT (0.82 MGD Avg. Day)	
1A	• Surface Discharge, Summer Irrigation	95 MG
1B	• Summer Irrigation Only (new golf course)	167 MG
1C	• Summer Irrigation with Winter Snowmaking	125 MG
	TWO TREATMENT PLANTS	
2A	• Meadow Plant Summer Irrigation, Mountain Plant Snowmaking	124 MG
2B	• Meadow Plant Summer Irrigation, Mountain Village Summer Irrigation at Jack Creek Mouth	153 MG
2C	• Meadow Plant Summer Irrigation, Surface Discharge, Snowmaking (0.5 MGD Plant)	100 MG

7.1.1 Option 1A - One Treatment Plant with a Surface Discharge and Summer Irrigation

SUMMARY:

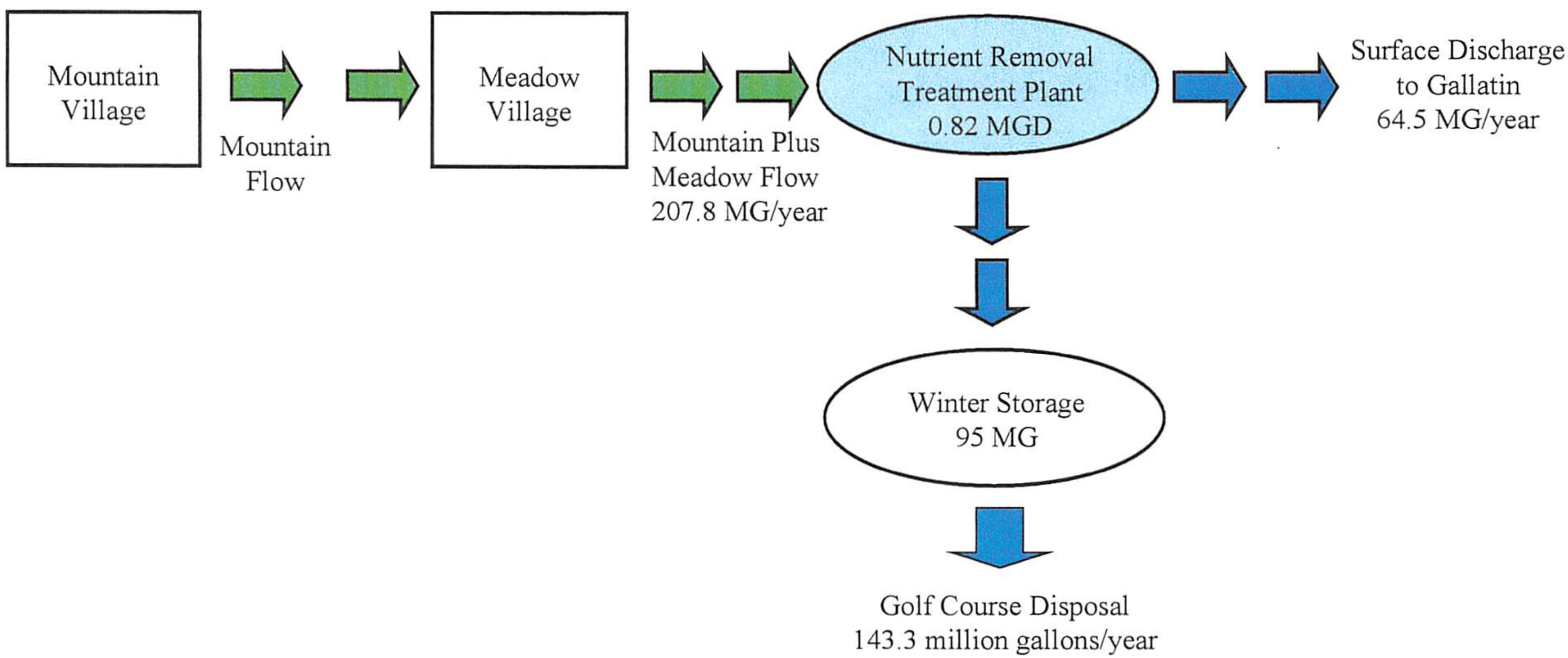
Treatment:		1 plant in Meadow Village (0.82 MGD)	
Storage:		79.9 MG Existing Ponds	
		15 MG New	
	Total	94.9 MG	
Disposal:		Existing Golf Course	143.3 MG
		Surface Discharge to Gallatin	64.5 MG
		Total	207.8 MG

Figure 7.1.1-1 provides an overview of the treatment, storage and disposal components in option 1A.

This option would involve constructing an oxidation ditch treatment plant at the existing lagoon site, constructing a 6-inch discharge line to the Gallatin River, constructing an additional 15 million gallons of storage on the existing golf course site or at a new site. This option minimizes the discharge to the Gallatin at the expense of adding additional storage. Water that could be discharged to the Gallatin during the winter would be stored to irrigate the golf course during the summer.

With the maximum allowable discharge to the Gallatin, this option would provide a discharge capacity of 260.8 million gallons per year; which is only slightly less than the projected full development flow of 279.31 million gallons per year. In order to reach the full discharge capacity of 260.8 million gallons per year an additional 56.8 million gallons of storage would have to be constructed. The additional storage would allow the discharge to the Gallatin at the maximum rate allowed under the discharge permit while still maintaining treated effluent in storage for irrigation of the golf course..

Table 7.1.1-1 shows the cost estimate to construct the various components of Option 1-A.



BIG SKY WASTEWATER FACILITY PLAN
OPTION 1A

FIGURE 7.1.1-1

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4M357.102 | September 1998

TABLE 7.1.1-1
OPTION 1A-OPINION OF PROBABLE COST

	Description	Units	Quantity	Unit cost	Total Cost
A. TREATMENT PLANT(0.82 MGD)					
	Pretreatment	L.S.	1	$ 265,000.00	$ 265,000.00
	Oxidation Ditch & Equipment	Ea.	2	$ 520,000.00	$ 1,040,000.00
	Final Clarifiers	Ea.	2	$ 125,000.00	$ 250,000.00
	Control/Maintenance/Lab	L.S.	1	$ 437,000.00	$ 437,000.00
	Aerobic Digesters	Ea.	2	$ 200,000.00	$ 400,000.00
	Waste/Return Pumping	L.S.	1	$ 230,000.00	$ 230,000.00
	Filter Reclaim Basin & Pumping	L.S.	1	$ 140,000.00	$ 140,000.00
	Belt Filter Press & Building	L.S.	1	$ 663,000.00	$ 663,000.00
	Odor Control Facilities	L.S.	1	$ 285,000.00	$ 285,000.00
	Biosolids Transport & Application	L.S.	1	$ 435,000.00	$ 435,000.00
	Chemical Feed Equipment	L.S.	1	$ 125,000.00	$ 125,000.00
	Site Work	L.S.	1	$ 250,000.00	$ 250,000.00
	Fill for Aeration Pond	L.S.	1	$ 120,000.00	$ 120,000.00
	Electrical	L.S.	1	$ 374,000.00	$ 374,000.00
	Controls & Instrumentation	L.S.	1	$ 177,000.00	$ 177,000.00
	Yard Piping	L.S.	1	$ 250,000.00	$ 250,000.00
	Process Piping	L.S.	1	$ 333,000.00	$ 333,000.00
	Mobilization	L.S.	1	$ 146,000.00	$ 146,000.00
	Subtotal				**$ 5,920,000.00**
B. STORAGE POND 15 MILLION GALLONS					
	Land Purchase	Ac	0	$ -	$ -
	Testing & Grade Staking	L.S.	1	$ 5,000.00	$ 5,000.00
	Site Grubbing	Ac	5	$ 1,000.00	$ 5,000.00
	Bedding for Liner	C.Y.	3,300	$ 20.00	$ 66,000.00
	Earthwork	C.Y.	118,000	$ 5.00	$ 590,000.00
	Liner and Cushion Fabric	S.F.	175,000	$ 1.00	$ 175,000.00
	Landscaping	L.S.	1	$ 30,000.00	$ 30,000.00
	Fencing	L.F.	1,600	$ 13.00	$ 20,800.00
	Piping & Valving	L.S.	1	$ 10,000.00	$ 10,000.00
	Subtotal				**$ 901,800.00**
C. DISCHARGE LINE TO THE GALLATIN					
	6-Inch PVC Pressure Pipe	LF.	10,500	$ 50.00	$ 525,000.00
	Stream Crossing	EA	2	$ 30,000.00	$ 60,000.00
	Highway Crossing-Bore	LF.	120	$ 450.00	$ 54,000.00
	Fittings	LS	1	$ 5,000.00	$ 5,000.00
	Additional Hillside Cut	LF.	1,500	$ 12.00	$ 18,000.00
	Surface Restoration	LF.	10,500	$ 7.00	$ 73,500.00
	Outlet Structure	LS	1	$ 25,000.00	$ 25,000.00
	Subtotal				**$ 760,500.00**
	SUBTOTAL				$ 7,582,300.00
	15% CONTINGENCY				$ 1,137,345.00
	SUBTOTAL				$ 8,719,645.00
	ENGINEERING/CONSTRUCTION MANAGEMENT				$ 1,307,946.75
	TOTAL				**$ 10,027,591.75**

7.1.2 Option 1B - One Treatment Plant, Summer Irrigation

SUMMARY

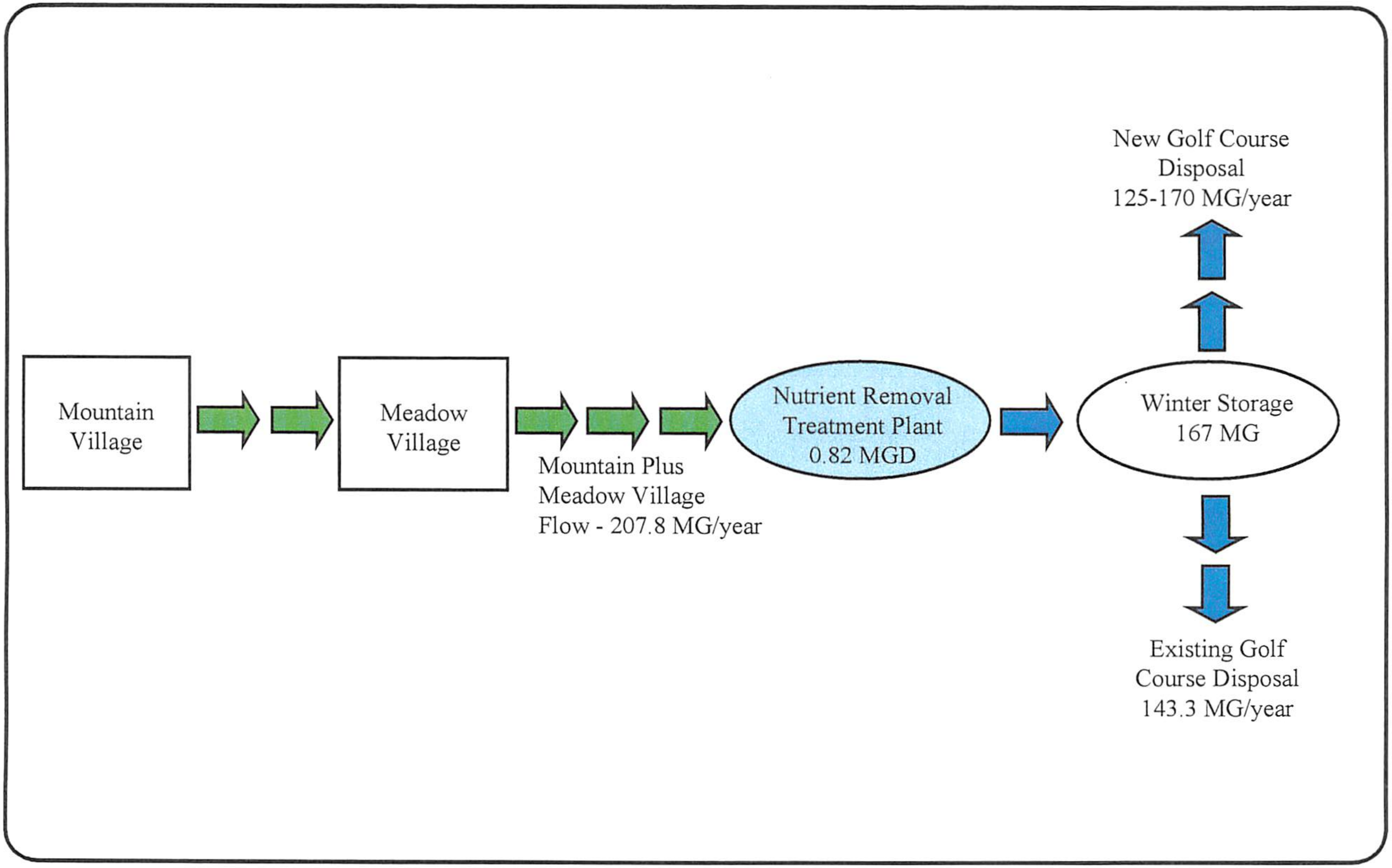
Treatment:		1 plant in Meadow Village (0.82 MGD)
Storage:		79.9 MG existing ponds
		15.9 MG new on existing golf course
		70.9 MG new golf course
	Total	166.7 MG
Disposal:		
		143.3 MG on existing golf course
		125-170 MG on new golf course
	Total	268.3 to 313.3 million gallons

Figure 7.1.2-1 provides an overview of option 1B.

This option would involve constructing an oxidation ditch treatment plant at the existing lagoon site, constructing 15.9 million gallons of storage on the existing golf course, constructing 70.9 million gallons of storage on a new golf course, and constructing a transmission line to the 70.9 million gallon storage pond. Effluent from the oxidation ditch would be filtered in the existing filtration system.

In this option the only effluent disposal would be irrigation of the golf courses. As discussed in Chapter 6, it is estimated that the existing golf course has a disposal capacity of 143.3 million gallons per year and the new course will have a disposal capacity of 125 to 170 million gallons per year. Therefore, this option would provide for a total disposal capacity of 268.3 to 313.3 million gallons per year. The storage volume currently planned would be adequate for an annual flow of 208 MG. At higher flows additional storage would be required.

Table 7.1.2-1 shows the estimated costs for construction of the various components. Only a subtotal cost is listed for components that are also included in Option 1A. Refer to Table 7.1.1-1 for a detailed estimate of those components.



BIG SKY WASTEWATER FACILITY PLAN
OPTION 1B

FIGURE 7.1.2-1

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4M357.102 | September 1998

TABLE 7.1.2-1
OPTION 1B-OPINION OF PROBABLE COST

Description		Units	Quanity	Unit cost	Total Cost
A Treatment Plant (Table 7.1.1-1)		LS	1	$ 5,920,000.00	**$5,920,000.00**
B. Storage on Golf Course (15.9 MG)					
	Testing & Grade Staking	LS	1	$ 5,000.00	$5,000.00
	Site Grubbing	AC.	5	$ 1,000.00	$5,000.00
	Bedding for Liner	CY	3,300	$ 20.00	$66,000.00
	Earthwork	CY	118,000	$ 5.00	$590,000.00
	Liner and Cushion Fabric	SF	175,000	$ 1.00	$175,000.00
	Landscaping	LS	1	$ 30,000.00	$30,000.00
	Fencing	LF	1,600	$ 13.00	$20,800.00
	Piping & Valving	LS	1	$ 10,000.00	$10,000.00
	Subtotal				**$901,800.00**
C. Storage Pond at New Golf Course(70.9 MG)					
	Testing & Grade Staking	LS	1	$7,000.00	$7,000.00
	Site Grubbing	AC.	20	$1,000.00	$20,000.00
	Bedding for Liner	CY	9,200	$20.00	$184,000.00
	Earthwork	CY	97,000	$5.00	$485,000.00
	Liner and Cushion Fabric	SF	743,000	$1.00	$743,000.00
	Landscaping	LS	3,732	$13.00	$48,516.00
	Fencing	LF	1	$3,300.00	$3,300.00
	Piping & Valving	LF	9,500	$50.00	$475,000.00
	Subtotal				**$1,965,816.00**
D. Development of New Golf Course		LS	1	$6,000,000.00	**$6,000,000.00**
	SUBTOTAL				$14,787,616.00
	15% CONTINGENCY				$2,218,142.40
	SUBTOTAL				$17,005,758.40
	ENGINEERING/CONSTRUCTION MANAGEMENT				$2,550,863.76
	TOTAL				**$19,556,622.16**

Through a Memorandum of Understanding dated May 19, 1995 between Boyne USA, Inc. and Big Sky County Water and Sewer District 363, the parties agreed that if the District can acquire sufficient lands for the construction of a new golf course Boyne would be responsible for the cost of design, construction and operation of the new course. The actual costs for acquiring land for the new golf course and the final ownership of the land is a matter remaining to be resolved by the parties and the landowners involved. Therefore land acquisition costs for the new course are not included in this estimate. The cost to develop a new golf course has been estimated to range between 4 to 6 million dollars. A cost of 6 million dollars is included in this estimate. Even though Boyne has agreed to pay for the cost of design and construction of the new golf course, the costs are included in this analysis in order to determine the lowest cost alternative.

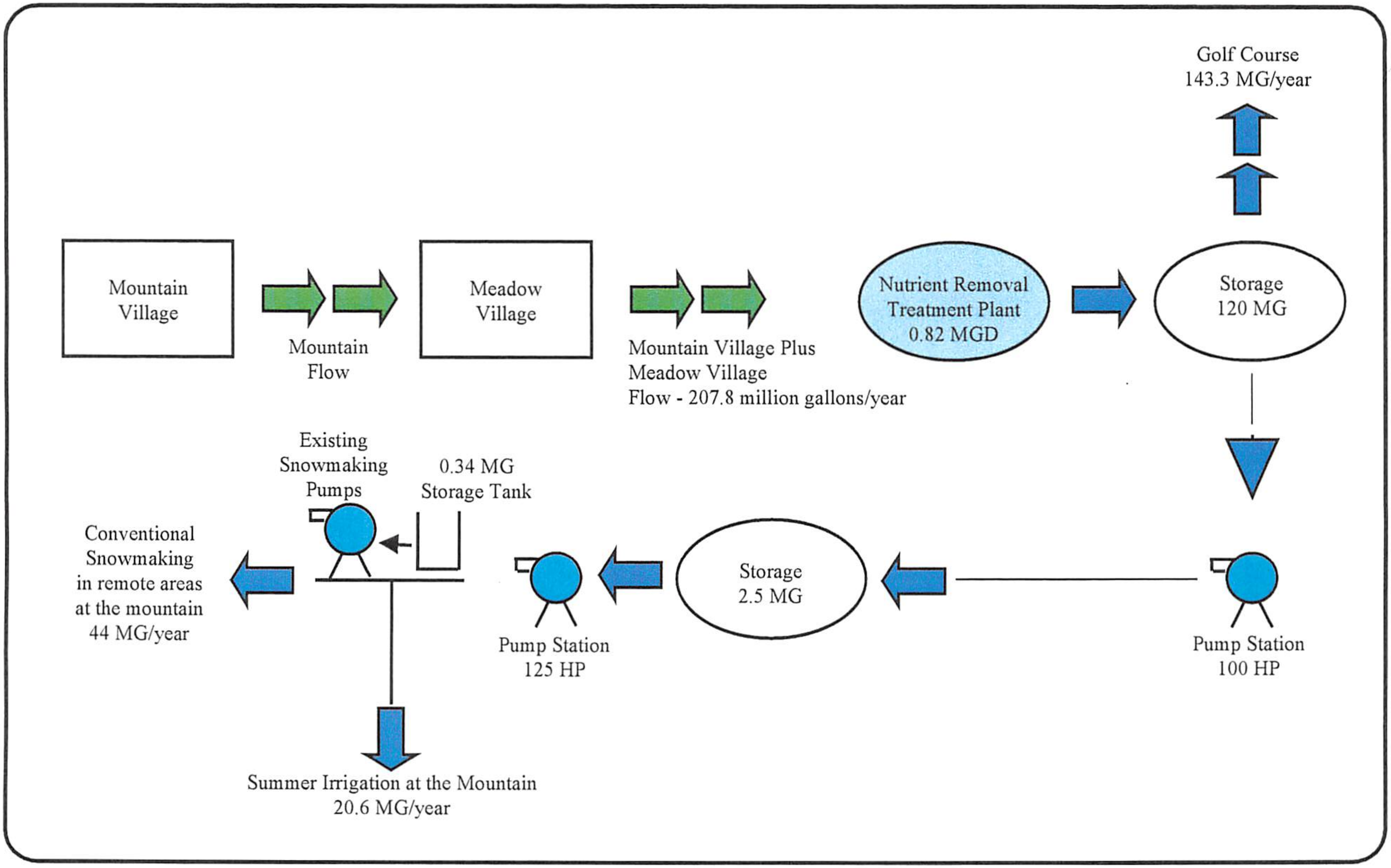
7.1.3 Option 1C - One Treatment Plant, Summer Irrigation, Winter Snowmaking at Big Sky Ski Area

SUMMARY

Treatment:		One plant in Meadow Village (0.82 MGD)
Storage:		79.9 MG existing ponds
		40.5 MG new ponds
	Total	120.4 MG
Disposal:		
		143.3 MG on existing golf course
		44.0 MG snowmaking at ski area
		20.6 MG summer irrigation on ski runs
	Total	207.9 MG

Figure 7.1.3-1 provides an overview of option 1C.

This option would consist of constructing an oxidation ditch treatment plant at the existing lagoon site, constructing an additional 40.5 MG of storage ponds, constructing a new 6-inch line to an intermediate storage area and a new 8-inch line from the intermediate storage to the mountain, and constructing two pump stations for pumping to the snowmaking site at the ski area.



BIG SKY WASTEWATER FACILITY PLAN
OPTION 1C

FIGURE 7.1.3-1

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4M357.102 | September 1998

Under this option, 143.3 million gallons would be disposed of by summer irrigation on the golf course, approximately 44 million gallons would be utilized for snowmaking in October through February. The remaining 20.6 million gallons would be spray irrigated on the ski runs during July and August.

In this option conventional snowmaking guns would be utilized rather than the high pressure freeze crystallization snow making system pilot tested. The freeze crystallization system is utilized when additional treatment is required. However, in this option the water would be treated in an advanced nutrient removal plant with effluent filtration before being sprayed. The water would be sprayed in remote areas off the ski runs where public exposure to the snow would be minimal. In this option it is assumed that the existing mountain snowmaking system would be utilized to spray effluent during the day in the remote areas and would also be used to make snow using existing surface water on the runs at night. Valving and additional piping would be installed to the remote areas used for spraying effluent. This option requires the use of land and equipment owned by the Big Sky ski area. Implementation of this option is highly dependent upon the cooperation of Boyne during the design and construction project phases. Additionally, a long term operating agreement that defines the terms and conditions for snowmaking and irrigation at the ski area is needed.

For this estimate, it is assumed an additional 7,000 feet of 4-inch line would be installed to the remote snowmaking sites and 12 new snowmaking guns would be purchased and dedicated to the effluent spraying. A 100 HP pump station (firm capacity) would be located at the treatment plant site and would pump to the intermediate storage pond and pump station located approximately 461 vertical feet below the ski area base. The treatment plant site lift station would have a discharge pressure of approximately 425 psi and therefore steel line would be required. The intermediate storage area would utilize an old 2.5 MG settling pond/lagoon for intermediate storage. The old pond would be lined and reconditioned to provide a storage volume of 2.5 million gallons.

The 125 HP intermediate pump station would pump to a small (0.34 MG) surge tank located near the existing snowmaking pumps. The surge tank would provide approximately 8 hours of storage from the intermediate pump station. Due to limited area and site constraints it is assumed a buried concrete basin would be used for the surge tank.

The line sizes and pump stations are sized based on pumping from the treatment plant to the intermediate storage pond on a 24-hour per day basis and from the intermediate storage pond to the surge tank during an eight hour period.

Table 7.1.3-1 shows the estimated project cost for this option.

TABLE 7.1.3-1
OPTION 1C-OPINION OF PROBABLE COST

Description		Units	Quanity	Unit cost	Total Cost
A. Treatment Plant(Table 7.1.1-1)		LS	1	$ 5,920,000.00	**$ 5,920,000.00**
B. Storage Pond 40.49 million gallons		LS	1	$ 1,121,000.00	**$ 1,121,000.00**
C. Pipeline to Mountain					
	6-inch steel line	LF	25,000	$ 42.50	$ 1,062,500.00
	8-inch steel line	LF	5,000	$ 56.50	$ 282,500.00
	cathodic protection	LS	1	$ 37,500.00	$ 37,500.00
	telemetry	LS	1	$ 20,000.00	$ 20,000.00
	valves	LS	1	$ 7,500.00	$ 7,500.00
	Subtotal				**$ 1,410,000.00**
D. Lower Pump Station(100 HP)		LS	1	$ 98,000.00	**$ 98,000.00**
E. Upper Pump Station(125 HP)		LS	1	$ 123,000.00	**$ 123,000.00**
F. Intermediate Storage 2.5 mg					
	liner and cushion fabric	SQ. FT.	45,000	$ 1.00	$ 45,000.00
	piping and valving	LS	1	$ 15,000.00	$ 15,000.00
	Subtotal				**$ 60,000.00**
I. Concrete Surge Basin(0.34MG)		LS	1	$ 340,000.00	**$ 340,000.00**
H.Mountain Snowmaking Improvements					
	4- inch Pipe line	LF	7,000	$25.00	$ 175,000.00
	Snowmaking Guns	EA	12	$10,000.00	$ 120,000.00
	Subtotal				**$295,000.00**
	SUBTOTAL				$9,367,000.00
	15% CONTINGENCY				$ 1,405,050.00
	SUBTOTAL				$10,772,050.00
	ENGINEERING/CONSTRUCTION MANAGEMENT				$1,615,807.50
	TOTAL				**$12,387,857.50**

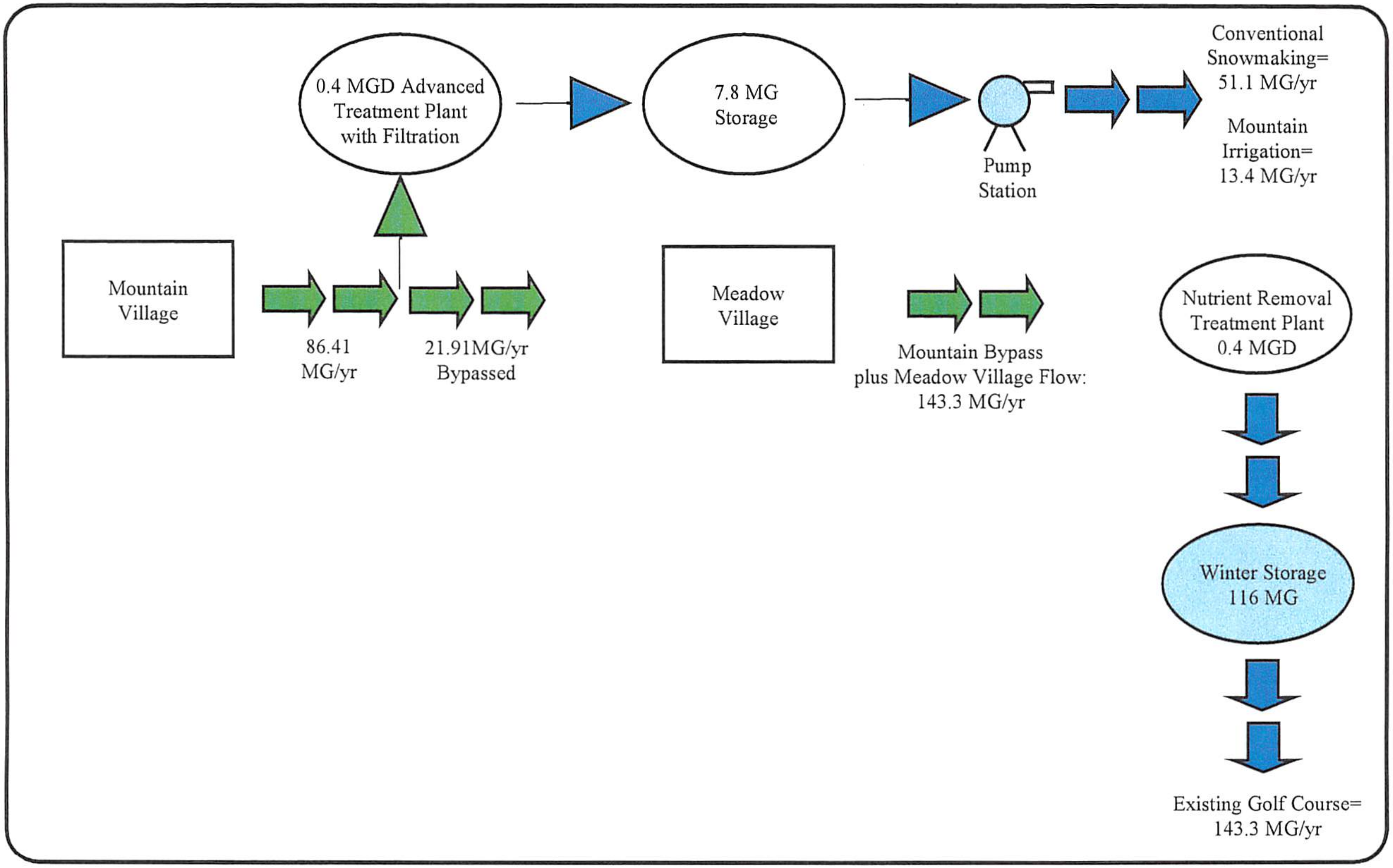
7.1.4 Option 2A - Two Treatment Plants, Summer Irrigation, Snowmaking

SUMMARY

Treatment:		0.41 MGD (Annual average) plant at Meadow
		0.40 MGD plant on Mountain
Storage:		79.9 MG Existing Ponds
		15.9 MG on Existing Golf Course
		20.2 MG New Site
	Total	116.0 MG
Disposal:		143.3 MG Existing Golf Course
		51.1 MG Snowmaking at Mountain
		13.4 MG Summer Irrigation at Mountain
	Total	207.8 MG

Figure 7.1.4-1 shows an overview of option 2A.

In this option two advanced treatment plants would be constructed. One plant would be located near the Mountain Village and would treat wastewater generated from the Mountain Village. The second plant would be located near the Meadow village and would treat the Meadow Village flows. This option is similar to option 1C in that treated wastewater from the Mountain Village would be disposed of by a snowmaking system using conventional snowmaking guns in the winter and by spray irrigation during July and August. The water would be sprayed in remote areas off the ski runs where public exposure to the snow would be minimal. In this option, it is assumed the existing mountain snowmaking system would be utilized to spray effluent during the day in the remote areas and would also be used to make snow using existing surface water on the runs at night. Valving and additional piping would be installed to the remote areas used for spaying effluent. Storage capacity would be provided at the Mountain Village to store flows generated during the late fall for later disposal in the snowmaking operation. During the spring of the year when snowmaking is not possible, Mountain



BIG SKY WASTEWATER FACILITY PLAN
OPTION 2A

FIGURE 7.1.4-1

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4M357.102 | September 1998

Village flows would be bypassed to the Meadow Village treatment plant. The Meadow Village Treatment plant would treat an annual average flow of 0.41 MGD with an estimated peak day flow of 1.2 MGD during the spring when the Mountain Village flows are being bypassed and infiltration is high.

This option requires 116 MG of storage volume in the Meadow Village area in addition to the 7.8 MG at the Mountain Village. With 79.9 MG at the existing lagoon site, and 15.9 million gallons on the existing golf course; an additional 20.2 million gallons of storage would be required for the Meadow Village. The additional storage would require approximately 5 acres.

Option 2A would require the following system components:

- new 0.41 MGD treatment plant with filtration at the Meadow Village
- new 0.4 MGD treatment plant, with filtration, at the Mountain Village
- construction of 15.9 MG of storage on the existing golf course
- construction of 7.8 MG of storage at the mountain
- construction of 20.2 MG of storage on a separate site
- Acquisition of approximately 5 acres for additional irrigation
- construction of a pump station and pipeline to the remote snowmaking and irrigation site

Table 7.1.4-1 shows the cost estimate for Option 2A.

TABLE 7.1.4-1
OPTION 2A-OPINION OF PROBABLE COST

Description		Units	Quanity	Unit cost	Total Cost
A. Meadow Village Plant(0.4MGD)		LS	1	$3,520,000.00	**$3,520,000.00**
B. Mountain Village Plant(0.4MGD)		LS	1	$3,520,000.00	**$3,520,000.00**
C. Mountain Village Storage (7.8 MG)		LS	1	$400,000.00	**$400,000.00**
D. Golf Course Storage (15.9 MG) Table 7.1.2-1		LS	1	$901,800.00	**$901,800.00**
E. Additional Storage 20.2 MG					
	Land	AC.	5	$50,000.00	$250,000.00
	Storage Pond	LS	1	$1,080,000.00	$1,080,000.00
	Subtotal				**$1,330,000.00**
F Mountain Snowmaking Improvements					
	4-Pipe line	LF	7,000	$25.00	$ 175,000.00
	Snowmaking Guns	EA	12	$10,000.00	$ 120,000.00
	Subtotal				**$295,000.00**
	SUBTOTAL				$9,966,800.00
	15% CONTINGENCY				$1,495,020.00
	SUBTOTAL				$11,461,820.00
	ENGINEERING/CONSTRUCTION MANAGEMENT				$1,719,273.00
	TOTAL				**$13,181,093.00**

7.1.5 Option 2B - Two Treatment Plants with Summer Irrigation and Disposal at Jack Creek

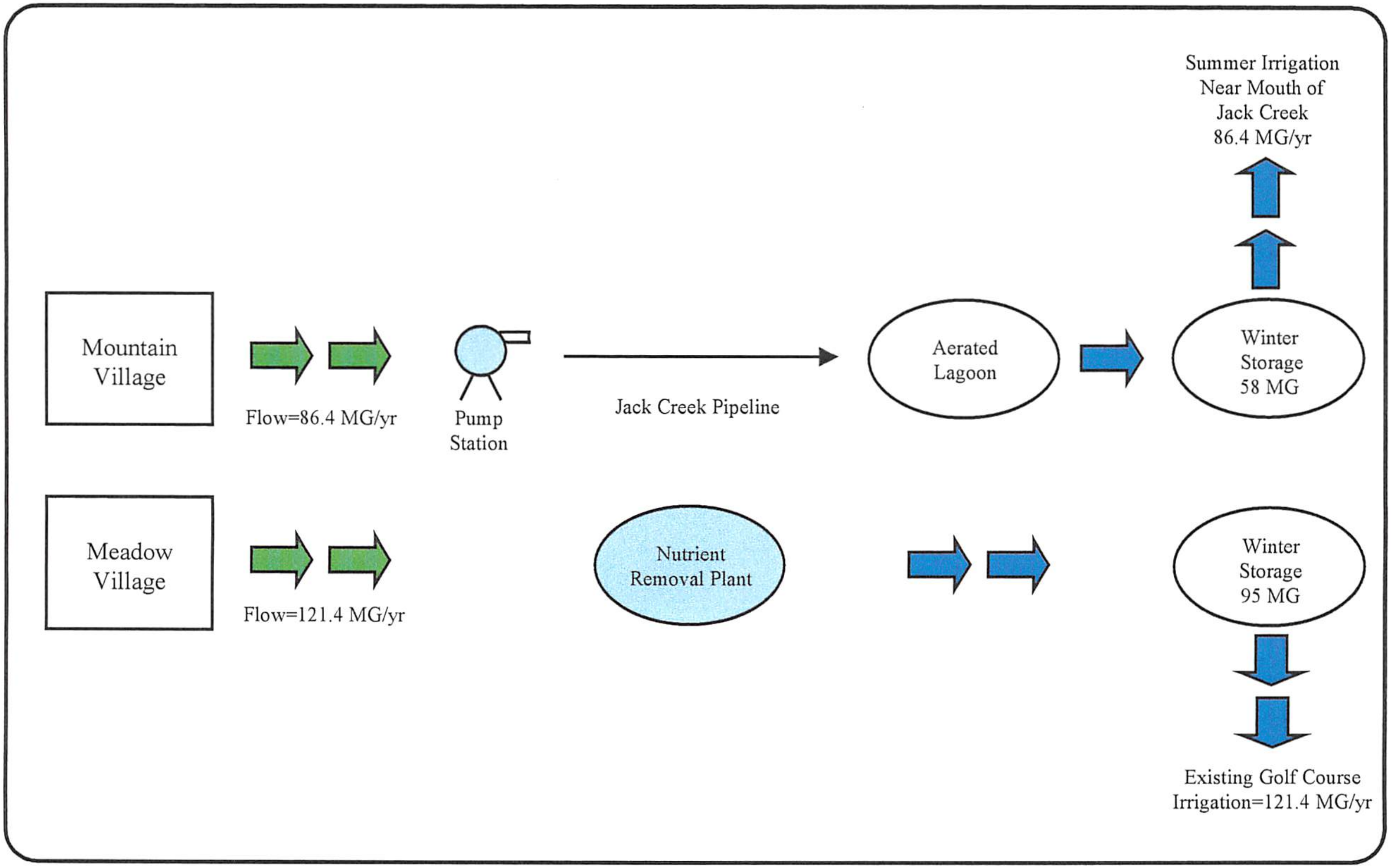
SUMMARY

Treatment:		0.41 MGD plant at Meadow
		0.40 MGD Aerated Lagoon at Mouth of Jack Creek
Storage:		79.9 MG Existing Ponds
		15.1 MG on Existing Golf Course
		58.0 MG at Mouth of Jack Creek
	Total	153.0 MG
Disposal:		121.4 MG Summer Irrigation on Golf Course
		86.4 MG Irrigation at Mouth of Jack Creek
	Total	207.8 MG

Figure 7.1.5-1 shows an overview of Option 2B.

This option would utilize summer irrigation for disposal of all the wastewater. Flow generated at the Mountain Village would be pumped through the Jack Creek Drainage to an aerated lagoon located near the mouth of Jack Creek. It is estimated that approximately 86.4 million gallons per year would be treated and irrigated near the mouth of Jack Creek. A 58 million gallon storage pond would be constructed at the mouth of Jack Creek.

Wastewater from the Meadow Village would be treated in an advanced nutrient removal plant. Irrigation of the golf course would continue to be used for effluent disposal.



BIG SKY WASTEWATER FACILITY PLAN
OPTION 2B

FIGURE 7.1.5-1

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4M357.102 | September 1998

This option would consist of the following components:

- New 0.41MGD treatment plant at the Meadow Village
- 15.1 MG of new storage on the Golf Course.
- An aerated lagoon (0.40 MGD) at the Mouth of Jack Creek
- 58 million gallons of storage at Jack Creek
- A pump station to pump over the Jack Creek drainage divide
- 8600 feet of 12-inch forcemain to the drainage divide
- 52,500 feet of 12-inch gravity line from the divide to the mouth of Jack Creek
- An irrigation system near the mouth of Jack Creek

Table 7.1.5-1 shows the cost estimate for option 2B

TABLE 7.1.5-1
OPTION 2B-OPINION OF PROBABLE COST

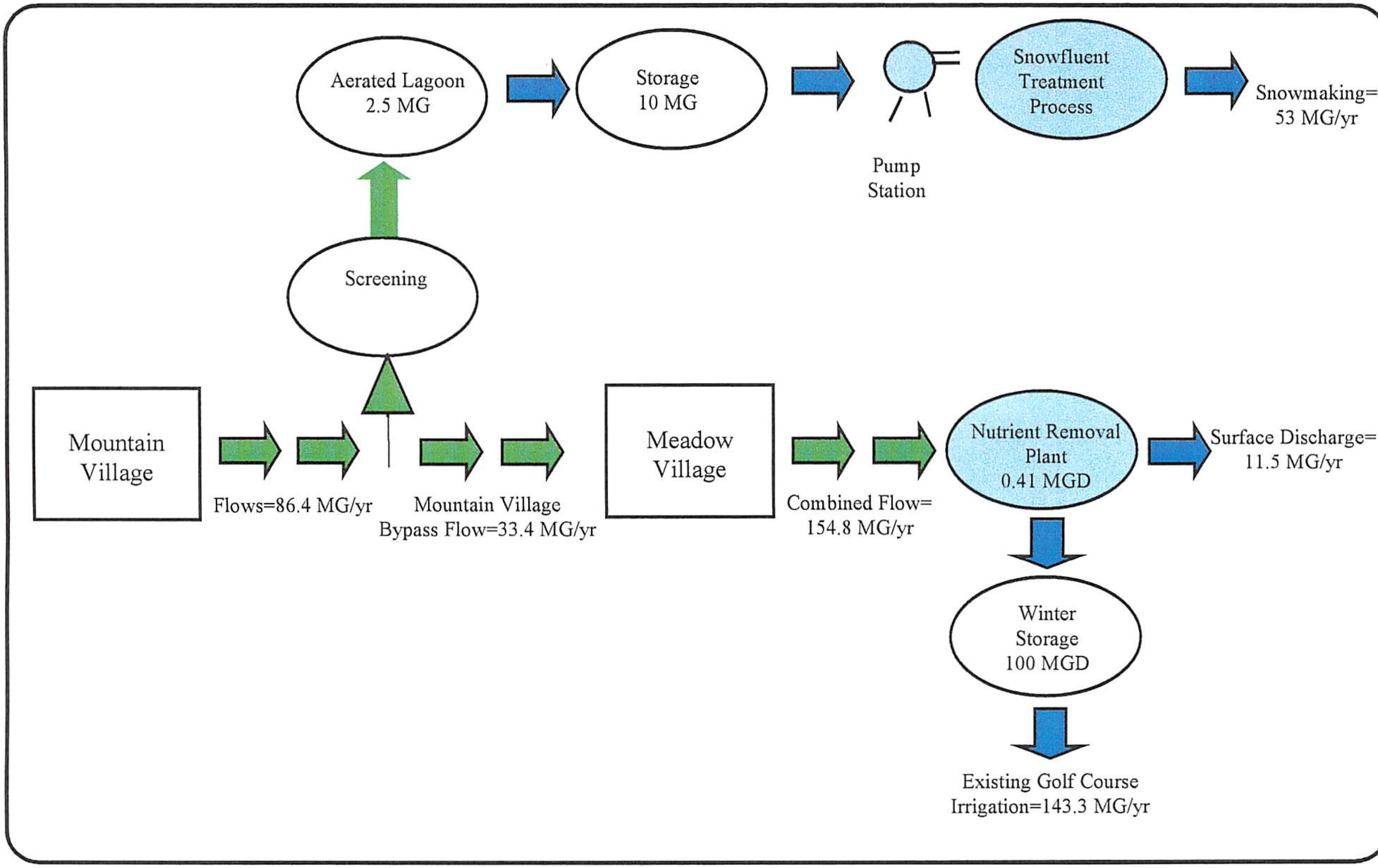
Description		Quantity	Units	Unit cost	Total Cost
A. PUMP STATION					
	Pumps	3	ea.	$10,000.00	$30,000.00
	Piping and fittings	1	ls	$25,000.00	$25,000.00
	Building and wet well	1,000	sq. ft.	$100.00	$100,000.00
	Building Heating and Ventilation	1	ls	$15,000.00	$15,000.00
	Electrical	1	ls	$30,000.00	$30,000.00
	Site Preparation and Grading	1	ls	$20,000.00	$20,000.00
	subtotal				**$220,000.00**
B. FORCE MAIN					
	12- Inch ductile iron	8,600	lf	$75.00	$645,000.00
	surface restoration	8,600	lf	$8.00	$68,800.00
	stream crossing	1	ea.	$10,000.00	$10,000.00
	subtotal				**$723,800.00**
C. GRAVITY LINE					
	12-Inch PVC	52,500	lf .	$75.00	$3,937,500.00
	manholes	105	ea.	$2,200.00	$231,000.00
	stream crossings	8		$10,000.00	$80,000.00
	surface restoration	52,500	lf	$8.00	$420,000.00
	erosion mitigation	1	ls	$75,000.00	$75,000.00
	subtotal				**$4,743,500.00**
D. AERATED LAGOON					
	Land purchase	5	acres	$15,000.00	$75,000.00
	Earthwork	64,000	cu. yds	$5.00	$320,000.00
	liner and cushion fabric	130,000	sq. ft.	$1.00	$130,000.00
	lagoon aeration	1	ls	$66,000.00	$66,000.00
	lagoon piping	1	ls	$117,000.00	$117,000.00
	blower building	1	ls	$40,000.00	$40,000.00
	subtotal				**$748,000.00**
E. STORAGE LAGOON (58 MG)					
	land purchase	11	acres	$15,000.00	$165,000.00
	Earthwork	90,000	cy	$5.00	$450,000.00
	liner and cushion fabric	481,000	sq.ft	$1.00	$481,000.00
	site piping	1	ls	$25,000.00	$25,000.00
	subtotal				**$1,121,000.00**
F. SPRAY IRRIGATION					
	Center pivot	1	ls	$60,000.00	$60,000.00
	pump	1	ls	$25,000.00	$25,000.00
	pipeline	1	ls	$15,000.00	$15,000.00
	subtotal				**$100,000.00**
G. MEADOW VILLAGE PLANT(0.4MGD)		1	ls	$3,520,000.00	**$3,520,000.00**
	SUBTOTAL				$11,176,300.00
	15% CONTINGENCY				$1,676,445.00
	SUBTOTAL				$12,852,745.00
	ENGINEERING/CONSTRUCTION MANAGEMENT				$1,927,911.75
	TOTAL				**$14,780,656.75**

7.1.6 Option 2C - Two Treatment Plants, Summer Irrigation, Snowmaking at Ski Area, Surface Discharge

SUMMARY

Treatment:		0.41 MGD Plant at Meadow Village(Annual Average)
		11 MG Aerated Pond for Pretreatment of Snowmaking
		0.50 MGD Snowmaking Plant
Storage:		79.9 MG at Existing Ponds
		20.1 MG on Golf Course
		10.0 MG at Snowmaking Site
	Total	110.0 MG
Disposal:		143.3 MG On Existing Golf Course
		53 MG Snowmaking
		11.5 MG Surface Discharge to Gallatin
	Total	207.8 MG

Figure 7.1.6-1 provides an overview of option 2C and Table 7.1.6-1 shows the cost estimate for Option 2C.



BIG SKY WASTEWATER FACILITY PLAN
OPTION 2C

FIGURE 7.1.6-1

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4M357.102 | September 1998

TABLE 7.1.6-1
OPTION 2C-OPINION OF PROBABLE COST

Description	Quantity	Units	Unit cost	Total Cost
A. Treatment Plant 0.4 MGD	1	LS	$3,520,000.00	$3,520,000.00
B. Snowmaking System (0.50 MGD)	1	LS	$1,900,000.00	$1,900,000.00
C. Site Development Costs for snowmaking	1	LS	$100,000.00	$100,000.00
D. Aeration Pond & Screening Facility(2.5MG)	1	LS	$519,000.00	$519,000.00
E.Storage Pond 10MG	1	LS	$600,000.00	$600,000.00
F. Site Piping and Valving	1	LS	$125,000.00	$125,000.00
G. Discharge Line to Gallatin	1	LS	$760,500.00	$760,500.00
H. Storage Pond on Golf Course(15mg)	1	LS	$901,800.00	$901,800.00
SUBTOTAL				$8,426,300.00
15% CONTINGENCY				$1,263,945.00
SUBTOTAL				$9,690,245.00
ENGINEERING/CONSTRUCTION MANAGEMENT				$1,453,536.75
TOTAL				**$11,143,781.75**

This option consists of an advanced nutrient removal plant located at the Meadow Village and a freeze crystallization snowmaking treatment plant located on Boyne property near the ski area and mountain village. Effluent from the advanced nutrient removal plant would be irrigated on the golf course (143 MG/yr) and discharged to the Gallatin River (11.5 MG/yr). During the winter approximately 53 MG of wastewater generated by the mountain village would be diverted to the freeze crystallization snowmaking process. The snowmaking sites shown previously in Figures 6.4-4 and 6.4-5 would be used as the spray areas.

The freeze crystallization process was pilot tested at Big Sky during the spring of 1997. The process was shown to be an effective treatment system with high removal rates nutrients and organics(Refer to Table 6.4-1 for results). The pretreatment in the aerated lagoon will provide odor control and allow settling of larger organic material. A screening facility would be located ahead of the aerated lagoon to screen rags and items that could interfere with the snowmaking pumps.

The Mountain Village effluent would be intercepted near an existing treatment pond located approximately 1 mile southeast of Lake Levinski. Several facilities would be built at this location to support the snowmaking operation including the following:

- Construct a pretreatment screening facility
- Construct a 2.5 MG aerated lagoon system prior to the snowmaking facility.
  The aerated lagoon would provide 6.5 days of treatment during the peak month flow.
- 10 MG of storage at the Mountain.
- Freeze Crystallization Snowmaking Plant
- A pump station to supply the snowmaking plant.
- Pipeline to the snowmaking site.
- 22-acre snowmaking site

In addition to the construction at the Mountain Village the following items would be constructed at the Meadow Village.

- Treatment plant at Meadow Village
- Discharge line to the Gallatin

7.1.7 Operation and Maintenance Costs

Table 7.1.7-1 gives the estimated operation and maintenance costs for the various options.

The operation and maintenance costs for each option were estimated based on the following:

- Labor costs are based on $20.00 per hour which includes direct labor costs, workmen's compensation insurance, and fringe benefits.
- Power costs were estimated at $0.02845 per kilowatt - hour.
- Demand charges were estimated of $5.30/KW.
- Manpower needs were estimated from the publication Estimating Staffing for Municipal Wastewater Treatment Facilities (US EPA, 1973)

Table 7.1.7-1 Estimated Annual Operation and Maintenance Costs							
ALTERNATIVE	OPERATION COST $/YEAR	MAINTENANCE COST $/YEAR	POWER COST $/YEAR	CHEMICAL COST $/YEAR	ADMINISTRATIVE COST $/YEAR	LAB COST $/YEAR	TOTAL O&M COST $/YEAR
Option 1A	102,400	51,100	77,000	20,000	6,900	8,000	265,400
Option 1B	102,400	51,100	80,500	20,000	6,900	8,000	268,900
Option 1C	102,400	64,500	109,900	20,000	6,900	8,000	311,700
Option 2A	185,600	94,300	89,300	20,000	8,900	10,000	408,100
Option 2B	102,400	51,100	135,000	20,000	6,900	8,000	323,400
Option 2C	128,800	45,100	82,000	20,000	6,900	10,000	292,700

7.1.8 Summary Costs

Table 7.1.8-1 shows the equivalent annual uniform cost for each option.

Table 7.1.8-2 provides a summary of the different options considered, the capacity of each component, and the estimated costs. As noted at the bottom of the table, the discharge line to the Gallatin and the line to the Mountain have the potential to dispose of additional water if required assuming approval from the Department of Environmental Quality.

7.2 FUTURE EXPANSION BEYOND 20-YEAR PLANNING PERIOD

Due to the difficulty and inaccuracies of predicting populations and flows for a greater time period, a 20-year planning period is generally used in evaluating wastewater treatment plans. However, it must be assumed that at some future time the treatment facility may have to be upgraded or expanded again. Therefore, it is prudent to give consideration to the future expansion possibilities for each treatment alternative considered.

The treatment options considered in Section 7.1 contain many of the same components in different combinations. The expandability of each component is considered.

Surface Discharge

In the recommended option, the discharge to the Gallatin would be limited to 11.5 MGY. Under the draft discharge permit the maximum annual discharge allowed would be limited to 117.0 MGY with a maximum discharge rate of 525 gpm in June. The installation of the 6-inch line would allow a discharge of 525 gallons per minute.

TABLE 7.1.8-1 Summary of Equivalent Annual Uniform Costs interest =8.25% period = 20 years				
ALTERNATIVE	CAPITAL COST	ANNUAL COST OF CAPITAL	ANNUAL O&M	EQUIVALENT ANNUAL UNIFORM COST
Option 1A- Surface Discharge Summer Irrigation	$10,027,591.75	$ 1,040,406.50	$ 265,400.00	$ 1,305,806.50
Option 1B-Summer Irrigation only (New Golf Course)	$19,556,622.16	$ 2,029,085.08	$ 268,900.00	$ 2,297,985.08
Option 1C- Summer Irrigation Winter Snowmaking	$12,387,857.50	$ 1,285,294.40	$311,700.00	$ 1,596,994.40
Option 2A-Summer Irrigation Snowmaking at Mountain	$13,181,093.00	$ 1,367,596.05	$408,100.00	$ 1,775,696.05
Option 2B-Summer Irrigation Golf Course and Jack Creek	$14,780,656.75	$ 1,533,557.78	$323,400.00	$ 1,856,957.78
Option 2C-Summer Irrigation, Snowmaking at Ski Area Surface Discharge	$11,143,781.75	$ 1,156,216.10	$292,700.00	$ 1,448,916.10

Table 7.1.8-2
Summary of Option Components
Note: Option 2C is the Preferred Alternative
Annual Flow Capacity of Components - Million Gallons Per year

Plan Option	Treatment Design Volume			Disposal - Volume MG					Pumping		Limiting Conditions				Estimated Capital Cost	Estimated Annual O&M
	Mountain Plant[1]	Meadow Plant[2]	Filtration	Existing G.C. Irrigation	Line to Gallatin[3]	Mountain[4]	New Site	Total Disposal	G.C. Pumping	Snowmaking Pumping	Limiting Component	Annual Flow MG/Yr	SFE's Served	% of 7926 Obligated SFE's		
Option 1A		207.8	252					207.8			Treatment Plant					
Surface Discharge					64.5											
Summer Irrigation				143.3		---	---		222	---		207.8	5399	68.1%	$10,027,590	$265,400
95 MG Storage																
Option 1B								293			storage					
Summer Irrigation		207.8	252	143.3	---	---			293	---		207.8	5399	68.1%	$19,556,622	$269,900
New Golf Course							150									
167 MG Storage																
Option 1C								207.8			Disposal & Filtration					
Summer Irrigation		207.8	252	143.3	---	20.7	---		222	50		207.8	5399	68.1%	$12,387,857	$311,700
Winter Snowmaking						44										
122 MG Storage																

[1] The volumes shown in the table represent the projected annual flow that would be treated at the Mountain plant.
[2] The volumes shown in the table represent the projected annual flow that would be treated at the Meadow plant.
[3] The 6-inch line to the Gallatin has a maximum capacity of 284 million gallons per year. The volumes shown in the table represent the volumes expected to be discharged in each option.
[4] The 6-inch and 8-inch line to the mountain would have a maximum capacity of 0.063 (231 MG/year) at the design velocity of 5 ft/s. The volumes shown in the table represent the volumes expected to be pumped to the mountain in each option.

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Table 7.1.8-2 continued
Summary of Option Components
Note: Option 2C is the Preferred Alternative
Annual Flow Capacity of Components - Million Gallons Per year

Plan Option	Treatment Design Volume			Disposal - Volume MG					Pumping		Limiting Conditions				Estimated Capital Cost	Estimated Annual O&M
	Mountain Plant[1]	Meadow Plant[2]	Filtration	Existing G.C. Irrigation	Line to Gallatin[3]	Mountain[4]	New Site	Total Disposal	G.C. Pumping	Snowmaking Pumping	Limiting Component	Annual Flow MG/Yr	SFE's Served	% of 7926 Obligated SFE's		
Option 2A	64.5	143.3	252					207.8			Disposal & Storage					
Summer Irrigation				143.3		13.4			222							
Snowmaking						51.1							5399	68.11%	$13,181,093	$408,100
123 MG Storage												207.8				
Option 2B																
Two Plants	86.4	121.4		121.4				207.8			Disposal & Storage					
Jack Creek Disposal			252				86.4									
Summer Irrigation																
153 MG Storage													5399	68.11	$14,780,656	$323,400
Option 2C																
Summer Irrigation				143.3							Treatment & Storage					
Surface Discharge	30.2	154.8	252		11.5			207.8				207.8	5399	68.11		
Snowmaking						53									$12,057,629	292,700
89.9 MG Storage																

[1] The volumes shown in the table represent the projected annual flow that would be treated at the Mountain plant.
[2] The volumes shown in the table represent the projected annual flow that would be treated at the Meadow plant.
[3] The 6-inch line to the Gallatin has a maximum capacity of 284 million gallons per year. The volumes shown in the table represent the volumes expected to be discharged in each option.
[4] The 6-inch and 8-inch line to the mountain would have a maximum capacity of 0.063 (231 MG/year) at the design velocity of 5 ft/s. The volumes shown in the table represent the volumes expected to be pumped to the mountain in each option.

Existing Golf Course

The golf course capacity is limited to approximately 143.3 million gallons per year during a wet year. Since the expansion completed in the Interim Action Work Plan maximized the disposal capacity of the golf course no additional expansion would be possible. However, the groundwater monitoring wells that have been installed will allow the development of a groundwater computer model that may indicate more or less volume can be applied. The irrigation pump station is sized for a flow of approximately 2466 gallons per minute, which is adequate to meet the dry year irrigation requirements. At a flow of 2466 gallons per minute, an eleven-hour irrigation window, and a 137-day irrigation season, the pump station has a capacity of 222.9 million gallons per year.

New Golf Course

The development of a new golf course would greatly increase the volume of treated wastewater that could be disposed of during the year. The exact disposal capacity would depend on the final location, size, and layout. Assuming an application rate similar to the existing course and a irrigation area of 200 acres results in a disposal volume of 155 million gallons per year.

Snowmaking

The area identified as a snowmaking site in Sections 32 and 33 consists of approximately 150 acres of which 60 acres are needed to treat and dispose of 65 million gallons per year. With the available land, the snowmaking system could be expanded to dispose of approximately 162 million gallons per year.

The alternative snowmaking sites identified in Figures 6.4-4 and 6.4-5 have a total area of approximately 21.7 acres. Snowmaking facilities using these sites would utilize the entire area and further expansion of the snowmaking operation would not be possible due to the site constraints.

Treatment Plant

In the recommended alternative, the treatment plant is designed for the peak spring time flows of 1.2 MGD. Sufficient area is available at the treatment plant site to add an additional oxidation ditch train..

The effluent filtration system, designed and implemented under the Interim Action Work Plan, has a capacity of 0.88 MGD at the maximum allowable filtration rate of 5 gpm/ft^2 with one filter out of service (Circular WQB-2 Design Standards for Wastewater Facilities). With all three filters in operation at the maximum loading rate, the filters will have a capacity of 1.32 MGD. As storage is provided ahead of the filters, it would normally be possible to take one or two filters out of service for maintenance. Therefore, the need for 100% backup capacity is not critical and the practical capacity is 1.32 MGD.

7.3 ENVIRONMENTAL IMPACTS

In this section, differences among alternatives as they effect the environment will be discussed.

7.3.1 Groundwater

Potential impacts to the groundwater are greatest in land disposal options such as spray irrigation, rapid infiltration basins or the snowmaking systems. While spray irrigation systems are designed to match the nutrient uptake rate of the crop, some leaching of nutrients will most likely occur. Slow rate spray irrigation systems are reported to have total nitrogen removal efficiencies of 67 to 84% (EPA, 1981). When a nutrient removal oxidation ditch process is used, the expected total nitrogen concentration will be 5 mg/l as N. Assuming a further nitrogen removal of 67 percent occurs in the land disposal system, the total nitrogen concentration of the leachate would be 1.65 mg/l-N. Background nitrate concentrations ranging from 0.06 to 4.9 mg/l were measured in the Big Sky vicinity in 1970 (Van Voast). Therefore, minimal or no impacts to the groundwater are expected from the land disposal options in which a nutrient removal treatment plant is used for the initial treatment. Also, when a land application system is based on agronomic uptake rates of applied nutrients, the system is classified as causing nonsignificant changes in water quality in ARM 17.30.716(f).

Snowmaking with treated wastewater is expected to have minimal or no impact on groundwater. The pilot test completed at Big Sky showed an average concentration of 2.6 mg/l total kjeldahl nitrogen in the meltwater while the nitrate + nitrite levels were reduced to 0.0 mg/l. The average total phosphorus levels in the meltwater was 3.7 mg/l which would result in an application of 58 pounds of phosphorus per year per acre to the snowmaking site (at 1.89 MG applied water/acre). Typical soils will have a phosphorus absorption capacity of 870 pounds per acre per foot of soil depth. Therefore, even neglecting crop uptake of phosphorus the top 4-feet of soil has enough absorption capacity to apply effluent for 60 years before the soil absorption capacity is exceeded.

A study completed in 1975 using lagoon effluent for snowmaking at Steamboat Springs, reported significant reductions in dissolved solids, BOD, and total phosphorus in the snowpack compared to the effluent (Wright-McLaughlin). The Steamboat Springs study also showed the ammonia nitrogen concentration in the snowpack was reduced from 12 mg/l to a mean of 1.8 mg/l. The reduction was attributed to volatilization because of the air movement through the snowpack.

A separate study conducted in Canada in 1989 (Novatec Consultants, Inc.) reported that typically more than 90 percent of the total nitrogen and 65 to 75 percent of the total phosphorus initially present in the snowpack was released in the first 30 percent of the meltwater. The majority of the initial meltwater will percolate into the soil. The study reported a positive effect on most of the agricultural parameters of the soil with significant increases in the available nitrogen and phosphorus. Phosphorus was readily adsorbed onto the soil. The study also reported that "up to 50 percent of the applied nitrogen may have been absorbed by the upper 1 meter of soil".

It is expected that meltwater from an artificial snowpack made from treated and recycled wastewater will have minimal impact on the groundwater. Any phosphorus percolating into the ground will be removed by the top soil layers. While some nitrate from the meltwater may reach the groundwater, the concentration is expected to be near background levels.

7.3.2 Surface Water

The pollution parameters of primary concern for surface waters are nitrate and phosphorus. Nitrate and phosphorus are nutrients that can stimulate algae growth in streams and reservoirs. Streams in the West Fork basin and the West Gallatin River are considered to be nitrogen limited. This implies that any increase in instream nitrogen concentrations has the potential to stimulate increased algae growth.

Surface waters in the West Fork drainage are generally of high quality. As shown previously in Table

4.1.2-1, mean nitrate concentrations ranged from 0.01 to 0.06 mg/l NO_3-N in samples collected from 1971 through 1974. Samples collected recently on the Middle Fork (Table 4.1.2-4) showed nitrate + nitrate concentrations ranging from <0.05 to 0.25 mg/l NO_3-N.

Of the 6 options considered, four may result in treated water entering a surface water either through a points source discharge to the Gallatin or through runoff from the snowmaking system.

A point source discharge to the Gallatin River would be limited to a volume (117 MG/year) that would cause a nonsignificant change in water quality as defined by the criteria in ARM 17.30.715 as discussed in Section 6.1. Also, unlike typical treatment plants with continuous discharges, the plant at Big Sky would have storage basins that could be used to time discharges to periods of high flow in the river.

Based on studies completed in Canada (Novatec Consultants Inc., 1989), it is expected that the majority of nutrients present in the snowpack would be concentrated in the early portion of the snowmelt, which would percolate into soil. The potential increase in nitrate concentration in the streams is not anticipated to result in any increased algae growth. During runoff conditions, the streams are turbid which will limit light penetration in the streams. Algae growth is significantly reduced in low light conditions. Also stream temperatures are low which will inhibit algae growth.

While increased nitrogen concentrations in the streams during spring runoff is not anticipated to result in any increased algae growth, the effect on downstream reservoirs (such as Canyon Ferry) must also be considered. The fact that nitrate runoff may occur from the Big Sky area does not necessarily mean that all of the nitrate reaches Canyon Ferry. A study conducted in a second-order mountain stream in North Carolina suggests that in-stream depletion of nitrate may represent a portion of the nutrient cycling in forest systems (Swank and Caskey, 1982). The study reported that denitrification in sediments of well oxygenated streams may be a significant route of nitrogen depletion in a flowing stream. The North Carolina study reported in-stream nitrate depletions of approximately 50 percent in the two years following a period of watershed disturbance. The 50 percent depletions were measured in a stream length of approximately 2500 feet. The in-stream depletions were related to denitrification in the stream sediments.

Even when the possibilities of in-stream denitrification and percolation of melt water into the soil are neglected, the possible impacts to Canyon Ferry Reservoir from runoff at Big Sky are minimal. A mass balance of nutrients entering Canyon Ferry Reservoir was reported in a 1986 study (Priscu). From April 15, 1986 to October 29, 1986 approximately 456,350 pounds of nitrate entered Canyon Ferry Reservoir. If all the nitrate in the recycled water used in the snowmaking operation, reached Canyon Ferry it would only represent 0.4% of the inlet load measured during a 6 month period at Canyon Ferry.

7.3.3 Historical and Archeological Sites

The existing treatment plant site has previously been disturbed by construction activities. Additional construction on the site is not expected to impact any historical or archeological sites.

The snowmaking alternatives would require installing new lines in the Mountain Village area. In option 1C the new line would parallel the existing sewer outfall line and therefore, construction would be in a previously disturbed area. In option 2C, new lines would be installed along the edge of areas that have been previously disturbed when the ski runs were cut.

Before construction of any of the options it is expected that a historical and archeological survey would be completed.

7.3.4 Floodplain and Wetlands

None of the alternatives being considered would be constructed in the floodplain. No wetlands have been identified that would be impacted by the alternatives under consideration. Pipeline alignments would be routed to avoid any wetland areas.

7.3.5 Plant and Wildlife Protection

The land disposal alternatives would provide a greater degree of protection for fish than the other alternatives. It is possible that substances toxic to fish could pass through any biological treatment system and be discharged to the receiving stream. However, as no industrial discharges are present in

Big Sky, this possibility is remote.

The Yellow Mule site is just outside the Grizzly Bear Management area. For all practical purposes, the construction and management practices would be the same as if the site was in the management area. The goal would be to minimize grizzly-human conflict potential. The Forest Service has indicated that if construction occurs in these areas, restrictions should be placed on the contractor to avoid potential grizzly-human contact. The restrictions suggested included not allowing any camping or storing of food at the construction site.

The Forest Service did suggest that grizzly bears might be attracted to a spray irrigation site due to the increased vegetation growth.

As discussed in Section 4.1.5 the only plant identified in the area as a sensitive species was Yellow Springbeauty which is located in the Porcupine Creek area. The Porcupine Creek area is not included in the recommended plan and, therefore, no impact is foreseen for the Yellow Springbeauty.

7.3.6 Air Quality

As noted in Section 4.1.8, the air quality in the area is considered to be high. However, the area is subject to temperature inversions that tend to trap air pollutants in low lying areas. The primary sources of air pollutants are expected to be automobile exhaust and smoke from fireplaces. Baseline studies completed in 1973 indicated that the Mountain Village tended to have less winds and would be more apt to have problems with air quality (Stuart, 1976).

The policy recommendation contained in Stuart's 1976 report is still valid and would serve to mitigate impacts on the air quality. The recommendation included limiting the amount of wood burning by limiting the number of new fireplaces or by eliminating burning during periods of high pollution potential. It was also recommended that zoning be implemented that would limit the number of fireplaces per given area.

The 1976 report also noted road dust from traffic over gravel roads as a source of airborne particulates. This problem has been substantially eliminated with the paving of the road to the

Mountain Village.

7.3.7 Traffic

Traffic volumes have increased significantly in the Big Sky area during the past 10 years. A traffic count station located between the US 191 and Highway 64 intersection and the Meadow Village shows the annual daily traffic (ADT) volume has increased nearly 130% since 1981 (Robert Peccia Associates, 1993). Traffic count data show the present ADT volume between US 191 and Meadow Village is 2,457 vehicles per day.

It is expected that traffic volumes will continue to increase in the Big Sky area as a result of development both inside and outside the water and sewer district. Increased commercial and residential development along US 191 will undoubtedly increase traffic in the resort area. Improvements required to serve the increased traffic volume have been detailed in the 1993 draft report entitled Gallatin Canyon/Big Sky Capital Improvement Plan.

Public transit systems are one means of reducing traffic volumes in the area. A shuttle bus service does operate in the area and provides local travel access to and from points in the Mountain Village, Meadow Village, and along US 191. The service only operates for sixteen weeks during the ski season. During the 1992-1993 season, total ridership on the shuttle buses was 49,231 passengers. This was an increase of 98% over the 1991-1992 season. The increased usage was attributed to the fact that the service was provided at no charge during 1992-1993 where in previous years there was a charge. As pointed out in the Gallatin Canyon/Big Sky Capital Improvement Plan, one means of mitigating traffic impacts is to expand the shuttle bus service.

7.3.8 Demands on Government Services

Fire Protection. The Gallatin Canyon Rural Fire District provides fire protection in the area. The District operates on a volunteer system with one full time paid position and approximately 23 volunteers. The District operates a three-bay fire station located in Westfork Meadows.

The effect on fire protection needs will be the same regardless of the wastewater treatment and disposal method selected. Increased development will lead to more fire calls and more emergency medical calls. However, the increased population will also provide a greater pool of potential volunteers to serve the area needs.

Police Protection. Police protection is provided by the Gallatin County Sheriff. Currently, the area is served by three deputies. In 1992, the Sheriff Department responded to 396 complaints and made 34 arrests.

The current level of service is funded through a cooperative agreement between Gallatin County, Madison County and the Big Sky Resort Tax.

It is expected that resort tax funds may also be used to help offset some of the costs of constructing and operating the wastewater treatment system.

7.4 RELIABILITY

Spray Irrigation Disposal

Spray irrigation disposal of the effluent from a treatment system is highly reliable, assuming a suitable site is available. The successful use of spray disposal will depend primarily on the soil conditions, crop selection, and application rates.

Oxidation Ditch (Modified Bardenpho Process)

The reliability of the oxidation ditch, in similar environmental conditions, is discussed in a memorandum in Appendix N. A review of data from 16 oxidation ditches shows that 90 percent of the effluent TSS and BOD_5 values were below 10 mg/l. Also, during the summer 90 percent of the ammonia values were below 1 mg/l. During the winter 80 percent of the ammonia values were below 1.0 mg/l. The plant data was from a variety of plant configurations not all of which were designed for nutrient removal. It is expected that the modified Bardenpho process will produce results equal to or better than that observed from the 16 plants reviewed.

The treatment process proposed for Big Sky will also consist of chemical coagulation, flocculation, settling and effluent filtration. The filtration process is expected to consistently produce an effluent with TSS and BOD_5 values less than 5.0 mg/l.

Snowmaking

Two scenarios were considered for snowmaking. In Options 1C, and 2A the snowmaking system utilized conventional treatment and conventional snowmaking equipment commonly used at ski areas. With this approach, the reliability is highly dependent on the quality of water produced in the treatment plant. Snowmaking with conventional equipment is considered a disposal method and not a treatment process. However, as discussed in Section 7.3.1, some reduction in BOD_5, total dissolved solids, and total phosphorus can be expected.

In Option 2C, a unique freeze crystallization process is planned for the snowmaking system. This system was pilot tested at Big Sky during the spring of 1997. With this process,. substantial treatment is achieved in the snowmaking system. The freeze crystallization process developed by Delta Engineering (Snowfluent®) relies primarily on the natural freezing process and therefore is highly reliable.

When snowmaking for winter disposal is coupled with irrigation of golf course for summer disposal, another level redundancy is added to the system. With a distribution system established on the ski area, it would be possible to utilize the area for summer spray irrigation.

7.5 PREFERRED ALTERNATIVE

The lowest cost alternative considered is Option 1A. However, Option 1A is limited to two discharge points; the existing golf course and the discharge to the Gallatin. While recognizing that a discharge to the Gallatin is a viable option, the District Board has expressed a desire to minimize any surface discharges.

The preferred alternative in terms of engineering reliability, providing multiple discharge options, and providing maintenance flexibility is Alternative 2C. Alternative 2C has a slightly higher Equivalent

Annual Uniform cost than Alternatives 1A(10%). However, Alternative 2C best matches the Districts goal of minimizing discharges to the Gallatin while still maintaining the surface discharge option. Alternative 2C also allows greater flexibility for meeting the legal obligations of the District. As discussed in section 3.0 and 5.2, the District has a legal commitment to provide service to 7,926.9 SFE's while the proposed plan will only provide service to the 5399 SFE's expected to be developed by the year 2020. By expanding the Meadow Village treatment plant and using the three discharge points at their full capacity, option 2C would provide a total discharge capacity of 313.3 million gallons per year. A flow of 313.3 million gallons per year meets the projected flow for all the legally obligated services currently in the District plus provides some reserve capacity.

The selection of option 2C as the preferred alternative is dependent on the Department of Environmental Quality's approval of the Snowfluent© process as a viable treatment system as demonstrated in the pilot test. If the Snowfluent© process is approved solely as a disposal method, with the stipulation that a redundant treatment process be installed ahead of the snowmaking process the costs of option 2C increase to the point that Option 1A would become the preferred alternative.

Option 1C has a cost that is only slightly more than the preferred option and with the margin of error in the estimates the costs of options 1C and 2C can be considered equivalent. Option 1C has a low cost primarily because it would utilize existing pumping facilities and pipelines owned by Boyne USA, Inc. Implementation of option 1C would be highly dependent upon cooperation by Boyne USA during the operation of the system. In option 1C the same pipelines and pumping facilities would be used for both the snowmaking on the ski area and the wastewater snowmaking operation. With this operation scenario there would undoubtedly be conflicts over which operation had priority.

While option 1C would meet the service obligations expected to occur during the next 20 years, its ability to meet the District's full legal service obligations would be limited. Suitable areas on the mountain for snowmaking, where runoff could be controlled, and the pump and pipeline capacity of the snowmaking system would limit the ability to increase the disposal capacity of option 1C.

Option 2C was selected as the preferred alternative because it provides the District with the means to meet all the legal service obligations by simply expanding the Meadow Village Treatment Plant.

8.0 RECOMMENDED ALTERNATIVE

8.1 DESCRIPTION AND PRELIMINARY DESIGN DATA

8.1.1 General

Option 2C is the recommended alternative for Big Sky. This alternative consists of constructing an oxidation ditch modified Bardenpho system to provide nutrient removal and tertiary levels of treatment for the Meadow Village and an aerated lagoon and snowmaking system for the Mountain Village. Detailed descriptions of these systems are provided in Section 8.1.2 and 8.1.3 respectively.

Effluent disposal will utilize a combination of a point source discharge to the Gallatin River, irrigation on the existing golf course and at the snowmaking site, and snowmaking using the Snowfluent® process. The discharge to the Gallatin River will be less than the volume that can be discharged while meeting the nonsignificance criteria contained in ARM 17.30.715. From an evaluation of the criteria for determining non-significant discharges, the trigger value for inorganic phosphorus will control and will limit the discharge to the Gallatin River. The Department of Environmental Quality has issued a draft discharge permit that will limit the discharge flows on a monthly basis. The draft discharge permit has been based on the monthly 7day 10 year low flows (7Q10) and an effluent total phosphorus concentration of 0.5 mg/l.

With the expansion of the golf course irrigation system to cover 185 acres and pump station improvements, approximately 143.4 million gallons per year can be disposed of on the golf course during the wettest year in 10. Winter snowmaking will be used to dispose of the 53 million gallons per year.

This combination of year round disposal options requires a storage option of 100 million gallons in the Meadow and 10 million gallons at the Mountain Village. The 100 million gallon storage for the Meadow Village includes a safety factor of approximately 23%. The storage safety factor is provided to allow for unforeseen events or weather conditions that could limit or delay the irrigation of the golf course. Under the Interim Action Work Plan 79.9 million gallons of storage was constructed at the Meadow Village Treatment Plant. In the long range plan an additional 30 MG of storage would be constructed. At least 10 MG would be located at the snowmaking site to supply the snowmaking system. The remaining 20 MG would be constructed either on the golf course or at a new site in the Meadow Village.

The expansion of the golf course irrigation system and the irrigation pump station was completed in the summer of 1997. While the expansions are a part of the Interim Action Plan they are inextricably tied to the Long Range Plan. The irrigation system expansion provides a more complete irrigation coverage on the existing fairways and adds irrigation to the roughs. The expanded irrigation covers approximately 185 acres.

A 6-inch discharge line will be constructed from the treatment plant site to the Gallatin River. The 6-inch line would allow a maximum discharge of approximately 0.6 to 0.8 MGD depending on pond depth and pipe friction factors. Any wastewater discharged to the Gallatin would be treated in the oxidation ditch, filtered and disinfected with ultra-violet light to prevent the formation of chlorination by-products in the discharge.

8.1.2 Oxidation Ditch Process Description

The process flow diagram for the oxidation ditch process is shown in Figure 8.1.2-1 and a preliminary site layout is shown in Figure 8.1.2-2. The site layout shown in Figure 8.1.2-2 is based on locating the plant at the location of the existing aeration basin. With this location the existing aeration basin would be filled and the new plant would be constructed on the fill. The District is currently negotiating with an adjacent landowner to locate the treatment plant on the north side of the West Fork in Section 31. Figure 8.1.2-3 shows this alternative plant location. The alternative location would allow the existing aeration basin to be retrofitted for use as additional storage. The alternative location would also place the plant in a location that would be less visible to the public. If negotiations with the adjacent landowner are successful, the plant would be located as shown in Figure 8.1.2-3. Otherwise the plant will be located as shown in Figure 8.1.2-2

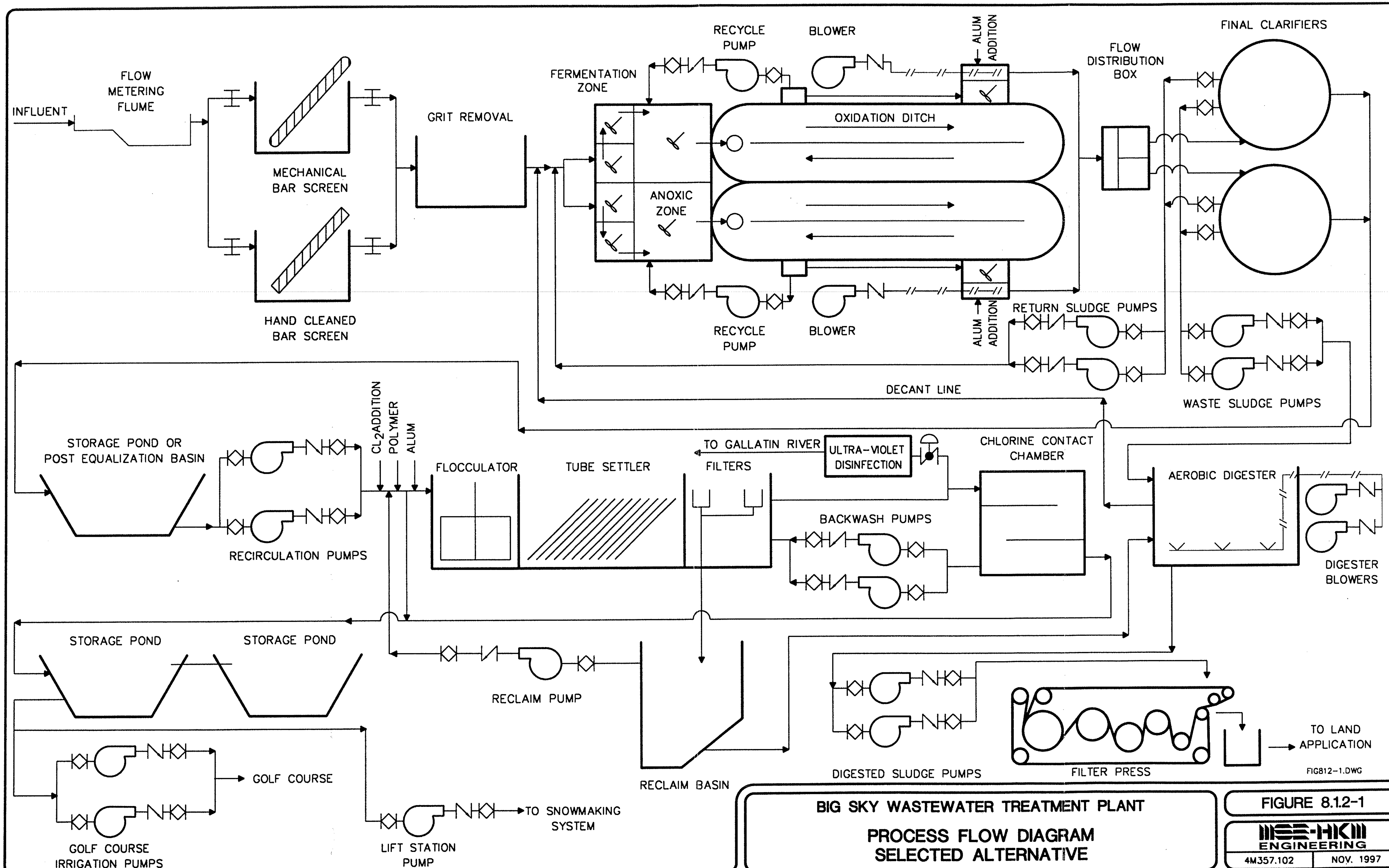
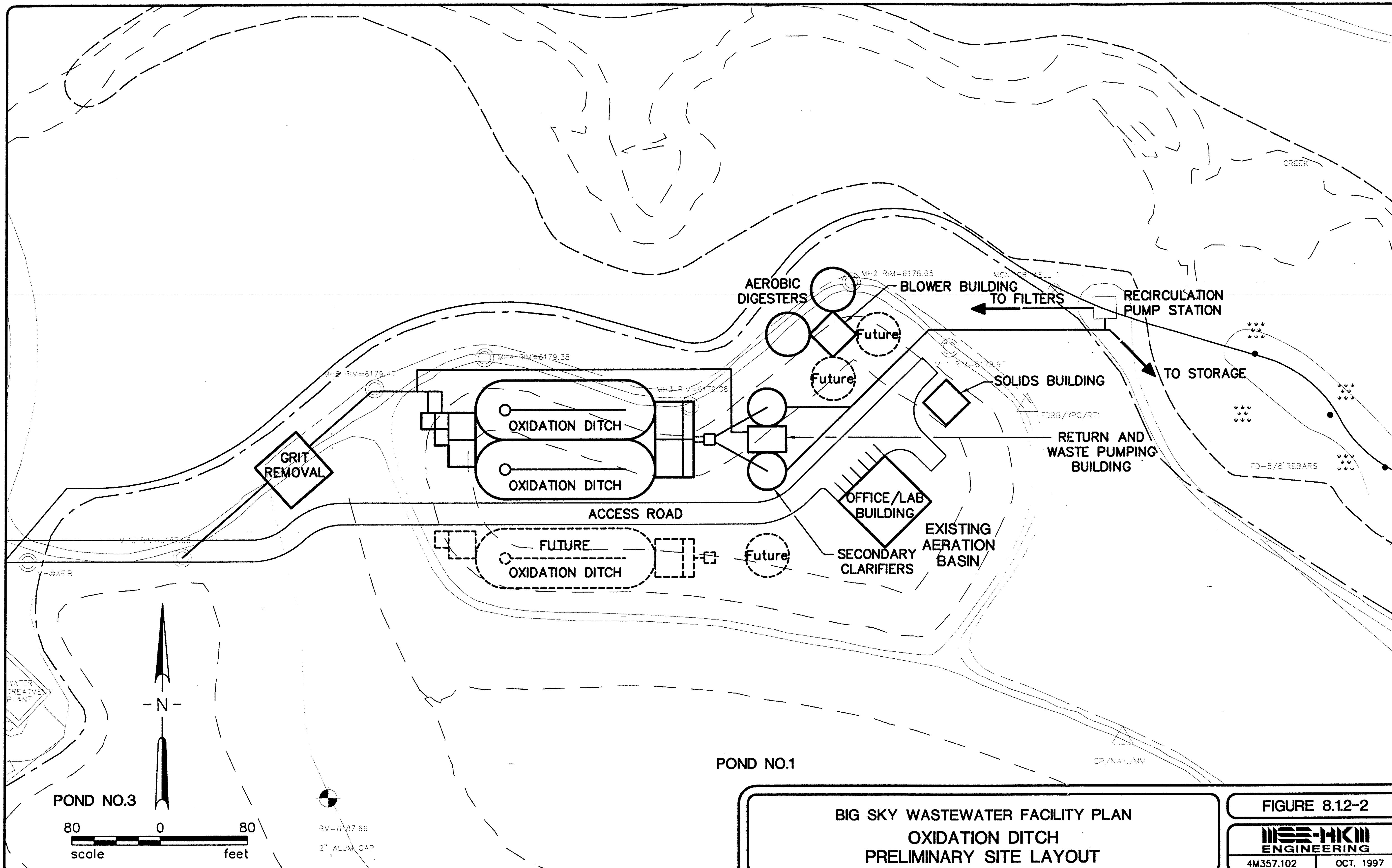


FIGURE 8.1.2-1

BIG SKY WASTEWATER TREATMENT PLANT

PROCESS FLOW DIAGRAM
SELECTED ALTERNATIVE



BIG SKY WASTEWATER FACILITY PLAN
OXIDATION DITCH
PRELIMINARY SITE LAYOUT

FIGURE 8.1.2-2

MSE-HKM ENGINEERING

4M357.102 | OCT. 1997

C1.DWG

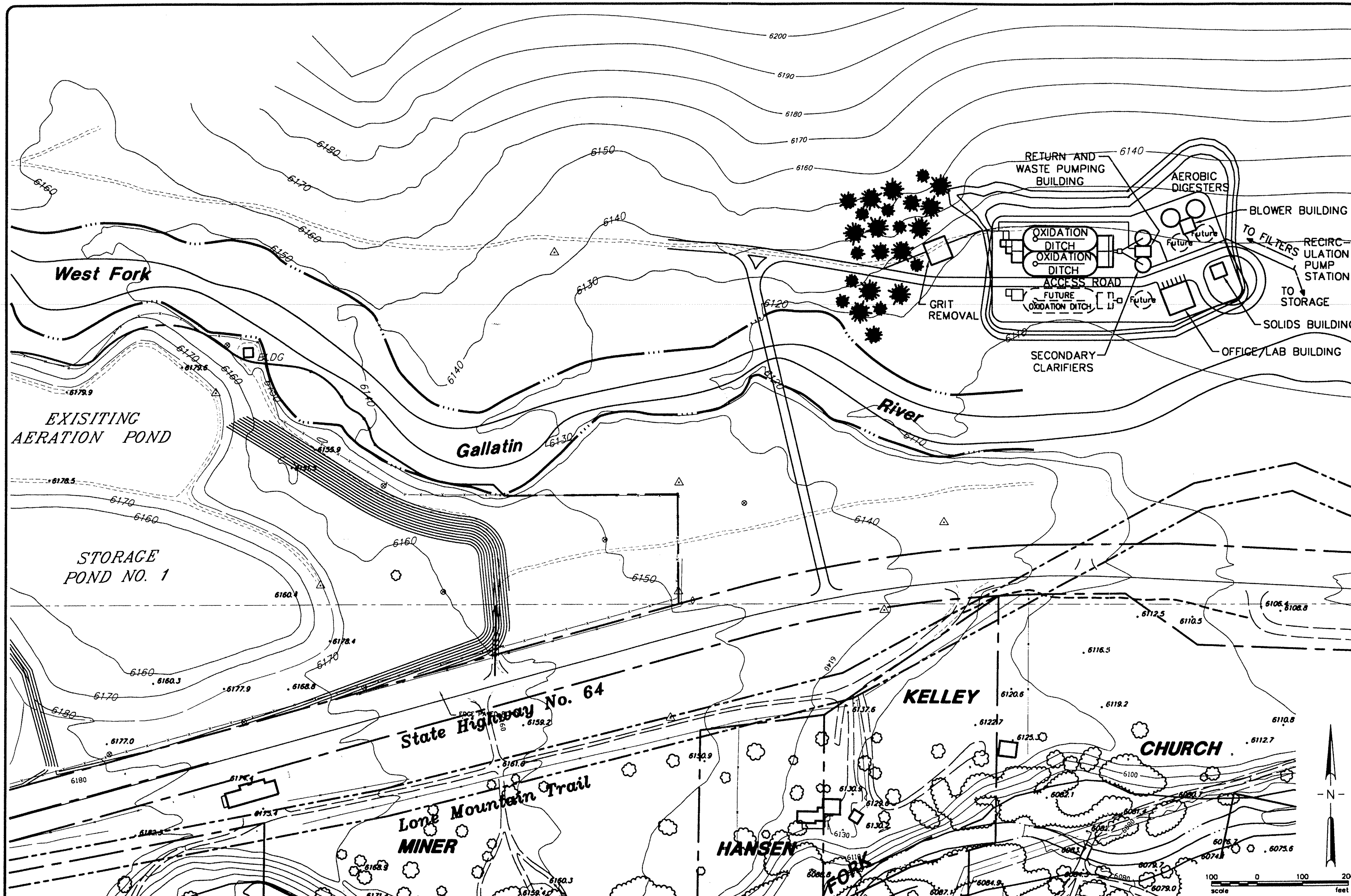


FIGURE 8.1.2-3

HKM ENGINEERING

6M357.106 SEPT. 1998

FIG812-3.DWG

BIG SKY WASTEWATER FACILITY PLAN

ALTERNATIVE PLANT LOCATION

The system consists of the following components:

- Pretreatment
  - Bar screen
  - Grit removal
- Oxidation ditch and equipment (modified Bardenpho system)
- Existing filtration system
- Aerobic digesters
- Belt filter press
- Sludge transport truck
- Chemical feed equipment
- Sludge pumps
- Disinfection
- Effluent pump stations
- 79.9 MG storage at the treatment plant site

The influent flow would continue to be measured at the existing metering station. After metering, the wastewater would pass through a mechanical bar screen to remove large objects which could damage downstream equipment. A hand cleaned bar screen would be provided as a back-up. Grit removal will follow the bar screens. A vortex type grit removal system will be utilized, to minimize the dissolved oxygen to the first (anaerobic) treatment stage.

The fermentation stage of the oxidation ditch process will consist of 3 anaerobic basins. Each basin will be approximately 19,330 gallons and will be mixed by a 1 HP mixer in each basin. Two anoxic basins, 0.089 MG each, will follow the anaerobic basins. A 5 HP mixer will be installed in each anoxic basin. Two oxidation ditches will be provided for nitrification and carbonaceous BOD removal. Each basin will be 0.795 MG with a 100 HP dual speed aerator. During normal operation each aerator would operate on low speed or 50 HP draw. At peak load occurrences the aerators would be operated on high speed. Internal recycle pumps will be used to recycle nitrate back to the anoxic zone. Each train will have 600 percent recycle capacity. Effluent polishing will be accomplished with a 0.093 MG second anoxic basin and a 7500 gallon reaeration basin.

Two 35 foot diameter clarifiers will be provided for final settling. At peak day flows, the surface overflow rate will be 665gpd/ft^2. Sludge from the final clarifiers will be wasted to the aerobic digesters. Two aerobic digesters will provide 60 days of mean cell residence time. Supernatant from the aerobic digesters will be returned to the head of the oxidation ditch. Polymer feed equipment will be provided to enhance solids settling in the aerobic digester. After digestion, solids will be dewatered to approximately 16 percent with a belt filter press. Filtrate and wash water from the belt press will be returned to the head of the grit removal system.

Existing granular media filters will be used to reduce the effluent suspended solids and phosphorus levels. The filter media consists of anthracite, sand, and garnet sand. An air scour/backwash system is used to clean the filters. The filter backwash water will flow to a reclaim basin for solids settling. The clarified backwash water will be returned to the filter inlet. The reclaim basin solids will be periodically pumped to the aerobic digester.

The filter effluent will flow by gravity through the chlorine contact chamber to the storage basins prior to golf course irrigation. Any wastewater discharged to the Gallatin River will be disinfected using ultraviolet light rather than chlorine. A flow control valve will be used to divert a portion of the flow to a ultraviolet disinfection process.

Several potential sludge disposal sites near Gallatin Gateway and near 4 Corners have been identified. The area near Gallatin Gateway lies in Township 2S Range 5E Sections 29, 30, 31, and 32. The 4 Corners site consists of Sections 13 and 24 in T2S 4E and Sections 18 and 19 in T2S R5E. Preliminary discussions with the landowners have taken place.

Sludge disposal sites and application rates will comply with the requirements of the 503 regulations discussed in Section 5.4.1. The actual application rate and land area required will depend on the crop nitrogen requirement and the pounds of nitrogen available in the sludge. Assuming a crop such as winter or spring wheat with a nitrogen fertilizer requirement of approximately 80 pounds per acre, an area of approximately 25 acres will be required for sludge disposal. In the winter when land application is not feasible, the dewatered sludge will be hauled to a landfill. In this instance, the sludge will be dewatered enough to pass the paint filter liquids test.

The preliminary design criteria for the proposed treatment system is shown in Table 8.1.1-1.

Table 8.1.1-1
Preliminary Design Criteria - Oxidation Ditch

FLOW	
Annual	150 MG
Average Day (Annual)	0.41 MGD
Average Day (Winter - Ski Season)	0.65 MGD
Peak Day	1.28MGD
Peak Hour	2.18 MGD
Minimum Day	0.10 MGD
BOD_5	
Average Day (Winter)	480 mg/l
Peak Day	625 mg/l
Average Loading (Winter)	2602 pounds/day
Peak Day Loading	4059 pounds/day
TSS	
Average Day (Winter)	450 mg/l
Peak Day (Winter)	586 mg/l
Average Loading (Winter)	2439 pounds/day
Peak Day Loading (Winter)	3804 pounds/day
Phosphorus	15 mg/l
TOTAL NITROGEN	60 mg/l
Ammonia	40 mg/l
Organic Nitrogen	20 mg/l
Alkalinity	240 mg/l
PRE-TREATMENT	
Mechanically Cleaned Bar Screen	
Number	1
Capacity	2.0 MGD
Spacing between bars	1-inch
Manually Cleaned Bar Screen	
Number	1
Capacity	2.0 MGD
Spacing between bars	2.5 inches

GRIT REMOVAL	
Number	1
Type	Vortex
Inlet Velocity	3.0 ft/s
OXIDATION DITCH	
Type	Modified Bardenpho
Number of Trains	2
Anaerobic Basins	3 @ 19,330 gallons each
Anoxic Basins	2 @ 89,000 gallons each
Carrousel Basins	2 @ 795,000 gallons each
Second Anoxic Basin	2 @ 93,000 gallons each
Reaeration Basin	2 @ 7,500 gallons each
Process SRT – Days	30 days
MLSS Concentration	4000 mg/l
Net Yield	0.70 lbs MLSS/lb BOD_r
FINAL CLARIFIERS	
Number	2
Diameter	35 feet
Surface Overflow Rate	
Peak Day	665 gpd/ft^2
Peak Hour	1,133 gpd/ft^2
FILTERS (Existing)	
Number	3
Loading Rate @ Avg. Day (0.564 MGD)(266 days of operation)	1.7 gpm/ft^2
Loading Rate With Two Filters	3.5 gpm/ft^2
Backwash Rate	15 gpm/ft^2
Backwash Volume	41,600 gallons
RECLAIM BASIN	
Number	1
Volume	83,200 gallons
BACKWASH PUMPS (Existing)	
Number	2
Capacity	2,775 gpm

<u>DIGESTER</u>	
Number	2
Type	Aerobic
Volume/Digester	168,00 gallons
MCRT	
Solids Loading	60 days
Avg. Day	1,281 lbs/day
Peak Month	1,868 lbs/day
<u>BELT PRESS</u>	
Number	2
Belt Width	1 meter
Feed Concentration %	2.0 (1.5 to 2.5)
Dewatered Cake Solids Concentration	16 (15 to 17)
<u>CHLORINE CONTACT BASIN (EXISTING)</u>	
Number	1
Volume	25,920
Detention Time	28 minutes
(at peak recirculation rate)	
<u>ULTRA-VIOLET DISINFECTION</u>	
Number of Units	2
Capacity Each	240 GPM
Number of Lamps Each Unit	24 - 36 inch lamps
Dosage	30,000 microwatt-seconds/cm^2

8.1.3 Snowmaking Process Description

The snowmaking operation will be supplied with wastewater from the Mountain Village. To do this requires intercepting the existing sewer system near an existing treatment pond located approximately 1 mile southeast of Lake Levinski.

Wastewater will be diverted from the existing outfall line to a new aerated lagoon system. The lagoon system will provide approximately 6.5 days of treatment. From the aerated lagoon the treated wastewater will flow to a 10 million gallon storage pond. Water from the storage pond will serve as the source water for the Snowfluent® process. The spray areas would be located as shown previously in Figures 6.4-4 and 6.4-5.

A 10-million-gallon storage pond will be constructed adjacent to the aerated lagoon. This pond will provide the storage volume necessary for the management of the projected wastewater flow. The storage pond will supply the snowmaking system allowing it to be operated independently of other system components.

The snowmaking system will consist of 6 to 10 towers 25 to 35 feet in height, spread over the snowmaking sites to provide an even distribution of the snow. The tower height ensures a complete freezing of the water droplets and increases the airborne time of each water droplet. Increased airborne time enhances the air stripping effect of gases and maximizing the sublimation effect.

Two compressors will be installed to add compressed air, to the wastewater flow ahead of the nozzles. The compressed air increases atomizing of the water droplets and projects the water droplets from the tower. A control system will be provided with the Snowfluent® system which logs all control variables such as ambient temperature, relative humidity, barometric pressure, wind speed, water temperature, and air pressure.

The snowmaking sites are approximately 21.7 acres including the buffer zone and a system of runoff control berms. Site A1 lies in section 29 Township 6 South, Range 3 East at an elevation of about 7000 feet. Site A2 lies in section 33 Township 6 South, Range 3 East at an elevation of about 7800 feet.. The District has negotiated an agreement with Boyne USA for use of the snowmaking sites.

The preliminary design criteria for the proposed snowmaking system is summarized in Table 8.1.3-1.

TABLE 8.1.3-1
PRELIMINARY DESIGN CRITERIA - SNOWMAKING SYSTEM

FLOW	
Annual	53 million gallons
Average Day (Winter)	0.38 million gallons
BOD_5	
Average Day	480 mg/l (1521 lb/day)
PRE-TREATMENT	
Bar Screen	
Number	1
Capacity	1.25 MGD
Aeration Pond	
HRT	6.5 days
Volume	2.5 million gallons
Aeration	
Type	Submerged – Static tube
Blower Size	50 HP
STORAGE	
Lined Storage Pond	
Number	1
Capacity	10 million gallons

TABLE 8.1.3-1 (continued) PRELIMINARY DESIGN CRITERIA – SNOWMAKING SYSTEM	
PUMPING	
Snowmaking Pump Station	
No. Pumps	3
Capacity	400 gpm ea.
Rating	225 HP ea.
SNOWMAKING	
Snowmaking Guns	
Number	6 to 10
Type	Tower
Pressure	500 psig
Land Requirements	
Snowmaking	22 acres
Average Applied snow Depth	15 feet
Air compressors	
Number	2
Pressure	135psi

8.2 O&M REQUIREMENTS

This section summarizes the personnel, procedures, and budget that will be necessary to operate, maintain, and manage the proposed treatment system.

Annual O&M Budget

The estimated annual O&M budget for the recommended alternative presented below in Table 8.2-1. Costs shown in Table 8.2-1 are based on the following assumptions.

1. It is anticipated that three full time employees will be required to operate and maintain the oxidation plant and the snowmaking process in addition to the system manager. One part time position will also be needed to cover vacations, sick days, when system repairs are needed and during the summer when sludge is being applied. The labor costs associated with the system manager and part time position are included in the existing system budget.

2. Labor costs are based on $20.00 per hour which includes direct labor costs, workmen's compensation insurance, and fringe benefits.

3. Power costs were estimated at $0.02845 per kilowatt-hour.

4. Demand charges were estimated at $5.30/KW.

5. The following chemical costs were assumed:

Chlorine	$0.50 per pound
Alum	$0.15 per pound
Polymer	$2.10 per pound

Table 8.2-1 Estimated Annual O&M Costs with Option 2D	
Operation Cost	128,800
Maintenance Cost	45,000
Power Cost	82,000
Chemical Costs	20,000
Administrative Cost	6,900
Lab Cost	8,000
SUBTOTAL PLANT BUDGET	**$292,700**
EXISTING SEWER SYSTEM BUDGET	**$956,924**
TOTAL SYSTEM BUDGET	**$1,249,624**

The budget shown in Table 8.2-1 represents the estimated cost to operate the new facility including the collection system. The existing budget for operating the sewer collection and treatment system is approximately $1,456,924.. Of this $956,924 are operating expenses that will be part of the rate base. The budget also includes $500,000 as a non-operating expense that represents the bond payment on the Interim Action Work Plan. The $500,000 is offset by the $500,000 the District receives from resort tax revenue. The existing budget expenses are summarized below.

Office General and Administrative	**$312,200**
Plant Operations	**$119,534**
Sewer Plant Operation	**$525,190**
Total	**$956,924**

Based on the current SFE count of approximately 2563.4, the annual O&M budget amounts to $40.62 per month per SFE. The current billing rate is $32.75 per month per SFE.

Staffing

It is estimated that three full time employees will be required to operate and maintain the oxidation ditch ,filtration plant, aerated lagoon and snowmaking plant, in addition to the system manager. A part time employee will also be required to cover vacations, sick days, and during sludge hauling in the summer. The system will require operation by a certified Class I operator.

The operation of the plant will require skilled operators that have knowledge of biological systems, chemistry and laboratory procedures, and mechanical skills. The oxidation ditch system, like any mechanical plant, will require preventative maintenance of the equipment in order to keep the plant functioning properly.

The operation of biological treatment plants is greatly affected by the motivation and training of the individual operator. The system management has the responsibility of ensuring that the operator has adequate time and funding to attend training seminars. The State of Montana requires that two continuing education credits be earned per two year period for Class I operators. A credit consists of 10 hours of qualified training time.

Laboratory Testing

Routine laboratory testing will be required to monitor and control the treatment process. A laboratory space and testing equipment will be provided in the design to allow the operators to run routine control testing.

Sludge Removal and Disposal

Sludge disposal must be made in accordance with the recently adopted 503 regulations as promulgated by the Environmental Protection Agency, February 19, 1993. The sludge disposal requirements were discussed previously in Section 5.4.1. Sludge from the aerobic digesters will be thickened to approximately 16 percent with a belt filter press. During the summer sludge will be land applied on agricultural land. During the winter sludge will be hauled to a landfill.

The site selection for land application sites will depend on topography, soil permeability, site drainage, depth to groundwater, subsurface geology, proximity to critical areas, and accessibility. Table 8.2-2 lists typical guidelines that should be used for evaluating sludge application sites.

Table 8.2-2
Typical Soil Limitations for Sludge Application Sites

CHARACTERISTIC	SLIGHT	MODERATE	SEVERE
Slope	<6%	6-12%	>12%
Depth to Water Table	>4 ft	2-4 ft	<2 ft
Flooding and Ponding	None	None	Occasional to Frequent
Depth to Bedrock	>4 ft	2-4 ft	<2 ft
Permeability of the Most Restricting Layer Above 3 Feet	0.1-0.3 in/hr	0.3-1.0 in/hr	<0.03 in/hr >1.0 in/hr
Available Water Capacity	>1.0 in/hr	0.5-1.0 in/hr	<0.5 in/hr

As discussed in Section 8.1.2, landowners of two potential sites have been contacted regarding sludge application. Final site selections will depend on negotiations with the landowners.

8.3 FINANCING

The State Revolving Fund (SRF) program is expected to be the used to finance the project. Loans through the SRF program have been at an interest rate of around 4.0%. It is doubtful that Big Sky could obtain funding from sources, such as Community Development Block Grants (CDBG) or FmHA loans. Those grants and loans are targeted toward low-income areas. The District currently receives $500,000 per year from resort tax revenues for funding of the work completed under the Interim Action Work Plan. The $500,000 is used to pay the annual debt service on the bonds. While additional money may be obtained from the resort tax for the Long Term Compliance Work Plan, the following financial evaluations assume no additional commitment of resort tax funds above the current funding level.

It is anticipated that either general obligation bonds, revenue bonds or a combination of general obligation and revenue bonds will be used to finance the improvements recommended in the Long Term Compliance Work Plan. With a general obligation bond, the annual debt service costs will be added to the tax obligations of the property owners within the District. With revenue bonds, the annual debt service cost is added to the sewer bill. When revenue bonds are used to finance the project, a debt service reserve equal to the lessor of 1 years principal and interest or 10% of the principal must be capitalized in the initial bond amount. In addition, the revenues collected must equal 125% of the annual debt service. Revenues collected in excess of the annual debt service reserve can be used for operation and maintenance expenses.

Four financial spreadsheets are shown to illustrate the estimated costs to the taxpayers at or system users at Big Sky. Tables 8.3-1 and 8.3-2 are based on financing with a general obligation bond and a revenue bond respectively. Tables 8.3-1 and 8.3-2 assume that plant investment fees, collected with the issuance of new sewer permits, are applied to the annual debt service. Tables 8.3-3 and 8.3-4 are also based on financing with general obligation bonds and/or revenue bonds but a worst case scenario is assumed in which there is no new construction and no collection of additional plant investment fee. In this case the current landowner or users would pay the entire cost of the improvements over the twenty-year life of the bond.

TABLE 8.3-1
CASH FLOW ANALYSIS WITH GENERAL OBLIGATION BOND
WITH INCREASING DISTRICT VALUATION

Est. Project Cost:	$11,143,782	Date of Funding:	01-May-1999
Funds on Hand	$ 3,130,841	Date of First Payment:	01-Jan-2000
Loan Costs	$152,902.26	# of Loan Payments	40
SRF Loan Com.:	$ 8,165,843	Final Loan Payoff Date	01-Jul-2019
Interest Rate:	4.0%	# of Years	20

loan costs		
Bond Counsel	$	10,000.00
Loan Origination	$	81,658.43
Administration	$	61,243.83
Total loan costs	$	152,902.26

Payment No.	Year	Month	Day	Pmt. Due Date	Total Interest Payment @ 4.0%	Total Principal Payment	Total Semiannual Payment	Outstanding Balance	Total Annual Payment	PROJECTED ANNUAL PIF REVENUE	NET PAYMENT Debt Service Minus PIF Revenue	District Assessed Valuation $x1000	Annual Debt Service Payment Per $100,000 of Assessed Value
	1997									$ 601,300		$ 415,000.00	
	1998									$ 1,058,500		$ 446,597.53	
	1999									$ 593,000		$ 555,752.62	
								8,165,843					
1	2000	1	1	01-Jan-2000	163,317	$135,191.64	298,509	8,030,652	597,017	$ 455,800	141,217	$ 572,413.13	$ 24.67
2		7	1	01-Jul-2000	160,613	$137,895.48	298,509	7,892,756					
3	2001	1	1	01-Jan-2001	157,855	$140,653.39	298,509	7,752,103	597,017	$ 496,050	100,967	$ 590,643.95	$ 17.09
4		7	1	01-Jul-2001	155,042	$143,466.46	298,509	7,608,636					
5	2002	1	1	01-Jan-2002	152,173	$146,335.78	298,509	7,462,301	597,017	$ 496,050	100,967	$ 608,874.76	$ 16.58
6		7	1	01-Jul-2002	149,246	$149,262.50	298,509	7,313,038					
7	2003	1	1	01-Jan-2003	146,261	$152,247.75	298,509	7,160,790	597,017	$ 496,050	100,967	$ 627,105.58	$ 16.10
8		7	1	01-Jul-2003	143,216	$155,292.70	298,509	7,005,498					
9	2004	1	1	01-Jan-2004	140,110	$158,398.56	298,509	6,847,099	597,017	$ 496,050	100,967	$ 645,336.39	$ 15.65
10		7	1	01-Jul-2004	136,942	$161,566.53	298,509	6,685,533					
11	2005	1	1	01-Jan-2005	133,711	$164,797.86	298,509	6,520,735	597,017	$ 496,050	100,967	$ 663,567.21	$ 15.22
12		7	1	01-Jul-2005	130,415	$168,093.82	298,509	6,352,641					
13	2006	1	1	01-Jan-2006	127,053	$171,455.69	298,509	6,181,185	597,017	$ 570,600	26,417	$ 684,708.83	$ 3.86
14		7	1	01-Jul-2006	123,624	$174,884.81	298,509	6,006,300					
15	2007	1	1	01-Jan-2007	120,126	$178,382.50	298,509	5,827,918	597,017	$ 570,600	26,417	$ 705,850.45	$ 3.74
16		7	1	01-Jul-2007	116,558	$181,950.15	298,509	5,645,968					
17	2008	1	1	01-Jan-2008	112,919	$185,589.16	298,509	5,460,379	597,017	$ 570,600	26,417	$ 726,972.91	$ 3.63
18		7	1	01-Jul-2008	109,208	$189,300.94	298,509	5,271,078					
19	2009	1	1	01-Jan-2009	105,422	$193,086.96	298,509	5,077,991	597,017	$ 570,600	26,417	$ 748,114.53	$ 3.53
20		7	1	01-Jul-2009	101,560	$196,948.70	298,509	4,881,042					
21	2010	1	1	01-Jan-2010	97,621	$200,887.67	298,509	4,680,154	597,017	$ 570,600	26,417	$ 769,256.15	$ 3.43
22		7	1	01-Jul-2010	93,603	$204,905.43	298,509	4,475,249					
23	2011	1	1	01-Jan-2011	89,505	$209,003.53	298,509	4,266,245	597,017	$ 406,700	190,317	$ 793,768.17	$ 23.98
24		7	1	01-Jul-2011	85,325	$213,183.61	298,509	4,053,062					
25	2012	1	1	01-Jan-2012	81,061	$217,447.28	298,509	3,835,615	597,017	$ 406,700	190,317	$ 818,280.19	$ 23.26
26		7	1	01-Jul-2012	76,712	$221,796.22	298,509	3,613,818					
27	2013	1	1	01-Jan-2013	72,276	$226,232.15	298,509	3,387,586	597,017	$ 406,700	190,317	$ 842,773.06	$ 22.58
28		7	1	01-Jul-2013	67,752	$230,756.79	298,509	3,156,829					
29	2014	1	1	01-Jan-2014	63,137	$235,371.93	298,509	2,921,457	597,017	$ 406,700	190,317	$ 867,285.08	$ 21.94
30		7	1	01-Jul-2014	58,429	$240,079.36	298,509	2,681,378					
31	2015	1	1	01-Jan-2015	53,628	$244,880.95	298,509	2,436,497	597,017	$ 406,700	190,317	$ 891,797.10	$ 21.34
32		7	1	01-Jul-2015	48,730	$249,778.57	298,509	2,186,719					
33	2016	1	1	01-Jan-2016	43,734	$254,774.14	298,509	1,931,944	597,017	$ 515,550	81,467	$ 920,196.58	$ 8.85
34		7	1	01-Jul-2016	38,639	$259,869.63	298,509	1,672,075					
35	2017	1	1	01-Jan-2017	33,441	$265,067.02	298,509	1,407,008	597,017	$ 515,550	81,467	$ 948,576.90	$ 8.59
36		7	1	01-Jul-2017	28,140	$270,368.36	298,509	1,136,639					
37	2018	1	1	01-Jan-2018	22,733	$275,775.73	298,509	860,864	597,017	$ 515,550	81,467	$ 976,976.37	$ 8.34
38		7	1	01-Jul-2018	17,217	$281,291.24	298,509	579,572					
39	2019	1	1	01-Jan-2019	11,591	$286,917.06	298,509	292,655	597,017	$ 515,550	81,467	$ 1,005,356.70	$ 8.10
40		7	1	01-Jul-2019	5,853	$292,655.41	298,509	(0)					
40	20 Years			40 Payments	$ 3,774,497	$ 8,165,843	$ 11,940,341		$ 11,940,341				

ASSESSED VALUE OF PROPERTY	ANNUAL COST OF DEBT SERVICE FOR LTCWP BASED ON PROJECTED YEAR 2000 ASSESSMENT VALUE
$50,000.00	$12.34
$100,000.00	$24.67
$150,000.00	$37.01
$200,000.00	$49.34
$250,000.00	$61.68
$300,000.00	$74.01
$350,000.00	$86.35
$400,000.00	$98.68
$500,000.00	$123.35
$550,000.00	$135.69
$600,000.00	$148.02
$650,000.00	$160.36
$700,000.00	$172.69
$750,000.00	$185.03
$800,000.00	$197.36
$850,000.00	$209.70
$900,000.00	$222.03
$950,000.00	$234.37
$1,000,000.00	$246.70
$1,250,000.00	$308.38
$1,500,000.00	$370.06
$1,750,000.00	$431.73
$2,000,000.00	$493.41
$2,500,000.00	$616.76
$3,000,000.00	$740.11

TABLE 8.3-2
CASH FLOW ANALYSIS WITH REVENUE BOND
WITH PROJECTED SFE INCREASE

Est. Project Cost:	$11,143,782	Date of Funding:	01-May-1999
Funds on Hand	$ 3,130,841	Date of First Payment:	01-Jan-2000
Loan Costs	$741,729.00	# of Loan Payments	40
SRF Loan Com.:	$ 8,754,670	Final Loan Payoff Date	01-Jul-2019
Interest Rate:	4.0%	# of Years	20

loan costs	
Project cost	$ 11,143,781.75
Funds on Hand	$ 3,130,840.55
Financed Project Cost	$ 8,012,941.20
Debt Service Reserve	$ 644,182.86
1% Loan origination	87,547
Bond Counsel	10,000
Total Bond Amount	$ 8,754,670.62

Payment No.	Year	Month	Day	Pmt. Due Date	Total Interest Payment @ 4.0%	Total Principal Payment	Total Semiannual Payment	Outstanding Balance	Total Annual Payment	PROJECTED ANNUAL PIF REVENUE	NET PAYMENT Debt Service Minus PIF Revenue	PROJECTED SFE'S	125% OF ANNUAL DEBT SERVICE PER SFE
	1997									$ 601,300		2.167.10	
	1998									$ 1,058,500		2.332.10	
	1999									$ 593,000		2.902.10	
								8,754,670					
1	2000	1	1	01-Jan-2000	175,093	$144,940.11	320,034	8,609,730	640,067	$ 455,800	164.267	2.989.10	$ 77.06
2		7	1	01-Jul-2000	172,195	$147,838.91	320,034	8,461,891					
3	2001	1	1	01-Jan-2001	169,238	$150,795.69	320,034	8,311,095	640,067	$ 496,050	144.017	3.084.30	$ 58.37
4		7	1	01-Jul-2001	166,222	$153,811.61	320,034	8,157,284					
5	2002	1	1	01-Jan-2002	163,146	$156,887.84	320,034	8,000,396	640,067	$ 496,050	144.017	3.179.50	$ 56.62
6		7	1	01-Jul-2002	160,008	$160,025.60	320,034	7,840,370					
7	2003	1	1	01-Jan-2003	156,807	$163,226.11	320,034	7,677,144	640,067	$ 496,050	144.017	3.274.70	$ 54.97
8		7	1	01-Jul-2003	153,543	$166,490.63	320,034	7,510,654					
9	2004	1	1	01-Jan-2004	150,213	$169,820.44	320,034	7,340,833	640,067	$ 496,050	144,017	3.369.90	$ 53.42
10		7	1	01-Jul-2004	146,817	$173,216.85	320,034	7,167,616					
11	2005	1	1	01-Jan-2005	143,352	$176,681.19	320,034	6,990,935	640,067	$ 496,050	144,017	3.465.10	$ 51.95
12		7	1	01-Jul-2005	139,819	$180,214.81	320,034	6,810,720					
13	2006	1	1	01-Jan-2006	136,214	$183,819.11	320,034	6,626,901	640,067	$ 570,600	69.467	3.575.50	$ 24.29
14		7	1	01-Jul-2006	132,538	$187,495.49	320,034	6,439,406					
15	2007	1	1	01-Jan-2007	128,788	$191,245.40	320,034	6,248,160	640,067	$ 570,600	69.467	3.685.90	$ 23.56
16		7	1	01-Jul-2007	124,963	$195,070.31	320,034	6,053,090					
17	2008	1	1	01-Jan-2008	121,062	$198,971.71	320,034	5,854,118	640,067	$ 570,600	69 467	3.796.20	$ 22.87
18		7	1	01-Jul-2008	117,082	$202,951.15	320,034	5,651,167					
19	2009	1	1	01-Jan-2009	113,023	$207,010.17	320,034	5,444,157	640,067	$ 570,600	69.467	3.906.60	$ 22.23
20		7	1	01-Jul-2009	108,883	$211,150.37	320,034	5,233,007					
21	2010	1	1	01-Jan-2010	104,660	$215,373.38	320,034	5,017,633	640,067	$ 570,600	69.467	4.017.00	$ 21.62
22		7	1	01-Jul-2010	100,353	$219,680.85	320,034	4,797,952					
23	2011	1	1	01-Jan-2011	95,959	$224,074.47	320,034	4,573,878	640,067	$ 406,700	233.367	4.145.00	$ 70.38
24		7	1	01-Jul-2011	91,478	$228,555.96	320,034	4,345,322					
25	2012	1	1	01-Jan-2012	86,906	$233,127.07	320,034	4,112,195	640,067	$ 406,700	233.367	4.273.00	$ 68.27
26		7	1	01-Jul-2012	82,244	$237,789.62	320,034	3,874,405					
27	2013	1	1	01-Jan-2013	77,488	$242,545.41	320,034	3,631,860	640,067	$ 406,700	233.367	4.400.90	$ 66.28
28		7	1	01-Jul-2013	72,637	$247,396.32	320,034	3,384,464					
29	2014	1	1	01-Jan-2014	67,689	$252,344.24	320,034	3,132,119	640,067	$ 406,700	233.367	4.528.90	$ 64.41
30		7	1	01-Jul-2014	62,642	$257,391.13	320,034	2,874,728					
31	2015	1	1	01-Jan-2015	57,495	$262,538.95	320,034	2,612,189	640,067	$ 406,700	233,367	4,656.90	$ 62.64
32		7	1	01-Jul-2015	52,244	$267,789.73	320,034	2,344,400					
33	2016	1	1	01-Jan-2016	46,888	$273,145.52	320,034	2,071,254	640,067	$ 515,550	124,517	4.805.20	$ 32.39
34		7	1	01-Jul-2016	41,425	$278,608.43	320,034	1,792,646					
35	2017	1	1	01-Jan-2017	35,853	$284,180.60	320,034	1,508,465	640,067	$ 515,550	124,517	4,953.40	$ 31.42
36		7	1	01-Jul-2017	30,169	$289,864.22	320,034	1,218,601					
37	2018	1	1	01-Jan-2018	24,372	$295,661.50	320,034	922,939	640,067	$ 515,550	124.517	5.101.70	$ 30.51
38		7	1	01-Jul-2018	18,459	$301,574.73	320,034	621,365					
39	2019	1	1	01-Jan-2019	12,427	$307,606.22	320,034	313,758	640,067	$ 515,550	124,517	5.249.90	$ 29.65
40		7	1	01-Jul-2019	6,275	$313,758.35	320,034	(0)					
40	20 Years			40 Payments	$ 4,046,670	$ 8,754,670	$ 12,801,341		$ 12,801,341				

TABLE 8.3-3
CASH FLOW ANALYSIS WITH GENERAL OBLIGATION BONDS
WITH FIXED DISTRICT VALUATION

PROJECT INFORMATION

Est. Project Cost:	$ 11,143,782	Date of Funding:	01-May-1999
Funds on Hand	$ 3,130,841	Date of First Payment:	01-Jan-2000
Loan Costs	$ 152,902.26	# of Loan Payments	40
SRF Loan Com.:	$ 8,165,843	Final Loan Payoff Date	01-Jul-2019
Interest Rate:	4.0%	# of Years	20

Payment No.	Year	Month	Day	Pmt. Due Date	Total Interest Payment @ 4.0%	Total Principal Payment	Total Semiannual Payment	Outstanding Balance	Total Annual Payment	Payment per $100,000 of assessed Value
	1997									
	1998									
	1999									
								8,165,843		
1	2000	1	1	01-Jan-2000	163,317	135,192	298,509	8,030,651.82	597,017	$ 143.86
2		7	1	01-Jul-2000	160,613	137,895	298,509	7,892,756		
3	2001	1	1	01-Jan-2001	157,855	140,653	298,509	7,752,103	597,017	$ 143.86
4		7	1	01-Jul-2001	155,042	143,466	298,509	7,608,636		
5	2002	1	1	01-Jan-2002	152,173	146,336	298,509	7,462,301	597,017	$ 143.86
6		7	1	01-Jul-2002	149,246	149,262	298,509	7,313,038		
7	2003	1	1	01-Jan-2003	146,261	152,248	298,509	7,160,790	597,017	$ 143.86
8		7	1	01-Jul-2003	143,216	155,293	298,509	7,005,498		
9	2004	1	1	01-Jan-2004	140,110	158,399	298,509	6,847,099	597,017	$ 143.86
10		7	1	01-Jul-2004	136,942	161,567	298,509	6,685,533		
11	2005	1	1	01-Jan-2005	133,711	164,798	298,509	6,520,735	597,017	$ 143.86
12		7	1	01-Jul-2005	130,415	168,094	298,509	6,352,641		
13	2006	1	1	01-Jan-2006	127,053	171,456	298,509	6,181,185	597,017	$ 143.86
14		7	1	01-Jul-2006	123,624	174,885	298,509	6,006,300		
15	2007	1	1	01-Jan-2007	120,126	178,383	298,509	5,827,918	597,017	$ 143.86
16		7	1	01-Jul-2007	116,558	181,950	298,509	5,645,968		
17	2008	1	1	01-Jan-2008	112,919	185,589	298,509	5,460,379	597,017	$ 143.86
18		7	1	01-Jul-2008	109,208	189,301	298,509	5,271,078		
19	2009	1	1	01-Jan-2009	105,422	193,087	298,509	5,077,991	597,017	$ 143.86
20		7	1	01-Jul-2009	101,560	196,949	298,509	4,881,042		
21	2010	1	1	01-Jan-2010	97,621	200,888	298,509	4,680,154	597,017	$ 143.86
22		7	1	01-Jul-2010	93,603	204,905	298,509	4,475,249		
23	2011	1	1	01-Jan-2011	89,505	209,004	298,509	4,266,245	597,017	$ 143.86
24		7	1	01-Jul-2011	85,325	213,184	298,509	4,053,062		
25	2012	1	1	01-Jan-2012	81,061	217,447	298,509	3,835,615	597,017	$ 143.86
26		7	1	01-Jul-2012	76,712	221,796	298,509	3,613,818		
27	2013	1	1	01-Jan-2013	72,276	226,232	298,509	3,387,586	597,017	$ 143.86
28		7	1	01-Jul-2013	67,752	230,757	298,509	3,156,829		
29	2014	1	1	01-Jan-2014	63,137	235,372	298,509	2,921,457	597,017	$ 143.86
30		7	1	01-Jul-2014	58,429	240,079	298,509	2,681,378		
31	2015	1	1	01-Jan-2015	53,628	244,881	298,509	2,436,497	597,017	$ 143.86
32		7	1	01-Jul-2015	48,730	249,779	298,509	2,186,719		
33	2016	1	1	01-Jan-2016	43,734	254,774	298,509	1,931,944	597,017	$ 143.86
34		7	1	01-Jul-2016	38,639	259,870	298,509	1,672,075		
35	2017	1	1	01-Jan-2017	33,441	265,067	298,509	1,407,008	597,017	$ 143.86
36		7	1	01-Jul-2017	28,140	270,368	298,509	1,136,639		
37	2018	1	1	01-Jan-2018	22,733	275,776	298,509	860,864	597,017	$ 143.86
38		7	1	01-Jul-2018	17,217	281,291	298,509	579,572		
39	2019	1	1	01-Jan-2019	11,591	286,917	298,509	292,655	597,017	$ 143.86
40		7	1	01-Jul-2019	5,853	292,655	298,509	(0)		
40	20 Years			40 Payments	$ 3,774,497	$ 8,165,843	$ 11,940,341		$ 11,940,341	

TABLE 8.3-4
CASH FLOW ANALYSIS WITH REVENUE BOND
WITH CURRENT SFE'S

Est. Project Cost:	$11,143,782	Date of Funding:	01-May-1999
Funds on Hand	$ 3,130,841	Date of First Payment:	01-Jan-2000
Loan Costs	$741,729.00	# of Loan Payments	40
SRF Loan Com.:	$ 8,754,670	Final Loan Payoff Date	01-Jul-2019
Interest Rate:	4.0%	# of Years	20

loan costs	
Project cost	$ 11,143,781.75
Funds on Hand	$ 3,130,840.55
Financed Project Cost	$ 8,012,941.20
Debt Service Reserve	$ 644,182.86
1% Loan origination	87,547
Bond Counsel	10,000
Total Bond Amount	$ 8,754,670.62

Payment No.	Year	Month	Day	Pmt. Due Date	Total Interest Payment @ 4.0%	Total Principal Payment	Total Semiannual Payment	Outstanding Balance	Total Annual Payment	PROJECTED ANNUAL PIF REVENUE	NET PAYMENT Debt Service Minus PIF Revenue	PROJECTED SFE'S	125% OF ANNUAL DEBT SERVICE PER SFE
	1997									$ 601,300		2,167.10	
	1998									$ 1,058,500		2,332.10	
	1999									$ 593,000		2,902.10	
								8,754,670					
1	2000	1	1	01-Jan-2000	175,093	$144,940.11	320,034	8,609,730	640,067	$ -	640,067	2,989.10	$ 267.67
2		7	1	01-Jul-2000	172,195	$147,838.91	320,034	8,461,891					
3	2001	1	1	01-Jan-2001	169,238	$150,795.69	320,034	8,311,095	640,067	$ -	640,067	3,084.30	$ 259.41
4		7	1	01-Jul-2001	166,222	$153,811.61	320,034	8,157,284					
5	2002	1	1	01-Jan-2002	163,146	$156,887.84	320,034	8,000,396	640,067	$ -	640,067	3,179.50	$ 251.64
6		7	1	01-Jul-2002	160,008	$160,025.60	320,034	7,840,370					
7	2003	1	1	01-Jan-2003	156,807	$163,226.11	320,034	7,677,144	640,067	$ -	640,067	3,274.70	$ 244.32
8		7	1	01-Jul-2003	153,543	$166,490.63	320,034	7,510,654					
9	2004	1	1	01-Jan-2004	150,213	$169,820.44	320,034	7,340,833	640,067	$ -	640,067	3,369.90	$ 237.42
10		7	1	01-Jul-2004	146,817	$173,216.85	320,034	7,167,616					
11	2005	1	1	01-Jan-2005	143,352	$176,681.19	320,034	6,990,935	640,067	$ -	640,067	3,465.10	$ 230.90
12		7	1	01-Jul-2005	139,819	$180,214.81	320,034	6,810,720					
13	2006	1	1	01-Jan-2006	136,214	$183,819.11	320,034	6,626,901	640,067	$ -	640,067	3,575.50	$ 223.77
14		7	1	01-Jul-2006	132,538	$187,495.49	320,034	6,439,406					
15	2007	1	1	01-Jan-2007	128,788	$191,245.40	320,034	6,248,160	640,067	$ -	640,067	3,685.90	$ 217.07
16		7	1	01-Jul-2007	124,963	$195,070.31	320,034	6,053,090					
17	2008	1	1	01-Jan-2008	121,062	$198,971.71	320,034	5,854,118	640,067	$ -	640,067	3,796.20	$ 210.76
18		7	1	01-Jul-2008	117,082	$202,951.15	320,034	5,651,167					
19	2009	1	1	01-Jan-2009	113,023	$207,010.17	320,034	5,444,157	640,067	$ -	640,067	3,906.60	$ 204.80
20		7	1	01-Jul-2009	108,883	$211,150.37	320,034	5,233,007					
21	2010	1	1	01-Jan-2010	104,660	$215,373.38	320,034	5,017,633	640,067	$ -	640,067	4,017.00	$ 199.17
22		7	1	01-Jul-2010	100,353	$219,680.85	320,034	4,797,952					
23	2011	1	1	01-Jan-2011	95,959	$224,074.47	320,034	4,573,878	640,067	$ -	640,067	4,145.00	$ 193.02
24		7	1	01-Jul-2011	91,478	$228,555.96	320,034	4,345,322					
25	2012	1	1	01-Jan-2012	86,906	$233,127.07	320,034	4,112,195	640,067	$ -	640,067	4,273.00	$ 187.24
26		7	1	01-Jul-2012	82,244	$237,789.62	320,034	3,874,405					
27	2013	1	1	01-Jan-2013	77,488	$242,545.41	320,034	3,631,860	640,067	$ -	640,067	4,400.90	$ 181.80
28		7	1	01-Jul-2013	72,637	$247,396.32	320,034	3,384,464					
29	2014	1	1	01-Jan-2014	67,689	$252,344.24	320,034	3,132,119	640,067	$ -	640,067	4,528.90	$ 176.66
30		7	1	01-Jul-2014	62,642	$257,391.13	320,034	2,874,728					
31	2015	1	1	01-Jan-2015	57,495	$262,538.95	320,034	2,612,189	640,067	$ -	640,067	4,656.90	$ 171.81
32		7	1	01-Jul-2015	52,244	$267,789.73	320,034	2,344,400					
33	2016	1	1	01-Jan-2016	46,888	$273,145.52	320,034	2,071,254	640,067	$ -	640,067	4,805.20	$ 166.50
34		7	1	01-Jul-2016	41,425	$278,608.43	320,034	1,792,646					
35	2017	1	1	01-Jan-2017	35,853	$284,180.60	320,034	1,508,465	640,067	$ -	640,067	4,953.40	$ 161.52
36		7	1	01-Jul-2017	30,169	$289,864.22	320,034	1,218,601					
37	2018	1	1	01-Jan-2018	24,372	$295,661.50	320,034	922,939	640,067	$ -	640,067	5,101.70	$ 156.83
38		7	1	01-Jul-2018	18,459	$301,574.73	320,034	621,365					
39	2019	1	1	01-Jan-2019	12,427	$307,606.22	320,034	313,758	640,067	$ -	640,067	5,249.90	$ 152.40
40		7	1	01-Jul-2019	6,275	$313,758.35	320,034	(0)					
40	20 Years			40 Payments	$ 4,046,670	$ 8,754,670	$ 12,801,341		$ 12,801,341				

9.0 IMPLEMENTATION

The schedule shown in Table 9.0-1 outlines the anticipated implementation schedule for the Long Term Compliance Work Plan.

TABLE 9.0-1

PROPOSED IMPLEMENTATION SCHEDULE

TASK	COMPLETION DATE
Submit Revised Draft to WQD and Reviewing Agencies	September 18, 1998
Conduct Public Hearing	September 29, 1998
Obtain WQD Comments	October 5, 1998
Submit Final LTCWP	October 9, 1998
Public Notice of Environmental Assessment	October 15,1998
Start Procurement of Design Engineer	October 18, 1998
WQD Review and Completion of Environmental Assessment	December 28,1998
Procure Design Engineer	January 8, 1999
Complete Preliminary Design of BNR plant (75%)	August 2, 1999
Submit Final Design to WQD	November 30, 1999
Obtain WQD Approval to Bid	February 5, 2000
Advertise for Bids	February 10, 2000
Open Bids	March 10, 2000
Notice to Proceed	April 19, 2000
Substantial Completion	September 1, 2001

10.0 PUBLIC PARTICIPATION

Several public hearings or informational meetings have been held over the past several years to discuss the project and alternatives being considered. A public meeting was held on April 8, 1993 to discuss the alternatives being considered for the project and to solicit input from the public. A total of 27 persons were in attendance. The attendance list is attached. A formal Public Hearing was held August 31, 1993 to discuss an earlier draft facility plan. A total of 36 persons were in attendance. The attendance list for the Public Hearing is also attached.

Since the Public hearings were held in 1993 the Interim Action Work Plan has been completed, a draft discharge permit has been published for comment, and the District has completed a pilot test on the proposed snowmaking system. This report reflects the changes that have occurred since the publication of the early draft facility plans.

A formal Public Hearing is scheduled for September 29, 1998 to present the alternatives discussed in this report. Any comments received will be addressed in the final version of this report.

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APPENDIX A

MAP OF COLLECTION SYSTEM

APPENDIX B

SOILS DATA AND DRILL LOGS ON GOLF COURSE


280B

280B

MAP UNIT DESIGN NOTE

NAME JB
AREA Big Sky
DATE FY 91

MAP UNIT NAME Libeg, CB-L, 0-4% slopes

LOCATION SHT 110

TYPE OF UNIT:
CONASSOCIATION: X :COMPLEX____ :ASSOCIATION____ :UNDIFFERENTIATED GROUP____

PARENT MATERIAL AND LANDFORM glacial outwash over cretaceous sediments

SLOPE GROUP 0-2% ELEVATION RANGE 6000-6500

COMPONET SERIES:

SERIES NAME	SURFACE TEXTURE	% OF M.U.	CAPABILITY IRR/NIRR	EROSION FACTORS K	T	I
A Libeg	CB-L	85				
B						
C						

INCLUSIONS: (CONTRASTING)

D soils That have < 35% rock fragments

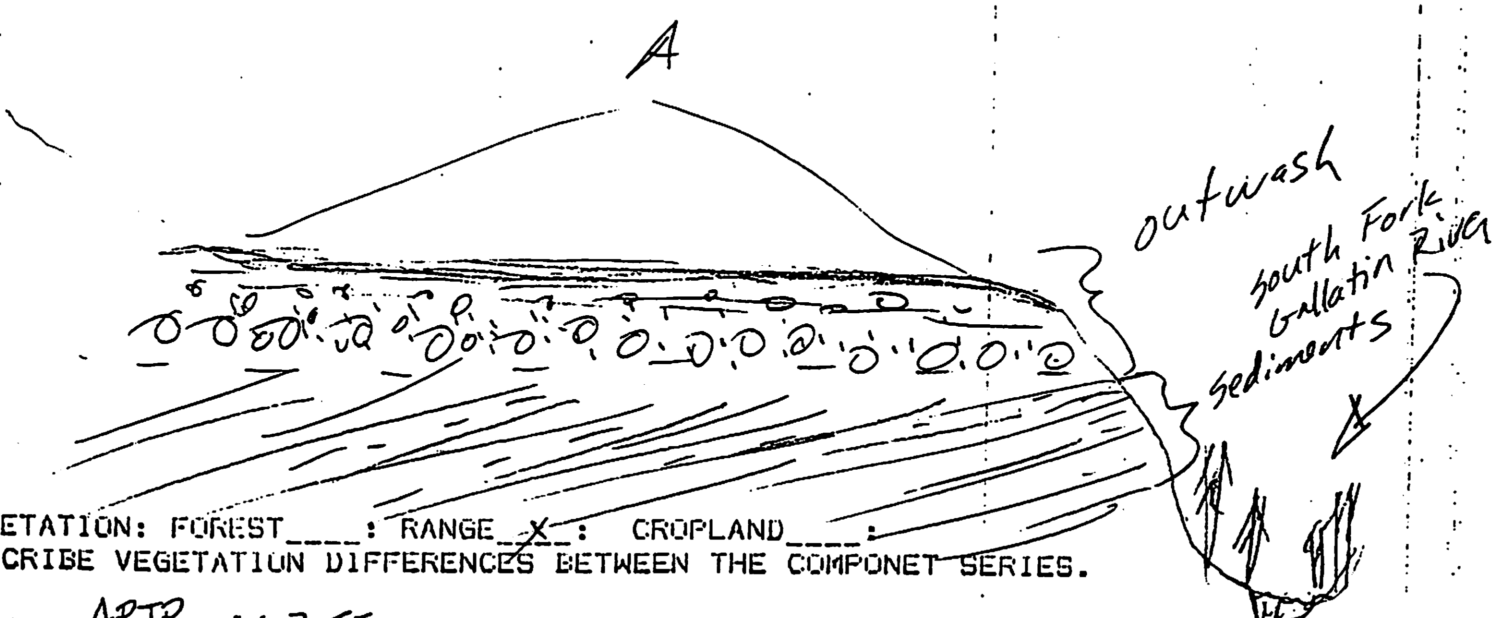
E ~~soils on~~

F

INCLUSIONS (NONCONTRASTING)

soils w/dark colored surfaces (pachic)

GEOMORPHIC LANDSCAPE DESCRIPTION: LANDSCAPE DIAGRAM AND POSITIONS OCCUPIED BY COMPONET SOILS AND INCLUSIONS.



VEGETATION: FOREST____ : RANGE X : CROPLAND____ :
DESCRIBE VEGETATION DIFFERENCES BETWEEN THE COMPONET SERIES.

ARTR, AGSP, FEID

779E

MAP UNIT DESIGN NOTE

NAME JB
AREA Big Sky
DATE 91

UNIT NAME Bridger - Libeg cpx, 8-25% slopes

LOCATION SHT 110

TYPE OF UNIT:
CONSOCIATION: ____ : COMPLEX X : ASSOCIATION ____ : UNDIFFERENTIATED GROUP ____

PARENT MATERIAL AND LANDFORM glacial till - toeslope

SLOPE GROUP 8-25% ELEVATION RANGE 6200-6800'

COMPONET SERIES:

	SERIES NAME	SURFACE TEXTURE	% OF M.U.	CAPABILITY IRR/NIRR	EROSION FACTORS K	T	I
A	Bridger	L	50				
B	Libeg	ST-L	35				
C							

INCLUSIONS: (CONTRASTING)

D ~~soils w/ stony or bouldery surface~~

E soils < 20" to soft beds

F soils lacking a thick dark surface (alfisols)

INCLUSIONS (NONCONTRASTING)

pachic soils

GEOMORPHIC LANDSCAPE DESCRIPTION: LANDSCAPE DIAGRAM AND POSITIONS OCCUPIED BY COMPONET SOILS AND INCLUSIONS.

VEGETATION: FOREST X : RANGE X : CROPLAND ____ :
DESCRIBE VEGETATION DIFFERENCES BETWEEN THE COMPONET SERIES.

- FEID, ARTR, CINQUEFOIL ← A
- [illegible] scattered PSME PICO ← B

ADVANCE COPY - SUBJECT TO CHANGE

Mapunits 280B and 779E

Series Libeg

Depth class: deep
Drainage class: well drained
Permeability: moderate
Landform: mountain slopes, stream terraces and alluvial fans
Parent material: alluvium and colluvium
Slope range: 0 to 60 percent
Elevation range: 5500 to 8500 feet
Annual precipitation: 20 to 24 inches
Annual air temperature: 34 to 38 degrees F
Frost free period: 50 to 75 days

Taxonomic Class: Loamy-skeletal, mixed Argic Cryoborolls

Typical Pedon Libeg cobbly loam, grassland (colors are for dry soil unless otherwise stated).

A - 0 to 7 inches; dark grayish brown (10YR 4/2) cobbly loam, very dark grayish brown (10YR 3/2) moist; moderate fine granular structure; soft, very friable, slightly sticky and slightly plastic; 15 percent gravels, 15 percent cobbles; neutral (pH 7.2); clear smooth boundary.

Bt1 - 7 to 22 inches; dark grayish brown (10YR 4/2) very gravelly sandy clay loam, dark yellowish brown (10YR 3/4) moist; weak medium subangular blocky structure; slightly hard, friable, nonsticky and nonplastic; 45 percent gravels, 15 percent cobbles; neutral (pH 7.2); gradual wavy boundary.

Bt2 - 22 to 45 inches; brown (10YR 5/3) extremely cobbly sandy clay loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; 25 percent gravels, 40 percent cobbles; mildly alkaline (pH 7.6); clear wavy boundary.

Bk - 45 to 60 inches; grayish brown (10YR 5/2) extremely cobbly sandy clay loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; 30 percent gravels, 35 percent cobbles; mildly alkaline (pH 7.8); strongly effervescent.

Range in Characteristics

Control section: 6 to 31 inches
Soil temperature: 36 to 40 degrees F.
Moisture control section: 4 to 12 inches
Mollic epipedon thickness: 7 to 15 inches
Content of clay in the control section: 18 to 35 percent
Rock fragments in the control section: 35 to 80 percent
Depth to the Bk horizon: greater than 40 inches
Soil phases: cobbly, stony, extremely stony

~~A horizon:~~

A horizon:
Texture (less than 2mm): loam
Clay content: 18 to 27 percent
Content of rock fragments: 25 to 35 percent (10 to 15 percent cobbles; 15 to 20 percent pebbles)
Reaction: pH 6.1 to 7.3

Bt horizons:
Texture (less than 2mm): loam, sandy clay loam, clay loam
Clay content: 18 to 35 percent
Content of rock fragments: 35 to 70 percent (20 to 35 percent cobbles; 25 to 40 percent pebbles)
Reaction: pH 6.1 to 7.3

Bk horizon:
Texture (less than 2mm): loam, sandy loam, sandy clay loam
Clay content: 18 to 35 percent
Content of rock fragments: 40 to 70 percent (20 to 35 percent cobbles; 20 to 35 percent pebbles)
Reaction: pH 7.4 to 7.8
Notes: some pedons lack the Bk horizon

Map Unit ~~[illegible]~~ 779E

Series Bridger

Depth class: very deep
Drainage class: well drained
Permeability: moderately slow
Landform: outwash plains and relict stream terraces
Parent material: mixed alluvium and glacial till
Slope range: 8 to 45 percent
Elevation range: 5500 to 8500 feet
Annual precipitation: 20 to 24 inches
Annual air temperature: 34 to 38 degrees F
Frost free period: 50 to 75 days

Taxonomic Class: Fine, mixed Argic Cryoborolls

Typical Pedon Bridger loam, in grassland (colors are for dry soil unless otherwise noted).

A - 0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark gray (10YR 3/1) moist; weak medium subangular blocky structure breaking to moderate medium granular structure; hard, friable, nonsticky and nonplastic; many very fine and fine roots, few medium and coarse roots; 5 percent gravels and 5 percent cobbles; neutral (pH 7.2); clear smooth boundary.

Bt1 - 8 to 15 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure; slightly hard, firm, slightly sticky and slightly plastic; common very fine and fine roots, few medium roots; 10 percent gravels and 5 percent cobbles; neutral (pH 7.2); clear wavy boundary.

Bt2 - 15 to 28 inches; yellowish brown (10YR 5/4) gravelly clay loam, brown (10YR 4/3) moist; weak medium prismatic structure; soft, friable, slightly sticky and slightly plastic; common very fine and fine roots, few medium roots; 15 percent gravels and 5 percent cobbles; mildly alkaline (pH 7.8); clear wavy boundary.

Bk1 - 28 to 49 inches; light gray (10YR 7/2) very cobbly clay loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, very friable, very sticky and plastic; few very fine and fine roots, few medium roots; 20 percent gravels and 25 percent cobbles; violently effervescent; moderately alkaline (pY 8.0) gradual wavy boundary.

Bk2 - 49 to 60 inches; pale brown (10YR 6/3) very gravelly clay loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; very hard, firm, sticky and slightly plastic; 35 percent gravels and 10 percent cobbles; violently effervescent; moderately alkaline (pH 8.0).

Range in Characteristics

<u>Control section:</u> 8 to 28 inches
<u>Soil temperature:</u> 36 to 40 degrees F.
<u>Moisture control section:</u> 4 to 12 inches
<u>Mollic epipedon thickness:</u> 7 to 16 inches
<u>Content of clay in the control section:</u> 35 to 50 percent
<u>Rock fragments in the control section:</u> 5 to 35 percent
<u>Depth to the Bk horizon:</u> 17 to 40 inches
<u>Soil phases:</u> cool, stony

<u>A horizon:</u>
<u>Texture (less than 2mm):</u> loam
<u>Clay content:</u> 18 to 27 percent
<u>Content of rock fragments:</u> 5 to 35 percent (0 to 5 percent stones; 0 to 10 percent cobbles; 5 to 20 percent pebbles)
<u>Reaction:</u> pH 6.1 to 7.3

<u>Bt1 horizon:</u>
<u>Texture (less than 2mm):</u> clay loam, silty clay loam, clay
<u>Clay content:</u> 30 to 50 percent
<u>Content of rock fragments:</u> 5 to 35 percent (0 to 5 percent stones; 0 to 10 percent cobbles; 5 to 20 percent pebbles)
<u>Reaction:</u> pH 6.1 to 7.3

<u>Bt2 horizon:</u>
<u>Texture (less than 2mm):</u> clay loam, silty clay loam, clay
<u>Clay content:</u> 35 to 50 percent
<u>Content of rock fragments:</u> 5 to 35 percent (0 to 5 percent stones; 0 to 10 percent cobbles; 5 to 20 percent pebbles)
<u>Reaction:</u> pH 6.1 to 7.8
<u>Notes:</u> some pedons are skeletal below 30 inches

<u>Bk horizon:</u>
<u>Texture (less than 2mm):</u> clay loam, sandy clay loam, loam
<u>Clay content:</u> 20 to 35 percent
<u>Content of rock fragments:</u> 10 to 50 percent (0 to 5 percent stones; 5 to 25 percent cobbles; 5 to 35 percent pebbles)
<u>Reaction:</u> pH 7.4 to 8.4
<u>Calcium carbonate equivalent:</u> 5 to 25 percent
<u>Notes:</u> some pedons lack the Bk horizon

NAME JB
AREA Big Sky
DATE FY 91

MAP UNIT DESIGN NOTE 608B

NIT NAME Turson Var - Fubar - Cryaquolls, 0-4% slopes Rare Flooding

TION SHT 110

PE OF UNIT:
SSOCIATION:____:COMPLEX X :ASSOCIATION____:UNDIFFERENTIATED GROUP____

RENT MATERIAL AND LANDFORM alluvium from high-gradient streams in narrow valleys.

E GROUP 0-4% ELEVATION RANGE________

PONET SERIES: SERIES NAME	SURFACE TEXTURE	% OF M.U.	CAPABILITY IRR/NIRR	EROSION FACTORS K	T	I
A Turson Var.	L	40				
B Fubar	CB-SL	25				
C Cryaquolls	—	20				

LUSIONS:(CONTRASTING)
D

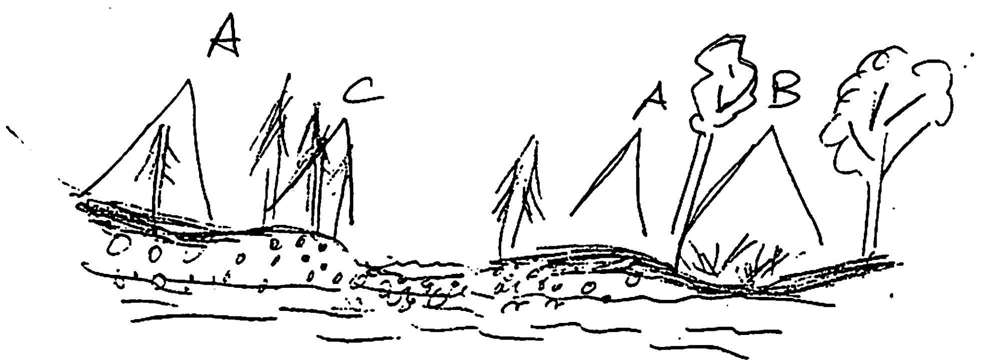
E

F

LUSIONS (NONCONTRASTING)
soils that are >40" to sand and gravel

MORPHIC LANDSCAPE DESCRIPTION:LANDSCAPE DIAGRAM AND POSITIONS
CUPIED BY COMPONET SOILS AND INCLUSIONS.

V varies by having a sand & gravel subsoil.



EGETATION: FOREST X : RANGE X : CROPLAND____:
DESCRIBE VEGETATION DIFFERENCES BETWEEN THE COMPONET SERIES.

A: grasses, forbs
B: willow, sedges, Aspen
C: PIEN, CARU, forbs

ADVANCE COPY - SUBJECT TO CHANGE

Map Unit 608B

LOCATION TURSON WY+ID MT

Established Series
Rev. AJC/HR
6/71

TURSON SERIES

Typically, Turson soils have very friable subangular blocky and granular calcareous A horizons and medium textured calcareous mottled C horizons. They overlie substratums of sand and gravel between 20 and 40 inches.

TAXONOMIC CLASS: Fine-loamy over sandy or sandy-skeletal, mixed Aquic Cryoborolls

TYPICAL PEDON: Turson loam - meadow (Colors are for dry soil unless otherwise noted.)

A1--0 to 10 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine subangular blocky structure that parts to moderate fine granules; slightly hard, very friable; calcareous; moderately alkaline (pH 8.0); gradual wavy boundary. (7 to 15 inches thick)

C--10 to 24 inches; brown (7.5YR 5/3) loam, dark brown (7.5YR 4/3) moist; common fine faint mottles of brown (7.5YR 4/4) moist; massive; hard, very friable; calcareous; moderately alkaline (pH 8.2); gradual wavy boundary. (5 to 33 inches thick)

IIC--24 to 60 inches; ~~calcareous~~ very gravelly loamy sand or sand.

TYPE LOCATION: Lincoln County, Wyoming; approximately 210 feet southeast of the W1/4 corner of sec. 14, T.32N., R.119W.

RANGE IN CHARACTERISTICS: These soils are underlain by contrasting sand and gravel at depths of 20 to 40 inches. These soils are mottled in the C horizon but lack mottles in the mollic epipedon. The mollic epipedon is 7 to 15 inches thick. Typically these soils are calcareous throughout but are noncalcareous in the upper 1 or 2 inches in some pedons. Organic carbon ranges from .8 to 5 percent in the surface horizons and decreases uniformly with depth. The upper part of the control section contains 0 to 35 percent coarse fragments and the lower part of the control section has 35 to 80 percent coarse fragments. The upper part of the control section is typically loam but clay ranges from 18 to 35 percent, silt from 20 to 55 percent, and sand from 15 to 55 percent with more than 15 percent but less than 35 percent fine or coarser sand. Mean annual soil temperature is 32 degrees to 46 degrees F. and mean summer soil

temperature is 40 degrees to 58 degrees F. The A1 horizon has hue of 2.5Y through 7.5YR, value of 4 or 5 dry and 2 or 3 moist and chroma of 1 through 3. It generally has granular or crumb structure but has weak subangular blocky structure in some pedons. It is soft to slightly hard and mildly to very strongly alkaline. The C horizon has hue of 2.5Y through 7.5YR, value of 5 or 6 dry or 4 or 5 moist, and chroma of 2 through 4. It contains few small faint mottles to common medium distinct mottles. ~~It contains about 2 to 8 percent calcium carbonate equivalent. The C horizon is moderately to strongly alkaline.~~

COMPETING SERIES: This is the Melton series of Idaho. Melton soils are noncalcareous throughout. (Humic Cryaquepts)

GEOGRAPHIC SETTING: The Turson soils are on nearly level to gently sloping flood plains and low terraces. Slopes range from 0 to about 6 percent. These soils formed in moderately thin deposits of medium textured alluvium overlying beds of sand and gravel. At the type location the average annual precipitation is 18 inches with about equal amounts of precipitation occurring during most months. These soils have a fluctuating water table which rises into the C horizon materials at some time during most seasons. The mean annual temperature is 39 degrees F., the mean summer temperature is 58 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the Dipman and Thayne soils. Dipman soils have mollic epipedons more than 16 inches thick, are very poorly drained, and lack a sandy-skeletal substratum. Thayne soils lack a sandy-skeletal substratum and are well drained.

DRAINAGE AND PERMEABILITY: somewhat poorly drained - Water table @ 3-6 ft. ~~Moderately well drained~~; slow runoff; moderate permeability in the upper part of the control section and rapid in the lower part.

USE AND VEGETATION: These soils are used as native pastureland or for native hay meadows. Principal native vegetation is bluegrass, meadow fescue, willows and sedges.

DISTRIBUTION AND EXTENT: High mountain valleys of Wyoming and Colorado. The series is of moderate extent.

1971.

OSED scanned by NSSQA. Last revised on 6/71.

National Cooperative Soil Survey
U.S.A.

LOCATION FUBAR AK

Established Series
Rev. BEK/JPM
2/90

Map Unit 608B

FUBAR SERIES (gravel bar areas along stream bottom)

The Fubar series consists of moderately well drained soils that are very shallow to sand and gravel on floodplains and low terraces. Fubar soils formed in a thin layer of loamy alluvium over stratified coarse textured alluvium. Slopes range from 0 to 7 percent. ~~Mean annual temperature is about 26 degrees F., and the average annual precipitation is about 12 inches.~~

TAXONOMIC CLASS: Sandy-skeletal, mixed Typic Cryofluvents

TYPICAL PEDON: Fubar fine sandy loam -- on a 1 percent slope under forest vegetation. (All colors are for moist soil)

Oi--3 to 0 inches; partially decomposed forest litter. (1 to 6 inches thick)

A--0 to 2 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak fine subangular blocky structure; very friable, nonsticky and nonplastic; common very fine and fine roots; slightly acid (pH 6.2); abrupt wavy boundary. (1 to 10 inches thick)

2C--2 to 60 inches; brown (10YR 5/3) very gravelly sand stratified with thin lenses of silt loam and fine sandy loam; single grain; loose, nonsticky and nonplastic; 40 percent gravel, 10 percent cobble; slightly acid (pH 6.4).

TYPE LOCATION: Upper Tanana Area, Alaska; in the SW 1/4 of Section 15, T.10S., R.10E., Fairbanks Meridian.

RANGE IN CHARACTERISTICS: Thickness of the organic mat ranges from 1 to 6 inches. Thickness of the loamy surface layer ranges from 1 to 8 inches. Texture of the particle size control section is sand or loamy sand with occasional thin strata of silt loam and fine sandy loam. Coarse fragment content ranges from 35 to 70 percent with 10 to 30 percent cobble and 25 to 40 percent gravel. The weighted average particle size is sandy-skeletal. Organic carbon decreases irregularly with depth. Reaction throughout the profile ranges from very strongly acid to neutral.

The A horizon has hue of 10YR or 2.5Y; value moist from 3 to 5; and chroma moist from 2 to 4. Texture is fine sandy loam, very fine sandy loam, or silt loam.

The 2C horizon is variegated sand and gravel. Thin strata of silt loam and fine sandy loam occur throughout.

COMPETING SERIES: This is the Hollow series in the same family. Hollow soils are calcareous.

GEOGRAPHIC SETTING: The Fubar series formed in a thin layer of loamy alluvium overlying stratified sandy and gravelly alluvium. Fubar soils are on floodplains and low terraces along major streams. Slopes range from 0 to 7 percent. The climate is subarctic continental with long, cold winters and short, warm summers. The mean annual temperature ranges from 25 to 28 degrees F., and the mean annual precipitation ranges from 10 to 14 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These include the Chena, Jarvis, Salchaket, and Tanana soils on similar landforms. Chena soils are not stratified. Jarvis and Salchaket soils are deeper than 10 inches to the underlying skeletal material. Tanana soils have permafrost within the control section.

DRAINAGE AND PERMEABILITY: ~~Moderately well drained.~~ Somewhat Poorly drained (Water table @ 3-6 ft) Runoff is slow. Permeability is moderate in the loamy surface and rapid in the underlying material.

DISTRIBUTION AND EXTENT: Tanana River Basin, Alaska. The series is of minor extent.

SERIES ESTABLISHED: Upper Tanana Area, Alaska, 1986.

REMARKS: Diagnostic features and horizons recognized in this profile include: assumed irregular organic carbon decrease with depth based on stratification and colors; sandy particle size with 50 percent coarse fragments from 2 to 60 inches; cryic temperature regime.

The Fubar series incorporates stratified, flooded soils that were formerly correlated as part of the Chena series.

National Cooperative Soil Survey
U.S.A.

SCS-SOILS-232G
12-70
CODE SOILS-11

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

"Swampy" areas w/ standing water on surface.

Soil type: Cryaquolls Mapunit 608B

File No. 565

Area: Big Sky - Middle Fork

Date: 9/13/91

Stop No.

Classification: fine, Argic Cryaquolls

Location: T6S, R3E Sec. 34 1200' W & 2200' N of SE corner

Sheet No. 110

Veg. (or crop): Willow, sedges, reedgrass

Climate: 20+

Parent material: alluvium

Physiography: hummocky

Relief: concave

Drainage: very poorly

Salt or alkali

Elevation: 6550'

Gr. water: 12-18"

Stoniness

Slope: 10%

Moisture: throughout

Aspect: NE

Root distrib.

% Clay *

Erosion wind: water:

% Coarse fragments *

% Coarser than V.F.S. *

Permeability

Additional notes

% Coarse Fragments		
Horizon	Gravel	Cobbles

* soil is saturated w/water to surface

* standing water @ 51"

* V.P.D soils in depressions and SWPD aspen stands on slightly higher positions.

* Control section average

Horizon	Depth in	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	pH Reaction BTB	Boundary	% Clay	Roots	Effervesc.
Oe	0-8	2.5Y 4/0	dec. roots 2.5Y 2/0	SICL	m	vh	vfi	s/p	6.0	cw	32-34	3vf,f 3m	eo
A	8-22	2.5Y 3/0	2.5Y 2/0 w/mottles of: 7.5YR 4/4	SIC	m	vh	vfi	vs/vp	6.0	cw	>40	2vf,f 1m	
[illegible]	22-31	2.5Y 4/0	2.5Y 3/2 w/mottles of 2.5Y 5/6	SIC	2msbk	xh	xfi	vs/vp	6.2	grw	>40	1vf,f	
[illegible]	31-60	2.5Y 6/2	2.5Y 4/2 w/mottles: 2.5Y 4/4	(>15% f.s.) SICL	[illegible]	vh	fi	vs/vp	6.8		36-38	1vf,f	↓

PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

Survey Area- GALLATIN COUNTY AREA, MONTANA

Map Symbol	Soil Name	Depth (In)	Clay (pct)	Moist Blk Density (g/cm3)	Permeability (In/hr)	Available water cap (In/in)	Soil React (pH)	Salinity (mmhos/cm)	Shrink Swell Pot.	Erosion Factor K	Erosion Factor T	Wind Erod. Group	Organic Matter (pct)
482C	PHILIPSBURG	0-14	20-27	-	0.6- 2.0	0.18-0.20	6.1-7.3	-	LOW	.28	5	6	4.- 8.
		14-27	25-35	-	0.2- 0.6	0.14-0.16	6.1-8.4	-	MODER	.28			-
		27-60	20-30	-	0.6- 2.0	0.12-0.14	7.9-9.0	0- 2	LOW	.17			-
	LIREG	0- 7	10-27	1.15-1.35	0.6- 2.0	0.12-0.14	6.1-7.3	0- 0	LOW	.17	5	6	2.- 4.
		7-60	20-35	1.40-1.60	0.6- 2.0	0.07-0.08	6.1-7.3	0- 0	LOW	.10			.5- 1.

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL | # of pages ▶

To Ray Armstrong | From NRCS- JAY BROOKER
Dept./Agency HKM Consulting | Phone # 587-6988
Fax # 406/656-6348 | Fax #

NSN 7540-01-317-7368 5099-101 GENERAL SERVICES ADMINISTRATION

U.S. Department of Agriculture
Natural Resources Conservation Service

ENGINEERING INDEX PROPERTIES
TABLE 1

Survey Area- GALLATIN COUNTY AREA, MONTANA

Map Symbol	Soil Name	Depth (In)	USDA Texture	Classification: Unified	Classification: AASHTO
482C	PHILIPSBURG	0-14	L	CL-ML	A-4
		14-27	CL L GR-CL	CL SC	A-6
		27-60	GR-CL GR-L	GM-GC CL-ML SC CL	A-4 A-6
	LIBEG	0- 7	CB-L	ML CL-ML SM SC-SM	A-4
		7-60	CNV-SCL CNV-CL CBX-CL	GM-GC GC	A-2 A-4 A-6

603.12(c)(1)(ii)(B)[4]

Table 603-45 USDA texture.

Texture modifier:

BY	Bouldery
BYV	Very bouldery
BYX	Extremely bouldery
CB	Cobbly
CBA	Angular cobbly
CBV	Very cobbly
CBX	Extremely cobbly
CN	Channery
CNV	Very channery
CNX	Extremely channery
CR	Cherty
CRC	Coarse cherty
CRV	Very cherty
CRX	Extremely cherty
FL	Flaggy
FLX	Extremely flaggy
FLV	Very flaggy
GR	Gravelly
GRC	Coarse gravelly
GRF	Fine gravelly
GRV	Very gravelly
GRX	Extremely gravelly
MK	Mucky
PT	Peaty
RB	Rubbly
SH	Shaly
SHV	Very shaly
SHX	Extremely shaly
SR	Stratified
ST	Stony
STV	Very stony
STX	Extremely stony
SY	Slaty
SYV	Very slaty
SYX	Extremely slaty

Texture terms:

COS	Coarse sand
S	Sand
FS	Fine sand
VFS	Very fine sand
LCOS	Loamy coarse sand
LS	Loamy sand
LFS	Loamy fine sand
LVFS	Loamy very fine sand
COSL	Coarse sandy loam
SL	Sandy loam
FSL	Fine sandy loam
VFSL	Very fine sandy loam
L	Loam
SIL	Silt loam
SI	Silt
SCL	Sandy clay loam
CL	Clay loam
SICL	Silty clay loam
SC	Sandy clay
SIC	Silty clay
C	Clay

Terms used in lieu of texture:

CE	Coprogenous earth
CEM	Cemented
CIND	Cinders
DE	Diatomaceous earth
FB	Fibric material
FRAG	Fragmental material
G	Gravel
GYP	Gypsiferous material
HM	Hemic material
ICE	Ice or frozen soil
IND	Indurated
MARL	Marl
MPT	Mucky-peat
MUCK	Muck
PEAT	Peat
SG	Sand and gravel
SP	Sapric material
UWB	Unweathered bedrock
VAR	Variable
WB	Weathered bedrock

ENGINEERING INDEX PROPERTIES
TABLE 2

Survey Area GALLATIN COUNTY AREA, MONTANA

Map Symbol	Soil Name	Depth (In)	Fragments >3 Inches (pct)	Percent passing - sieve number 4	10	40	200	Liquid limit (pct)	Plasticity Index
482C	PHILIPSBURG	0-14	0-10	95-100	90-100	80-100	65- 80	20- 30	0- 10
		14-27	0-10	75-100	70- 95	65- 90	45- 70	30- 40	10- 20
		27-60	0-10	60- 80	50- 75	45- 70	35- 55	25- 35	5- 15
	TIRFG	0- 7	15-30	75- 95	70- 90	60- 80	45- 70	20- 30	0- 10
		7-60	5-55	40- 60	30- 50	20- 45	15- 40	25- 35	5- 15

MEMORANDUM

TO: TRAVIS TEEGARDEN, FILE

DATE: JULY 6, 1995

FROM: GREG UNDERHILL

SUBJECT: BIG SKY WASTEWATER APPLICATION- MONITOR WELL INSTALLATION-4B357.102

On June 26 and 27 1995 six monitor wells were installed at various locations on the golf course at Big Sky Montana. The monitor wells were constructed of 2 inch ID flush threaded solid and factory slotted (.01 inch) Schedule 40 PVC. The wells were capped using bentonite, grout and 8 inch diameter, flush mount, water tight, steel manholes. Water tight locking caps were placed over the 2 inch PVC casings. The wells were installed to depths ranging from 16.7 to 34.4 feet.

Field logs showing the completion of each monitor well and corrosponding field classified (ASTM D 2488) soil profiles are attached along with a map showing the locations of the wells on the golf course.

The wells were installed by Red Tiger Drilling of Manhattan MT. The installation was observed and approved by me.

SURFICIAL GEOLOGY

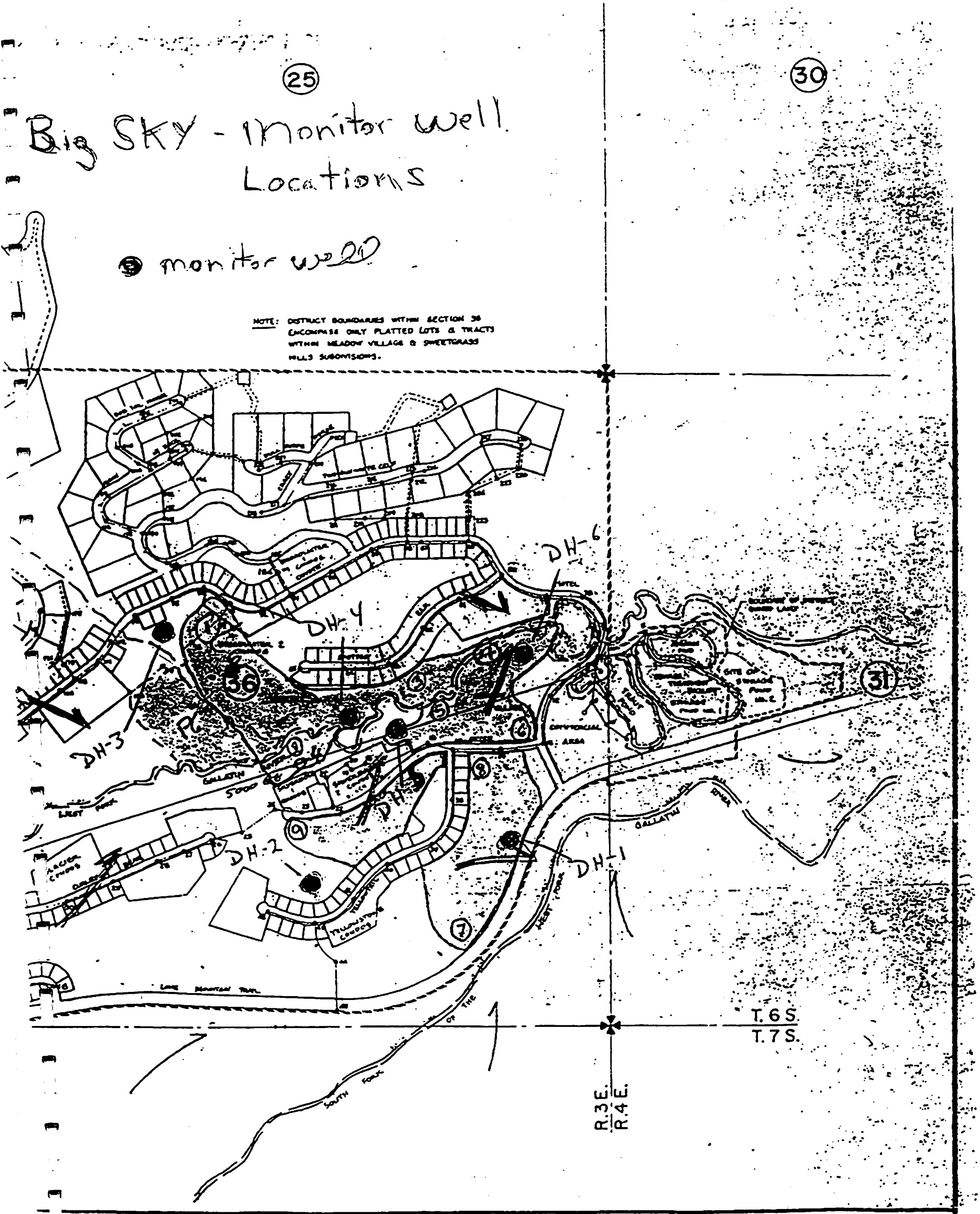
The golf course is located on three predominate soil deposits; glacial outwash (Pinedale Glacial period), alluvial fan deposits from side drainages and alluvial stream deposits of the West Fork Gallatin River.

SOIL PROFILE

The soil profile encountered consisted predominately of approximately 1 to 1.5 feet of clay loam topsoil overlaying poorly graded gravel with clay, sand, cobbles and occasional boulders. Clay shale was encountered underlaying the gravel at depths ranging from 13 to 18 feet in all drill holes with the exception of drill hole 3. Shale was not encountered in drill hole 3 which was advanced to 37.4 feet. Soils encountered in drill hole 3 consisted of fine gravels with scattered cobbles and very sandy zones (alluvial fan deposits).

LABORATORY TESTING

Six soil samples were taken for gradation and hydrometer tests. The samples were taken from excavations for lysimeters which were being installed during monitor well installation. Samples from the lysimeter excavations are more representative of the course grained soils than samples obtained from the drill holes. The results of the testing will be included with this memorandum when completed.



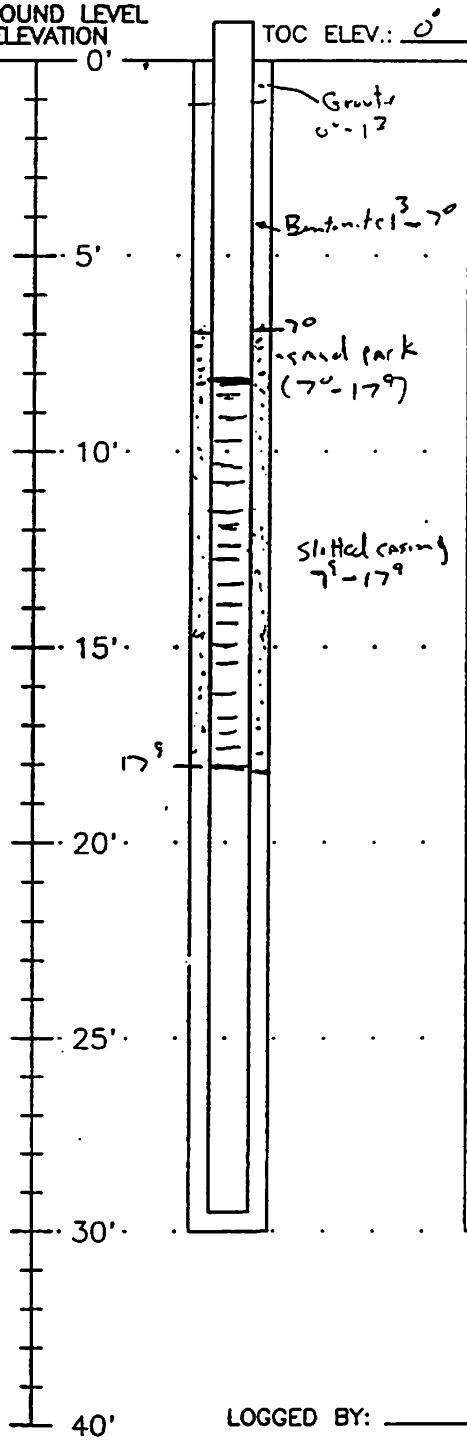
R.I.D. 305 BIG SKY. MONTANA

WELL LOG AND COMPLETION DETAILS

WELL NUMBER: BH-1

PROJECT: Big Sky	DRILLING METHOD: Air Rotary	SEAL TYPE: w.r. monit. 5"
LOCATION:	CASING TYPE/DIA: 2"	GROUT: 0'-1³
	SCREEN TYPE/LENGTH: PT slot	BOREHOLE DIA.: 6"
DATE DRILLED: 6/26/95	SCREEN SLOT SIZE: .01	DEPTH TO WATER: ≈ 8⁷
TOTAL DEPTH DRILLED: 15⁰	FILTER PACK: Silica sand 8-15	TOP OF CASING ELEV.:

GROUND LEVEL ELEVATION — TOC ELEV.: 0' — LITHOLOGY — ORGANIC VAPOR READINGS/COMMENTS



Lithology:

0-1' topsoil [illegible]

1'-10 Poorly Graded Gravel with sand Cobbles ~~[illegible]~~ boulders, GP, dry, v. dense, lt brown,

10-13 GP-GC, sat, very dense, with cobbles & boulders

13²-18 Clay shale, weathered, gray brown

15-17⁸ Clay shale, Hard, gray brown, slightly dry

Organic vapor readings/comments:

SS#1 - GP cuttings — Could not drive

SS - 19/. Bouncing spoon on boulder cobbles

SSS 53/50/0³

Hole caving in casing to set well

LOGGED BY:

ACAD#: ?.dwg
REV: — DATE: 5-24-95
DRAFTER:

1600 well
1900 /well cased

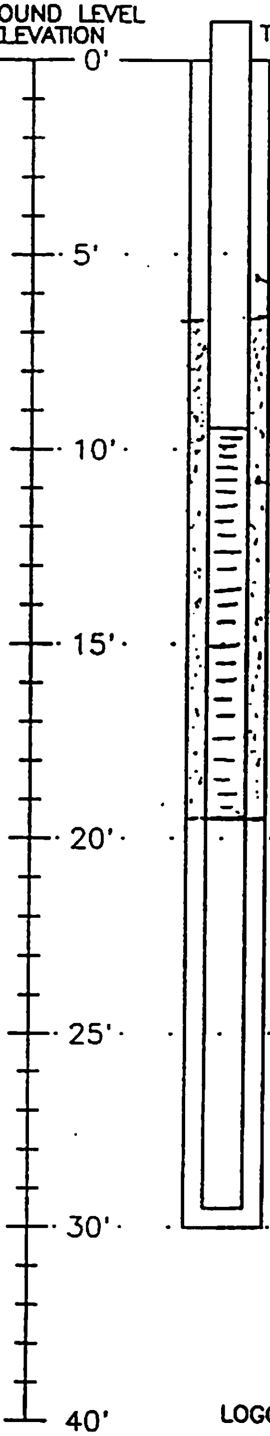
18
-10
8

WELL LOG AND COMPLETION DETAILS

WELL NUMBER: DH-2

PROJECT: Big Sky	DRILLING METHOD: Air rotary	SEAL TYPE: Grout w/ bentonite
LOCATION:	CASING TYPE/DIA: Sch 40 PVC / 2"	GROUT: +0²–1²
	SCREEN TYPE/LENGTH: slotted PVC	BOREHOLE DIA.: 6"
DATE DRILLED: 6/26/95	SCREEN SLOT SIZE: .01	DEPTH TO WATER: 9.3
TOTAL DEPTH DRILLED: 19⁶	FILTER PACK: Silica Sand 19⁶–6⁸	TOP OF CASING ELEV.:

GROUND LEVEL ELEVATION	TOC ELEV.: +0²	LITHOLOGY	ORGANIC VAPOR READINGS/COMMENTS
0'	Grout 0²–1²; Solid casing +0²–9⁶	0°–0⁷ Topsoil loam, Clay loam	Hole caving; run casing to set well
5'	Bentonite 2–6⁸	0⁷–13' Poorly Graded Gravel with clay, cobbles and boulders, GP-GC, dry, v. coarse	
10'	Sand Pack 6⁸–19⁶		
15'	Slotted Casing 9⁶–19⁶	13' Clay Shale, gray brown	PB sample cuttings
20'		19⁶–TD in shale	
25'			Hole Ca
30'			
40'			



LOGGED BY: G. Underhill

MSE INC.

ACAD#: ?.dwg
REV: – DATE: 5-24-95
DRAFTER:

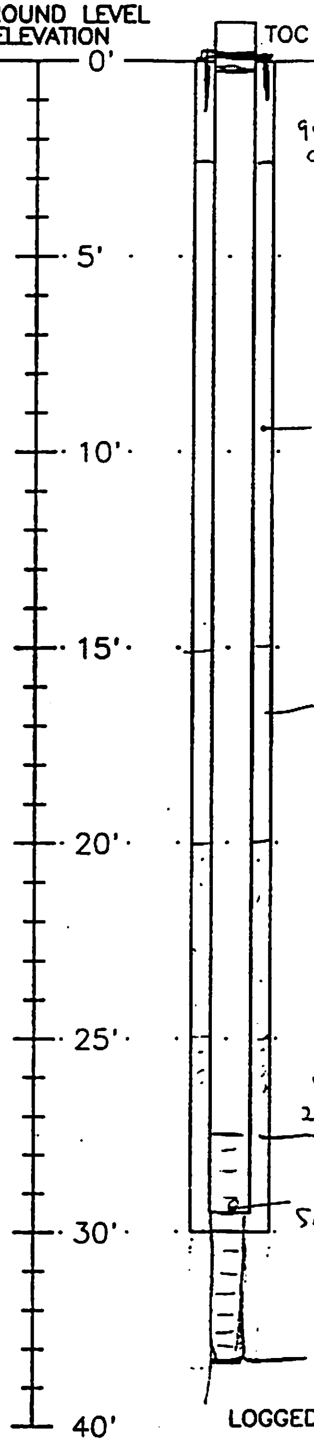
24.0
11.5
12.0
24.0

WELL LOG AND COMPLETION DETAILS

WELL NUMBER: OH-3

PROJECT: Big Sky	DRILLING METHOD: air rotary	SEAL TYPE: [illegible]
LOCATION: alluvial fan	CASING TYPE/DIA: sch 40 PVC / 2" ID	GROUT: 0'-2.5
	SCREEN TYPE/LENGTH:	BOREHOLE DIA.: 6"
DATE DRILLED: 6/27/95	SCREEN SLOT SIZE: .01	DEPTH TO WATER: 35
TOTAL DEPTH DRILLED:	FILTER PACK: 10-20 silica sand	TOP OF CASING ELEV.: -0'

GROUND LEVEL ELEVATION	TOC ELEV.: -0'	LITHOLOGY	ORGANIC VAPOR READINGS/COMMENTS
0'	grout 0'-2.5	0-1.5 topsoil/loam	
		1.5-37.4 Poorly Graded Gravel gravel - sand & silt GP-GM, sl. moist, medium dense, lt brown	
5'			
10'	Bentonite 2.5-15	very silty with fine sand moist @ 10'	
		cobbles @ 15 slightly moist	
15'	Cavings 15-20	very sandy @ 18-20	PB - 18°
20'			
25'	Sand 20-37.4		
30'	Slotted PVC 27.4-37.4	cobbles @ 30 v. sandy @ 32	
		TD @ 37.4	
40'			



LOGGED BY: Greg Underhill

MSE INC.

ACAD#: ?.dwg
REV: – DATE: 5-24-95
DRAFTER:

39.1
40
2.8
37.4

WELL LOG AND COMPLETION DETAILS

WELL NUMBER: DH-4

PROJECT: Big Sky	DRILLING METHOD: air rotary	SEAL TYPE: wt 8" monument cover
LOCATION: [illegible] side west fork	CASING TYPE/DIA: sch 40 pvc / 2"	GROUT: 0^0-1^5
	SCREEN TYPE/LENGTH: sch 40 / 10'	BOREHOLE DIA.: 6"
DATE DRILLED: [illegible]/27/95	SCREEN SLOT SIZE: .01	DEPTH TO WATER: 3^0
TOTAL DEPTH DRILLED: 21^2	FILTER PACK: 10-20 Silica Sand	TOP OF CASING ELEV.: -0^2

GROUND LEVEL ELEVATION	TOC ELEV.: ______	LITHOLOGY	ORGANIC VAPOR READINGS/COMMENTS
0'	Grout 1^5-0^4; Bentonite 1^5-4^0	0^0-1^5 Topsoil; 1^5-3^0 Poorly Graded gravel w sand, moist, med dense	
5'	Solid pvc 0^2-11^2	3^0-18 Poorly graded gravel with sand & cobbles, wet, v dense, sat @ 4.5	5^0 - SSS 3/0 . bouncing spoon on cobble; PB - cuttings
10'		abundant cobbles and boulders	SSS 3/0 spoon bouncing on cobble; rough and slow drilling; 9'
15'	Silica sand 4^0-21^2; Slotted casing 11^2-21^2	18^0-21^2 Clay shale, weathered, soft, dk gray	PB - 18^0-20 cuttings
20'		21^2 - TD	
25'			
30'			
40'			

LOGGED BY: Greg Underhill

MSE INC.

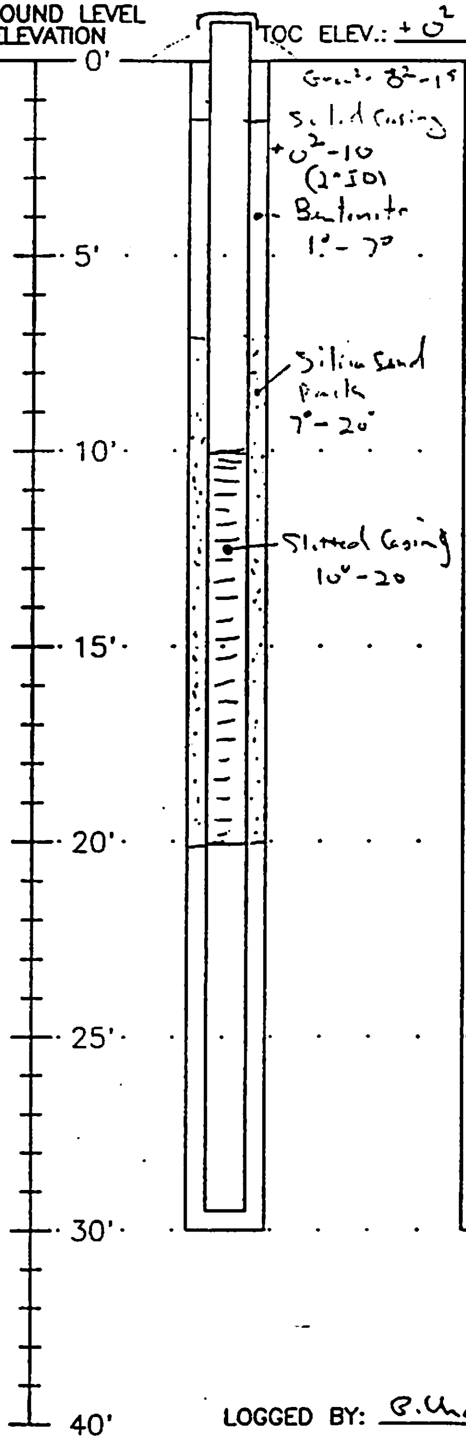
ACAD#: ?.dwg
REV: - DATE: 5-24-95
DRAFTER:

WELL LOG AND COMPLETION DETAILS

WELL NUMBER: DH-5

PROJECT: Big Sky	DRILLING METHOD: Air Rotary	SEAL TYPE:
LOCATION:	CASING TYPE/DIA: Sch 40 PVC / 2"	GROUT: 0'-1.5'
	SCREEN TYPE/LENGTH: PVC / 10'	BOREHOLE DIA.: 6"
DATE DRILLED: 6/26/95	SCREEN SLOT SIZE: .01	DEPTH TO WATER: 10'
TOTAL DEPTH DRILLED:	FILTER PACK: 10-20 Silica Sand	TOP OF CASING ELEV.: +0.2

GROUND LEVEL ELEVATION	TOC ELEV.: +0.2	LITHOLOGY	ORGANIC VAPOR READINGS/COMMENTS



LITHOLOGY:

0-1.5' topsoil

sandy silty Clay, CL, moist, firm, dk brown with scattered gravel (Clay in Alluvium)

8'-11'

Poorly Graded Gravel with sand, GP; sat, dense (Alluvium)

11'-14'

Poorly graded Gravel with cobbles & occasional boulders Clayey in part

14'- Clay Shale

ORGANIC VAPOR READINGS/COMMENTS:

Hole caving ran casing to set well

PB 14'-16' cuttings shale

LOGGED BY: B. Underhill

MSE INC.

ACAD#: ?.dwg
REV: – DATE: 5–24–95
DRAFTER:

WELL LOG AND COMPLETION DETAILS

WELL NUMBER: DH-6

PROJECT: Big Sky	DRILLING METHOD: Air rotary	SEAL TYPE:
LOCATION: Adjacent to West Fork	CASING TYPE/DIA: Sch 40 pvc / 2" 0.0	GROUT:
	SCREEN TYPE/LENGTH: Sch 40 / 10'	BOREHOLE DIA.: 6"
DATE DRILLED: 6/27/95	SCREEN SLOT SIZE: .01	DEPTH TO WATER: ≈3.5
TOTAL DEPTH DRILLED:	FILTER PACK: 10-20 Sil. Sand	TOP OF CASING ELEV.: ~0.3

GROUND LEVEL ELEVATION	TOC ELEV.: ~0.3	LITHOLOGY	ORGANIC VAPOR READINGS/COMMENTS
0'		0'-1' Topsoil etc.	
		1'-4' Silty clay with organic matter, moist, firm, dk brown	
5'		4.0-11.5 poorly Graded gravel with sand, sat, loose medium dense, med brown clayey in part (alluvium)	
10'		11.5-15' Clay shale, weathered, soft, dk grey	
		15'-16.7 clay shale, hard, dk grey	PB - cutting sample
15'			
		16.7 TD	
20'			
25'			
30'			
40'			

LOGGED BY: G. Underhill

MSE INC.

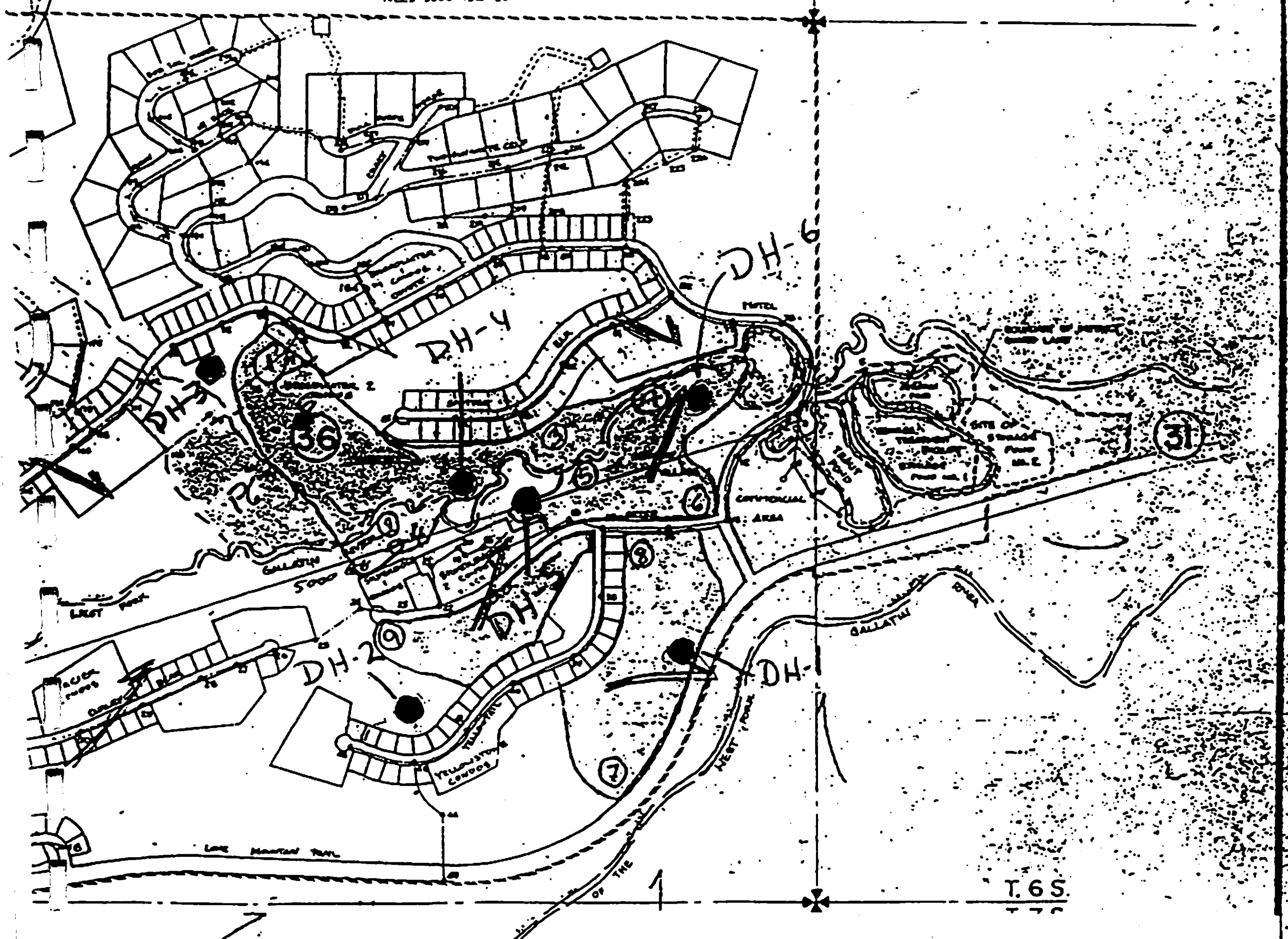
ACAD#: ?.dwg
REV: – DATE: 5-24-95
DRAFTER:

monument

Big SKY - Monitor Well Locations

● monitor well
Big Sky will obtain utility Locates prior to drilling

NOTE: DISTRICT BOUNDARIES WITHIN SECTION 36 ENCOMPASS ONLY PLATTED LOTS & TRACTS WITHIN MEADOW VILLAGE & SWEETGRASS HILLS SUBDIVISIONS.



Post-it® Fax Note 7671	Date 6/21/95 # of pages ▶
To Chip Hamilton	From Greg Underhill
Co./Dept. Big Sky	Co. MSE-HKM
Phone #	Phone # 656-6399
Fax # (406) 995-4899	Fax #

21, 1995

R.I.D. 305 BIG SKY. MONTANA

31-17-80

HKM ASSOCIATES
BILLINGS, MONTANA

PROJECT NAME Big Sky — PROJECT NO. 4B357.102

DATE SAMPLED 6/28-29/55 — DATE REC'D AT LAB 6/29/55 — SUBMITTED BY Gc

LAB NO.	DRILL HOLE	DEPTH FT.	VISUAL CLASSIFICATION	TYPE SAMPLE	ATTERBURG LIMITS	PROCTOR M/D (STD) (MOD)	GRADATION	PERMEABILITY (FALL) (CONST.)	DIRECT SHEAR	CONSOLIDATION	TRIAXIAL SHEAR	SWELL (LIN.) (CONST.)	RESISTIVITY PH SO4	UNCONFINED COMPESSION	EC, pH, SV,	pH (Ca Cl2)	EC (EXTRACT)	SAR	NATURAL MOISTURE CONTENT	Hydro
	L-1	0-1'	CL with organics	PB			X												X	X
		1'-2.5'	GP-GC	Sack			X													X
	L-5	0-1	CL with organics	PB			✓												✓	✓
		1'-2.5'	GP-GC	Sack			✓													X
	L-6	0-1'	CL with organics	PB			✓												X	X
		1'-2.5'	GP-GC	Sack			X													X

APPENDIX C

WATER QUALITY STANDARDS

MONTANA DEPARTMENT OF HEALTH
AND
ENVIRONMENTAL SCIENCES

WATER QUALITY DIVISION

Administrative Rules of Montana

SURFACE WATER QUALITY STANDARDS

Phone (406) 444-2406

Revised July 1994

Sub-Chapter 6

Surface Water Quality Standards

16.20.601 POLICY (1) The following standards are adopted to conserve water by protecting, maintaining, and improving the quality and potability of water for public water supplies, wildlife, fish and aquatic life, agriculture, industry, recreation, and other beneficial uses. (History: Sec. 75-5-201 and 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80.)

16.20.602 APPLICATION AND COMPOSITION OF SURFACE WATER QUALITY STANDARDS (1) The standards in this subchapter are adopted to establish maximum allowable changes in surface water quality and to establish a basis for limiting the discharge of pollutants which affect prescribed beneficial uses of surface waters.

(2) The surface water quality standards are composed of all rules of this subchapter.

(3) The provisions of ARM 16.20.631 through 16.20.635 and 16.20.641 and 16.20.642 apply to all surface waters unless they conflict with ARM 16.20.615 through 16.20.624 in which case the requirements of ARM 16.20.615 through 16.20.624 prevail.

(4) The standards of this subchapter are applicable where these standards are or would be violated by discharges to groundwater. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1992 MAR p. 2064, Eff. 9/11/92.)

16.20.603 DEFINITIONS In this subchapter the following terms have the meanings indicated below and are supplemental to the definitions given in 75-5-103, MCA:

(1) "Acutely toxic conditions" means conditions lethal to aquatic organisms passing through the mixing zone. Lethality is a function of the magnitude of pollutant concentrations and the duration of organism exposure to those concentrations.

(2) "Bioconcentrating parameters" means the parameters listed in department circular WQB-7 which have a bioconcentration factor greater than 300.

(3) "Carcinogenic parameters" means the parameters categorized as carcinogens in department circular WQB-7.

(4) "Chronic toxicity" means that death or functional impairment occurs or can be expected to occur to organisms exposed for periods of time exceeding 96 hours.

(5) "Conduit" means any artificial or natural duct, either open or closed, capable of conveying liquids or pollutants.

(6) "Conventional water treatment" means in order of application the processes of coagulation, sedimentation, filtration and chlorination. If determined necessary by the department it also includes taste and odor control and lime softening.

(7) "Dewatered stream" means a perennial or intermittent stream from which water has been removed for one or more beneficial uses.

(8) "Discharge" means the injection, deposit, dumping, spilling, leaking, placing, or failing to remove any pollutant so that it or any constituent thereof may enter into state waters, including ground water.

(9) "EPA" means the US Environmental Protection Agency.

(10) "Ephemeral stream" means a stream or part of a stream which flows only in direct response to precipitation in the immediate water-shed or in response to the melting of a cover of snow and ice and whose channel bottom is always above the local water table.

(11) "Geometric mean" means the value obtained by taking the Nth root of the product of the measured values where zero values for measured values are taken to be the detection limit.

(12) "Harmful parameters" means parameters listed as harmful in department circular WQB-7.

(13) "Intermittent stream" means a stream or reach of a stream that is below the local water table for at least some part of the year, and obtains its flow from both surface run-off and ground water discharge.

(14) "Mixing zone" means the area of a water body contiguous to an effluent with characteristics qualitatively or quantitatively different from those of the receiving water. The mixing zone is a place where effluent and receiving water mix and not a place where effluents are treated. Certain water quality standards may not apply in the mixing zone for those parameters regulated by a MPDES or NPDES permit. An effluent, in its mixing zone, may not block passage of aquatic organisms nor may it cause acutely toxic conditions, except that ammonia, chlorine, and dissolved oxygen may be present at concentrations so as to cause potentially toxic conditions in no more than 10% of the mixing zone provided that there is no lethality to aquatic organisms passing through the mixing zone. The area in which these exceedences may be allowed shall be as small as practicable. Provisions for specific mixing zones will be determined on a case by case basis by application of the department's surface water mixing zone implementation guide.

(15) "MPDES" means the Montana Pollutant Discharge Elimination System.

(16) "NPDES" means the National Pollutant Discharge Elimination System.

(17) "Naturally occurring" means conditions or material present from runoff or percolation over which man has no con-

trol or from developed land where all reasonable land, soil and water conservation practices have been applied. Conditions resulting from the reasonable operation of dams in existence as of July 1, 1971 are natural.

(18) "Nonpoint source" means the source of pollutants which originates from diffuse runoff, seepage, drainage, or infiltration.

(19) "Pesticide" means insecticides, herbicides, rodenticides, fungicides or any substance or mixture of substances intended for preventing, destroying, controlling, repelling, altering life processes, or mitigating any insects, rodents, nematodes, fungi, weeds and other forms of plant or animal life.

(20) "Pollutants" means sewage, industrial wastes and other wastes as defined in 75-5-103(1),(2),(3), MCA.

(21) "Reasonable land, soil, and water conservation practices" means methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include but are not limited to structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after pollution-producing activities.

(22) "Sediment" means solid material settled from suspension in a liquid; mineral or organic solid material that is being transported or has been moved from its site of origin by air, water or ice and has come to rest on the earth's surface, either above or below sea level; or inorganic or organic particles originating from weathering, chemical precipitation or biological activity.

(23) "Settleable solids" means inorganic or organic particles that are being transported or have been transported by water from the site or sites of origin and are settled or are capable of being settled from suspension.

(24) "Sewer" means a pipe or conduit that carries wastewater or drainage water.

(25) "Surface waters" means any waters on the earth's surface, including but not limited to, streams, lakes, ponds, and reservoirs; and irrigation and drainage systems discharging directly into a stream, lake, pond, reservoir or other surface water. Water bodies used solely for treating, trans-porting or impounding pollutants shall not be considered surface water.

(26) "Storm sewer" or "storm drain" means a pipe or conduit that carries storm water and surface water and street washings.

(27) "Toxic parameters" means those parameters listed as toxins in department circular WQB-7.

(28) "True color" means the color of water from which the turbidity has been removed.

(29) "Turbidity" means a condition in water or wastewater caused by the presence of suspended matter resulting in

the scattering and absorption of light rays.

(30) The board hereby adopts and incorporates by reference department circular WQB-7, entitled "Montana Numeric Water Quality Standards" (1994 edition), which establishes limits for toxic, carcinogenic, bioconcentrating, and other harmful parameters in water. Copies of circular WQB-7 may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620.

(31) The board hereby adopts and incorporates by reference ARM 16.20.1801 through 16.20.1810, which contain criteria to be used to determine the mixing zones appropriate to different sets of conditions. A copy of ARM 16.20.1801 through 16.20.1810 may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620 [phone: (406) 444-2406]. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1988 MAR p. 1191, Eff. 6/10/88; AMD, 1988 MAR p. 2221, Eff. 10/14/88; AMD, 1992 MAR p. 2064, Eff. 9/11/92; AMD, 1994 MAR p. 2136, Eff. 8/12/94.)

16.20.604 WATER-USE CLASSIFICATIONS--CLARK FORK-COLUMBIA RIVER DRAINAGE EXCEPT THE FLATHEAD AND KOOTENAI RIVER DRAINAGES The water-use classifications adopted for the Clark Fork of the Columbia River drainage are as follows:

(1) Clark Fork River drainage except waters listed in (1)(a)-(1)(n) B-1

(a) Warm Springs drainage to Myers Dam near Anaconda A-1

(b) Silver Bow Creek (mainstem) from the confluence of Blacktail Deer Creek to Warm Springs Creek I
(The concentrator tailings pond and Silver Bow Creek drainage from this pond downstream to Blacktail Deer Creek and the tailings ponds at Warm Springs have no classification.)

(c) Yankee Doodle Creek drainage to and including the North Butte water supply reservoir . A-Closed

(d) Basin Creek drainage to and including the South Butte water supply reservoir . . . . . . A-Closed

(e) Clark Fork River (mainstem) from Warm Springs Creek to Cottonwood Creek (near Deer Lodge) C-2

(f) Clark Fork River (mainstem) from Cottonwood Creek to the Little Blackfoot River C-1

(g) Tin Cup Joe Creek drainage to the Deer Lodge water supply intake . . . . A-Closed

(h) Georgetown Lake and tributaries

above Georgetown Dam (headwaters of Flint Creek drainage) A-1

(i) Fred Burr Lake and headwaters from source to the outlet of the lake (Philipsburg water supply) . . . . A-Closed

(j) South Boulder Creek drainage to the Philipsburg water supply intake A-1

(k) Rattlesnake drainage to the Missoula water supply intake . . . . A-Closed

(l) Packer and Silver Creek drainage (tributaries to the St. Regis River) to the Saltese water supply intake A-1

(m) Ashley Creek drainage to the Thompson Falls water supply intake . . . . A-Closed

(n) Pilgrim Creek drainage to the Noxon water supply intake A-1

(History: Sec. 75-5-201 and 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1988 MAR p. 1191, Eff. 6/10/88.)

16.20.605 WATER-USE CLASSIFICATIONS -- FLATHEAD RIVER DRAINAGE The water-use classifications adopted for the Flathead River are as follows:

(1) Flathead River drainage above Flathead Lake except waters listed in subsections (1)(a) through (1)(h) B-1

(a) Essex Creek drainage to the Essex water supply intake . . . . A-Closed

(b) Stillwater River (mainstem) from Logan Creek to the Flathead River. B-2

(c) Whitefish Lake and its tributaries. A-1

(d) Whitefish River (mainstem) from the outlet of Whitefish Lake to the Stillwater River. . . B-2

(e) Haskill Creek drainage to the Whitefish water supply intake A-1

(f) Ashley Creek (mainstem) from Smith Lake to bridge crossing on the airport road about one mile south of Kalispell B-2

(g) Ashley Creek (mainstem) from bridge crossing on airport road to the Flathead River. . . . C-2

(h) North and middle forks of the Flathead River above their junction A-1

(2) Flathead Lake and its tributaries from Flathead River inlet to U.S. Highway 93 bridge at Polson except Swan River and portions of Hellroaring Creek as listed in subsections (2)(a) through (2)(c) but including Swan Lake proper and Lake Mary Ronan proper A-1

(a) Swan River drainage (except Swan Lake proper) B-1

(b) Hellroaring Creek drainage to the Polson water supply intake. . . . . A-Closed

(c) Remainder of Hellroaring Creek drainage . . B-1

(3) Flathead River drainage below the highway bridge at Polson to confluence with Clark Fork River except tributaries listed in subsections (3)(a) through (3)(h) B-1

(a) Second Creek drainage to the Ronan water supply intake . . . . A-Closed

(b) Crow Creek (mainstem) from road crossing in Section 16, T20N, R20W to the Flathead River . . . B-2

(c) Little Bitterroot River (mainstem) from Hubbart Reservoir dam to the Flathead River B-2

(d) Hot Springs Creek drainage to the Hot Springs water supply intake . . . . A-Closed

(e) Hot Springs Creek (mainstem) from the Hot Springs water supply intake to the Little Bitterroot River. C-3

(f) Tributaries to Hot Springs Creek (if any) from the Hot Springs water supply intake to the Little Bitterroot River B-1

(g) Mission Creek drainage to the St. Ignatius water supply intake. A-1
(h) Mission Creek (mainstem) from U.S. Highway No. 93 crossing to the Flathead River B-2
(History: Sec. 75-5-201 and 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1982 MAR p. 1745, Eff. 10/1/82; AMD, 1984 MAR p. 1802, Eff. 12/14/84; AMD, 1988 MAR p. 1191, Eff. 6/10/88.)

16.20.606 WATER-USE CLASSIFICATIONS -- KOOTENAI RIVER DRAINAGE The water-use classifications adopted for the Kootenai River are as follows:
(1) All waters except those listed in subsections (1)(a) through (1)(d). B-1
(a) Deep Creek drainage (tributary to the Tobacco River) to the Fortine water supply intake . . A-1
(b) Rainy Creek drainage to the W. R. Grace Company water supply intake A-1
(c) Rainy Creek (mainstem) from the W. R. Grace Company water supply intake to the Kootenai River C-1
(d) Flower Creek drainage to the Libby water supply intake A-1
(History: Sec. 75-5-201 and 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80.)

16.20.607 WATER-USE CLASSIFICATIONS -- MISSOURI RIVER DRAINAGE EXCEPT YELLOWSTONE, BELLE FOURCHE, AND LITTLE MISSOURI RIVER DRAINAGES The water-use classifications adopted for the Missouri River are as follows:
(1) Missouri River drainage to and including the Sun River drainage except tributaries listed in subsections (1)(a) through (1)(m) B-1
(a) East Gallatin River (mainstem) from Montana Highway No. 293 crossing about one-half mile north of Bozeman to Dry Creek about five miles east of Manhattan. B-2
(b) Lyman and Sourdough (Bozeman) Creek drainages to the Bozeman water supply intakes . . . . A-Closed
(c) Hyalite Creek drainage to the Bozeman water supply intake A-1
(d) Big Hole River drainage to Butte Water Company intake above Divide A-1
(e) Rattlesnake Creek drainage to the Dillon water supply intake A-1
(f) Indian Creek drainage to the Sheridan water supply intake. A-1
(g) Basin Creek drainage to the Basin water supply intake A-1

(h) McClellan Creek drainage to the East Helena water supply intake A-1

(i) Prickly Pear Creek (mainstem) from the Montana Highway No. 433 crossing about one mile northwest of East Helena to Lake Helena. I

(j) Ten Mile Creek drainage to the Helena water supply intake. A-1

(k) Willow Creek drainage to the White Sulphur Springs water supply intake . . . . A-Closed

(l) Muddy Creek mainstem (tributary of Sun River). I

(m) Sun River (mainstem) from Muddy Creek to the Missouri River B-3

(2) Missouri River drainage from Sun River to Rainbow Dam. B-2

(3) Missouri River drainage from Rainbow Dam in Great Falls to the Marias River except waters listed in subsections (3)(a) through (3)(d) B-3

(a) Belt Creek drainage to and including Otter Creek drainage except portion of O'Brien Creek listed in subsection (3)(a)(i). B-1

(i) O'Brien Creek drainage to the Neihart water supply intake A-1

(b) Belt Creek (mainstem) from Otter Creek to the Missouri River B-2

(c) Tributaries to Belt Creek from Otter Creek to the Missouri River B-1

(d) Highwood and Shonkin Creek drainages. . . . B-1

(4) Marias River drainage except the tributaries and segments listed in subsections (4)(a) through (4)(g) B-2

(a) Cutbank Creek drainage except waters listed in subsections (4)(a)(i) and (ii). B-1

(i) Willow Creek (mainstem) from the Montana Highway No. 464 crossing about one-half mile north of Browning to Cutbank Creek B-2

(ii) Cutbank Creek (mainstem) from Old Maid Miller Coulee near Cut Bank to Birch Creek . . . B-2

(b) Two Medicine Creek drainage except for the waters listed in subsections (4)(b)(i) through (4)(b)(iii). B-1

(i) Midvale Creek drainage to the East Glacier water supply intake. . . . . A-Closed

(ii) Summit Creek drainage to the Summit water supply intake. . . . . A-Closed

(iii) Two Medicine Creek (mainstem) from Badger Creek to Birch Creek. B-2

(c) Dry Fork Marias River (mainstem) from Interstate 15 crossing near Conrad to Marias River B-3

(d) Teton River drainage to and including Deep Creek near Choteau B-1

(e) Marias River mainstem from Tiber Dam to the county road crossing in section 17, township 29 north, range 5 east B-1

(f) Teton River below Highway (Interstate) 15 . . . . B-3

(5) Missouri River drainage from Marias River to Fort Peck Dam except waters listed in subsections (5)(a) through (5)(f) C-3

(a) Missouri River (mainstem) from Marias River to Fort Peck Dam B-3

(b) Eagle Creek drainage to but excluding Dog Creek B-1

(c) Judith River drainage except waters listed in subsections (5)(c)(i) through (5)(c)(v) . . B-1

(i) Big Spring Creek (mainstem) from the Mill Ditch headgate to the Judith River B-2

(ii) Judith River (mainstem) from Big Spring Creek to the Missouri River. B-2

(iii) Sage Creek drainage below U.S. Highway 87 . . . . C-3

(iv) Wolf Creek drainage below U.S. Highway 87 . . . . C-3

(v) Tributaries to Judith River from Big Spring Creek to the Missouri River. C-3

(d) Cow Creek drainage to but excluding Al's Creek. B-1

(e) Musselshell River drainage to Deadman's Basin diversion canal above Shawmut except for the water listed in subsection (5)(e)(i). B-1

(i) Musselshell River (mainstem) from Hopley Creek to Deadman's Basin Diversion Canal near Shawmut. B-2

(f) Musselshell River drainage below Deadman's Basin diversion canal above Shawmut except for the waters listed in subsections (5)(f)(i)-(5)(f)(iv). C-3

(i) Deadman's Basin Reservoir B-1

(ii) Careless and Swimming Woman Creek drainage above their confluence north of Ryegate. . . B-1

(iii) Flatwillow Creek drainage above U.S. Highway 87 crossing south of Grassrange. B-2

(iv) South Willow Creek drainage above county road bridge in T10N, R24E, Section 7 . . . . . B-1

(6) Missouri River drainage from Fort Peck Dam to the Milk River B-2

(7) Milk River drainage from source (or from the Glacier National Park Boundary) to the International Boundary B-1

(8) Milk River drainage from the International Boundary to the Missouri River except the tributaries listed in subsections (8)(a) through (8)(c). B-3

(a) Big Sandy Creek drainage to Town of Big Sandy infiltration wells. B-1

(b) Beaver, Little Box Elder and Clear Creek drainage (near Havre) B-1

(c) Peoples Creek drainage to and including the South Fork of Peoples Creek drainage. B-1

(9) Missouri River drainage from Milk River to North Dakota boundary except waters listed in subsections (9)(a) through (9)(d) C-3

(a) Missouri River (mainstem) from Milk River to North Dakota boundary B-3

(b) Wolf Creek drainage near Wolf Point B-2

(c) Antelope Creek drainage near Antelope . . . B-3

(d) Poplar River drainage B-2

(History: Sec. 75-5-201 and 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1982 MAR p. 1745, Eff. 10/1/82; AMD, 1984 MAR p. 1802, Eff. 12/14/84; AMD, 1988 MAR p. 1191, Eff. 6/10/88.)

16.20.608 WATER-USE CLASSIFICATION -- YELLOWSTONE RIVER DRAINAGE The water-use classifications adopted for the Yellowstone River are as follows:

(1) Yellowstone River drainage to the Laurel water supply intake. B-1

(2) Yellowstone River drainage from the Laurel water supply intake to the Billings water supply intake except the tributaries listed in subsections (2)(a) through (2)(c) B-2

(a) Clarks Fork Yellowstone River drainage from source to the Wyoming state line and from the Wyoming state line to and including Jack Creek near Bridger B-1

(b) Mainstem of the Clarks Fork River from Jack Creek to the Yellowstone River. B-2

(c) Tributaries to the Clarks Fork Yellowstone River from Jack Creek to the Yellowstone River except the portion of West Fork of Rock Creek listed in subsection (2)(c)(i) B-1

(i) West Fork of Rock Creek drainage to the Red Lodge water supply intake. A-1

(3) Yellowstone River drainage from the Billings water supply intake to the North Dakota state line and including the Big Horn River drainage except the waters listed in subsections (3)(a) through (3)(f) C-3

(a) Yellowstone River mainstem. B-3

(b) Pryor Creek drainage to Interstate 90 . . . B-1

(c) Big Horn drainage above but excluding Williams Coulee near Hardin B-1

(d) Little Big Horn drainage above and including Lodgegrass Creek drainage near Lodge Grass B-1

(e) Remainder of the Little Big Horn drainage B-2

(f) Big Horn River mainstem from Williams Coulee to Yellowstone River. B-2

(4) Yellowstone River drainage from Big Horn River to North Dakota boundary except waters listed in subsections (4)(a) through (4)(d) C-3

(a) Yellowstone River mainstem from Big Horn River to North Dakota boundary B-3

(b) Tongue River (mainstem) from Wyoming boundary to Prairie Dog Coulee. B-2

(c) Tongue River mainstem from Prairie Dog Coulee to Yellowstone River B-3

(d) Fox Creek drainage near Sidney. B-2

(History: Sec. 75-5-201 and 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1988 MAR p. 1191, Eff. 6/10/88.)

16.20.609 WATER-USE CLASSIFICATIONS -- LITTLE MISSOURI RIVER DRAINAGE -- BELLE FOURCHE DRAINAGE

(1) The water-use classifications adopted for all waters in the Little Missouri and Belle Fourche drainages are C-3

(History: Sec. 75-5-201 and 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80.)

16.20.610 WATER-USE CLASSIFICATIONS -- HUDSON BAY DRAINAGE The water-use classifications for the Hudson Bay drainage are:

(1) All waters outside Glacier National Park B-1

(History: Sec. 75-5-201 and 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80.)

<u>16.20.611 WATER-USE CLASSIFICATIONS -- NATIONAL PARK, WILDERNESS AND PRIMITIVE AREA WATERS</u> The water-use classifications for all national park, wilderness and primitive area waters are as follows:

(1) All waters even if classifications listed in ARM 16.20.604 through ARM 16.20.610 imply or state otherwise. A-1

(History: Sec. 75-5-201 and 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80.)

<u>16.20.612 WATER-USE CLASSIFICATIONS -- INDIAN RESERVATIONS</u> (1) All waters are unclassified, even if listed in ARM 16.20.604 through 16.20.611. (History: Sec. 75-5-201 and 75-5-301, MCA; IMP, Sec. 75-5-301, MCA; NEW, 1988 MAR p. 1191, Eff. 6/10/88.)

Rules 16.20.613 through 16.20.614 reserved

NEXT PAGE IS 16-949

16.20.615 SPECIFIC SURFACE WATER QUALITY STANDARDS--GENERAL (1) Specific surface water quality standards, along with general provisions in ARM 16.20.631 through 16.20.635 and ARM 16.20.641 and 16.20.642, protect the beneficial water uses set forth in the water-use descriptions for the following classifications of water.

(2) Standards for organisms of the coliform group are based on a minimum of five samples obtained during separate 24-hour periods during any consecutive 30-day period analyzed by the most probable number or equivalent membrane filter methods. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80.)

16.20.616 A-CLOSED CLASSIFICATION (1) Waters classified A-Closed are suitable for drinking, culinary, and food processing purposes after simple disinfection. Water quality is suitable for swimming, recreation, growth, and propagation of fishes and associated aquatic life, although access restrictions to protect public health may limit actual use of A-Closed waters for these uses.

(2) Public access and activities such as livestock grazing and timber harvest are to be controlled by the utility owner under conditions prescribed and orders issued by the department.

(3) No person may violate the following specific water quality standards for waters classified A-Closed:

(a) The geometric mean number of organisms in the coliform group must not exceed 50 per 100 milliliters.

(b) No change from naturally occurring dissolved oxygen levels is allowed.

(c) No change from natural pH is allowed.

(d) No increase above naturally occurring turbidity is allowed.

(e) No increase above naturally occurring water temperature is allowed.

(f) No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) No increase in true color is allowed.

(h) No increases of carcinogenic, bioconcentrating, toxic or harmful parameters, pesticides and organic and inorganic materials, including heavy metals, above naturally occurring concentrations, are allowed.

(i) No increase in radioactivity above natural background levels is allowed. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1988 MAR p. 1191, Eff. 6/10/88; AMD, 1994 MAR p. 2136, Eff. 8/12/94.)

16.20.617 A-1 CLASSIFICATION (1) Waters classified A-1 are suitable for drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities.

(2) Water quality must be suitable for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(3) No person may violate the following specific water quality standards for waters classified A-1:

(a) The geometric mean number of organisms in the coliform group must not exceed 50 per 100 milliliters if resulting from domestic sewage.

(b) Dissolved oxygen concentration must not be reduced below the applicable standards given in department circular WQB-7.

(c) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

(d) No increase above naturally occurring turbidity is allowed except as permitted in ARM 16.20.633.

(e) A 1°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 66°F; within the naturally occurring range of 66°F to 66.5°F, no discharge is allowed which will cause the water temperature to exceed 67°F; and where the naturally occurring water temperature is 66.5°F or greater, the maximum allowable increase in water temperature is 0.5°F. A 2°F-per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F, and a 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F.

(f) No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) True color must not be increased more than two units above naturally occurring color.

(h)(i) Concentrations of carcinogenic, bioconcentrating, toxic, or harmful parameters which would remain in the water after conventional water treatment may not exceed the applicable standards set forth in department circular WQB-7.

(ii) Dischargers issued permits under ARM Title 16, chapter 20, subchapter 9, shall conform with ARM Title 16, chapter

20, subchapter 7, the nondegradation rules, and may not cause receiving water concentrations to exceed the applicable standards contained in department circular WQB-7 when stream flows equal or exceed the design flows specified in ARM 16.20.631(4).

(iii) If site-specific criteria are developed using the procedures given in the Water Quality Standards Handbook (US EPA, Dec. 1983), and provided that other routes of exposure to toxic parameters by aquatic life are addressed, the criteria so developed shall be used as water quality standards for the affected waters and as the basis for permit limits instead of the applicable standards in department circular WQB-7.

(iv) In accordance with 75-5-306(1), MCA, it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water as long as the minimum treatment requirements, adopted pursuant to 75-5-305, MCA, are met.

(4) The board hereby adopts and incorporates herein by reference the following:

(a) Department circular WQB-7, entitled "Montana Numeric Water Quality Standards" (1994 edition), which establishes limits for toxic, carcinogenic, bioconcentrating, and other harmful parameters in water; and

(b) the Water Quality Standards Handbook (US EPA, Dec. 1983) which sets forth procedures for development of site-specific criteria.

(c) Copies of these materials may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1984 MAR p. 1802, Eff. 12/14/84; AMD, 1988 MAR p. 1191, Eff. 6/10/88; AMD, 1994 MAR p. 2136, Eff. 8/12/94.)

16.20.618 B-1 CLASSIFICATION (1) Waters classified B-1 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(2) No person may violate the following specific water quality standards for waters classified B-1:

(a) During periods when the daily maximum water temperature is greater than 60°F, the geometric mean number of organisms in the fecal coliform group must not exceed 200 per 100 milliliters, nor are 10 percent of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters.

(b) Dissolved oxygen concentration must not be reduced below the levels given in department circular WQB-7.

(c) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

(d) The maximum allowable increase above naturally occurring turbidity is 5 nephelometric turbidity units except as permitted in ARM 16.20.633.

(e) A 1°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 66°F; within the naturally occurring range of 66°F to 66.5°F, no discharge is allowed which will cause the water temperature to exceed 67°F; and where the naturally occurring water temperature is 66.5°F or greater, the maximum allowable increase in water temperature is 0.5°F. A 2°F-per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F, and a 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F. This applies to all waters in the state classified B-1 except for Prickly Pear Creek from McClellan Creek to the Montana Highway No. 433 crossing where a 2°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 65°F; within the naturally occurring range of 65°F to 66.5°F, no discharge is allowed which will cause the water temperature to exceed 67°F; and where the naturally occurring water temperature is 66.5°F or greater, the maximum allowable increase in water temperature is 0.5°F.

(f) No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) True color must not be increased more than five units above naturally occurring color.

(h)(i) Concentrations of carcinogenic, bioconcentrating, toxic or harmful parameters which would remain in the water after conventional water treatment may not exceed the applicable standards set forth in department circular WQB-7.

(ii) Dischargers issued permits under ARM Title 16, chapter 20, subchapter 9, shall conform with ARM Title 16, chapter 20, subchapter 7, the nondegradation rules, and may not cause receiving water concentrations to exceed the applicable standards specified in department circular WQB-7 when stream flows equal or exceed the design flows specified in ARM 16.20.631(4).

(iii) If site-specific criteria are developed using the procedures given in the Water Quality Standards Handbook (US EPA, Dec. 1983), and provided that other routes of exposure to toxic parameters by aquatic life are addressed, the criteria so developed shall be used as water quality standards for the affected waters and as the basis for permit limits instead of the applicable standards in department circular WQB-7.

(iv) In accordance with 75-5-306(1), MCA, it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water as long as the minimum treatment requirements, adopted pursuant to 75-5-305, MCA, are met.

(3) The board hereby adopts and incorporates by reference the following:

(a) Department circular WQB-7, entitled "Montana Numeric Water Quality Standards" (1994 edition), which establishes standards for toxic, carcinogenic, bioconcentrating, and harmful parameters in water; and

(b) The Water Quality Standards Handbook (US EPA, Dec. 1983) which sets forth procedures for development of site-specific criteria.

(c) Copies of these materials may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1982 MAR p. 1746, Eff. 10/1/82; AMD, 1984 MAR p. 1802, Eff. 12/14/84; AMD, 1988 MAR p. 1191, Eff. 6/10/88; AMD, 1994 MAR p. 2136, Eff. 8/12/94.)

16.20.619 B-2 CLASSIFICATION (1) Waters classified B-2 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(2) No person may violate the following specific water quality standards for waters classified B-2:

(a) During periods when the daily maximum water temperature is greater than 60°F, the geometric mean number of organisms in the fecal coliform group must not exceed 200 per 100 milliliters, nor are 10% of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters.

(b) Dissolved oxygen concentration must not be reduced below the applicable standards given in department circular WQB-7.

(c) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 9.0 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

(d) The maximum allowable increase above naturally occurring turbidity is 10 nephelometric turbidity units except as permitted in ARM 16.20.633.

(e) A 1°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 66°F; within the naturally occurring range of 66°F to 66.5°F, no discharge is allowed which will cause the water temperature to exceed 67°F; and where the naturally occurring water temperature is 66.5°F or greater, the maximum allowable increase in water temperature is 0.5°F. A 2°F-per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F, and a 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F.

(f) No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) True color must not be increased more than five units above naturally occurring color.

(h)(i) Concentrations of carcinogenic, bioconcentrating, toxic or harmful parameters which would remain in the water after conventional water treatment may not exceed the applicable standards set forth in department circular WQB-7.

(ii) Dischargers issued permits under ARM Title 16, chapter 20, subchapter 9, shall conform with ARM Title 16, chapter 20, subchapter 7, the nondegradation rules, and may not cause receiving water concentrations to exceed the applicable standards specified in department circular WQB-7 when stream flows equal or exceed the design flows specified in ARM 16.20.631(4).

(iii) If site-specific criteria are developed using the procedures given in the Water Quality Standards Handbook (US EPA, Dec. 1983), and provided that other routes of exposure to toxic parameters by aquatic life are addressed, the criteria so developed shall be used as water quality standards for the affected waters and as the basis for permit limits instead of the applicable standards in department circular WQB-7.

(iv) In accordance with 75-5-306(1), MCA, it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water as long as the minimum treatment requirements, adopted pursuant to 75-5-305, MCA, are met.

(3) The board hereby adopts and incorporates by reference the following:

(a) Department circular WQB-7, entitled "Montana Numeric Water Quality Standards" (1994 edition), which establishes standards for toxic, carcinogenic, bioconcentrating, and harmful parameters in water; and

(b) the Water Quality Standards Handbook (US EPA, Dec. 1983) which sets forth procedures for development of site-specific criteria.

(c) Copies of these materials may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1982 MAR p. 1746, Eff. 10/1/82; AMD, 1984 MAR p. 1802, Eff. 12/14/84; AMD, 1988 MAR p. 1191, Eff. 6/10/88; AMD, 1994 MAR p. 2136, Eff. 8/12/94.)

16.20.620 B-3 CLASSIFICATION (1) Waters classified B-3 are suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(2) No person may violate the following specific water quality standards for waters classified B-3:

(a) During periods when the daily maximum water temperature is greater than 60°F, the geometric mean number of organisms in the fecal coliform group must not exceed 200 per 100 milliliters, nor are 10% of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters.

(b) Dissolved oxygen concentration must not be reduced below the applicable standards specified in department circular WQB-7.

(c) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 9.0 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

(d) The maximum allowable increase above naturally occurring turbidity is 10 nephelometric turbidity units except as permitted in ARM 16.20.633.

(e) A 3°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 77°F; within the naturally occurring range of 77°F to 79.5°F, no thermal discharge is allowed which will cause the water temperature to exceed 80°F; and where the naturally occurring water temperature is 79.5°F or greater, the maximum allowable increase in water temperature is 0.5°F. A 2°F-per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F, and a 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F.

(i) These allowable increases apply to all waters in the state classified B-3, except for the mainstem of the Yellowstone River from the Billings water supply intake to the water diversion at Intake, where a 3°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 79°F; within the range of 79°F to 81.5°F, no thermal discharge is allowed which will cause the water temperature to exceed 82°F; and where the naturally occurring water temperature is 81.5°F or greater, the maximum allowable increase in water temperature is 0.5°F.

(ii) From the water diversion at Intake to the North Dakota state line, a 3°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 82°F; within the range of 82°F to 84.5°F, no thermal discharge is allowed which will cause the water temperature to exceed 85°F; and where the naturally occurring water temperature is 84.5°F or greater, the maximum allowable increase in water temperature is 0.5°F.

(f) No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) True color must not be increased more than five units above naturally occurring color.

(h)(i) Concentrations of carcinogenic, bioconcentrating, toxic, or harmful parameters which would remain in the water after conventional water treatment may not exceed the applicable standards set forth in department circular WQB-7.

(ii) Dischargers issued permits under ARM Title 16, chapter 20, subchapter 9, shall conform with ARM Title 16, chapter 20, subchapter 7, the nondegradation rules, and may not cause receiving water concentrations to exceed the applicable standards specified in department circular WQB-7 when stream flows equal or exceed the design flows specified in ARM 16.20.631(4).

(iii) If site-specific criteria are developed using the procedures given in the Water Quality Standards Handbook (US EPA, Dec. 1983), and provided that other routes of exposure to toxic parameters by aquatic life are addressed, the criteria so developed shall be used as water quality standards for the affected waters and as the basis for permit limits instead of the applicable standards specified in department circular WQB-7.

(iv) In accordance with 75-5-306(1), MCA, it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water as long as the minimum treatment requirements, adopted pursuant to 75-5-305, MCA, are met.

(3) The board hereby adopts and incorporates by reference the following:

(a) Department circular WQB-7, entitled "Montana Numeric Water Quality Standards" (1994 edition), which establishes standards for toxic, carcinogenic, bioconcentrating, and harmful parameters in water; and

(b) the Water Quality Standards Handbook (US EPA, Dec.

1983) which sets forth procedures for development of site-specific criteria.

(c) Copies of these materials may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1982 MAR p. 1746, Eff. 10/1/82; AMD, 1984 MAR p. 1802, Eff. 12/14/84; AMD, 1988 MAR p. 1191, Eff. 6/10/88; AMD, 1994 MAR p. 2136, Eff. 8/12/94.)

16.20.621 C-1 CLASSIFICATION (1) Waters classified C-1 are suitable for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(2) No person may violate the following specific water quality standards for waters classified C-1:

(a) During periods when the daily maximum water temperature is greater than 60°F, the geometric mean number of organisms in the fecal coliform group must not exceed 200 per 100 milliliters, nor are 10% of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters.

(b) Dissolved oxygen concentration must not be reduced below the applicable standards given in department circular WQB-7.

(c) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 8.5 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

(d) The maximum allowable increase above naturally occurring turbidity is 5 nephelometric turbidity units except as permitted in ARM 16.20.633.

(e) A 1°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 66°F; within the naturally occurring range of 66°F to 66.5°F, no discharge is allowed which will cause the water temperature to exceed 67°F; and where the naturally occurring water temperature is 66.5°F or greater, the maximum allowable increase in water temperature is 0.5°F. A 2°F-per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F, and a 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F.

(f) No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) True color must not be increased more than five units above naturally occurring color.

(h)(i) Concentrations of carcinogenic, bioconcentrating, toxic, or harmful parameters may not exceed levels which render the waters harmful, detrimental or injurious to public health. Concentrations of toxic parameters also may not exceed the applicable standards specified in department circular WQB-7.

(ii) Dischargers issued permits under ARM Title 16, chapter 20, subchapter 9, shall conform with ARM Title 16, chapter 20, subchapter 7, the nondegradation rules, and may not cause receiving water concentrations to exceed the applicable standards specified in department circular WQB-7 when stream flows equal or exceed the design flows specified in ARM 16.20.631(4).

(iii) If site-specific criteria are developed using the procedures given in the Water Quality Standards Handbook (US EPA, Dec. 1983), and provided that other routes of exposure to toxic parameters by aquatic life are addressed, the criteria so developed shall be used as water quality standards for the affected waters and as the basis for permit limits instead of the applicable standards in department circular WQB-7.

(iv) In accordance with 75-5-306(1), MCA, it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water as long as the minimum treatment requirements, adopted pursuant to 75-5-305, MCA, are met.

(3) The board hereby adopts and incorporates by reference the following:

(a) Department circular WQB-7, entitled "Montana Numeric Water Quality Standards" (1994 edition), which establishes standards for toxic, carcinogenic, bioconcentrating, and harmful parameters in water; and

(b) the Water Quality Standards Handbook (US EPA, Dec. 1983) which sets forth procedures for development of site-specific criteria.

(c) Copies of these materials may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1982 MAR p. 1746, Eff. 10/1/82; AMD, 1984 MAR p. 1802, Eff. 12/14/84; AMD, 1988 MAR p. 1191, Eff. 6/10/88; AMD, 1994 MAR p. 2136, Eff. 8/12/94.)

16.20.622 C-2 CLASSIFICATION (1) Waters classified C-2 are suitable for bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.

(2) No person may violate the following specific water quality standards for waters classified C-2:

(a) During periods when the daily maximum water temperature is greater than 60°F, the geometric mean number of organisms in the fecal coliform group must not exceed 200 per 100 milliliters, nor are 10% of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters.

(b) Dissolved oxygen concentration may not be reduced below 7.0 milligrams per liter from October 1 through June 1 nor below 6.0 milligrams per liter from June 2 through September 30. These levels apply to all waters in the state classified C-2 except for Ashley Creek below the bridge crossing on airport road where the dissolved oxygen concentrations may not be reduced below 5 mg/l from October 1 through June 1, nor below 3 mg/l from June 2 through September 30.

(c) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 9.0 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

(d) The maximum allowable increase above naturally occurring turbidity is 10 nephelometric turbidity units except as permitted in ARM 16.20.633.

(e) A 1°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 66°F; within the naturally occurring range of 66°F to 66.5°F, no discharge is allowed which will cause the water temperature to exceed 67°F; and where the naturally occurring water temperature is 66.5°F or greater, the maximum allowable increase in water temperature is 0.5°F. A 2°F-per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F, and a 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F.

(f) No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils, or floating solids which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) True color must not be increased more than five units above naturally occurring color.

(h)(i) Concentrations of carcinogenic, bioconcentrating, toxic, or harmful parameters may not exceed levels which render the waters harmful, detrimental or injurious to public health. Concentrations of toxic parameters also may not exceed the applicable standards specified in department circular WQB-7.

(ii) Dischargers issued permits under ARM Title 16, chapter 20, subchapter 9, shall conform with ARM Title 16, chapter 20, subchapter 7, the nondegradation rules, and may not cause receiving water concentrations to exceed the applicable standards specified in department circular WQB-7 when stream flows equal or exceed the design flows specified in ARM 16.20.631(4).

(iii) If site-specific criteria are developed using the procedures given in the Water Quality Standards Handbook (US EPA, Dec. 1983), and provided that other routes of exposure to toxic parameters by aquatic life are addressed, the criteria so developed shall be used as water quality standards for the affected waters and as the basis for permit limits instead of the applicable standards in department circular WQB-7.

(iv) In accordance with 75-5-306(1), MCA, it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water as long as the minimum treatment requirements, adopted pursuant to 75-5-305, MCA, are met.

(3) The board hereby adopts and incorporates by reference the following:

(a) Department circular WQB-7, entitled "Montana Numeric Water Quality Standards" (1994 edition), which establishes standards for toxic, carcinogenic, bioconcentrating, and harmful parameters in water; and

(b) The Water Quality Standards Handbook (US EPA, Dec. 1983) which sets forth procedures for development of site-specific criteria.

(c) Copies of these materials may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1982 MAR p. 1746, Eff. 10/1/82; AMD, 1984 MAR p. 1802, Eff. 12/14/84; AMD, 1988 MAR p. 1191, Eff. 6/10/88; AMD, 1994 MAR p. 2136, Eff. 8/12/94.)

16.20.623 I CLASSIFICATION (1) The goal of the state of Montana is to have these waters fully support the following uses: drinking, culinary, and food processing purposes after conventional treatment; bathing, swimming, and recreation; growth and propagation of fishes and associated aquatic life, waterfowl, and furbearers; and agricultural and industrial water supply. An analysis will be performed for each of these waters during each triennial standards review period to determine the factors preventing or limiting attainment of the designated uses listed herein. Based on these analyses, the specific standards listed below will be adjusted to reflect any improvements which have occurred in water quality as a result of water quality control of nonpoint-source pollution.

(2) No person may violate the following specific water quality standards for waters classified I:

(a) During periods when the daily maximum water temperature is greater than 60°F, the geometric mean number of organisms in the fecal coliform group must not exceed 200 per 100 milliliters, nor are 10% of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters.

(b) Dissolved oxygen concentration must not be reduced below 3.0 milligrams per liter.

(c) Hydrogen ion concentration must be maintained within the range of 6.5 to 9.5.

(d) No increase in naturally occurring turbidity is allowed which will or is likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(e) No increase in naturally occurring temperature is allowed which will or is likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(f) No increases above naturally occurring concentrations of sediment and settleable solids, oils, or floating solids are allowed which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) No increase in naturally occurring true color is allowed which will or is likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(h)(i) No discharges of toxic, carcinogenic, or harmful parameters may commence or continue which lower or are likely to lower the overall water quality of these waters.

(ii) As the quality of these waters improves due to control of nonpoint sources, point-source dischargers will be required to improve the quality of their discharges following the MPDES rules (ARM Title 16, chapter 20, subchapter 9).

(iii) Beneficial uses are considered supported when the concentrations of toxic, carcinogenic, or harmful parameters in these waters do not exceed the applicable standards specified in department circular WQB-7 when stream flows equal or exceed the flows specified in ARM 16.20.631(4) or, alternatively, for aquatic life when site-specific criteria are developed using the procedures given in the Water Quality Standards Handbook (US EPA, Dec. 1983), and provided that other routes of exposure to toxic parameters by aquatic life are addressed. The limits so developed shall be used as water quality standards for the affected waters and as the basis for permit limits instead of the applicable standards in department circular WQB-7.

(iv) Limits for toxic, carcinogenic, or harmful parameters in new discharge permits issued pursuant to the MPDES rules (ARM Title 16, chapter 20, subchapter 9) are the larger of either the applicable standards specified in department circular WQB-7, site-specific standards, or one-half of the mean in-stream concentrations immediately upstream of the discharge point.

(3) The board hereby adopts and incorporates by reference the following:

(a) Department circular WQB-7, entitled "Montana Numeric Water Quality Standards" (1994 edition), which establishes standards for toxic, carcinogenic, bioconcentrating, and harmful parameters in water; and

(b) The Water Quality Standards Handbook (US EPA, Dec. 1983).

(c) Copies of this material may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1982 MAR p. 1746, Eff. 10/1/82; AMD, 1988 MAR p. 1191, Eff. 6/10/88; AMD, 1994 MAR p. 2136, Eff. 8/12/94.)

16.20.624 C-3 CLASSIFICATION (1) Waters classified C-3 are suitable for bathing, swimming and recreation, growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers. The quality of these waters is naturally marginal for drinking, culinary and food processing purposes, agriculture and industrial water supply. Degradation which will impact established beneficial uses will not be allowed.

(2) No person may violate the following specific water quality standards for waters classified C-3:

(a) During periods when the daily maximum water temperature is greater than 60°F, the geometric mean number of organisms in the fecal coliform group must not exceed 200 per 100 milliliters, nor are 10% of the total samples during any 30-day period to exceed 400 fecal coliforms per 100 milliliters.

(b) Dissolved oxygen concentration must not be reduced below the applicable standards specified in department circular WQB-7.

(c) Induced variation of hydrogen ion concentration (pH) within the range of 6.5 to 9.0 must be less than 0.5 pH unit. Natural pH outside this range must be maintained without change. Natural pH above 7.0 must be maintained above 7.0.

(d) The maximum allowable increase above naturally occurring turbidity is 10 nephelometric turbidity units, except as permitted in ARM 16.20.633.

(e) A 3°F maximum increase above naturally occurring water temperature is allowed within the range of 32°F to 77°F; within the range of 77°F to 79.5°F, no thermal discharge is allowed which will cause the water temperature to exceed 80°F;

and where the naturally occurring water temperature is 79.5°F or greater, the maximum allowable increase in water temperature is 0.5°F. A 2°F-per-hour maximum decrease below naturally occurring water temperature is allowed when the water temperature is above 55°F, and a 2°F maximum decrease below naturally occurring water temperature is allowed within the range of 55°F to 32°F.

(f) No increases are allowed above naturally occurring concentrations of sediment, settleable solids, oils or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.

(g) True color must not be increased more than five units above naturally occurring color.

(h)(i) Concentrations of carcinogenic, bioconcentrating, toxic, or harmful parameters which would remain in the water after conventional water treatment may not exceed the applicable standards set forth in department circular WQB-7.

(ii) Dischargers issued permits under ARM Title 16, chapter 20, subchapter 9, shall conform with ARM Title 16, chapter 20, subchapter 7, the nondegradation rules, and may not cause receiving water concentrations to exceed the applicable standards specified in department circular WQB-7 when stream flows equal or exceed the design flows specified in ARM 16.20.631(4).

(iii) If site-specific criteria are developed using the procedures given in the Water Quality Standards Handbook (US EPA, Dec. 1983), and provided that other routes of exposure to toxic parameters by aquatic life are addressed, the criteria so developed shall be used as water quality standards for the affected waters and as the basis for permit limits instead of the applicable standards specified in department circular WQB-7.

(iv) In accordance with 75-5-306(1), MCA, it is not necessary that wastes be treated to a purer condition than the natural condition of the receiving water as long as the minimum treatment requirements, adopted pursuant to 75-5-305, MCA, are met.

(3) The board hereby adopts and incorporates by reference the following:

(a) Department circular WQB-7, entitled "Montana Numeric Water Quality Standards" (1994 edition), which establishes standards for toxic, carcinogenic, bioconcentrating, and harmful parameters in water; and

(b) The Water Quality Standards Handbook (US EPA, Dec. 1983) which sets forth procedures for development of site-specific criteria.

(c) Copies of these materials may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana

59620. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1982 MAR p. 1746, Eff. 10/1/82; AMD, 1984 MAR p. 1802, Eff. 12/14/84; AMD, 1988 MAR p. 1191, Eff. 6/10/88; AMD, 1994 MAR p. 2136, Eff. 8/12/94.)

Rules 16.20.625 through 16.20.630 reserved

NEXT PAGE IS 16-967

16.20.631 TREATMENT STANDARDS (1) The degree of waste treatment required to restore and maintain the quality of surface waters to the standards shall be based on the surface water quality standards and the following:

(a) The state's policy of nondegradation of existing high water quality as described in section 75-5-303, MCA;

(b) Present and anticipated beneficial uses of the receiving water;

(c) The quality and nature of the flow of the receiving water;

(d) The quantity and quality of the sewage, industrial waste or other waste to be treated; and

(e) The presence or absence of other sources of pollution on the same watershed.

(f) During periods when the maximum daily water temperature is less than 60°F, the instream fecal coliform concentrations shall be limited by the Department only when necessary to protect human health.

(2) Sewage must receive a minimum of secondary treatment as defined by EPA in accordance with requirements set forth in the Federal Water Pollution Control Act, 33 U.S.C., et seq., (Supp. 1973) as amended, and 40 CFR Part 133 and subsequent amendments. Copies of 40 CFR Part 133 and subsequent amendments may be obtained from the department.

(3) Industrial waste must receive, as a minimum, treatment equivalent to the best practicable control technology currently available (BPCTCA) as defined in 40 CFR Subchapter N and subsequent amendments. Copies of 40 CFR Subchapter N and subsequent amendments may be obtained from the department. In cases where BPCTCA is not defined by EPA, industrial waste must receive a minimum of secondary treatment or equivalent as determined by the department.

(4) For design of disposal systems, stream flow dilution requirements must be based on the minimum consecutive 7-day average flow which may be expected to occur on the average of once in 10 years. When dilution flows are less than the above design flow at a point discharge, the discharge is to be governed by the permit conditions developed for the discharge through the waste discharge permit program. If the flow records on an affected surface water are insufficient to calculate a 10-year 7-day low flow, the department shall determine an acceptable stream flow for disposal system design. The department shall determine the acceptable stream flow for disposal system design for controlling nitrogen and phosphorus concentrations.

(5) Where the department has determined that the disposal of sewage may adversely affect the quality of a lake or other state waters, the department may require additional information and data concerning such possible effects. Upon review of such information the department may impose specific requirements for sewage treatment and disposal as are necessary and appropriate

to assure compliance with the water quality act, Title 75, Chapter 5, MCA. (History: Sec. 75-5-201 and 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1982 MAR p. 1746, Eff. 10/1/82; AMD, 1984 MAR p. 1802, Eff. 12/14/84.)

16.20.632 OPERATION STANDARDS (1) Owners and operators of water impoundments operating prior to July 1971 that cause conditions harmful to prescribed beneficial uses of state water shall demonstrate to the satisfaction of the department that continued operations will be done in the best practicable manner to minimize harmful effects. New water impoundments must be designed to provide temperature variations in discharging water that maintain or enhance the existing propagating fishery and associated aquatic life. As a guide, the following temperature variations are recommended: Continuously less than 40°F during the months of January and February, and continuously greater than 44°F during the months of June through September. (History: Sec. 75-5-201 and 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80.)

16.20.633 PROHIBITIONS (1) State surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will:

(a) Settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines;

(b) Create floating debris, scum, a visible oil film (or be present in concentrations at or in excess of 10 milligrams per liter) or globules of grease or other floating materials;

(c) Produce odors, colors or other conditions as to which create a nuisance or render undesirable tastes to fish flesh or make fish inedible;

(d) Create concentrations or combinations of materials which are toxic or harmful to human, animal, plant or aquatic life; and

(e) Create conditions which produce undesirable aquatic life.

(2) No wastes may be discharged and no activities conducted such that the wastes or activities, either alone or in combination with other wastes or activities, will violate, or can reasonably be expected to violate, any of the standards.

(3) No wastes are to be discharged and no activities conducted which, either alone or in combination with other wastes or activities, will cause violations of surface water quality standards; provided, a short term exemption from a surface water quality standard may be authorized by the department under the following conditions:

(a) If the department of fish, wildlife and parks reviews a short-term construction or hydraulic project under section

87-5-501, et seq., MCA, or section 75-7-101, et seq., MCA, an increase in turbidity caused by the project will be exempt from the applicable turbidity standard unless the department is advised by the department of fish, wildlife and parks that the project may result in a significant increase in turbidity. If the department is advised that the project may cause a significant increase in turbidity, the project will be exempt from the applicable turbidity standard only if it is carried out in accordance with conditions prescribed by the department in a 16.20.633(3) authorization.

(i) A 16.20.633(3) application form must be submitted to the department by the applicant and a 16.20.633(3) authorization issued by the department prior to the day on which the applicant commences the short-term construction or hydraulic project.

(b) If the department approves the location, timing, and methods of game fish population restoration authorized by the department of fish, wildlife and parks, restoration activities causing violations of surface water quality standards may be exempt from the standards.

(c) If a short-term activity other than those described in (a) and (b) above causes unavoidable short-term violations of the turbidity, total dissolved solids, or temperature standards, the activity is exempt from the standard if it is carried out in accordance with conditions prescribed by the department in a 16.20.633(3) authorization form.

(i) A 16.20.633(3) application form must be submitted to the department by the applicant and a 16.20.633(3) authorization issued by the department prior to the day on which the applicant commences the short-term activity.

(4) Leaching pads, tailing ponds, or water, waste, or product holding facilities must be located, constructed, operated and maintained in such a manner and of such materials so as to prevent the discharge, seepage, drainage, infiltration, or flow which may result in the pollution of surface waters. The department may require that a monitoring system be installed and operated if the department determines that pollutants are likely to reach surface waters or present a substantial risk to public health.

(a) Complete plans and specifications for proposed leaching pads, tailing ponds, or water, waste, or product holding facilities utilized in the processing of ore must be submitted to the department no less than 180 days prior to the day on which it is desired to commence their operation.

(b) Leaching pads, tailing ponds, or water, waste, or product holding facilities operating as of the effective date of this rule must be operated and maintained in such a manner so as to prevent the discharge, seepage, drainage, infiltration or flow which may result in the pollution of surface waters.

(5) Dumping of snow from municipal and/or parking lot snow removal activities directly into surface waters or placing

snow in a location where it is likely to cause pollution of surface waters is prohibited unless authorized in writing by the department.

(6) Until such time as minimum stream flows are established for dewatered streams, the minimum treatment requirements for discharges to dewatered receiving streams must be no less than the minimum treatment requirements set forth in ARM 16.20.631(2) and (3).

(7) Treatment requirements for discharges to ephemeral streams must be no less than the minimum treatment requirements set forth in ARM 16.20.631(2) and (3). Ephemeral streams are subject to ARM 16.20.631 through 16.20.635 and ARM 16.20.641 and 16.20.642 but not to the specific water quality standards of ARM 16.20.615 through 16.20.624.

(8) Pollution resulting from storm drainage, storm sewer discharges, and non-point sources, including irrigation practices, road building, construction, logging practices, overgrazing and other practices must be eliminated or minimized as ordered by the department.

(9) Application of pesticides in or adjacent to state surface waters must be in compliance with the labeled direction, and in accordance with provisions of the Montana Pesticides Act (Title 80, chapter 8, MCA) and the Federal Environmental Pesticides Control Act (7 U.S.C. 136, et seq., (Supp. 1973) as amended). Excess pesticides and pesticide containers must not be disposed of in a manner or in a location where they are likely to pollute surface waters.

(10) No pollutants may be discharged and no activities may be conducted which, either alone or in combination with other wastes or activities, result in the total dissolved gas pressure relative to the water surface exceeding 110 percent of saturation.

(11) On all public water supply watersheds, detailed plans and specifications for the construction and operation of logging roads will be submitted to the department for its approval as required by Title 75, chapter 6, MCA. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1988 MAR p. 1191, Eff. 6/10/88.)

16.20.634 MIXING ZONE (1) Discharges to surface waters may be granted a mixing zone on a case by case basis by the department in accordance with its written implementation policy.

(2) In granting a mixing zone, the department shall ensure:

(a) that chronic toxicity does not result outside of the mixing zone;

(b) the extent of the mixing zone is minimized to the extent practicable;

(c) the granting of a mixing zone does not affect existing or reasonably anticipated uses outside of the mixing zone. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1992 MAR p. 2064, Eff. 9/11/92.)

16.20.635 SAMPLING METHODS (1) Methods of sample collection, preservation and analysis used to determine compliance with the standards must be in accordance with the latest edition of Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association or in accordance with tests or procedures that have been found to be equally or more applicable by EPA as set forth in 40 CFR 136 and subsequent amendments. Copies of 40 CFR 136 and subsequent amendments may be obtained at the department. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80.)

Rules 16.20.636 through 16.20.640 reserved

16.20.641 RADIOLOGICAL CRITERIA (1) No person may cause radioactive materials in surface waters to exceed the standards specified in department circular WQB-7.

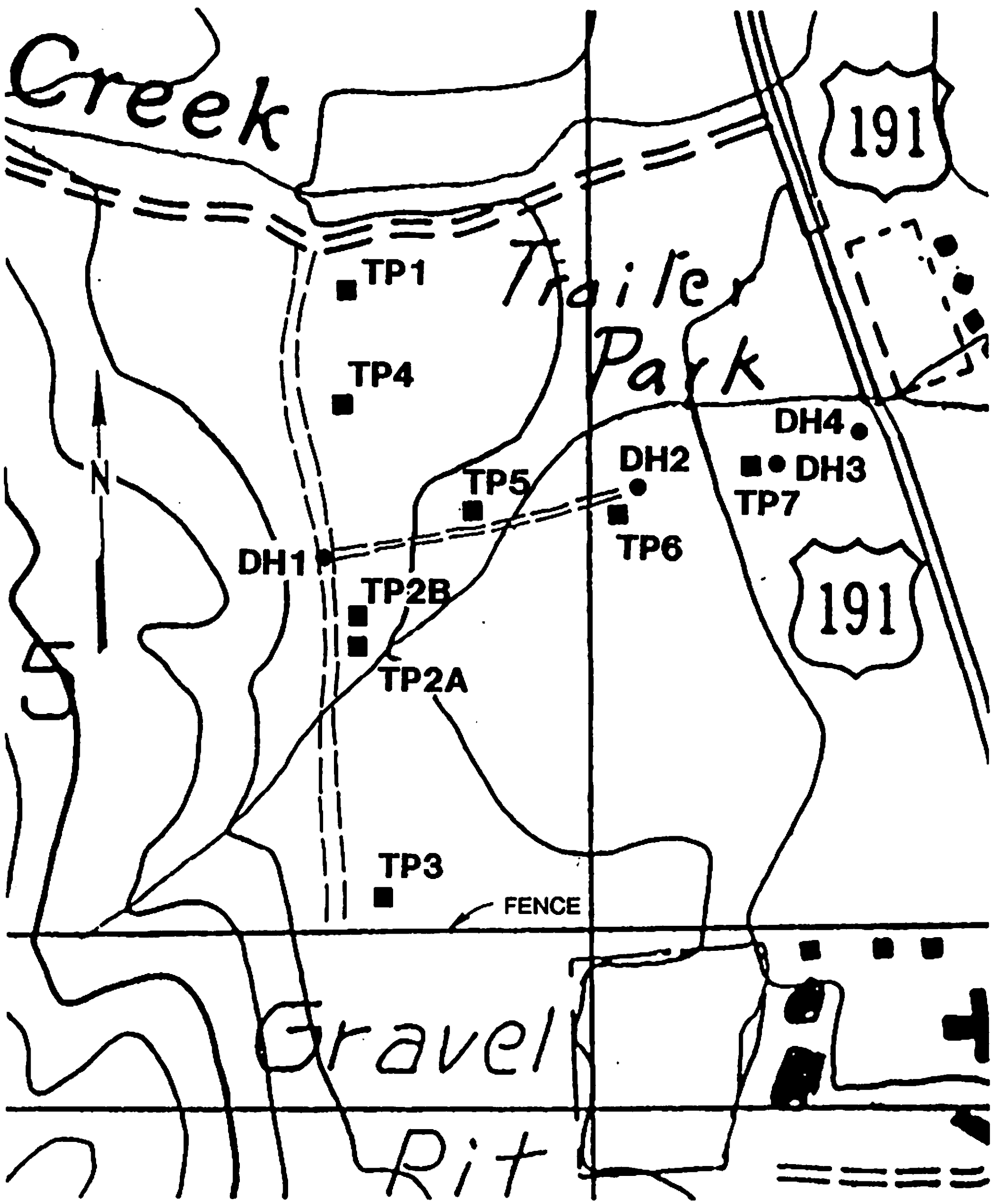
(2) The board hereby adopts and incorporates by reference department circular WQB-7, entitled "Montana Numeric Water Quality Standards" (1994 edition), which establishes limits for toxic, carcinogenic, bioconcentrating, and harmful parameters in water. Copies of the circular may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1988 MAR p. 1191, Eff. 6/10/88; AMD, 1994 MAR p. 2136, Eff. 8/12/94.)

16.20.642 BIOASSAYS (1) Bioassay tolerance concentrations must be determined using the latest available research results for the materials, by bioassay tests procedures for simulating actual stream conditions as set forth in the latest edition of Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association, ASTM Standards Part 31, or in accordance with tests or analytical procedures that are found to be equal or more applicable by EPA. Any bioassay studies made must be made using a representative sensitive local species and life stages of economic or ecological importance; provided other species whose relative sensitivity is known may be used when there is difficulty in providing the more sensitive species in sufficient numbers or when such species are unsatisfactory for routine confined bioassays. All bioassay methods and species selections must be approved by the department. (History: Sec. 75-5-201, 75-5-301, MCA; IMP, Sec. 75-5-301, MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1988 MAR p. 1191, Eff. 6/10/88.)

16.20.643 METAL LIMITS IS REPEALED (History: Sec. 75-5-301 MCA; IMP, Sec. 75-5-301 MCA, Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, REP, 1980 MAR p. 2252, Eff. 8/1/80.)

APPENDIX D

DRILL HOLE GRADATIONS AT MICHENER CREEK SITE



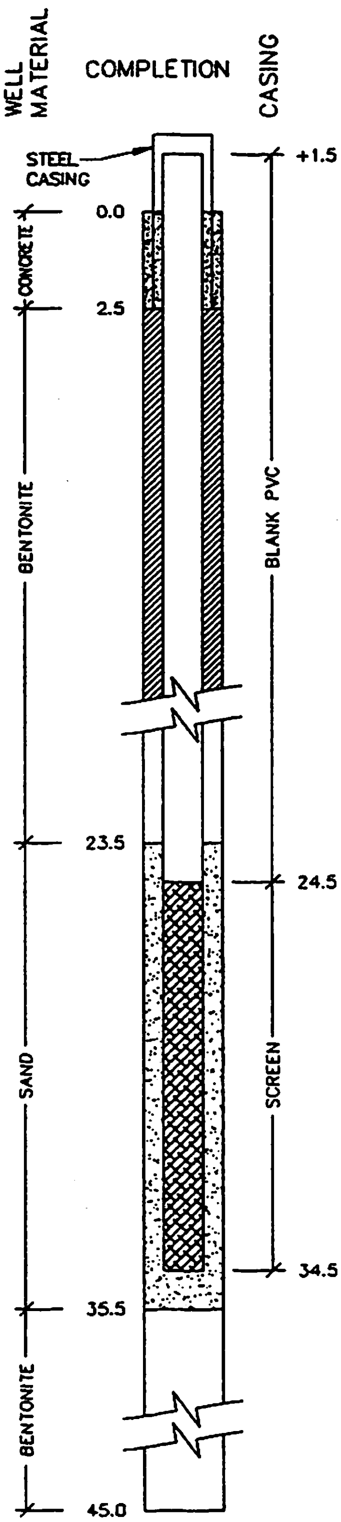
Point	Northing	Easting	Elevation
DH1	10830.8	9681.85	1028.21
DH2	10028.5	9988.41	1003.22
DH3	9835.63	9995.45	971.44
DH4	9595.04	10104.4	960.88
TP1	10915.2	10505.3	1027.03
TP2A	10732.8	9454	1021.54
TP2B	10745.7	9504.2	1021.28
TP3	10527.5	8852.97	1017.15
TP4	10785	10563.6	1018.27
TP5	10479.8	9840.32	1006.68
TP6	10184.9	9915.21	1006.89
TP7	9859.94	10035.9	970.01

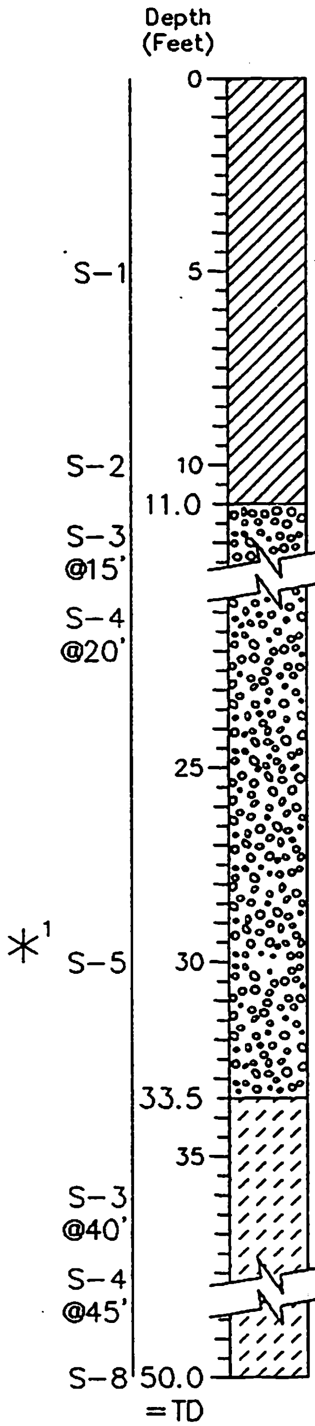
BIG SKY WATER WWTP

EXPLORATION HOLE LOCATIONS

HKM ASSOCIATES
ENGINEERS • PLANNERS

4M357.102	MAR. 1993





CLAYEY SILT; *brown, moist, 2' of frost*

SILTY SANDY GRAVEL; *gray to brown, moist, some silty layers and some coarse cleaner layers*

18'–19.5', silty layer, very little gravel

*[1] SAMPLE GRADATION

28% Gravel
55% Sand
17% Fines

~27', became cleaner

~30'–32', coarse layer with boulder
32'–33.5', silty layer
33.5', casing drives hard, quit casing, started open hole

SILTY CLAY; *(Weathered Shale), hard, moist, somewhat consolidated, grading into more consolidated material with depth, smooth drilling, hole stayed open with no casing.*

48', turned gray

WATER TABLE MONITORING

Hole dry during drilling
Dry on 4/8/93

Date Drilled: 2/18/93
Hole Started: 10:00 a.m.
Hole Finished: 12:00 noon

Drill Type: Drill Tech D-40K
Driller: PC Exploration
Field Eng'r/Geologist: DSC

BIG SKY WATER WWTP

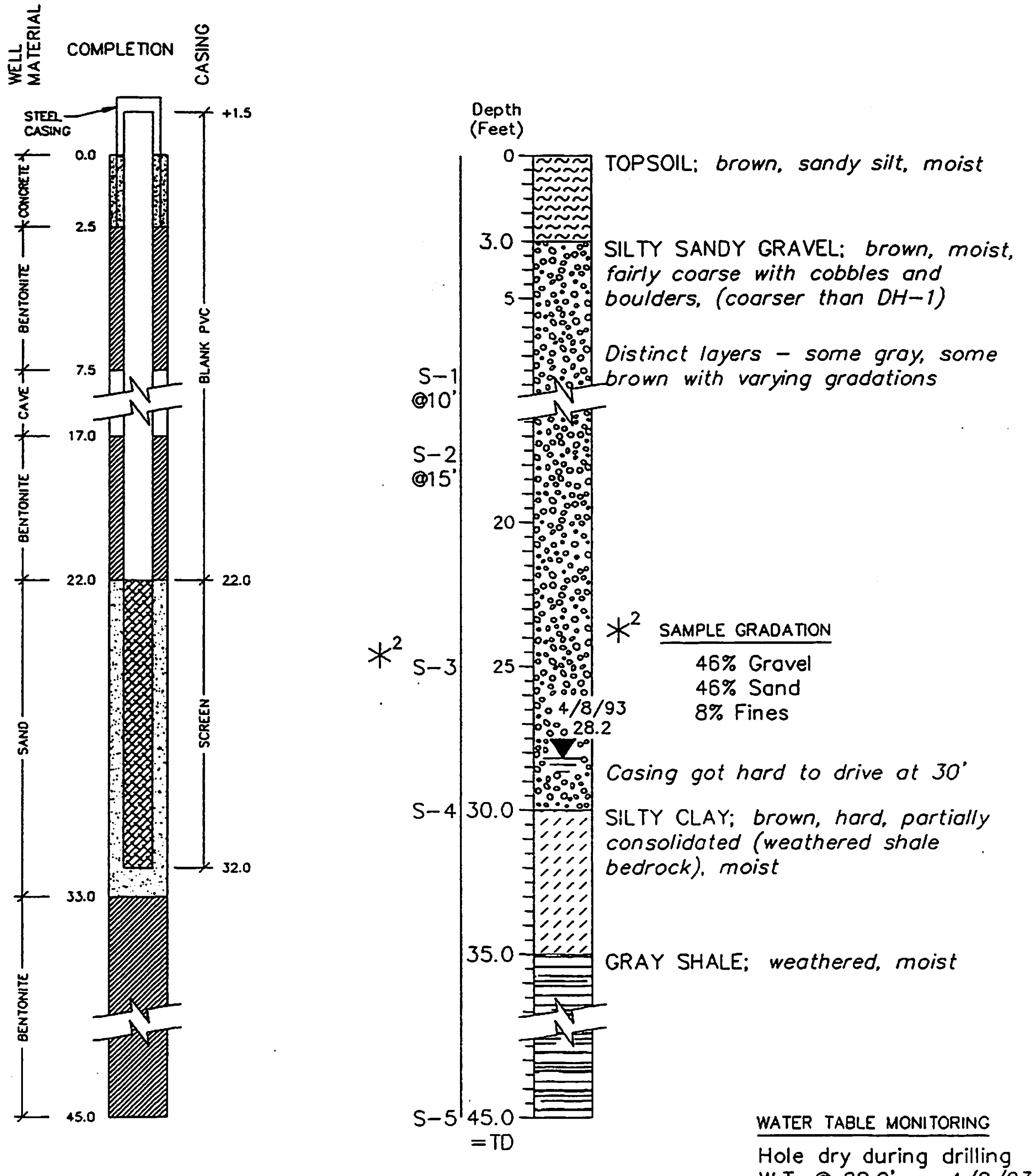
DRILL HOLE 1 (DH-1)

FIGURE #

HKM ASSOCIATES
ENGINEERS • PLANNERS

4M357.102	MAR. 1993

DH-1.DWG



Date Drilled: 2/18/93
Hole Started: 12:15 p.m.
Hole Finished: 2:00 p.m.

Drill Type: Drill Tech D-40K
Driller: PC Exploration
Field Eng'r/Geologist: DSC

BIG SKY WATER WWTP

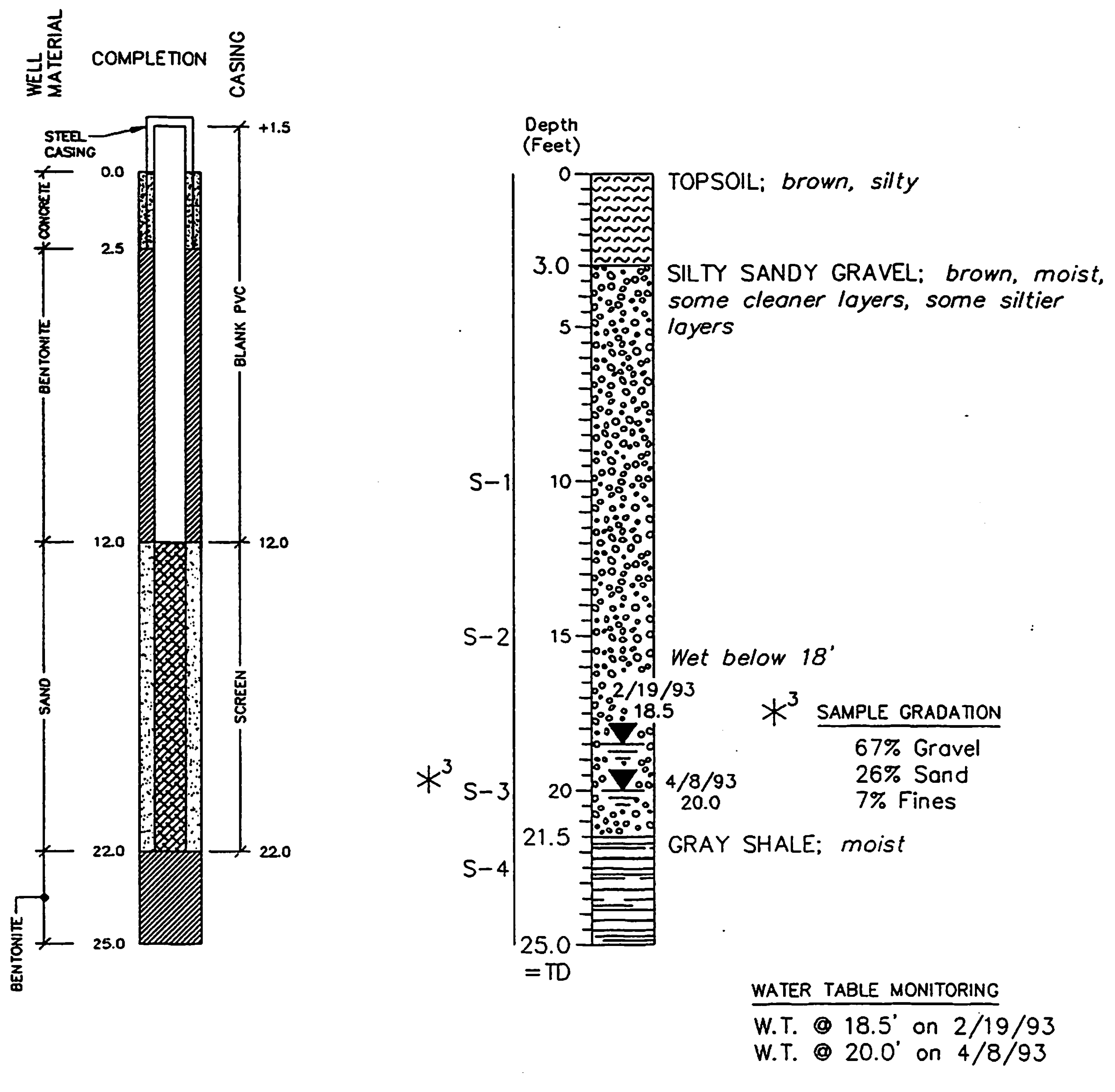
DRILL HOLE 2 (DH-2)

FIGURE #

HKM ASSOCIATES
ENGINEERS · PLANNERS

4M357.102	MAR. 1993

DH-2.DWG



Date Drilled: 2/19/93
Hole Started: 2:30 p.m.
Hole Finished: 3:40 p.m.

Drill Type: Drill Tech D-40K
Driller: PC Exploration
Field Eng'r/Geologist: DSC

BIG SKY WATER WWTP

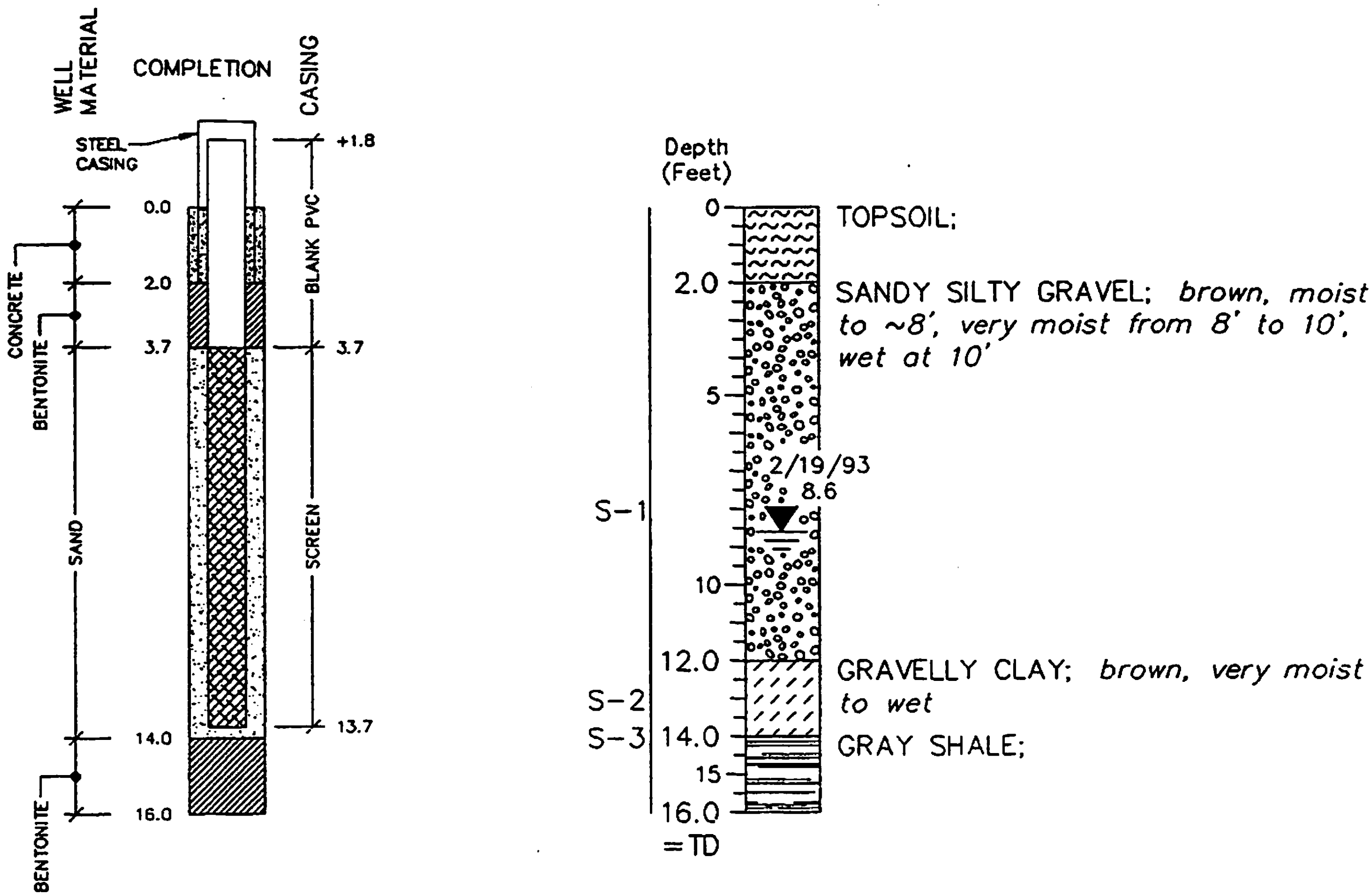
DRILL HOLE 3 (DH-3)

FIGURE #

HKM ASSOCIATES
ENGINEERS · PLANNERS

4M357.102 | MAR. 1993

DH-3.DWG



WATER TABLE MONITORING

W.T. @ 8.6' on 2/19/93
W.T. @ 8.7' on 4/8/93

Date Drilled: 2/19/93
Hole Started: 4:15
Hole Finished: 4:50

Drill Type: Drill Tech D-40K
Driller: PC Exploration
Field Eng'r/Geologist: DSC

BIG SKY WATER WWTP

DRILL HOLE 4 (DH-4)

FIGURE #

HKM ASSOCIATES
ENGINEERS · PLANNERS

4M357.102	MAR. 1993

DH-4.DWG

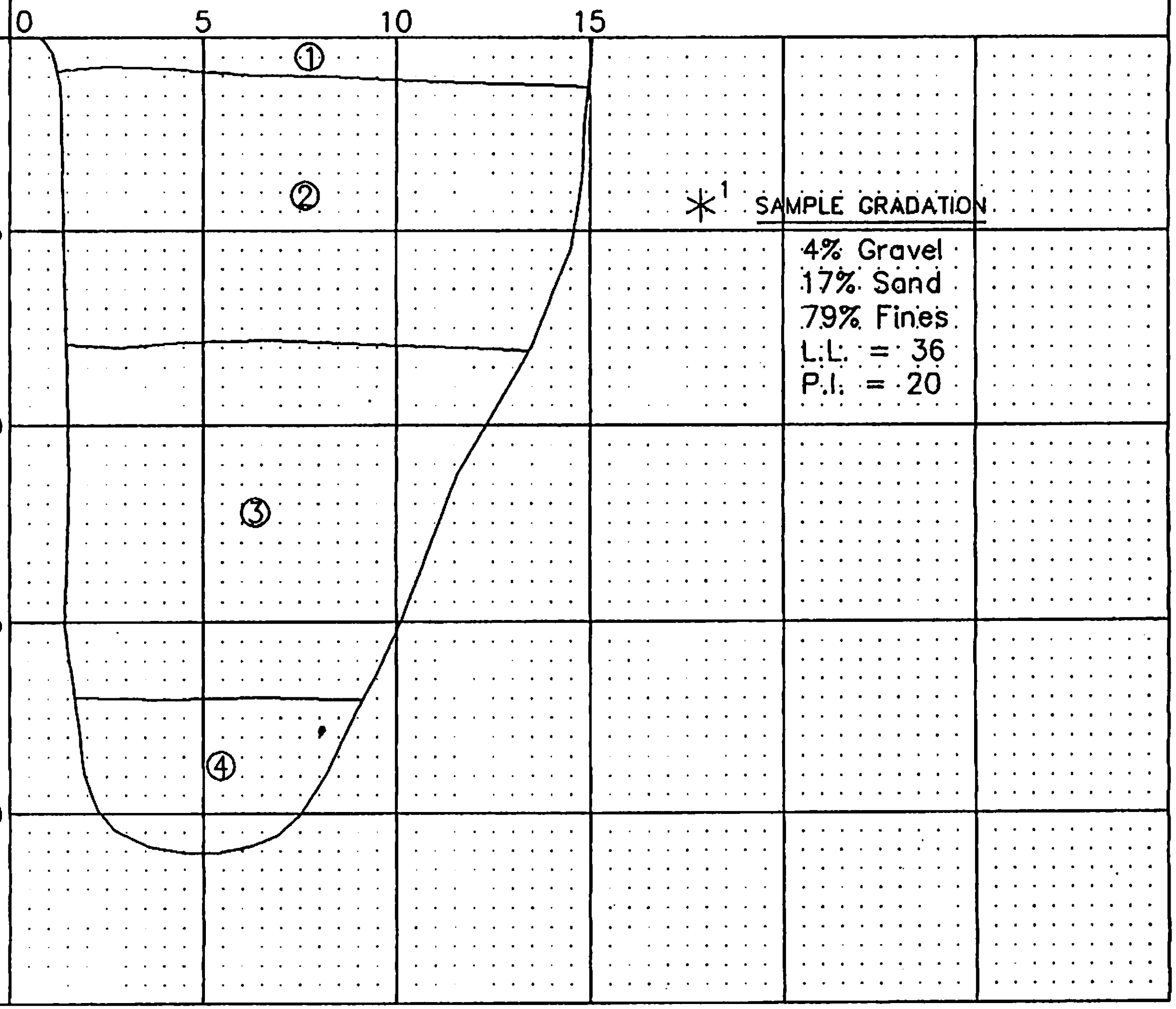
LOG OF BACKHOE TEST PIT

Project Big Sky WWTP   Job No. 4M357.102   Test Pit No. TP-1

DESCRIPTION OF MATERIALS (Description at Horiz. Sta. ____)	Ground Water	% Water Content	Samples	Depth Ft.
① Brown silt with organics (Topsoil) frozen				
② Medium stiff, tan, sandy lean clay, moist, very few pebbles and rocks, scattered salts, some sandy zones, 1' thick gravelly layer at 7'–8'		17.6	S-1 @3' ✳1	5
③ Dense, brown sandy silt with FeOx mottling and salts, and with occasional pebbles and cobbles, moist.			S-2 @10'	10
		17.9	S-3 @11'	
④ Dense, brown (mottled FeOx), silty gravel with cobbles, very dirty (~40% fines), rocks are very light, soft (Huckleberry Ridge Tuff?)				15
		9.5	S-4 @17'	
		12.8	S-5 @19'	20

Sketch of East Pit Side   Surface Elevation: Approx.

Horizontal Distance in Feet



Location south side of Michener Creek on alluvial fan

Date 2/12/93

Backhoe Type John Deere 790

Backhoe Operator Kenyon Noble

Field Eng'r/Geologist DSC

Surface Elev. ____

Total Depth 21'

Ground Water Dry

Other ____

FIGURE #

HKM ASSOCIATES
ENGINEERS · PLANNERS

4M357.102 | MAR. 1993

TP-1.

LOG OF BACKHOE TEST PIT

Project Big Sky WWTP   Job No. 4M357.102   Test Pit No. TP-2A

DESCRIPTION OF MATERIALS (Description at Horiz. Sta. ____)

① Brown silt with rocks and organics, frozen (Topsoil)

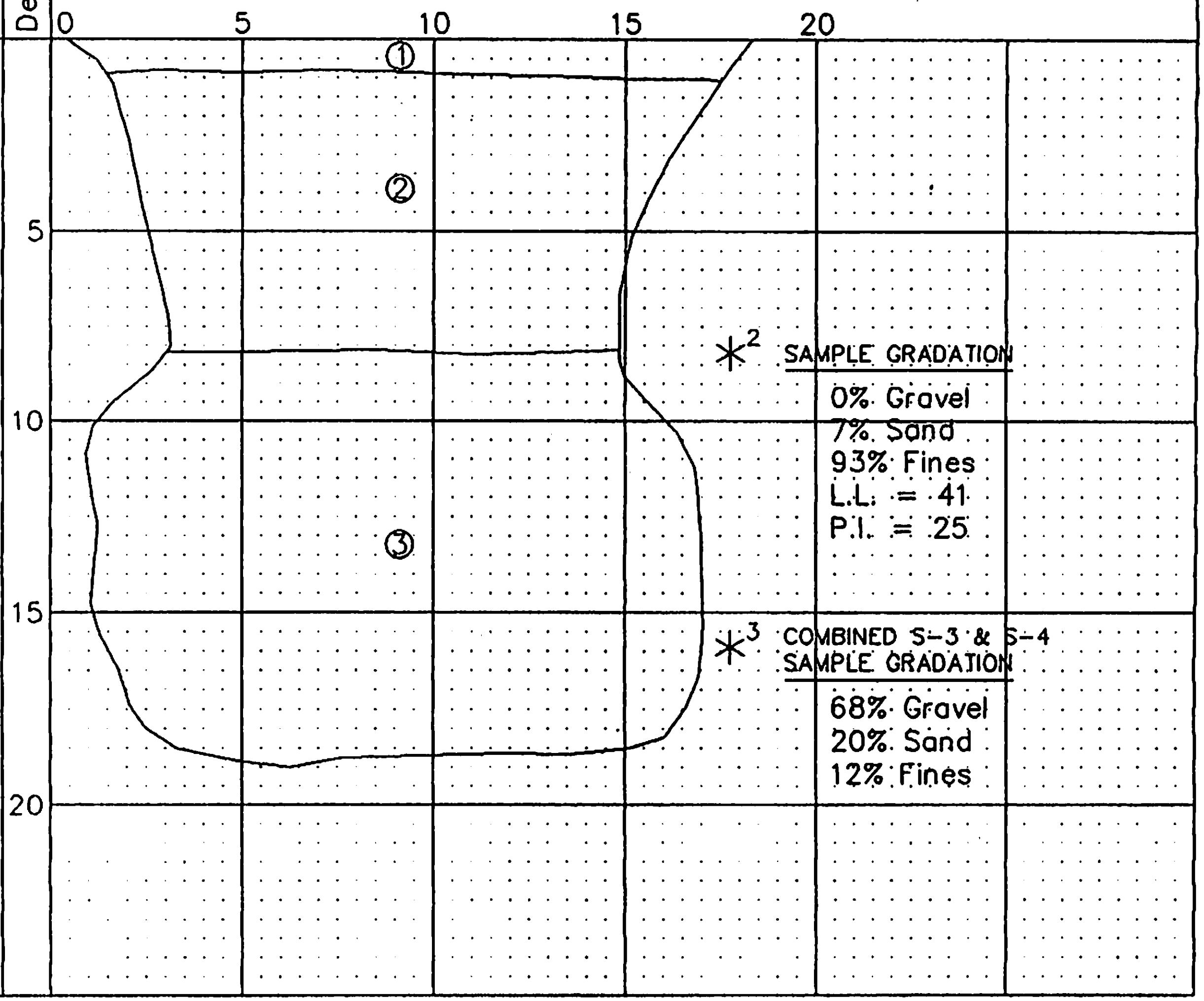
② Medium dense, lean clay, moist, with occasional pebbles (very few), varigated

③ Dense, silty clayey gravel with cobbles and boulders to ~16", moist, rocks are both rounded and angular, fairly intermixed even within same layer. 2' thick cleaner (sandier) layer at ~14'.

Ground Water	% Water Content	Samples	Depth Ft.
	24.2	S-1 @6'	
		✳2	
	7.1	S-2 @14'	
	7.2	S-3 @16'	
		✳3	
	6.3	S-4 @19'	

Sketch of East Pit Side   Surface Elevation: Approx.

Horizontal Distance in Feet



Location ~1000' south of Michener Creek on bench

Date 2/12/93

Backhoe Type John Deere 790

Backhoe Operator Kenyon Noble

Field Eng'r/Geologist DSC

Surface Elev. ____

Total Depth 19'

Ground Water Dry

Other ____

FIGURE #

HKM ASSOCIATES
ENGINEERS • PLANNERS

4M357.102   MAR. 1993

TP-2A.DWG

LOG OF BACKHOE TEST PIT

Project Big Sky WWTP   Job No. 4M357.102   Test Pit No. TP-3

DESCRIPTION OF MATERIALS
(Description at Horiz. Sta. ____)

Columns: Ground Water | % Water Content | Samples | Depth Ft.

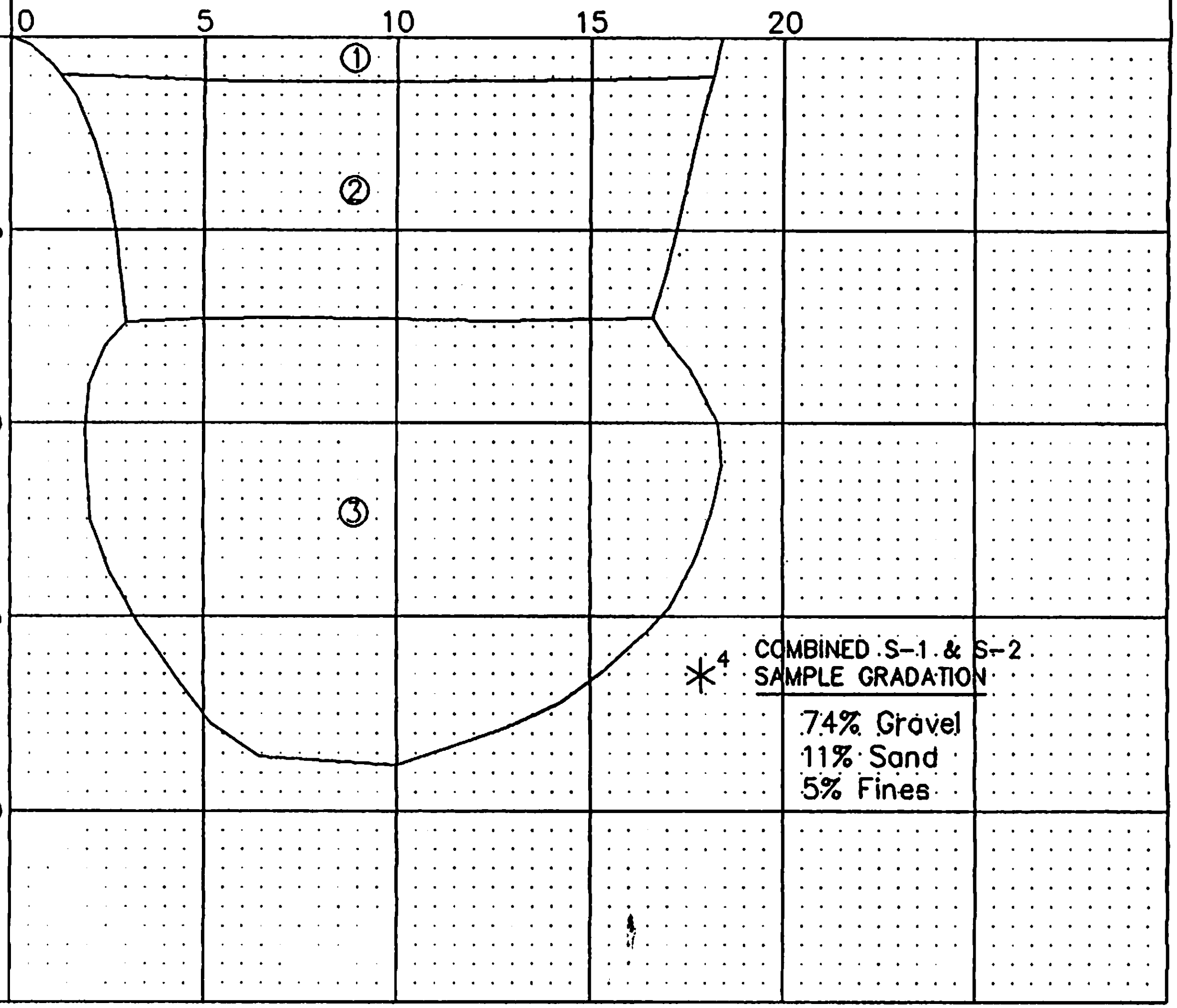
Sketch of North Pit Side   Surface Elevation: Approx.

① Brown, frozen organic silt topsoil

② Medium dense, tan lean clay, moist, very few pebbles, stands vertical (same as other TP's)

③ Very dense, well graded, coarse cobbly, bouldery gravel with silt and sand. Cleaner and denser than gravel encountered in TP-2. Rocks primarily rounded (almost entirely), rocks to 12" common

Samples: S-1 @12'; *4; S-2 @19'



Location near south fence line on Sec. 5
Date 2/12/93
Backhoe Type John Deere 790
Backhoe Operator Kenyon Noble
Field Eng'r/Geologist DSC
Surface Elev. ____
Total Depth 19'
Ground Water Dry
Other

FIGURE #

HKM ASSOCIATES
ENGINEERS • PLANNERS
57.10   M 993

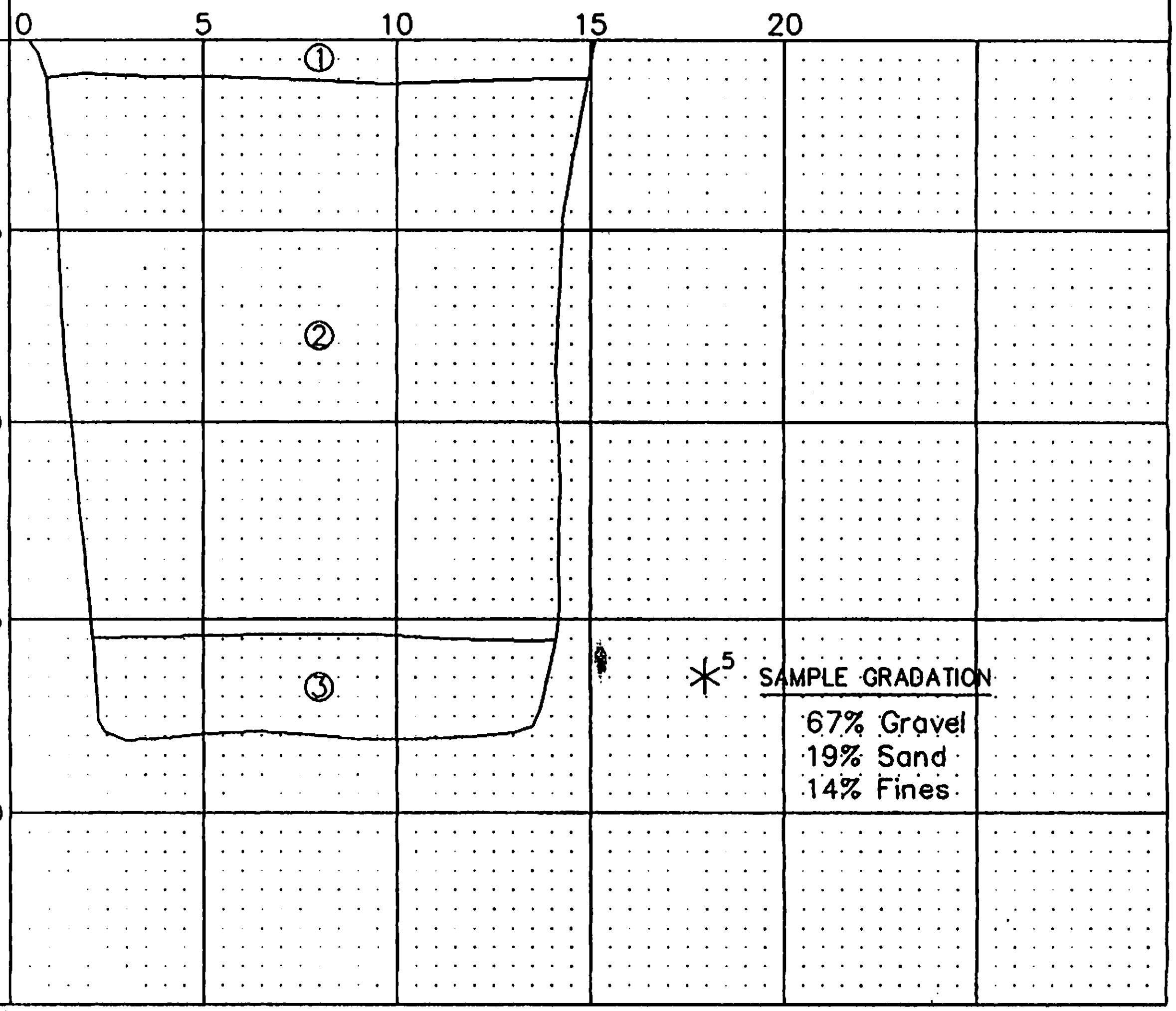
LOG OF BACKHOE TEST PIT

Project Big Sky WWTP   Job No. 4M357.102   Test Pit No. TP-4

DESCRIPTION OF MATERIALS (Description at Horiz. Sta. ___)	Ground Water	% Water Content	Samples	Depth Ft.
① Frozen, brown, organic silt topsoil ② Medium, tan lean clay, moist, (same as other TP's) ③ Dense to very dense, silty sandy gravel with angular rock to ~10", dirty, moist		7.5	S-1 @18' $\ast^5$	5, 10, 15, 20

Sketch of East Pit Side   Surface Elevation: Approx.

Horizontal Distance in Feet



Location ~400' south of Michener Creek on bench, in low area

Date 2/12/93

Backhoe Type John Deere 790

Backhoe Operator Kenyon Noble

Field Eng'r/Geologist DSC

Surface Elev. ____

Total Depth 18'

Ground Water Dry

Other ____

FIGURE #

HKM ASSOCIATES
ENGINEERS • PLANNERS

4M357.102 | MAR. 1993

TP-4.DWG

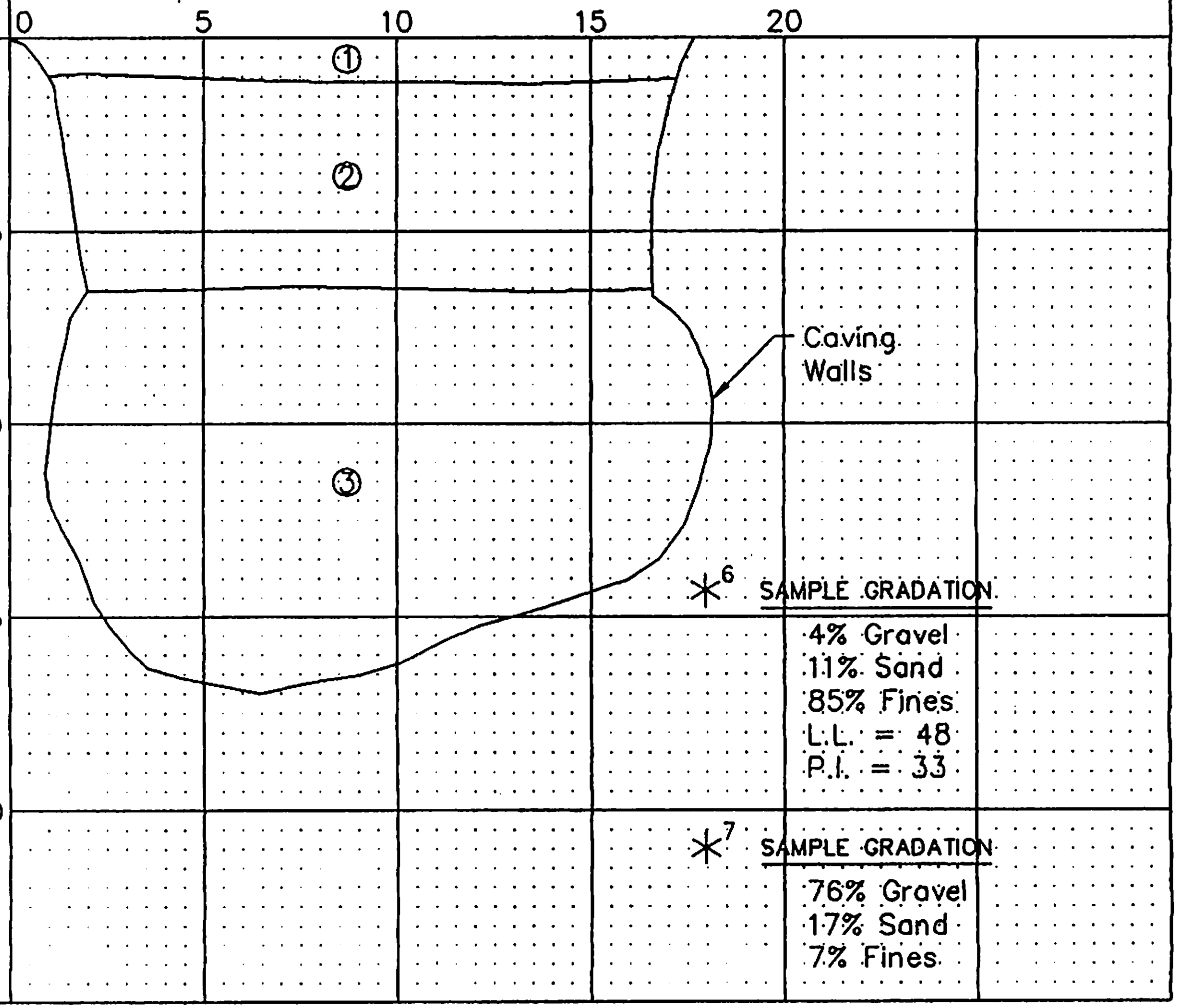
LOG OF BACKHOE TEST PIT

Project: Big Sky WWTP — Job No. 4M357.102 — Test Pit No. TP-5

DESCRIPTION OF MATERIALS (Description at Horiz. Sta. ____)	Ground Water	% Water Content	Samples	Depth Ft.
① Frozen, brown, organic silt topsoil				
② Medium to dense, brown with light variations, lean clay with sand, moist, some zones fairly pebbly – others quite clayey				5
③ Dense to very dense, brown silty, clayey, sandy, cobbly, bouldery gravel, moist, boulders to 16'		19.4	S-1 @6' ✳6	
				10
		4.7	S-1 @11' ✳7	
				15
				20

Sketch of East Pit Side — Surface Elevation: Approx.

Horizontal Distance in Feet



Location: ~400' east of access road between TP-4 and TP-2

Date: 2/12/93

Backhoe Type: John Deere 790

Backhoe Operator: Kenyon Noble

Field Eng'r/Geologist: DSC

Surface Elev. ____

Total Depth: 17'

Ground Water: Dry

Other ____

FIGURE #

HKM ASSOCIATES — ENGINEERS • PLANNERS

4M357.102 — MAR. 1993

TP-5.DWG

LOG OF BACKHOE TEST PIT

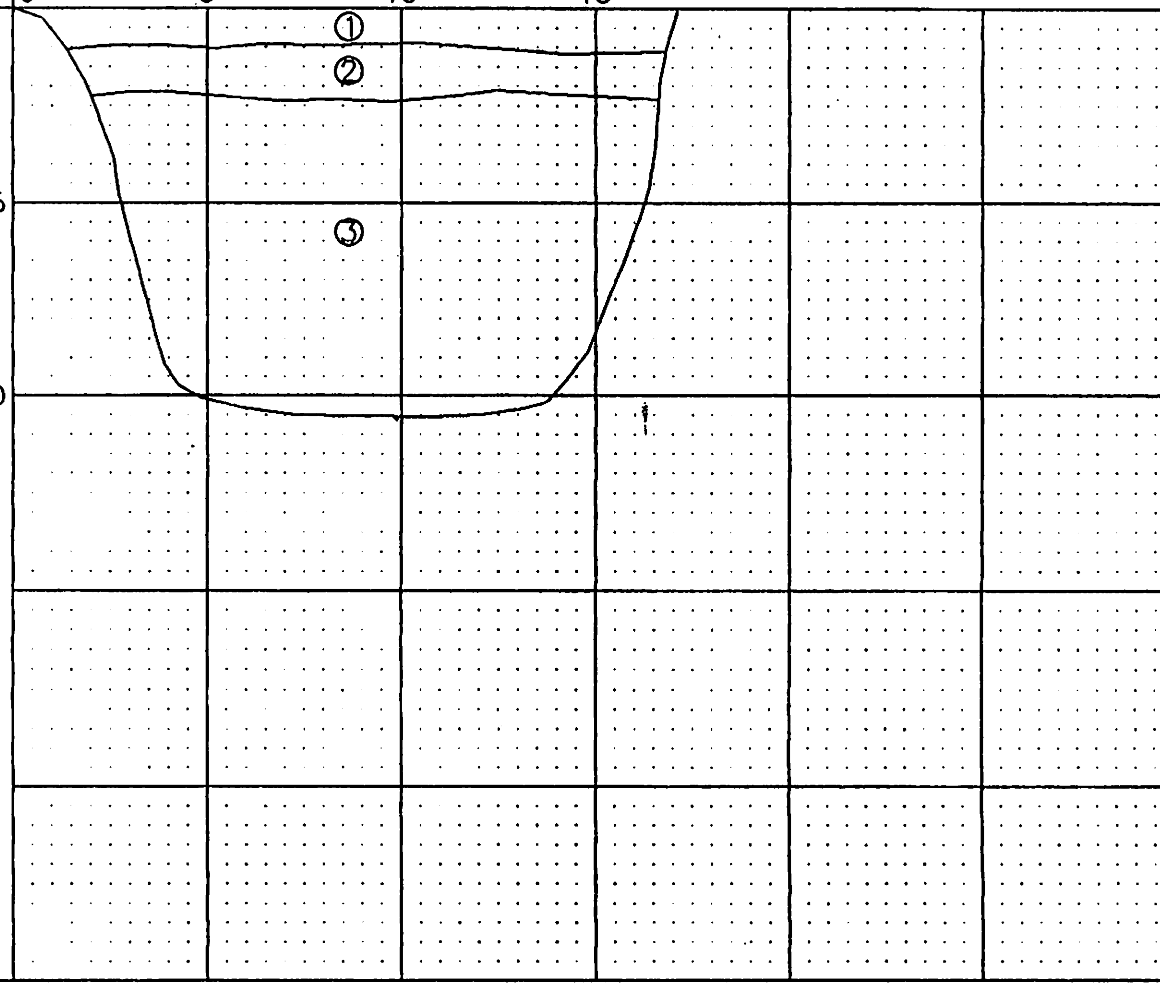
Project Big Sky WWTP　　Job No. 4M357.102　　Test Pit No. TP-6

DESCRIPTION OF MATERIALS (Description at Horiz. Sta. ____)	Ground Water	% Water Content	Samples	Depth Ft.
① Topsoil ② Brown, lean clay with sand ③ Dense to very dense, brown sandy, silty gravel with cobbles and boulders to ~12". Rounded rocks, est. ~8% fines.				5 10

Sketch of East Pit Side　　Surface Elevation: Approx.

Horizontal Distance in Feet

0　5　10　15



Location see map ~150' west of top of terrace slope

Date 2/12/93

Backhoe Type John Deere 790

Backhoe Operator Kenyon Noble

Field Eng'r/Geologist DSC

Surface Elev. ______

Total Depth 10'

Ground Water Dry

Other ______

FIGURE #

HKM ASSOCIATES
ENGINEERS · PLANNERS

4M357.102　MAR. 1993

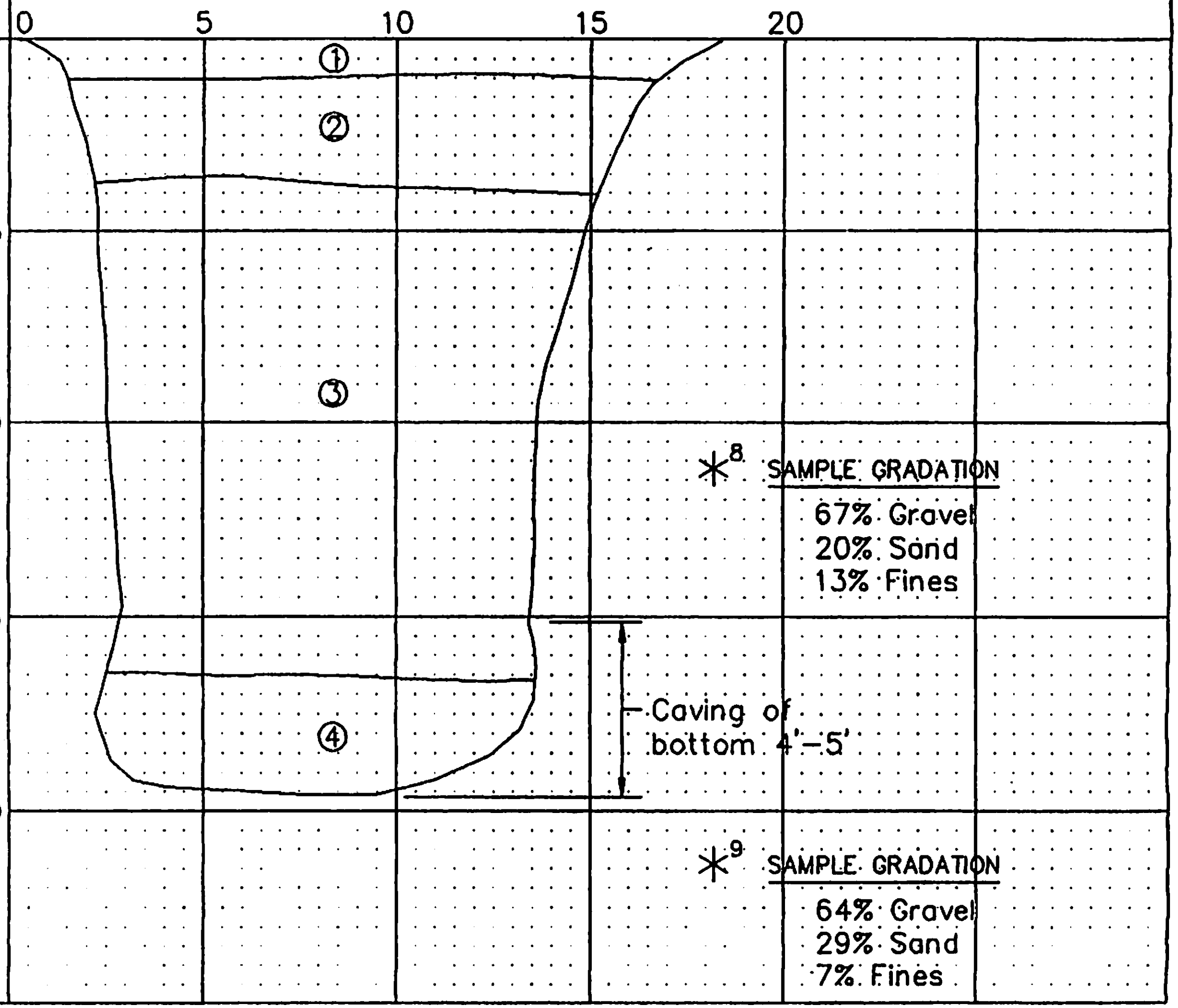
TP-6.DWG

LOG OF BACKHOE TEST PIT

Project: Big Sky WWTP   Job No. 4M357.102   Test Pit No. TP-7

DESCRIPTION OF MATERIALS (Description at Horiz. Sta. ___)	Ground Water	% Water Content	Samples	Depth Ft.
① Topsoil ② Medium, light tan, sandy lean clay, with gravel and cobbles, moist, mottled, FeOx stains ③ Dense to very dense, brown with abundant FeOx and white salts, silty, sandy gravel with cobbles and boulders, moist, some clayey zones, rounded rock ④ Very dense, sandy gravel with cobbles and boulders, fairly clean, moist			S-1 @16' *8 S-1 @19' *9	5 10 15 20

Sketch of East Pit Side   Surface Elevation: Approx.



Location: at toe of terrace slope, ~25' elev. below top of terrace slope

Date: 2/12/93

Backhoe Type: John Deere 790

Backhoe Operator: Kenyon Noble

Field Eng'r/Geologist: DSC

Surface Elev. ______

Total Depth: 19.5'

Ground Water: Dry

Other ______

FIGURE #

HKM ASSOCIATES
ENGINEERS · PLANNERS

4M357.102   MAR 93

TP-7.DWG

APPENDIX E

NONDEGRADATION RULES

DEPARTMENT OF ENVIRONMENTAL QUALITY

WATER QUALITY STANDARDS

Administrative Rules of Montana

NONDEGRADATION OF WATER QUALITY

Phone (406) 444- 4323

Revised December 1996

Sub-Chapter 7

Nondegradation of Water Quality

NEXT PAGE IS 17-2509

Sub-Chapter 7

Nondegradation of Water Quality

17.30.701 PURPOSE (1) The purpose of this subchapter is to prohibit degradation of high quality state waters, except in certain limited circumstances, by implementing the nondegradation policy set forth in 75-5-303, MCA, and providing criteria and procedures for:

(a) determining which activities will degrade high quality waters;

(b) department review and decision making;

(c) determining the required water quality protection practices if degradation is authorized; and

(d) public review and appeal of department decisions. (History: 75-5-301, 75-5-303, MCA; IMP, 75-5-301, MCA; NEW, 1994 MAR p. 2136, Eff. 8/12/94; TRANS, from DHES, 1996 MAR p. 1499.)

17.30.702 DEFINITIONS Unless the context clearly states otherwise, the following definitions, in addition to those in 75-5-103, MCA, apply throughout this subchapter (Note: 75-5-103, MCA, includes definitions for "degradation", "existing uses", "high quality waters", and "parameter."):

(1) "Bioconcentrating parameters" means the parameters listed in department Circular WQB-7 which have a bioconcentration factor greater than 300.

(2) "Carcinogenic parameters" means the parameters listed as carcinogens in department Circular WQB-7.

(3) "Degradation" is defined in 75-5-103, MCA, and also means any increase of a discharge that exceeds the limits established under or determined from a permit or approval issued by the department prior to April 29, 1993.

(4) "Existing water quality" means the quality of the receiving water, including chemical, physical, and biological conditions immediately prior to commencement of the proposed activity or that which can be adequately documented to have existed on or after July 1, 1971, whichever is the highest quality.

(5) "Ground water" means water occupying the voids within a geologic stratum and within the zone of saturation.

(6) "Harmful parameters" means the parameters listed as harmful in department Circular WQB-7.

(7) "Highest statutory and regulatory requirements" means all applicable effluent limitations, water quality standards, permit conditions, water quality protection practices, or reasonable land, soil, and water conservation practices. It also means compliance schedules or corrective action plans for the protection of water issued under order of a court,

department, or board of competent jurisdiction.

(8) "High quality waters" is defined in 75-5-103(9), MCA and does not include class I surface waters (ARM 17.30.628) or class IV ground waters (ARM 17.30.1002(d)).

(9) "Level 2 treatment" means a waste water treatment system that will provide a higher degree of treatment than conventional systems, including the removal of at least 60% of nitrogen as measured from the raw influent load to the system. The term does not include treatment systems for industrial waste.

(10) "Load" means the mass of a parameter per unit of time.

(11) "Management or conservation practice" means a measure to control or minimize pollution of ground and surface waters from a nonpoint source. Examples of such measures include, but are not limited to, revegetation of disturbed soil, grazing management to prevent overgrazing, contour farming, strip farming, protection of riparian areas, drainage control, and impoundments which detain surface runoff or irrigation return water for sediment control.

(12) "Mixing zone" is defined in 75-5-103, MCA, and also means a limited area of a surface water body or a portion of an aquifer, where initial dilution of a discharge takes place and where water quality changes may occur and where certain water quality standards may be exceeded.

(13) "Montana pollutant discharge elimination system" or "MPDES" means the permit system developed by the state of Montana for controlling the discharge of pollutants from point sources into state waters, pursuant to ARM Title 17, chapter 30, subchapter 13.

(14) "Montana ground water pollution control system" or "MGWPCS" means the permit system developed by the state of Montana for controlling the discharge of pollutants into state ground water, pursuant to ARM Title 17, chapter 30, subchapter 10.

(15) "Nutrients" means total inorganic phosphorus and total inorganic nitrogen.

(16) "New or increased source" means an activity resulting in a change of existing water quality occurring on or after April 29, 1993. The term does not include the following:

(a) sources from which discharges to state waters have commenced or increased on or after April 29, 1993, provided the discharge is in compliance with the conditions of, and does not exceed the limits established under or determined from, a permit or approval issued by the department prior to April 29, 1993;

(b) nonpoint sources discharging prior to April 29, 1993;

(c) withdrawals of water pursuant to a valid water right existing prior to April 29, 1993; and

(d) activities or categories of activities causing nonsignificant changes in existing water quality pursuant to ARM 17.30.715, 17.30.716, or 75-5-301(5)(c), MCA.

(17) "Nonpoint source" means a diffuse source of pollutants resulting from the activities of man over a relatively large area, the effects of which normally must be addressed or controlled by a management or conservation practice.

(18) "Outstanding resource waters" or "ORW" means all state waters that are located in national parks, national wilderness or primitive areas. ORW also means state waters that have been identified as possessing outstanding ecological, or domestic water supply significance and subsequently have been classified as an ORW by the board.

(19) "Permit" means either an MPDES permit or an MGWPCS permit.

(20) "Reporting values" means the values listed as reporting values in department Circular WQB-7, and are the detection levels that must be achieved in reporting ambient monitoring results to the department unless otherwise specified in a permit, approval or authorization issued by the department.

(21) "Surface waters" means any water on the earth's surface including, but not limited to, streams, lakes, ponds, and reservoirs and irrigation drainage systems discharging directly into a stream, lake, pond, reservoir or other water on the earth's surface. Water bodies used solely for treating, transporting or impounding pollutants are not considered surface water for the purposes of this subchapter.

(22) "Toxic parameters" means the parameters listed as toxins in department Circular WQB-7.

(23) "Trigger values" means the values listed as trigger values in department Circular WQB-7 for parameters categorized as toxic, and are used to determine if proposed activities will cause degradation.

(24)(a) The board hereby adopts and incorporates by reference:

(i) department Circular WQB-7, entitled "Montana Numeric Water Quality Standards" (December, 1995 edition), which establishes limits for toxic, carcinogenic, bioconcentrating, and harmful parameters in water; and

(ii) 40 CFR Part 136, as they existed on July, 1992, which contain guidelines establishing test procedures for the analysis of pollutants.

(b) Copies of this material may be obtained from the Department of Environmental Quality, PO Box 200901, Helena, MT 59620-0901. (History: 75-5-301, 75-5-303, MCA; IMP, 75-5-303, MCA; NEW, 1994 MAR p. 2136, Eff. 8/12/94; AMD, 1995 MAR p. 1798, Eff. 9/15/95; AMD, 1996 MAR p. 555, Eff. 2/23/96; TRANS, from DHES, 1996 MAR p. 1499.)

Rules 17.30.703 and 17.30.704 reserved

NEXT PAGE IS 17-2781

<u>17.30.705 NONDEGRADATION POLICY--APPLICABILITY AND LIMITATION</u> (1) The provisions of this subchapter apply to any activity of man resulting in a new or increased source which may cause degradation.

(2) Department review of proposals for new or increased sources will determine the level of protection required for the impacted water as follows:

(a) For all state waters, existing and anticipated uses and the water quality necessary to protect those uses must be maintained and protected.

(b) For high quality waters, degradation may be allowed only according to the procedures in ARM 17.30.708. These rules apply to any activity that may cause degradation of high quality waters, for any parameter, unless the changes in existing water quality resulting from the activity are determined to be nonsignificant under ARM 17.30.715 or 17.30.716. If degradation of high quality waters is allowed, the department will assure that within the United States geological survey hydrologic unit upstream of the proposed activity, there shall be achieved the highest statutory and regulatory requirements for all point and nonpoint sources. This assurance will be achieved through ongoing administration by the department of mandatory programs for control of point and nonpoint discharges.

(c) For outstanding resource waters, no degradation is allowed.

(3) The department will comply with the provisions of the Montana Environmental Policy Act in the implementation of this subchapter. (History: 75-5-301, 75-5-303, MCA; <u>IMP</u>, 75-5-303, MCA; <u>NEW</u>, 1994 MAR p. 2136, Eff. 8/12/94; <u>TRANS</u>, from DHES, 1996 MAR p. 1499.)

<u>17.30.706 INFORMATIONAL REQUIREMENTS FOR NONDEGRADATION SIGNIFICANCE/AUTHORIZATION REVIEW</u> (1) Any person proposing an activity which may cause degradation is responsible for compliance with 75-5-303, MCA. Except as provided in (2) of this rule, a person may either:

(a) determine for themselves, using the standards contained in ARM 17.30.715 and 17.30.716, that the proposed activity will not cause significant changes in water quality as defined in ARM 17.30.705; or

(b) submit an application to the department pursuant to (3) of this rule, for the department to make the determination.

(2) The department will determine whether a proposed activity may cause degradation based on information submitted by the applicant for all activities that are permitted, approved, licensed, or otherwise authorized by the department.

(3) Any person proposing an activity or class of activities which may cause degradation and is not an activity included under (2) of this rule may complete a department

"Application for Determination of Significance". Information required on the application includes, but is not limited to, the following:

(a) quantity and concentration of the parameters expected to change as a result of the proposed activity;

(b) length of time that the water quality is expected to be changed;

(c) character of the discharge;

(d) an analysis of the existing water quality of the receiving water, and any other downstream or downgradient waters which may be reasonably expected to be impacted, including natural variations and fluctuations in the parameter(s) which may change as a result of the proposed activity;

(e) proposed water quality protection practices.

(4) The department will review the application and make a determination whether the proposed change in water quality is nonsignificant according to ARM 17.30.715 or 17.30.716 within 60 days of receipt of the completed application.

(5) Whenever the department determines that a proposed activity will not result in degradation, the department may require monitoring to verify compliance with this subchapter and 75-5-303, MCA.

(6) Whenever the department determines that a proposed activity will result in degradation, the applicant shall complete an application to degrade state waters if the applicant decides to proceed with the proposed activity as planned. The department will not begin review of the application until the required fee has been paid to the department.

(7) In order to provide the information that is required for the department to determine whether or not degradation is necessary because there are no economically, environmentally, and technologically feasible alternatives to the proposed activity that would result in no degradation, an application to degrade state waters shall include, but not be limited to, the following, when applicable:

(a) a complete description of the proposed activity;

(b) the proposed effluent or discharge limitation(s);

(c) a statement of reasons for the proposed effluent or discharge limitation(s);

(d) an analysis of alternatives to the proposed activity, consistent with accepted engineering principles, demonstrating there are no economically, environmentally, and technologically feasible alternatives that are less-degrading or non-degrading. The analysis must be limited to only those alternatives that would accomplish the proposed activity's purpose;

(e) an analysis of the existing water quality of the receiving water and any other downstream or downgradient waters which may be impacted, including natural variations and fluctuations in the water quality parameter(s) for which an authorization to degrade is requested;

(f) the concentration, likely environmental fate, biological effects, and load for each parameter in the discharge likely to degrade existing water quality;

(g) the distribution of existing flows and their expected frequency;

(h) an analysis demonstrating the expected surface or ground water quality for all alternatives considered in (d) above;

(i) an analysis of the ground water flow system, including water-bearing characteristics of subsurface materials, rate and direction of ground water flow, and an evaluation of surface and ground water interaction;

(j) data concerning cumulative water quality effects of existing and authorized activities;

(k) a proposed monitoring and reporting plan that will determine the actual water quality changes.

(8)(a) An applicant must demonstrate that the proposed activity will result in important economic or social development that exceeds the costs to society of allowing the proposed change in water quality. Factors to be addressed in the application may include, but are not limited to, the positive and negative effects of the following:

(i) allowing the proposed change in water quality;

(ii) employment considering the existing level of employment, unemployment, and wage levels in the area (i.e., increasing, maintaining, or avoiding a reduction in employment);

(iii) the fiscal status of the local, county, or state government and local public schools;

(iv) the local or state economies (i.e., increased or reduced diversity, multiplier effects);

(v) social or historical values;

(vi) public health;

(vii) housing (i.e., availability and affordability);

(viii) existing public service systems and local educational systems; or,

(ix) correction of an environmental or public health problem.

(b) Factors included in the demonstration required in (a) above must be quantified whenever this can be done reliably and cost-effectively. Other factors, which cannot be quantified, may be represented by an appropriate unit of measurement. If the department determines that more information is required, the department may require additional information from the applicant or seek such additional information from other sources.

(9) To determine whether or not existing and anticipated uses will be fully protected, the department shall require the following information:

(a) a showing that the change will not result in violations of Montana water quality standards outside of a mixing zone; and

(b) an analysis of the impacts of the proposed water quality changes on the existing and anticipated uses of the impacted state water.

(10) To demonstrate the least degrading water quality protection practices will be fully implemented prior to, during, and after the proposed activity, the applicant shall provide to the department a complete description and schedule for implementation of the water quality protection practices associated with the proposed activity and a viable plan showing the ability to implement the water quality protection practices.

(11) Any application submitted pursuant to this subchapter must comply with the signature and certification requirements of ARM 17.30.1323.

(12) The department shall notify the applicant in writing within 60 days after receipt of an application to degrade state waters that the application does or does not contain all the information necessary for the department's nondegradation review. If the information from the supplemental submittal and any subsequent supplemental submittal is inadequate, the department shall notify the applicant in writing, within 30 days after receipt of the supplemental submittal, what additional information must be submitted. In any review subsequent to the first, the department may not make a determination of incompleteness on the basis of a deficiency which could have been noted in the first review.

(13) The board hereby adopts and incorporates by reference ARM 17.30.1323, which sets forth signature and certification requirements for MPDES permit applications. A copy of ARM 17.30.1323 may be obtained from the Department of Environmental Quality, PO Box 200901, Helena, MT 59620-0901. (History: 75-5-301, 75-5-303, MCA; IMP, 75-5-303, MCA; NEW, 1994 MAR p. 2136, Eff. 8/12/94; TRANS, from DHES, 1996 MAR p. 1499.)

NEXT PAGE IS 17-2787

17.30.707 DEPARTMENT PROCEDURES FOR NONDEGRADATION REVIEW

(1) Upon a determination by the department that an application to degrade state waters required under this rule is complete, the department will prepare a preliminary decision either authorizing degradation or denying the application to degrade according to the procedures in ARM 17.30.708.

(2) An application to degrade state waters will be denied unless the applicant has affirmatively demonstrated and the department finds, based on a preponderance of evidence, the proposed activity to be in full compliance with 75-5-303, MCA, using the standards set out in (3)-(6) of this rule. The department shall consider an analysis by the applicant and any substantive relevant information either submitted by the public or otherwise available.

(3) To determine that degradation is necessary because there are no economically, environmentally, and technologically feasible alternatives to the proposed activity that would result in no degradation, the department shall consider the following:

(a) The department will determine the economic feasibility of the alternative water quality protection practices by evaluating the cost effects of the proposed alternatives on the economic viability of the project and on the applicant by using standard and accepted financial analyses.

(b) In order to determine the environmental feasibility of an alternative, the department will consider whether such alternative practices are available and will compare the overall environmental impacts of the various alternatives and the commitment of resources necessary to achieve the alternatives.

(c) In order to determine technological feasibility of an alternative, the department will consider whether such alternative practices are available and consistent with accepted engineering principles.

(4)(a) To determine that the proposed activity will result in important economic or social development that exceeds the benefit to society of maintaining existing high-quality waters and exceeds the costs to society of allowing degradation of high-quality waters, the department must find that the proposed activity will provide important economic or social development which outweighs any cost to society of allowing the proposed change in water quality. In making its determination, the department may consider factors that include, but are not limited to, the following:

(i) effects on the state or local community resulting from increased employment opportunities considering the existing level of employment, unemployment, and wage levels in the area;

(ii) effects on the state or local economies;

(iii) effects on the fiscal status of the local, county or state governments and local public schools;

(iv) effects on the local or state economies (i.e., increased or reduced diversity, multiplier effects);

(v) effects on social or historical values;

(vi) effects on public health;

(vii) effects on housing (i.e., availability and affordability);

(viii) effects on existing public service systems and local educational systems; or,

(ix) correction of an environmental or public health problem.

(b) In making the determination required in (a) above, the department must weigh any costs associated with the loss of high quality waters against any social or economic benefits demonstrated by the applicant. The department may also consider as a cost to society any identified and/or quantifiable negative social or economic effects resulting from the proposed activity.

(5) To determine that existing and anticipated uses of the receiving waters will be fully protected and that water quality standards will not be violated as a result of the proposed degradation, the department shall consider all available information.

(6) In order to authorize degradation under this rule, the department must determine that the least degrading water quality protection practices determined by the department to be economically, environmentally, and technologically feasible will be implemented prior to, during, and after the proposed activity until the degradation no longer occurs.

(7) The department shall make its preliminary decision either authorizing degradation or denying the application to degrade within 180 days after receipt of a complete application from the applicant. This time period may be extended upon agreement of the applicant or whenever an environmental impact statement must be prepared pursuant to Title 75, chapter 1, parts 1 and 2, MCA.

(8) To the maximum extent possible, the department will coordinate any application to degrade state waters with the permitting and approval requirements of other laws or programs administered by the department or by any other local, state, or federal agency. (History: 75-5-301, 75-5-303, MCA; IMP, 75-5-303, MCA; NEW, 1994 MAR p. 2136, Eff. 8/12/94; TRANS, from DHES, 1996 MAR p. 1499.)

17.30.708 DEPARTMENT PROCEDURES FOR ISSUING PRELIMINARY AND FINAL DECISIONS REGARDING AUTHORIZATIONS TO DEGRADE (1) A preliminary decision to deny or authorize degradation must be accompanied by a statement of basis for the decision and, if applicable, a detailed statement of conditions imposed upon any authorization to degrade.

(2) The preliminary decision must include the following information, if applicable:

(a) a description of the proposed activity;

(b) the level of protection required, e.g. for high-quality waters or ORW;

(c) a determination that degradation is or is not necessary based on the availability of economically, environmentally and technologically feasible alternatives that will prevent degradation;

(d) a determination of economic or social importance;

(e) a determination that all existing and anticipated uses will or will not be fully protected;

(f) the amount of allowed degradation;

(g) a description of the required water quality protection practices;

(h) a description of all monitoring and reporting requirements; and

(i) a specific identification of any mixing zone the department proposes to allow.

(3) A statement of basis for the decision must be prepared for every preliminary decision. In general, the statement of basis must briefly set forth the principal facts and significant factual, legal, methodological or policy questions considered in preparing the authorization. The statement of basis must include, when applicable:

(a) a description of the proposed activity which is the subject of the authorization;

(b) the type and quantity of degradation which will result if the proposed activity is authorized;

(c) a summary of the basis for the conditions imposed in any preliminary decision, including references to applicable statutory or regulatory provisions;

(d) a summary and analysis of alternatives to the proposed activity;

(e) a description of the procedures for reaching a final decision on the draft authorization including:

(i) the beginning and ending dates of the comment period and the address where comments will be received;

(ii) procedures for requesting a hearing; and

(iii) any other procedures by which the public may participate in the final decision;

(f) name and telephone number of a person to contact for additional information; and

(g) reasons supporting the preliminary decision.

(4) The preliminary decision, accompanying statement of basis, and, if applicable, the statement of conditions imposed, must be publicly noticed and made available for public comment for at least 30 days but not more than 60 days prior to a final decision. In providing public notice, the department shall comply with the following:

(a) procedures for public notice set forth in ARM

17.30.1372; and

(b) procedures for the distribution of information set forth in ARM 17.30.1041.

(5) During the public comment period any interested person may submit written comments on the preliminary decision and may request a public hearing. A request for a public hearing must be in writing and must state the nature of the issues proposed to be raised in the hearing. The department shall hold a hearing if it determines that there may be a significant degree of public interest in the preliminary decision. Any public hearing conducted under this subsection is not a contested case hearing under the provisions of the Montana Administrative Procedure Act, Title 2, chapter 4, MCA.

(6) Within 60 days after the close of the public comment period, the department shall issue a final decision accompanied by a statement of basis for the decision and, if applicable, a statement of conditions. The final decision and statement of basis will be prepared according to the requirements of (2) and (3) of this rule. In addition, the statement of basis for a final decision must include the following:

(a) which provisions, if any, of the preliminary decision have been changed in the final decision and the reasons for the change; and

(b) a description and response to all substantive comments on the preliminary decision raised during the public comment period or during any hearing.

(7) Upon issuing a final decision, the department shall notify the applicant and each person who has submitted written comments or requested notice of that decision. The notice must include reference to the procedures for appealing the decision. The final decision is effective upon issuance.

(8) The board hereby adopts and incorporates by reference ARM 17.30.1372, which sets forth procedures for issuing public notices of MPDES permit applications and hearings, and ARM 17.30.1041 which sets forth requirements for distribution and copying of public notices and permit applications. Copies of ARM 17.30.1372 and 17.30.1041 may be obtained from the Department of Environmental Quality, PO Box 200901, Helena, MT 59620-0901. (History: 75-5-301, 75-5-303, MCA; IMP, 75-5-303, MCA; NEW, 1994 MAR p. 2136, Eff. 8/12/94; TRANS, from DHES, 1996 MAR p. 1499.)

Rules 17.30.709 through 17.30.714 reserved

NEXT PAGE IS 17-2795

<u>17.30.715 CRITERIA FOR DETERMINING NONSIGNIFICANT CHANGES IN WATER QUALITY</u> (1) The following criteria will be used to determine whether certain activities or classes of activities will result in nonsignificant changes in existing water quality due to their low potential to affect human health or the environment. These criteria consider the quantity and strength of the pollutant, the length of time the changes will occur, and the character of the pollutant. Except as provided in (2) of this rule, changes in existing surface or ground water quality resulting from the activities that meet all the criteria listed below are nonsignificant, and are not required to undergo review under 75-5-303, MCA:

(a) activities that would increase or decrease the mean monthly flow of a surface water by less than 15% or the 7-day 10 year low flow by less than 10%;

(b) discharges containing carcinogenic parameters or parameters with a bioconcentration factor greater than 300 at concentrations less than or equal to the concentrations of those parameters in the receiving water;

(c) discharges containing toxic parameters or nutrients, except as specified in (d) and (e) below, which will not cause changes that equal or exceed the trigger values in department Circular WQB-7. Whenever the change exceeds the trigger value, the change is not significant if the resulting concentration outside of a mixing zone designated by the department does not exceed 15% of the lowest applicable standard;

(d) changes in the concentration of nitrate in ground water which will not cause degradation of surface water if the sum of the predicted concentrations of nitrate at the boundary of any applicable mixing zone will not exceed the following values:

(i) 7.5 mg/L for nitrate sources other than domestic sewage;

(ii) 5.0 mg/L for domestic sewage effluent discharged from a conventional septic system;

(iii) 7.5 mg/L for domestic sewage effluent discharged from a septic system using level two treatment, as defined in ARM 17.30.702; or

(iv) 7.5 mg/L for domestic sewage effluent discharged from a conventional septic system in areas where the groundwater nitrate level exceeds 5.0 mg/L primarily from sources other than human waste.

For purposes of this subsection (d), the word "nitrate" means nitrate as nitrogen; and

(e) changes in concentration of total inorganic phosphorus in ground water if water quality protection practices approved by the department have been fully implemented and if an evaluation of the phosphorus adsorptive capacity of the soils in the area of the activity indicates that phosphorus will be removed for a period of 50 years prior to a discharge to any surface waters;

(f) changes in the quality of water for any harmful parameter for which water quality standards have been adopted other than nitrogen, phosphorous, and carcinogenic, bioconcentrating, or toxic parameters, in either surface or ground water, if the changes outside of a mixing zone designated by the department are less than 10% of the applicable standard and the existing water quality level is less than 40% of the standard;

(g) changes in the quality of water for any parameter for which there are only narrative water quality standards if the changes will not have a measurable effect on any existing or anticipated use or cause measurable changes in aquatic life or ecological integrity.

(2) Notwithstanding compliance with the criteria of (1) of this rule, the department may determine that the change in water quality resulting from an activity which meets the criteria in (1) of this rule is degradation based upon the following:

(a) cumulative impacts or synergistic effects;

(b) secondary byproducts of decomposition or chemical transformation;

(c) substantive information derived from public input;

(d) changes in flow;

(e) changes in the loading of parameters;

(f) new information regarding the effects of a parameter; or

(g) any other information deemed relevant by the department and that relates to the criteria in (1) of this rule.

(3) The department may determine that a change in water quality resulting from an activity or category of activities is nonsignificant based on information submitted by an applicant that demonstrates conformance with the guidance found in 75-5-301(5)(c), MCA. In making a determination under this subsection, the department shall allow for public comment prior to a decision pursuant to the public notice procedures in ARM 17.30.1372. (History: 75-5-301, 75-5-303, MCA; IMP, 75-5-303, MCA; NEW, 1994 MAR p. 2136, Eff. 8/12/94; AMD, 1995 MAR p. 1040, Eff. 6/16/95; AMD, 1995 MAR p. 2256, Eff. 10/27/95; TRANS, from DHES, 1996 MAR p. 1499.)

<u>17.30.716 CATEGORIES OF ACTIVITIES THAT CAUSE NONSIGNIFICANT CHANGES IN WATER QUALITY</u> (1) The following categories or classes of activities have been determined by the department to cause changes in water quality that are non-significant due to their low potential for harm to human health or the environment and their conformance with the guidance found in 75-5-301(5)(c), MCA:

(a) activities which are nonpoint sources of pollution where reasonable land, soil, and water conservation practices are applied and existing and anticipated beneficial uses will be fully protected;

(b) use of agricultural chemicals in accordance with a specific agrichemical management plan promulgated under 80-15-212, MCA, if applicable, or in accordance with a US EPA approved label and where existing and anticipated uses will be fully protected;

(c) changes in existing water quality resulting from an emergency or remedial activity that is designed to protect public health or the environment and is approved, authorized, or required by the department;

(i) changes in existing water quality resulting from treatment of a public water supply system as defined in 75-6-102(12), MCA, or a public sewage system as defined in 75-6-102(11), MCA, by chlorination or other similar means designed to protect the public health or the environment and approved, authorized, or required by the department.

(d) use of drilling fluids, sealants, additives, disinfectants and rehabilitation chemicals in water well or monitoring well drilling, development, or abandonment, if used according to department-approved water quality protection practices (ARM Title 36, chapter 21);

(e) short-term changes in existing water quality resulting from activities authorized by the department pursuant to 75-5-308, MCA;

(f) land application of animal waste, domestic septage, or waste from public sewage treatment systems containing nutrients where wastes are land applied in a beneficial manner, application rates are based on agronomic uptake of applied nutrients and other parameters will not cause degradation;

(g) incidental leakage of water from a public water supply system as defined in 75-6-102(12), MCA, or from a public sewage system as defined in 75-6-102(11), MCA, utilizing best practicable control technology designed and constructed in accordance with ARM 17.38.101 and 17.38.105;

(h) discharges of water from monitoring well or water well tests, hydrostatic pressure and leakage tests, or wastewater from the disinfection or flushing of water mains and storage reservoirs conducted in accordance with department-approved water quality protection practices;

(i) oil and gas drilling, production, abandonment, plugging, and restoration activities performed in accordance with ARM Title 36, chapter 22;

(j) short-term changes in existing water quality resulting from ordinary and everyday activities of humans or domesticated animals, including but not limited to recreational activities such as boating, hiking, fishing, wading, swimming and camping, fording of streams or other bodies of water by vehicular or other means, and drinking from or crossing of streams or other bodies of water by livestock and other domesticated animals;

(k) coal and uranium prospecting performed in accordance with ARM 26.4.1001, et seq.;

(l) solid waste management systems, motor vehicle wrecking facilities, and county motor vehicle graveyards licensed and operating in accordance with ARM Title 17, chapter 50;

(m) hazardous waste management facilities permitted and operated in accordance with ARM Title 17, chapter 54.

(2) No application need be made to the department for a determination of whether a water quality change is nonsignificant if the activity causing the change is listed in (1) of this rule. (History: 75-5-301, 75-5-303, MCA; IMP, 75-5-303, MCA; NEW, 1994 MAR p. 2136, Eff. 8/12/94; TRANS, from DHES, 1996 MAR p. 1499.)

17.30.717 IMPLEMENTATION OF WATER QUALITY PROTECTION PRACTICES (1) The owner of a new or increased source for which no water quality protection practices are approved by the department must design and submit a viable plan for implementation of the necessary water quality protection practices for department review, modification, and approval prior to implementation. (History: 75-5-301, 75-5-303, MCA; IMP, 75-5-303, MCA; NEW, 1994 MAR p. 2136, Eff. 8/12/94; TRANS, from DHES, 1996 MAR p. 1499.)

Sub-Chapters 8 and 9 reserved

NEXT PAGE IS 17-2825

APPENDIX F

SURFACE WATER QUALITY DATA FROM 1976, 1994, 1995 AND 1996

SURFACE WATER RESULTS - September 1995

All Common, Nutrient, and Metal parameter values in mg/l

Field parameters → Commons → Nutrients → Metals (Standard Analyses) → Metals Scan (ICP) →

Sample #	Site	Location Latitude	Longitude	Legal	Temp (oC)	pH	Conduc.	TDS (mg/l)	Hard	Cl	CO3	F	HCO3	SO4	NO3	OP	TKN	TP	Ca	K	Mg	Na	Al	As	B	Ba	Be	Ca
[illegible]	West Fk above main Gallatin	N45/15.972	W111/16.436	6S/3E/32 dbda	9	8.7	0.183	166	134	1.6	144	0.12	63	13.6	0.05	0.003	<0.1	0.005	38.3	1.8	9.2	6.8	0.03	0.005	0.02	0.06	0	36.0
BSSW 9-26/4	Middle Fk at Thunder Wolf	N45/16.889	W111/22 364	6S/3E/28 cbbc	7.2	8.2	0 107	91	82	1.3	<1.0	0.10	72	8.5	0.05	0.003	<0.1	0 011	24.7	1.1	4 9	3 7	0 08	0 01	0.02	0.05	0	23.8
[illegible]	Beehive Ck at Upper Bridge	N45/18.381	W111/23.112	6S/3E/17 dcac	7.8	7.8	0.122	104	105	<1.0	56	0.10	41	<6.0	0.02	0.007	<0.1	0.009	31.0	1.0	6.7	1.3	0.01	0	0.005	0.08	0	29.0
BSSW 9-26/8	South Fork at Firelight	N45/15.317	W111/19.314	7S/3E/01 cbba	6 6	8 5	0.168	143	137	<1.0	88	0.11	30	16.3	0.02	0.004	<0.1	0.005	38.2	1 4	10 0	4 7	0 02	0	0 02	0.06	0	36.0
[illegible]	South Fork at Ousel Falls	N45/14.388	W111/20.400	7S/3E/10 acdb	5.6	8.4	0.159	133	130	1.0	70	0.10	42	17.6	0.03	0.005	<0.1	0.006	36.7	1.3	9.4	3.6	LS	LS	LS	LS	LS	LS

Metals Scan Continued →

Sample #	Site	Location Latitude	Longitude	Legal	Temp (oC)	pH	Conduc.	TDS (mg/l)	Hard	Cd	Co	Cr	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Si	Sr	Ti	V	Zn
[illegible]	West Fk above main Gallatin	N45/15.972	W111/16.436	6S/3E/32 dbda	[illegible]	8.7	0.183	156	134	0	0.00	0	0	0.005	1.58	10.1	0.005	0.005	7.07	0	0	0	0	3.89	0.16	0.01	0.005	0.005
BSSW 9-26/4	Middle Fk at Thunder Wolf	N45/16.889	W111/22.364	6S/3E/28 cbbc	7.2	8.2	0.107	91	82	0	0.005	0	0	0.08	1.08	5.33	0.005	0.005	5.69	0	0	0	0	5.21	0.11	0.01	0.005	0.005
[illegible]	Beehive Ck at Upper Bridge	N45/18.381	W111/23.112	6S/3E/17 dcac	7.8	7.8	0.122	104	105	0	0.005	0	0	0.12	0.63	7.26	0.005	0.005	4.10	0	0	0	0	2.96	0.07	0.005	0.005	0.005
BSSW 9-26/8	South Fork at Firelight	N45/15.317	W111/19.314	7S/3E/01 cbba	6.6	8.5	0.168	143	137	0	0 005	0	0	0.02	1 17	11.3	0.005	0 005	6 11	0 005	0	0	0	3 66	0 12	0.01	0 005	0 005
[illegible]	South Fork at Ousel Falls	N45/14.388	W111/20.400	7S/3E/10 acdb	5.6	8.4	0.159	133	130	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS	LS

LS = Lost sample

Alkalinity as Mg/l CaCo3

Conductivity as micro-mohs/cm

Values of 0.005 denote analyses <0.01 mg/l

Samples analyzed by State Lab - Helena

BIG SKY WATER AND SEWER DISTRICT #363
WATER TESTING PROGRAM

GALLATIN RIVER: WATER ANALYSIS 1996

GALLATIN RIVER (ABOVE)	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
09-Jan-97											
27-Feb-97	74	4	ND	ND	0.07	0.068	8.2	ND	0.12	ND	180
01-May-97	2	ND		ND	ND	0.07	8.0	ND	ND	ND	310
20-Jun-97	6	32	1	0.01	0.04	0.08	7.9	0.05	0.3	ND	189
31-Jul-97		3	ND	ND	0.02	0.07	7.9	ND	ND	2	364

GALLATIN RIVER (BELOW)	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
09-Jan-97											
27-Feb-97	ND	ND	ND	ND	0.05	0.14	8.2	ND	ND	3.6	460
01-May-97	4	ND		ND	ND	0.13	8.2	ND	0.16	ND	170
20-Jun-97	10	22	1	0.01	0.02	0.07	7.9	0.5	0.5	ND	86
31-Jul-97		14	ND	ND	0.02	ND	8.1	ND	ND	1	227

ALL RESULTS IN mg/L EXCEPT FOR FECAL COLIFORMS AND pH

BIG SKY WATER AND SEWER DISTRICT #363
WATER TESTING PROGRAM

GALLATIN TRIBUTARIES: WATER ANALYSIS 1996

MIDDLE FORK ABOVE MEADOW	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
09-Jan-97	3	ND	ND	ND	ND	0.17	8.1	ND	ND	ND	98
27-Feb-97	4	ND	ND	ND	ND	0.17	8.0	ND	ND	3.6	100
01-May-97		ND		ND	ND	ND	7.9	ND	0.17	ND	110
20-Jun-97	21	17	1	ND	0.01	0.06	7.8	0.05	0.5	ND	41
31-Jul-97		3	ND	ND	ND	0.05	8.2	ND	0.6	ND	102

MIDDLE FORK BELOW MEADOW	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
09-Jan-97	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27-Feb-97	10	ND	ND	ND	0.06	0.3	8.0	ND	ND	ND	150
01-May-97		10		ND	ND	0.35	8.0	ND	0.18	ND	110
20-Jun-97	74	11	2	ND	ND	0.1	7.8	0.05	0.5	ND	56
31-Jul-97		3	ND	ND	ND	0.07	8.3	ND	0.5	1	118

MIDDLE FORK BELOW PLANT	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
09-Jan-97	6	5	ND	ND	ND	0.32	8.3	ND	ND	ND	190
27-Feb-97	11	ND	1	ND	ND	0.32	8.2	ND	0.2	4	180
01-May-97	14	ND		ND	ND	0.32	8.1	ND	0.1	3	140
20-Jun-97	31	16	1	ND	0.01	0.1	7.9	0.05	0.8	ND	52
31-Jul-97		2	1	ND	ND	0.08	8.4	ND	0.6	1	121

SOUTH FORK	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
09-Jan-97	5	ND	ND	ND	ND	0.13	8.2	ND	ND	ND	210
27-Feb-97	ND	ND	ND	ND	ND	0.16	8.3	ND	ND	ND	190
01-May-97	ND	ND		ND	ND	ND	8.3	ND	0.17	ND	150
31-Jul-97		19	ND	ND	0.03	0.05	8.1	ND	ND	ND	141

NORTH FORK	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
09-Jan-97	6	0	ND	ND	ND	0.05	8.1	0.1	0.5	ND	95

ALL RESULTS IN mg/L EXCEPT FOR FECAL COLIFORMS AND pH

BIG SKY WATER AND SEWER DISTRICT #363
WATER TESTING PROGRAM

GALLATIN RIVER: WATER ANALYSIS 1995

GALLATIN RIVER (ABOVE)	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY	2	14	1	ND	0.02	0.11	8.1	ND	0.1	ND	410
FEBRUARY	ND	ND	ND	ND	ND	0.12	8.1	ND	ND	ND	380
MARCH	ND	9	ND	0.02	ND	ND	8.3	ND	ND	ND	270
APRIL	8	10	2	ND	ND	ND	8.4	0.12	1.8	ND	200
MAY	42	190	ND	ND	0.16	0.1	8.1	ND	0.59	ND	210
JUNE	12	44	ND	ND	ND	ND	8.1	ND	1.4	6	170
JULY	16	ND	ND	ND	ND	0.09	8	ND	ND	ND	200
AUGUST	ND	ND	ND	ND	ND	ND	8.2	ND	ND	ND	320
SEPTEMBER											
OCTOBER											
NOVEMBER											
DECEMBER											

GALLATIN RIVER (BELOW)	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY	4	10	1	ND	0.03	0.11	8.0	ND	0.1	ND	450
FEBRUARY	14	ND	ND	ND	ND	0.15	8.1	ND	ND	ND	420
MARCH	ND	ND	1	ND	ND	0.11	8.2	ND	ND	ND	300
APRIL	2	4	2	ND	ND	ND	8.3	ND	1.4	ND	200
MAY	30	88	ND	ND	0.12	0.07	8.0	ND	1.6	ND	180
JUNE	ND	13	ND	ND	ND	ND	8.0	ND	1.4	6	160
JULY	2	7	ND	ND	ND	0.05	8.0	ND	ND	ND	130
AUGUST	ND	ND	ND	ND	ND	ND	8.2	ND	1.7	ND	410
SEPTEMBER											
OCTOBER											
NOVEMBER											
DECEMBER											

ALL RESULTS IN mg/L EXCEPT FOR FECAL COLIFORMS AND pH

BIG SKY WATER AND SEWER DISTRICT #363
WATER TESTING PROGRAM

GALLATIN TRIBUTARIES: WATER ANALYSIS 1995

NORTH FORK ABOVE MEADOW	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY	14	10	1	ND	0.02	0.17	8.3	ND	ND	ND	150
FEBRUARY	6	ND	ND	0.01	0.06	0.16	8.2	ND	ND	ND	120
MARCH	ND	7	2	0.01	ND	0.14	8.3	ND	ND	ND	140
APRIL	116	ND	2	ND	ND	ND	8.2	ND	1.9	ND	130
MAY	16	170	1	ND	0.16	0.07	7.9	ND	0.8	ND	60
JUNE	2	4	ND	ND	ND	2.0	7.8	0.1	2	ND	69
JULY	21	ND	ND	ND	ND	ND	7.5	ND	ND	ND	90
AUGUST	9	ND	ND	ND	ND	0.06	8.3	ND	ND	ND	100
SEPTEMBER											
OCTOBER											
NOVEMBER											
DECEMBER											

NORTH FORK BELOW MEADOW	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY	18	13	1	ND	0.02	0.17	8.2	ND	0.2	ND	150
FEBRUARY	14	ND	ND	0.01	ND	0.16	8.2	ND	ND	ND	150
MARCH	ND	7	1	0.01	ND	0.16	8.3	0.09	ND	ND	150
APRIL	84	ND	2	ND	ND	0.16	8.2	ND	1.8	ND	130
MAY	16	140	ND	ND	0.14	0.15	7.9	ND	0.8	ND	68
JUNE	4	4	ND	ND	ND	ND	7.9	ND	1.3	ND	69
JULY	7	ND	ND	ND	ND	ND	7.5	ND	ND	ND	80
AUGUST	5	ND	ND	ND	ND	0.09	8.2	ND	ND	ND	120
SEPTEMBER											
OCTOBER											
NOVEMBER											
DECEMBER											

NORTH FORK BELOW PLANT	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY	14	12	1	ND	0.03	0.27	8.3	ND	0.3	ND	170
FEBRUARY	10	6	1	ND	ND	0.29	8.2	ND	ND	6	180
MARCH	10	ND	1	ND	ND	0.16	8.5	ND	ND	ND	180
APRIL	6	ND	2	ND	ND	0.22	8.3	ND	1.6	ND	150
MAY	18	170	ND	ND	0.12	0.07	7.9	ND	0.61	ND	62
JUNE	14	ND	ND	ND	ND	ND	8.0	ND	0.9	ND	92
JULY	6	ND	ND	ND	ND	ND	8.5	ND	ND	ND	120
AUGUST	5	ND	ND	ND	ND	ND	8.4	ND	ND	ND	120
SEPTEMBER											
OCTOBER											
NOVEMBER											
DECEMBER											

SOUTH FORK	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY	0	9	2	ND	ND	0.17	8.3	ND	0.1	ND	190
FEBRUARY	14	4	ND	ND	ND	0.18	8.2	ND	ND	ND	180
MARCH	2	4	1	ND	ND	0.11	8.4	ND	ND	ND	200
APRIL	4	7	2	ND	ND	ND	8.4	0.23	1.6	ND	170
MAY	10	110	ND	ND	0.12	0.07	8.0	ND	1.4	ND	110
JUNE	4	11	ND	ND	ND	ND	8.0	ND	1.6	ND	110
JULY	6	ND	ND	ND	ND	ND	8.4	ND	ND	ND	170
AUGUST	6	7	ND	ND	ND	ND	8.5	ND	ND	ND	150
SEPTEMBER											
OCTOBER											
NOVEMBER											
DECEMBER											

ALL RESULTS IN mg/L EXCEPT FOR FECAL COLIFORMS AND pH

BIG SKY WATER AND SEWER DISTRICT #363
WATER TESTING PROGRAM

MOUNTAIN VILLAGE (CASCADE): WATER ANALYSIS 1995

WEST FORK UPPER CASCADE	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY											
FEBRUARY											
MARCH											
APRIL					START TESTING						
MAY	4	ND	4	ND	ND	0.08	7.4	ND	2.1	ND	56
JUNE	300	5	1	ND	ND	ND	7.6	ND	1.5	ND	54
JULY	90	ND	ND	ND	ND	ND	6.7	ND	ND	ND	46
AUGUST											
SEPTEMBER											
OCTOBER											
NOVEMBER											
DECEMBER											

WEST FORK LOWER CASCADE	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY											
FEBRUARY											
MARCH											
APRIL						START TESTING					
MAY	26	68	3	ND	ND	0.13	7.7	ND	1.5	34	36
JUNE	21	ND	1	ND	ND	ND	7.6	ND	1.6	ND	46
JULY	100	ND	ND	ND	ND	ND	7.0	0.07	ND	ND	42
AUGUST											
SEPTEMBER											
OCTOBER											
NOVEMBER											
DECEMBER											

WEST FORK BELOW DAM	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY											
FEBRUARY											
MARCH											
APRIL						START TESTING					
MAY	36	16	2	ND	ND	0.21	7.8	ND	1.5	ND	120
JUNE	16	6	2	ND	ND	0.06	7.6	ND	1.8	ND	53
JULY	12	ND	ND	ND	ND	0.1	8.1	ND	ND	ND	72
AUGUST											
SEPTEMBER											
OCTOBER											
NOVEMBER											
DECEMBER											

Surface Water

Chemistry and Bacteriology

TABLE 9 Conductivity (micromhos @ 25 C)

Sites	1970 #	1970 mean	1971 #	1971 mean	1972 #	1972 mean	1973 #	1973 mean	1974 #	1974 mean
West Fork										
1	10	125	13	167	13	169	12	182	11	170
2			13	150	11	143	8	153	11	152
3			13	157	13	149	5	157		
4			13	189	13	184	5	194	4	216
4a							7	199	11	188
5			12	231	13	231	12	254	10	245
6	10	169	14	232	13	220	12	255	10	236
8	10	168	3	191	5	197				
9			6	100	8	102	5	111	7	98
10			6	78	9	93	11	96	11	98
10a									10	89
11	10	104	6	110	5	127				
12					4	100	12	85	11	85
13							7	125	10	110
14							7	114	7	116
L1					2	272				
L1a					3	290				
West Gallatin										
1	9	178	10	244	13	257	11	269	10	256
2			8	247	9	250	7	296		
3	9	101	7	153	8	136				
4			8	260	9	262				
5			9	272	9	263				
6			8	259	9	266				
7	7	60	8	79	8	80				
8	9	223	8	276	9	275	7	341	10	301
9	9	229	9	286	9	271	7	337	10	300
10			9	298	9	288				
11	9	340	8	271	13	270	12	274	10	282
11a									4	365
12			7	246	9	266				
13			8	253	8	251				
14a	9	142					7	210	8	184
14b									10	187
15	9	242					7	364	7	306
16	9	209					7	302	10	270

TABLE 10 Field pH

Sites	1970 #	1970 mean	1971 #	1971 mean	1972 #	1972 mean	1973 #	1973 mean	1974 #	1974 mean
West Fork										
1	1	7.60	14	8.00	13	7.95	13	7.86	11	7.73
2			14	7.76	11	7.76	9	7.63	11	7.64
3			13	7.70	13	7.91	5	7.89		
4			13	7.88	13	8.02	5	7.99	4	8.00
4a							8	7.85	11	8.01
5			12	8.02	13	8.18	13	8.14	10	7.53
6	6	8.38	15	8.04	13	8.10	13	7.94	10	8.14
8	1	7.48	3	7.93	5	8.22				
9			6	7.68	8	7.63	5	7.60	7	7.61
10			6	7.48	9	7.54	11	7.39	11	7.30
10a									10	7.20
11	1	7.48	6	7.54	5	7.57				
12					4	7.56	13	7.41	11	7.59
13							8	7.44	10	6.99
14							7	7.20	7	7.41
L1					2	7.67				
L1a					3	7.25				
West Gallatin										
1	9	8.44	10	8.12	13	8.21	11	8.36	10	8.46
2			8	8.22	9	8.13	7	8.32		
3	9	8.29	7	8.22	8	7.98				
4			8	8.32	9	8.19				
5	9	8.35	9	8.29	9	8.19				
6			8	8.21	9	8.15				
7	7	7.99	8	7.76	8	7.75				
8	9	8.54	8	8.25	9	8.13	7	8.29	10	8.49
9	9	8.53	9	8.27	9	8.13	7	8.36	10	8.40
10			9	8.30	9	8.19				
11	9	7.99	8	8.30	13	8.28	12	8.24	10	8.31
12			7	8.36	9	8.28				
13			8	8.35	8	8.28				
14a	9	8.33					8	8.08	9	8.07
14b									10	8.15
15	9	8.44					8	8.41	7	8.30
16	9	8.41					8	8.26	10	8.32

TABLE II Calcium (meq/l Ca^{++})

Site	1970 #	1970 mean	1971 #	1971 mean	1972 #	1972 mean	1973 #	1973 mean	1974 #	1974 mean
West Fork										
1	12	1.11	14	1.26	13	1.14	11	1.27	6	1.26
2	12	0.93	14	0.99	11	0.90	8	0.88	6	0.94
3	3	0.63	13	1.08	13	1.00	4	1.16		
4	3	0.84	14	1.31	13	1.31	4	1.53	2	1.96
4a							7	1.34	6	1.45
5	12	1.51	12	1.69	13	1.62	11	1.70	5	1.61
6	11	1.63	15	1.69	13	1.56	11	1.67	5	1.64
7	2	1.00								
8	3	1.15	3	1.34	5	1.63				
9	1	0.64	6	0.82	8	0.70	4	0.71	4	0.74
10	1	0.40	6	0.48	9	0.54	9	0.56	6	0.64
10a									6	0.61
11	1	0.48	6	0.70	5	0.99				
12					4	0.55	11	0.49	6	0.51
13							7	0.75	5	0.71
14							6	0.63	4	0.59
L1					2	1.82				
L1a					3	3.24				
West Gallatin										
1	9	1.67	10	1.76	13	1.82	9	1.78	5	1.69
2			8	1.72	9	1.76	6	1.85		
3	9	1.31	7	1.08	8	0.96				
4			8	1.85	9	1.86				
5			9	1.97	9	1.89				
6			8	1.86	9	1.93				
7	7	0.51	8	0.42	8	0.49				
8	9	2.04	8	1.92	9	1.96	6	2.14	5	1.53
9	9	2.10	9	2.07	9	2.06	6	2.18	5	1.99
10			9	2.17	9	2.07				
11	9	2.88	8	1.96	13	1.97	10	2.02	5	1.87
11a									2	2.34
12			7	1.75	9	1.85				
13			8	1.59	8	1.81				
14a	9	1.34					7	1.03	5	1.08
14b									5	1.16
15	9	2.32					7	2.39	4	2.23
16	9	1.95					7	1.86	5	1.80

TABLE 12 Magnesium (meq/1 M_g^{++})

Site	1970 #	1970 mean	1971 #	1971 mean	1972 #	1972 mean	1973 #	1973 mean	1974 #	1974 mean
West Fork										
1	12	.37	14	.43	13	.43	11	.48	6	.49
2	12	.27	14	.35	11	.31	8	.29	6	.44
3	3	.22	13	.35	13	.40	4	.44		
4	3	.26	14	.49	13	.48	4	.59	2	.38
4a							7	.43	6	.44
5	12	.62	12	.64	13	.57	11	.71	5	.78
6	9	.55	15	.59	13	.65	11	.68	5	.65
7	2	.42								
8	3	.46	3	.48	5	.46				
9	1	.16	6	.20	8	.23	4	.19	4	.21
10	1	.18	6	.17	9	.20	9	.23	6	.25
10a									6	.20
11	1	.20	6	.20	5	.27				
12					4	.18	11	.22	6	.20
13							7	.23	5	.24
14							6	.23	4	.20
L1					2	.48				
L1a					3	.94				
West Gallatin										
1	9	.68	10	.71	13	.71	9	.87	5	.76
2			8	.66	9	.73	6	.82		
3	9	.31	7	.38	8	.34				
4			8	.80	9	.82				
5			9	.73	9	.82				
6			8	.89	9	.79				
7	7	.19	8	.19	8	.18				
8	9	1.08	8	.76	9	.78	6	1.00	5	.90
9	9	1.19	9	.82	9	.79	6	.99	5	.93
10			9	.84	9	.86				
11	9	1.21	8	.75	13	.71	10	.84	5	.82
11a									2	1.25
12			7	.75	9	.76				
13			8	.81	8	.72				
14a	8	.60					7	.48	5	.69
14b									5	.39
15	9	1.09					7	1.06	4	1.01
16	9	.86					7	.83	5	.74

TABLE 13 Potassium (meq/l K^+)

Site	1970 #	1970 mean	1971 #	1971 mean	1972 #	1972 mean	1973 #	1973 mean	1974 #	1974 mean
West Fork										
1	12	.03	12	.03	13	.03	11	.03	4	.02
2	12	.02	12	.02	11	.02	7	.02	4	.02
3	3	.02	12	.03	13	.02	5	.03		
4	3	.02	12	.03	13	.03	5	.03	1	.03
4a							6	.02	4	.02
5	12	.02	11	.03	13	.03	11	.02	3	.02
6	11	.02	12	.03	13	.03	11	.02	3	.02
7	2	.02								
8	3	.02	3	.02	5	.02				
9			5	.02	8	.01	3	.01	2	.01
10			5	.02	9	.01	9	.01	4	.02
10a			5	.02					4	.02
11					5	.02				
12					4	.01	11	.01	4	.01
13							6	.01	3	.01
14							5	<.01	3	.01
L1					2	.08				
L1a					3	.03				
West Gallatin										
1	9	.04	9	.04	13	.03	9	.03	3	.02
2			7	.03	9	.03	5	.03		
3	9	.04	6	.04	8	.04				
4			7	.04	9	.03				
5			8	.04	9	.03				
6			7	.04	9	.03				
7	7	.04	7	.05	8	.04				
8	9	.03	7	.03	9	.03	5	.03	3	.03
9	9	.03	8	.04	9	.03	5	.03	3	.03
10			8	.03	9	.03				
11	9	.04	8	.04	13	.03	10	.03	3	.03
11a									1	.03
12			6	.04	9	.03				
13			7	.03	8	.03				
14a	9	.05					6	.04	3	.05
14b									3	.05
15	9	.04					6	.03	2	.03
16	9	.03					6	.03	3	.03

TABLE 14 Sodium (meq/l Na^+)

Site	1970 #	1970 mean	1971 #	1971 mean	1972 #	1972 mean	1973 #	1973 mean	1974 #	1974 mean
West Fork										
1	12	.08	12	.08	13	.10	11	.07	4	.07
2	11	.17	12	.25	11	.21	7	.20	4	.27
3	3	.06	12	.20	13	.18	5	.25		
4	3	.09	12	.24	13	.19	5	.27	1	.19
4a							6	.18	4	.22
5	11	.18	11	.25	13	.21	11	.25	3	.24
6	11	.15	12	.24	13	.20	11	.23	3	.22
7	2	.11								
8	3	.09	3	.14	5	.14				
9			5	.12	8	.11	3	.09	2	.12
10			5	.15	9	.16	9	.17	4	.16
10a									4	.21
11			5	.08	5	.10				
12					4	.18	11	.16	4	.17
13							6	.14	3	.16
14							5	.20	3	.19
L1					2	.49				
L1a					3	.22				
West Gallatin										
1	9	.17	9	.19	13	.19	9	.20	3	.17
2			7	.19	9	.19	5	.19		
3	9	.10	6	.12	8	.12				
4			7	.20	9	.20				
5			8	.21	9	.20				
6			7	.20	9	.20				
7	7	.09	7	.11	8	.12				
8	9	.18	7	.21	9	.20	5	.21	3	.20
9	9	.19	8	.21	9	.21	5	.21	3	.19
10			8	.21	9	.21				
11	9	.20	7	.23	13	.23	10	.22	3	.21
11a									1	.24
12			6	.21	9	.21				
13			7	.22	8	.21				
14a	9	.33					6	.25	3	.32
14b									3	.32
15	9	.14					6	.14	2	.14
16	9	.23					6	.20	3	.19

TABLE 15 Chloride (meq/l Cl^-)

Site	1970 #	1970 mean	1971 #	1971 mean	1972 #	1972 mean	1973 #	1973 mean	1974 #	1974 mean
West Fork										
1	12	.008	12	.007	13	.012	12	.011	5	.008
2	12	.013	12	.013	11	.012	8	.013	5	.016
3	3	.006	11	.009	13	.014	5	.014		
4	3	.005	12	.014	13	.015	5	.017	2	.021
4a							7	.021	5	.017
5	12	.015	10	.015	13	.015	12	.016	4	.012
6	11	.010	13	.014	13	.013	12	.018	4	.013
7	2	.006								
8	3	.004	3	.009	5	.010				
9			5	.007	8	.008	4	.010	3	.006
10			5	.006	9	.011	10	.013	5	.009
10a									5	.030
11			5	.003	5	.009				
12					4	.013	12	.011	5	.006
13							7	.017	4	.014
14							6	.013	3	.008
L1					2	.230				
L1a					3	.023				
West Gallatin										
1	8	.018	8	.018	13	.024	10	.027	4	.015
2			6	.013	9	.021	6	.022		
3	8	.011	5	.011	8	.013				
4			6	.016	9	.023				
5			7	.019	9	.021				
6			6	.015	9	.020				
7	7	.012	6	.008	8	.011				
8	8	.018	6	.016	9	.021	6	.027	4	.016
9	8	.023	7	.020	9	.023	6	.027	4	.017
10			7	.020	9	.023				
11	8	.026	7	.017	13	.018	11	.023		
11a									4	.011
12			7	.012	9	.017			1	.003
13			6	.012	8	.019				
14a	8	.017					7	.019	4	.034
14b							7	.019	4	.011
15	8	.015					7	.019	3	.012
16	8	.016							4	.008

TABLE 16 Sulfate (meq/l $SO_4^{=}$)

Site	1970		1971		1972		1973		1974	
	#	mean	#	mean	#	mean	#	mean	#	mean
West Fork										
1	12	.14	14	.15	13	.13	12	.19	5	.17
2	12	.22	14	.16	11	.13	8	.26	5	.18
3	3	.14	13	.15	13	.15	5	.21		
4	3	.16	13	.15	13	.15	5	.23	2	.17
4a							7	.16	5	.17
5	12	.38	11	.42	13	.33	12	.39	4	.45
6	11	.45	14	.39	13	.34	12	.46	4	.45
7	2	.24								
8	3	.27	3	.27	5	.25				
9			6	.24	8	.22	4	.25	3	.26
10			6	.10	9	.15	10	.15	5	.16
10a			6	.10					5	.15
11					5	.08				
12					4	.19	12	.17	5	.15
13							7	.18	4	.14
14							6	.15	3	.14
L1					2	.18				
L1a					3	.18				
West Gallatin										
1	8	.88	10	.86	13	.83	10	.96	4	.88
2			8	.83	9	.73	6	.97		
3	8	.15	6	.08	8	.13				
4			8	.92	9	.80				
5			9	1.02	9	.83				
6			8	.97	9	.82				
7	7	.14	8	.04	8	.08				
8	8	1.66	8	.86	8	.79	6	1.16	4	1.16
9	6	1.48	9	1.14	9	.90	6	1.22	4	1.20
10			9	1.08	9	.99				
11	6	3.06	8	.79	13	.65	11	.81	4	.71
11a									1	2.19
12			8	.54	9	.54				
13			7	.59	8	.51				
14a	8	.29					7	.22	4	.27
14b									4	.26
15	8	.76					7	.61	3	.63
16	8	.84					7	.63	4	.68

TABLE 17 Total Alkalinity (meq/l)

Site	1970 #	1970 mean	1971 #	1971 mean	1972 #	1972 mean	1973 #	1973 mean	1974 #	1974 mean
West Fork										
1	11	1.46	14	1.70	13	1.64	13	1.82	11	1.71
2	11	1.33	14	1.49	11	1.29	9	1.28	11	1.39
3	2	1.02	13	1.52	13	1.47	5	1.75		
4	2	1.30	14	1.93	13	1.73	5	2.35	4	2.21
4a							8	1.85	11	1.83
5	11	2.14	12	2.29	13	2.13	13	2.36	10	2.28
6	10	1.84	15	2.18	13	2.02	13	2.31	10	2.01
7	1	1.58								
8	2	1.63	3	1.84	5	1.88				
9	2	0.72	5	0.76	8	0.78	5	0.72	7	0.81
10	1	0.70	5	0.67	9	0.70	11	0.82	11	0.91
10a									10	0.78
11	1	0.76	5	0.99	5	1.28				
12					4	1.00	13	0.72	11	0.71
13							8	1.00	10	1.04
14							7	0.98	7	1.13
L1					2	2.88				
L1a					3	4.22				
West Gallatin										
1	8	1.93	10	1.86	13	1.92	11	2.03	10	1.90
2			8	2.05	9	1.96	7	2.04		
3	8	1.59	7	1.48	8	1.49				
4			8	2.09	9	2.03				
5			9	2.17	9	2.04				
6			7	2.07	9	2.07				
7	7	.85	8	0.79	8	0.75				
8	8	2.30	8	2.19	9	2.12	7	2.31	10	2.07
9	8	2.35	9	2.20	9	2.13	7	2.27	10	2.25
10			9	2.30	9	2.19				
11	8	2.72	8	2.37	13	2.28	12	2.38	10	2.25
11a									4	2.06
12			7	2.26	9	2.23				
13			8	2.23	8	2.17				
14a	8	1.92					8	1.66	9	1.84
14b									10	1.69
15	8	3.20					8	3.12	7	2.73
16	8	2.36					8	2.32	10	2.38

TABLE 18 Nitrate (mg/l NO_3^--N)

Site	1970 #	1970 mean	1971 #	1971 mean	1972 #	1972 mean	1973 #	1973 mean	1974 #	1974 mean
West Fork										
1	9	.03	14	.05	13	.04	13	.03	11	.03
2			14	.04	11	.02	9	<.01	11	.02
3			13	.04	13	.03	5	.04		
4			14	.06	13	.04	5	.05	4	.01
4a							8	.02	11	.02
5	9	.01	12	.02	13	.02	13	.01	10	.02
6	7	.01	15	.04	13	.02	13	.02	10	.02
8			3	<.01	5	<.01				
9			6	.11	8	.09	5	.09	7	.07
10			6	.03	8	.03	11	.03	11	.02
10a									10	.01
11	9	.01	6	.01	5	<.01				
12					4	.04	13	.03	11	.05
13							8	.03	10	.03
14							7	.03	7	.01
L1					3	<.01				
L1a					2	<.01				
West Gallatin										
1	7	<.01	10	.01	13	.02	11	<.01	10	.01
2			8	<.01	9	.02	7	<.01		
3	7	.01	7	.04	8	.04				
4			8	<.01	9	.01				
5			9	<.01	9	.01				
6			8	<.01	9	.01				
7	6	<.01	8	.02	8	.03				
8	7	<.01	8	<.01	9	.02	7	<.01	10	<.01
9			9	<.01	9	.01	7	<.01	10	<.01
10			9	.01	9	.01				
11	7	.03	8	.08	13	.01	12	<.01	10	<.01
11a									4	.02
12			7	<.01	9	.01				
13			8	<.01	8	<.01				
14a	7	<.01					8	<.01	9	<.01
14b									10	<.01
15	7	<.01					8	<.01	7	<.01
16	7	<.01					8	<.01	10	<.01

TABLE 19 Ammonia (mg/1 NH_3^+ -N)

Site	1970 #	1970 mean	1971 #	1971 mean	1972 #	1972 mean	1973 #	1973 mean	1974 #	1974 mean
West Fork										
1	10	.01	11	.01	11	<.01	10	.02	10	<.01
2			11	.01	10	.02	8	.02	10	.01
3			10	.02	12	<.01	3	.02		
4			11	.02	12	<.01	3	.02	3	<.01
4a							7	.01	10	<.01
5	10	.06	9	.01	12	.01	10	.01	9	<.01
6	7	.01	11	.02	12	<.01	10	.02	9	<.01
8			3	.02	4	<.01				
9			6	<.01	7	<.01	5	<.01	6	<.01
10			6	.01	8	.01	7	.02	10	<.01
10a									9	<.01
11	10	.01	6	.02	4	<.01				
12					4	<.01	10	.02	10	<.01
13							7	.03	9	<.01
14							6	.02	6	<.01
L1					2	.20				
L1a					3	.02				
West Gallatin										
1	8	<.01	10	.02	12	.02	9	.04	9	.04
2			8	<.01	8	<.01	6	.03		
3	8	<.01	7	.02	7	<.01				
4			8	<.01	8	<.01				
5			9	<.01	8	.01				
6			8	.01	8	.01				
7	7	<.01	8	.02	7	<.01				
8	8	<.01	8	.01	8	<.01	6	.02	9	.02
9			9	.01	8	.02	6	.02	9	.01
10			9	.01	8	<.01				
11	8	<.01	8	.01	12	.02	9	.05	9	.01
11a									4	.01
12			8	.02	8	.01				
13			9	.02	7	.01				
14a	8	.01					7	.02	8	<.01
14b							7	.02	9	<.01
15	8	<.01							6	<.01
16	8	.01					7	.01	9	<.01

TABLE 20 Orthophosphate (mg/l PO_4^{-3} -P)

Site	1970 #	1970 mean	1971 #	1971 mean	1972 #	1972 mean	1973 #	1973 mean	1974 #	1974 mean
West Fork										
1	9	.01	13	<.01	13	<.01	13	<.01	11	<.01
2			13	.01	11	.01	9	.02	11	.01
3			12	<.01	13	.01	5	.02		
4			13	.01	13	.01	5	.02	4	.04
4a							8	<.01	11	<.01
5	9	.01	11	<.01	13	<.01	13	<.01	10	<.01
6	8	.01	14	<.01	13	<.01	13	.01	10	<.01
8			3	.01	5	<.01				
9			6	<.01	8	<.01	5	<.01	7	<.01
10			6	<.01	8	<.01	11	.01	11	.01
10a					5	<.01			10	.01
11	9	.01	6	<.01						
12					4	<.01	13	.01	11	.01
13							8	<.01	10	<.01
14							7	.01	7	.02
L1					2	.75				
L1a					3	.01				
West Gallatin										
1	8	<.01	10	.02	13	.02	11	.02	10	.02
2			8	.02	9	.02	7	.02		
3	8	.05	7	.06	8	.05				
4			8	.12	9	.02				
5			9	.02	9	.02				
6			8	.02	9	.02				
7	7	.06	8	.08	8	.08				
8	8	<.01	8	.02	9	.02	7	.01	10	.01
9			9	.01	9	.02	7	.01	10	.02
10			9	.01	9	.02				
11	8	.02	8	.02	12	.02	12	.02	10	.05
11a									4	.02
12			7	.02	8	.02				
13			8	.02	8	.02				
14a	8	.02					8	.02	9	.02
14b									10	.02
15	8	.01					8	.01	7	<.01
16	8	.02					8	.02	10	.01

TABLE 25

Fecal Coliforms MF
(organisms/100 ml)

West Fork 1973

SITES	WF1	WF2	WF4	WF4a	WF5	WF6	WF9
No. of Samples	7	7		7	7	7	4
High	6	45		27	34	73	11
Low	1	1		1	1	1	1
Arithmetic mean	3	9		7	7	14	4
Geometric mean	2	4		4	3	5	2

SITES	WF10	WF10a	WF12	WF13	WF14	L1
No. of Samples	7		7	7	7	6
High	23		35	51	12	7800
Low	1		5	1	1	0
Arithmetic mean	14		15	10	3	1619
Geometric mean	9		11	4	2	209

West Fork 1974

SITES	WF1	WF2	WF4	WF4a	WF5	WF6	WF9
No. of Samples	11	11	4	11	10	12	7
High	17	18	4	14	11	23	2
Low	1	1	1	1	1	1	1
Arithmetic mean	3	4	2	3	3	4	1
Geometric mean	2	3	1	2	2	2	1

SITES	WF10	WF10a	WF12	WF13	WF14	L1
No. of Samples	11	10	11	11	6	10
High	9	8	6	4	620	19000
Low	1	1	1	1	4	1
Arithmetic mean	3	2	2	2	138	5210
Geometric mean	2	2	2	1	45	1425

Fecal Coliforms MF
(organisms/100 ml)

TABLE 26

West Gallatin 1973

	WG1	WG2	WG8	WG9	WG11	WG14a	WG14b	WG15	WG1[illegible]
No. of samples	7	7	7	7	7	7		7	7
High	4	2	3	2	8	2		5	4
Low	1	1	1	1	1	1		1	1
Arithmetic mean	2	1	2	1	3	1		3	2
Geometric mean	1	1	1	1	2	1		2	1

West Gallatin 1974

	WG1	WG2	WG8	WG9	WG11	WG14a	WG14b	WG15	WG16
No. of samples	13		9	10	13	9	10	7	10
High	34		13	16	34	8	8	11	8
Low	1		1	1	1	1	1	1	1
Arithmetic mean	7		4	4	6	3	3	4	4
Geometric mean	3		3	3	3	2	2	3	2

Fecal Coliforms
(Calculated from % EC positives and coliform geometric means)
organisms/100ml

TABLE 27

Sites	1970	1971	1972	1973	1974
West Fork					
1	5	1	4	5	2
2	13	19	30	12	9
3	29	18	29	6	
4	30	5	27	18	5
5	9	6	10	4	3
6	13	9	21	6	6
8	21	5	8		
9	30	9	2	1	2
10	38	22	20	30	5
11	3	7	7		
12			24	10	2
13				3	2
14				6	48
West Gallatin					
1		7	16	3	5
2		8	28	2	
3		11	44		
4		6	32		
5		7	53		
6		11	51		
7		1	21		
8		9	36	2	3
9		11	28	1	2
10		15	27		
11		5	9	5	7
12		11	8		
13		40	13		
14a			39	7	2
15				3	4
16				2	4

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FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4866
DATE: 02/14/94 jmw

WATER ANALYSIS

M. Fork Above Meadow
Sampled 01/26/94
Submitted 01/27/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	2	01/28/94
5-Day Biochemical Oxygen Demand	1 ✓	01/27/94
Ortho-phosphate as P	0.03	02/10/94
Total Phosphorus as P	0.05	02/08/94
Nitrate plus Nitrite as N	0.15	01/31/94
pH	8.2 s.u.	01/28/94
Ammonia as N	<0.1	01/28/94
Total Kjeldahl Nitrogen	<0.1	01/31/94
Chloride	1	01/28/94
Total Dissolved Solids @ 180°C	131	01/28/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4867
DATE: 02/14/94 jmw

WATER ANALYSIS

M. Fork Below Meadow
Sampled 01/26/94
Submitted 01/27/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	5	01/28/94
5-Day Biochemical Oxygen Demand	2	01/27/94
Ortho-phosphate as P	0.02	02/10/94
Total Phosphorus as P	0.03	02/08/94
Nitrate plus Nitrite as N	0.25	01/31/94
pH	8.2 s.u.	01/28/94
Ammonia as N	<0.1	01/28/94
Total Kjeldahl Nitrogen	<0.1	01/31/94
Chloride	1	01/28/94
Total Dissolved Solids @ 180°C	143	01/28/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4874
DATE: 02/14/94 jmw

WATER ANALYSIS

Middle Fork Below Plant
Sampled 01/26/94
Submitted 01/27/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	12	01/28/94
5-Day Biochemical Oxygen Demand	1	01/27/94
Ortho-phosphate as P	0.02	02/10/94
Total Phosphorus as P	0.04	02/08/94
Nitrate plus Nitrite as N $NO_3 + NO_2$	0.24	01/31/94
pH	8.3 s.u.	01/28/94
Ammonia as N	<0.1	01/28/94
Total Kjeldahl Nitrogen	0.3	02/02/94
Chloride	3	01/28/94
Total Dissolved Solids @ 180°C	153	01/28/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4865
DATE: 02/14/94 jmw

WATER ANALYSIS

Gallatin River
Sampled 01/26/94
Submitted 01/27/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	<1	01/28/94
5-Day Biochemical Oxygen Demand	1	01/27/94
Ortho-phosphate as P	0.02	02/10/94
Total Phosphorus as P	0.03	02/08/94
Nitrate plus Nitrite as N	0.10	01/31/94
pH	8.0 s.u.	01/28/94
Ammonia as N	<0.1	01/28/94
Total Kjeldahl Nitrogen	<0.1	01/31/94
Chloride	2	01/28/94
Total Dissolved Solids @ 180°C	373	01/28/94

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement Dist. 305
Box 57
Big Sky, MT 59716

LAB NO.: 94-6875
DATE: 03/08/94 lm

WATER ANALYSIS

North Fork Above Meadow
Sampled 02/23/94
Submitted 02/24/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	1	02/28/94
Total Dissolved Solids @ 180 °C	138	02/25/94
Total Suspended Solids	1	02/28/94
pH	8.1 s.u.	02/28/94
5-Day Biochemical Oxygen Demand	1	02/24/94
Nitrate plus Nitrite as N	0.14	02/28/94
Ammonia as N	<0.1	02/28/94
Total Phosphorus as P	0.10	03/01/94
Ortho-phosphate as P	0.04	02/24/94
Total Kjeldahl Nitrogen	<0.1	03/01/94

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FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement Dist. 305
Box 57
Big Sky, MT 59716

LAB NO.: 94-6873
DATE: 03/08/94 lm

WATER ANALYSIS

North Fork Below Meadow
Sampled 02/23/94
Submitted 02/24/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	1	02/28/94
Total Dissolved Solids @ 180 °C	155	02/25/94
Total Suspended Solids	2	02/28/94
pH	8.2 s.u.	02/28/94
5-Day Biochemical Oxygen Demand	1 ✓	02/24/94
Nitrate plus Nitrite as N	0.24	02/28/94
Ammonia as N	<0.1	02/28/94
Total Phosphorus as P	0.10	03/01/94
Ortho-phosphate as P	0.04	02/24/94
Total Kjeldahl Nitrogen	<0.1	03/01/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement Dist. 305
Box 57
Big Sky, MT 59716

LAB NO.: 94-6874
DATE: 03/08/94 lm

WATER ANALYSIS

North Fork Below Plant
Sampled 02/23/94
Submitted 02/24/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	3	02/28/94
Total Dissolved Solids @ 180 °C	171	02/25/94
Total Suspended Solids	26	02/28/94
pH	8.2 s.u.	02/28/94
5-Day Biochemical Oxygen Demand	1	02/24/94
Nitrate plus Nitrite as N	0.27	02/28/94
Ammonia as N	<0.1	02/28/94
Total Phosphorus as P	0.09	03/01/94
Ortho-phosphate as P	0.04	02/24/94
Total Kjeldahl Nitrogen	<0.1	03/01/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement Dist. 305
Box 57
Big Sky, MT 59716

LAB NO.: 94-6876
DATE: 03/08/94 lm

WATER ANALYSIS

Gallatin River
Sampled 02/23/94
Submitted 02/24/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	2	02/28/94
Total Dissolved Solids @ 180 °C	373	02/25/94
Total Suspended Solids	3	02/28/94
pH	8.1 s.u.	02/28/94
5-Day Biochemical Oxygen Demand	1	02/24/94
Nitrate plus Nitrite as N	0.09	02/28/94
Ammonia as N	<0.1	02/28/94
Total Phosphorus as P	0.10	03/01/94
Ortho-phosphate as P	0.03	02/24/94
Total Kjeldahl Nitrogen	<0.1	03/01/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement Dist. 305
Box 57
Big Sky, MT 59716

LAB NO.: 94-6877
DATE: 03/08/94 lm

WATER ANALYSIS

South Fork River
Sampled 02/23/94
Submitted 02/24/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	<1	02/28/94
Total Dissolved Solids @ 180 °C	174	02/25/94
Total Suspended Solids	<1	02/28/94
pH	8.2 s.u.	02/28/94
5-Day Biochemical Oxygen Demand	<1	02/24/94
Nitrate plus Nitrite as N	0.16	02/28/94
Ammonia as N	<0.1	02/28/94
Total Phosphorus as P	0.08	03/01/94
Ortho-phosphate as P	0.03	02/24/94
Total Kjeldahl Nitrogen	<0.1	03/01/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12634
DATE: 04/11/94 lm

WATER ANALYSIS

South Fork
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	3	03/31/94
5-Day Biochemical Oxygen Demand	1	03/30/94
Ortho-phosphate as P	0.03	04/07/94
Nitrate plus Nitrite as N	<0.05	04/01/94
pH	8.2 s.u.	03/31/94
Total Phosphorus as P	0.04	04/06/94
Ammonia as N	<0.1	04/01/94
Total Kjeldahl Nitrogen	<0.1	03/31/94
Chloride	<1	03/31/94
Total Dissolved Solids @ 180° C	160	04/04/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12635
DATE: 04/11/94 lm

WATER ANALYSIS

North Fork Above Meadow
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	2	03/31/94
5-Day Biochemical Oxygen Demand	<1	03/30/94
Ortho-phosphate as P	0.07	04/04/94
Nitrate plus Nitrite as N	0.08	04/01/94
pH	8.0 s.u.	03/31/94
Total Phosphorus as P	0.07	04/06/94
Ammonia as N	<0.1	04/01/94
Total Kjeldahl Nitrogen	<0.1	03/31/94
Chloride	2	03/31/94
Total Dissolved Solids @ 180° C	138	04/04/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12636
DATE: 04/11/94 lm

WATER ANALYSIS

North Fork Below Meadow
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	36	03/31/94
5-Day Biochemical Oxygen Demand	2	03/30/94
Ortho-phosphate as P	0.05	04/04/94
Nitrate plus Nitrite as N	0.22	04/01/94
pH	8.0 s.u.	03/31/94
Total Phosphorus as P	0.06	04/06/94
Ammonia as N	<0.1	04/01/94
Total Kjeldahl Nitrogen	<0.1	03/31/94
Chloride	2	03/31/94
Total Dissolved Solids @ 180° C	149	04/04/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12637
DATE: 04/11/94 lm

WATER ANALYSIS

North Fork Below Plant
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	13	03/31/94
5-Day Biochemical Oxygen Demand	1	03/30/94
Ortho-phosphate as P	0.04	04/06/94
Nitrate plus Nitrite as N	0.21	04/01/94
pH	8.2 s.u.	03/31/94
Total Phosphorus as P	0.08	04/06/94
Ammonia as N	<0.1	04/01/94
Total Kjeldahl Nitrogen	<0.2	04/01/94
Chloride	4	03/31/94
Total Dissolved Solids @ 180° C	174	04/04/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12645
DATE: 04/11/94 lm

WATER ANALYSIS

Gallatin Above
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Ortho-phosphate as P	0.10	04/04/94
Nitrate plus Nitrite as N	<0.05	03/31/94
Total Phosphorus as P	0.14	04/06/94
Ammonia as N	<0.1	03/31/94
Total Kjeldahl Nitrogen	<0.1	04/04/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12646
DATE: 04/11/94 lm

WATER ANALYSIS

Gallatin Below
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Ortho-phosphate as P	0.07	04/07/94
Nitrate plus Nitrite as N	0.12	03/31/94
Total Phosphorus as P	0.08	04/06/94
Ammonia as N	<0.1	03/31/94
Total Kjeldahl Nitrogen	<0.1	04/04/94

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LABORATORY REPORT

TO:	Terry Threlkeld	LAB NO.:	94-12647
ADDRESS:	Water & Sewer Dist. #363	DATE:	04/11/94 lm
	P.O. Box 160057		
	Big Sky, MT 59716		

WATER ANALYSIS

Gallatin A
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	11	03/31/94
5-Day Biochemical Oxygen Demand	1	03/30/94
pH	8.2 s.u.	03/31/94
Chloride	<1	03/31/94
Total Dissolved Solids @ 180° C	207	04/04/94

REMARKS: Both of these unpreserved bottles were labeled "Gallatin Raw".

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12648
DATE: 04/11/94 lm

WATER ANALYSIS

Gallatin B
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	20	03/31/94
5-Day Biochemical Oxygen Demand	<1	03/30/94
pH	8.1 s.u.	03/31/94
Chloride	2	03/31/94
Total Dissolved Solids @ 180° C	319	04/04/94

REMARKS: Both of these unpreserved bottles were labeled "Gallatin Below".

Lab Nos. 94-12634-48

QUALITY ASSURANCE DATA PACKAGE

This report includes the results of quality assurance tests performed with the sample analyses. They are performed to determine if the methodology is in control and to monitor the laboratory's ability to produce accurate and precise results.

Constituent	Duplicate Analysis -------mg/l (ppm)------- Original	Duplicate	Spiked Analysis, % Recovery	Blank Analysis, mg/l (ppm)	-----Reference----- Sample Analysis, mg/l (ppm)	Acceptance Range, mg/l (ppm)	Date Analyze
Total Suspended Solids	26	26	N/A	<1	N/A	N/A	03/31/94
5-Day Biochemical Oxygen Demand	293	283	N/A	N/A	222	168-228	03/30/9
Orth-phosphate as P	0.07	0.07	102	<0.01	0.96	0.87-1.09	04/04/94
Nitrate plus Nitrite as N	<0.05	<0.05	100	<0.05	3.44	3.2-4.0	04/01/9
pH, s.u.	7.5	7.7	N/A	N/A	N/A	N/A	N/A
Total Phosphorus as P	0.02	0.02	102	<0.01	1.12	0.94-1.26	04/06/9
Ammonia as N	<0.1	<0.1	94	<0.1	2.19	1.87-2.60	04/01/94
Total Kjeldahl Nitrogen	0.6	0.6	102	<0.1	3.2	2.6-4.0	04/04/9
Chloride	29	29	112	<1	52	45-55	03/31/9
Total Dissolved Solids @ 180° C	324	326	98	N/A	N/A	N/A	04/04/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-17018
DATE: 05/04/94 lm

WATER ANALYSIS

South Fork
Sampled 04/25/94
Submitted 04/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	1	05/03/94
Total Dissolved Solids @ 180° C	104	04/28/94
pH	7.9 s.u.	04/27/94
Total Suspended Solids	52	04/27/94
5-Day Biochemical Oxygen Demand	1	04/27/94
Total Kjeldahl Nitrogen	0.5	04/28/94
Nitrate plus Nitrite as N	0.12	04/29/94
Ammonia as N	<0.1	04/29/94
Total Phosphorus as P	0.14	04/28/94
Ortho-phosphate as P	0.05	04/27/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-17019
DATE: 05/04/94 lm

WATER ANALYSIS

North Fork Above Meadow
Sampled 04/25/94
Submitted 04/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	1	05/03/94
Total Dissolved Solids @ 180° C	85	04/28/94
pH	7.7 s.u.	04/27/94
Total Suspended Solids	30	04/28/94
5-Day Biochemical Oxygen Demand	1	04/27/94
Total Kjeldahl Nitrogen	0.3	04/28/94
Nitrate plus Nitrite as N	0.09	04/29/94
Ammonia as N	<0.1	04/29/94
Total Phosphorus as P	0.10	04/28/94
Ortho-phosphate as P	0.05	04/27/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-17020
DATE: 05/04/94 lm

WATER ANALYSIS

North Fork Above Plant
Sampled 04/25/94
Submitted 04/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	2	05/03/94
Total Dissolved Solids @ 180° C	87	04/28/94
pH	7.7 s.u.	04/27/94
Total Suspended Solids	62	04/28/94
5-Day Biochemical Oxygen Demand	<1	04/27/94
Total Kjeldahl Nitrogen	0.4	04/28/94
Nitrate plus Nitrite as N	0.10	04/29/94
Ammonia as N	<0.1	04/29/94
Total Phosphorus as P	0.09	04/28/94
Ortho-phosphate as P	0.04	04/27/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-17021
DATE: 05/04/94 lm

WATER ANALYSIS

North Fork Below Plant
Sampled 04/25/94
Submitted 04/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	2	05/03/94
Total Dissolved Solids @ 180° C	87	04/28/94
pH	7.8 s.u.	04/27/94
Total Suspended Solids	64	04/28/94
5-Day Biochemical Oxygen Demand	<1	04/27/94
Total Kjeldahl Nitrogen	0.4	04/28/94
Nitrate plus Nitrite as N	0.10	04/29/94
Ammonia as N	<0.1	04/29/94
Total Phosphorus as P	0.09	04/28/94
Ortho-phosphate as P	0.04	04/27/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-17022
DATE: 05/04/94 lm

WATER ANALYSIS

Gallatin Above
Sampled 04/25/94
Submitted 04/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	1	05/03/94
Total Dissolved Solids @ 180° C	225	04/28/94
pH	7.9 s.u.	04/27/94
Total Suspended Solids	46	04/28/94
5-Day Biochemical Oxygen Demand	<1	04/27/94
Total Kjeldahl Nitrogen	0.3	04/28/94
Nitrate plus Nitrite as N	0.11	04/29/94
Ammonia as N	<0.1	04/29/94
Total Phosphorus as P	0.08	04/28/94
Ortho-phosphate as P	0.02	04/27/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-17023
DATE: 05/04/94 lm

WATER ANALYSIS

Gallatin Below
Sampled 04/25/94
Submitted 04/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	<1	05/03/94
Total Dissolved Solids @ 180° C	128	04/28/94
pH	7.9 s.u.	04/27/94
Total Suspended Solids	60	04/28/94
5-Day Biochemical Oxygen Demand	<1	04/27/94
Total Kjeldahl Nitrogen	0.7	04/28/94
Nitrate plus Nitrite as N	0.12	04/29/94
Ammonia as N	<0.1	04/29/94
Total Phosphorus as P	0.10	04/28/94
Ortho-phosphate as P	0.07	04/27/94

Lab Nos. 94-17011-23

QUALITY ASSURANCE DATA PACKAGE

This report includes the results of quality assurance tests performed with the sample analyses. They are performed to determine if the methodology is in control and to monitor the laboratory's ability to produce accurate and precise results.

Constituent	Duplicate Analysis ------mg/l (ppm)------ Original	Duplicate	Spiked Analysis, % Recovery	Blank Analysis, mg/l (ppm)	-----Reference----- Sample Analysis, mg/l (ppm)	Acceptance Range, mg/l (ppm)	Date Analyzed
Chloride	45	45	100	<1	509	450-550	05/03/94
Total Dissolved Solids @ 180° C	341	335	100	<1	9960	9000-11000	04/28/94
pH, s.u.	7.7	7.7	N/A	5.5	7.1	6.7-7.3	04/27/94
Total Suspended Solids	62	62	N/A	<1	N/A	N/A	04/28/94
5-Day Biochemical Oxygen Demand	6	6	N/A	<1	213	168-228	04/27/94
Total Kjeldahl Nitrogen	0.4	0.4	104	<0.1	3.2	2.6-4.0	04/28/94
Nitrate plus Nitrite as N	0.09	0.09	101	<0.05	3.44	3.2-4.0	04/29/94
Ammonia as N	<0.1	<0.1	98	<0.1	2.16	1.87-2.60	04/29/94
Total Phosphorus as P	0.04	0.04	90	<0.01	0.97	0.94-1.26	04/28/94
Ortho-phosphate as P	0.02	0.02	101	<0.01	1.03	0.87-1.09	04/27/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23265
DATE: 06/08/94 jmw

WATER ANALYSIS

Gallatin Below
Sampled 05/25/94
Submitted 05/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	<1	06/02/94
Total Dissolved Solids @ 180°C	189	05/31/94
pH	7.9 s.u.	05/27/94
Total Suspended Solids	64	05/26/94
Total Kjeldahl Nitrogen	<0.1	06/02/94
Ammonia as N	<0.1	06/03/94
Nitrate plus Nitrite as N	<0.05	06/03/94
Total Phosphorus as P	0.06	05/31/94
Ortho-phosphate as P	0.03	05/27/94
5-Day Biochemical Oxygen Demand	<1	05/26/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23266
DATE: 06/08/94 jmw

WATER ANALYSIS

Gallatin Above
Sampled 05/25/94
Submitted 05/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	<1	06/02/94
Total Dissolved Solids @ 180°C	120	05/31/94
pH	8.0 s.u.	05/27/94
Total Suspended Solids	112	05/26/94
Total Kjeldahl Nitrogen	<0.1	06/02/94
Ammonia as N	<0.1	06/03/94
Nitrate plus Nitrite as N	0.07	06/03/94
Total Phosphorus as P	0.17	05/31/94
Ortho-phosphate as P	0.07	05/27/94
5-Day Biochemical Oxygen Demand	<1	05/26/94

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23267
DATE: 06/08/94 jmw

WATER ANALYSIS

N. Fork Below Plant
Sampled 05/25/94
Submitted 05/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	<1	06/02/94
Total Dissolved Solids @ 180°C	69	05/31/94
pH	7.8 s.u.	05/27/94
Total Suspended Solids	37	05/26/94
Total Kjeldahl Nitrogen	<0.1	06/02/94
Ammonia as N	<0.1	06/03/94
Nitrate plus Nitrite as N	0.05	06/03/94
Total Phosphorus as P	0.08	05/31/94
Ortho-phosphate as P	0.03	05/27/94
5-Day Biochemical Oxygen Demand	<1	05/26/94

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.
P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23268
DATE: 06/08/94 jmw

WATER ANALYSIS

N. Fork Below Meadow
Sampled 05/25/94
Submitted 05/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	<1	06/02/94
Total Dissolved Solids @ 180°C	67	05/31/94
pH	7.5 s.u.	05/27/94
Total Suspended Solids	42	05/26/94
Total Kjeldahl Nitrogen	<0.1	06/03/94
Ammonia as N	<0.1	06/03/94
Nitrate plus Nitrite as N	0.06	06/03/94
Total Phosphorus as P	0.07	05/31/94
Ortho-phosphate as P	0.03	05/27/94
5-Day Biochemical Oxygen Demand	<1	05/26/94

ENERGY LABORATORIES

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P.O. BOX 30916 • 1107 SOUTH BROADWAY • BILLINGS, MT 59107-0916 • PHONE (406) 252-6325
FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23269
DATE: 06/08/94 jmw

WATER ANALYSIS

N. Fork Above Meadow
Sampled 05/25/94
Submitted 05/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	<1	06/02/94
Total Dissolved Solids @ 180°C	68	05/31/94
pH	7.6 s.u.	05/27/94
Total Suspended Solids	38	05/26/94
Total Kjeldahl Nitrogen	<0.1	06/03/94
Ammonia as N	<0.1	06/03/94
Nitrate plus Nitrite as N	0.05	06/03/94
Total Phosphorus as P	0.09	05/31/94
Ortho-phosphate as P	0.03	05/27/94
5-Day Biochemical Oxygen Demand	<1	05/26/94

ENERGY LABORATORIES

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FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23270
DATE: 06/08/94 jmw

WATER ANALYSIS

S. Fork
Sampled 05/25/94
Submitted 05/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	1	06/02/94
Total Dissolved Solids @ 180°C	91	05/31/94
pH	7.8	05/27/94
Total Suspended Solids	188	05/26/94
Total Kjeldahl Nitrogen	<0.1	06/03/94
Ammonia as N	<0.1	06/03/94
Nitrate plus Nitrite as N	<0.05	06/03/94
Total Phosphorus as P	0.07	05/31/94
Ortho-phosphate as P	0.03	05/27/94
5-Day Biochemical Oxygen Demand	<1	05/24/94

Lab Nos. 94-23258-70

QUALITY ASSURANCE DATA PACKAGE

This report includes the results of quality assurance tests performed with the sample analyses. They are performed to determine if the methodology is in control and to monitor the laboratory's ability to produce accurate and precise results.

Constituent	Duplicate Analysis ——mg/l (ppm)—— Original	Duplicate	Spiked Analysis, % Recovery	Blank Analysis, mg/l (ppm)	----Reference---- Sample Analysis, mg/l (ppm)	Acceptance Range, mg/l (ppm)	Date Analyze
Chloride	36	36	102	3	76	69-85	06/02/94
Total Dissolved Solids @ 180°C	459	460	100	<1	N/A	N/A	05/31/9
pH, s.u.	7.6	7.6	N/A	N/A	7.1	6.7-7.3	05/27/94
Total Suspended Solids	112	114	N/A	<1	N/A	N/A	05/26/94
Total Kjeldahl Nitrogen	<0.1	<0.1	108	<0.1	3.4	2.6-4.0	06/02/9
Ammonia as N	<0.1	<0.1	99	<0.1	2.2	1.87-2.60	06/03/9
Nitrate plus Nitrite as N	<0.05	<0.05	100	<0.05	3.36	3.20-4.00	06/03/94
Total Phosphorus as P	0.12	0.12	97	<0.01	0.09	0.07-0.13	05/31/94
Ortho-phosphate as P	0.03	0.02	95	<0.01	1.01	0.87-1.09	05/27/9
5-Day Biochemical Oxygen Demand	13	12	N/A	<1	202	168-228	05/26/94

LAB. NO. (78?

'ONTANA DEPARTMENT OF HEALT' AND ENVIRONMENTAL SCIENCES

Public Health Lab, W.F. Cogswell Building, Helena, Montana 59620

Phone: 444-2642

SAMPLING PROCEDURE: *Received* 1-27-94 *Reported* 1-30-94

1. Remove screen. Allow water to run 2-3 minutes. If you have a water softener use an outside tap.
2. Fill bottle to neck—without touching inside (this leaves ½ inch air space. Do not rinse out bottle.
3. Fill out sampling information below and return to lab within 48 hours.
4. Enclose $14.00 check or money order to cover cost. Results will not be sent until fee is paid.

DATE Collected 1/26/94 Time 1:30

Owner of Water Source

Location of Water Source Big Sky (*Nearest City*)

County Gallatin

Type of Supply *(Circle One)* Cistern Well Spring (River — circled) Gallatin River (*Other (Please Specify)*)

Collector of Sample: Thrlkell Phone No. 995-2660

Person to Receive Report *(Please Print)*:

NAME: Tug Thrlkell / RID 365

Street or RFD: P.O. Box 160066

City: Big Sky MT Zip: 59716

DO NOT WRITE BELOW THIS LINE

TOTAL COLIFORM

Multiple Tube *Membrane Filter*

(FECAL COLIFORM — circled) (+) 1/100 ml

~~*Multiple Tube*~~ (*Membrane Filter* — circled)

☐ Satisfactory At This Time

☐ Contaminated

Water supply should be disinfected and retested before it is used as drinking water or for household purposes. Consult your county sanitarian for treatment procedures.

REMARKS: SLIGHT TURBIDITY

(initials)

Acct

LAB. NO. ....?182

"ONTANA DEPARTMENT OF HEALT' AND ENVIRONMENTAL SCIENCES

Public Health Lab, W.F. Cogswell Building, Helena, Montana 59620

Phone: 444-2642

SAMPLING PROCEDURE:

Received 1-27-94 *Reported* 1-30-94

1. Remove screen. Allow water to run 2-3 minutes. If you have a water softener use an outside tap.
2. Fill bottle to neck—without touching inside (this leaves ½ inch air space. Do not rinse out bottle.
3. Fill out sampling information below and return to lab within 48 hours.
4. Enclose $14.00 check or money order to cover cost. Results will not be sent until fee is paid.

DATE Collected 1/26/94 Time 1:20

Owner of Water Source

Location of Water Source Big Sky *Nearest City*

County GALLATIN

Type of Supply *(Circle One)* Cistern Well Spring (River) N. Fork Below Plant *Other (Please Specify)*

Collector of Sample: Thrlkld Phone No. 995-2660

Person to Receive Report *(Please Print):*

NAME: Terry Threlkeld / RID 305

Street or RFD: P.O. Box 160066

City: Big Sky MT Zip: 59716

DO NOT WRITE BELOW THIS LINE

TOTAL COLIFORM

Multiple Tube *Membrane Filter*

(FECAL COLIFORM) (+)

11/100 mls

~~*Multiple Tube*~~ (*Membrane Filter*)

☐ Satisfactory At This Time

☐ Contaminated

Water supply should be disinfected and retested before it is used as drinking water or for household purposes. Consult your county sanitarian for treatment procedures.

REMARKS:

TURBID

Acct

LAB. NO. [illegible]

"ONTANA DEPARTMENT OF HEALT' AND ENVIRONMENTAL SCIENCES

Public Health Lab, W.F. Cogswell Building, Helena, Montana 59620
Phone: 444-2642

SAMPLING PROCEDURE: *Received* 1-27-94 *Reported* 1-30-94

1. Remove screen. Allow water to run 2-3 minutes. If you have a water softener use an outside tap.
2. Fill bottle to neck—without touching inside (this leaves ½ inch air space. Do not rinse out bottle.
3. Fill out sampling information below and return to lab within 48 hours.
4. Enclose $14.00 check or money order to cover cost. Results will not be sent until fee is paid.

DATE Collected 1/26/94 Time 11:22 AM

Owner of Water Source SURFACE WATER

Location of Water Source BIG SKY
Nearest City

County GALLATIN

Type of Supply *(Circle One)* Cistern Well Spring River (circled) ______ *Other (Please Specify)*
MIDDLE FORK ABOVE MEADOW

Collector of Sample: THRELKELD Phone No. 995 2660

Person to Receive Report *(Please Print):*

NAME: Terry Threlkeld / RID 305

Street or RFD: P.O. BOX 160066

City: BIG SKY MT Zip: 59716

DO NOT WRITE BELOW THIS LINE

TOTAL COLIFORM

______	______
Multiple Tube	*Membrane Filter*

FECAL COLIFORM (circled) (+)

43/100 mls	______
~~*Multiple Tube*~~	*Membrane Filter* (circled)

☐ Satisfactory At This Time

☐ Contaminated
Water supply should be disinfected and retested before it is used as drinking water or for household purposes. Consult your county sanitarian for treatment procedures.

REMARKS:

TURBID

Acct ✓

LAB. NO. 13781

MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

Public Health Lab, W.F. Cogswell Building, Helena, Montana 59620
Phone: 444-2642

SAMPLING PROCEDURE: *Received* 1-27-94 *Reported* 1-30-94

1. Remove screen. Allow water to run 2-3 minutes. If you have a water softener use an outside tap.
2. Fill bottle to neck—without touching inside (this leaves ½ inch air space. Do not rinse out bottle.
3. Fill out sampling information below and return to lab within 48 hours.
4. Enclose $14.00 check or money order to cover cost. Results will not be sent until fee is paid.

only 1 Btl marked Above Meadow
This Btl is marked Below Meadow

DATE Collected 1/26/94 Time 11:40

Owner of Water Source

Location of Water Source BIG SKY (Nearest City)

County GALLATIN

Type of Supply *(Circle One)* Cistern Well Spring (River) M. FORK Other *(Please Specify)*

Below ~~Above~~ MEADOW

Collector of Sample: Threlkeld Phone No. 995-2660

Person to Receive Report *(Please Print)*:

NAME: Tom Threlkeld / BID 305

Street or RFD: P.O. Box 160066

City: BIG SKY MT Zip: 59716

DO NOT WRITE BELOW THIS LINE

TOTAL COLIFORM

Multiple Tube	*Membrane Filter*
(FECAL COLIFORM) (+)	9/100 mls
~~*Multiple Tube*~~	(*Membrane Filter*)
☐ Satisfactory At This Time	☐ Contaminated
REMARKS: SLIGHT TURBIDITY	Water supply should be disinfected and retested before it is used as drinking water or for household purposes. Consult your county sanitarian for treatment procedures.

Acct

ONTANA DEPART IT OF HEALTH AND EN' 'RONMENTAL SCIENCES
UBLIC HEALTH LABO..ATORY W.F. COGSWELL ..ILDING HELENA, MONTANA 59620
)6) 444-2642 FAX #(406) 444-1802

ease Press Firmly

REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

VSID: B0000090 CITY/SYSTEM: BIG SKY RID 305 FECAL COUNTY: GALLATIN

Terry Threlkeld Date: 2/23/94 Hour: 12:?? Am Received: 2-23-94

Operator: Operator Certification No. Reported: 2-26-94

	Sample Site No. or Repeat Location**	Cl RES P.P.M.	Lab. No.	RESULTS — LAB USE ONLY Total Coliform	Fecal	HPC
	N. FORK ABOVE MEADOW		015372	turbid	18/100	
	N. FORK BELOW MEADOW		015373	turbid	7/100	
	N. FORK BELOW PLANT		015374	turbid	4/100	
	GALLATIN RIVER		015375	turbid	4/100	
	SOUTH FORK RIVER		015376	turbid	21/100	

System Contract No.
995-2660

RID 305 - BIG SKY
C/O TERRY THRELKELD
PO BOX 160066
BIG SKY, MT 59716

RESULTS of the examination of samples at the time received indicated that the water
( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately*** ✓

DATE NOTIFIED

*SEE BACK OF FORM FOR EXPLANATION

Certified Analyst: [signature]

ONTANA DEPART   NT OF HEALTH AND ENVIRONMENTAL SCIENCES
JBLIC HEALTH LABC... TORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
06) 444-2642 FAX #(406) 444-1802

ease Press Firmly

REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

WSID: B0000090 CITY/SYSTEM: BIG SKY RID 305 FECAL COUNTY: GALLATIN

...ected by: Terry Threlkeld Date: 3-16-94 Hour: 9:26 Received: 3-16-94 3pm

...ied Operator: Operator Certification No. Reported: 3-19-94

Sample Type*	Sample Site No. or Repeat Location**	Cl RES P.P.M.	Lab. No.	RESULTS — LAB USE ONLY Total Coliform	Fecal	HPC
	① M. FORK ABOVE MEADOW		016785		4/100	Turbid
	② M. FORK ABOVE PLANT		016786		6/100	
	③ M. FORK BELOW PLANT		016787		35/100	
	④ GALLATIN ABOVE CONFLUENCE		016788	Heavy turbidity	<1/100	
	⑤ GALLATIN BELOW CONFLUENCE		016789		3/100	
A	⑥ SOUTH FORK		016790		<1/100	

ystem Contract No. 995-2660

RID 305 - BIG SKY
C/O TERRY THRELKELD
PO BOX 160066
BIG SKY, MT 59716

*SEE BACK OF FORM FOR EXPLANATION

RESULTS of the examination of samples at the time received indicated that the water w...
( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***
✓

DATE NOTIFIED:

Certified Analyst: [signature]

ONTANA DEPAR NT OF HEALTH AND ENVIRONMENTAL SCIENCES
UBLIC HEALTH LAB ATORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
06) 444-2642 FAX #(406) 444-1802

ease Press Firmly

REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

WSID: B0000090 CITY/SYSTEM BIG SKY RID 305 FECAL COUNTY: GALLATIN

ected by: Terry Threlkeld Date: 4/25/94 Hour: 9:00 Received: 4-25-94

fied Operator: Operator Certification No. Reported: 4-29-94

Sample Type*	Sample Site No. or Repeat Location**	Cl RES P.P.M.	Lab. No.	RESULTS — LAB USE ONLY Total Coliform	Fecal	HPC
	① N. FORK ABOVE MEADOW		C18375	5	5 fc/100 ml	
	② N. FORK ABOVE PLANT		C18376		12 fc/100 ml	
	③ N. FORK BELOW PLANT		C18377		12 fc/100	
	④ GALLATIN ABOVE		C18378		12 fc/100	
	⑤ GALLATIN BELOW		C18379		4 fc/100 ml	
	⑥ SOUTH FORK		C18380		9 fc/100 ml	

ystem Contract No.

995-2660

RID 305 - BIG SKY
C/O TERRY THRELKELD
PO BOX 160066
BIG SKY, MT 59716

RESULTS of the examination of samples at the time received indicated that the water v

( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED

*SEE BACK OF FORM FOR EXPLANATION

Certified Analyst: DD

MONTANA DEPAR' 'NT OF HEALTH AND ENVIRONMENTAL SCIENCES
PUBLIC HEALTH LAB...ATORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
406) 444-2642 FAX #(406) 444-1802

Please Press Firmly

REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

300ccc 9C

PWSID: BIG SKY CITY/SYSTEM: WSD 363 FECAL GALLATIN COUNTY: 995-4166

Collected by: TERRY THRELKELD Date: 5/25/94 Hour: Received: 5-25-94

Certified Operator: Operator Certification No. Reported: 5/28/94

Sample Type*	Sample Site No. or Repeat Location**	Cl RES P.P.M.	Lab. No.	RESULTS — LAB USE ONLY: Total Coliform	Fecal	HPC
	(7) N. FORK ABOVE MEADOW		023176	turbid	6/100	
	(8) N. FORK BELOW MEADOW		023177	turbid	3/100	
	(9) N. FORK BELOW PLANT		023178	turbid	6/100	
	(10) S. FORK		023179	Slightly turbid	<1/100mls	
	(11) GALLATIN BELOW		023180	Slightly turbid	1/100	
	(12) GALLATIN ABOVE		02318[illegible]	turbid	12/100	

System Contract No.

WATER SEWER DISTRICT 363
C/O TERRY THRELKELD
PO BOX 160066
Big SKY MT 59716

*SEE BACK OF FORM FOR EXPLANATION

RESULTS of the examination of samples at the time received indicated that the water

( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED

Certified Analyst: JT

M.E. LAB

MONTANA ENVIRONMENTAL LABORATORY
376 W. Washington P. O. Box 8900 Kalispell, MT 59904-1900
Phone 755-2131 FAX 257-5359

Certified by the MDHES according to the Federal Drinking Water Standards

PLEASE FILL IN -- PRESS FIRMLY

ADDRESS WHERE SAMPLE WAS COLLECTED FROM: Big Sky Montana (...)
(street address, house #, legal description, property name, etc.)

City: Bozeman County: Gallatin

Date Collected: 2/15/94 Time: 3:00 PM

Collector of Sample: Cliff Phone No.: 586-6812

Optional:

Type of Supply *(Circle One)* (Well) (Depth of Well 50), Spring, Cistern,

Lake or other Surface Supply: ______

PERSON TO RECEIVE REPORT *(Please Fill In)*

Name: Patti Drilling

Street: 80130 Gallatin Road

City: Bozeman State: MT Zip: 59715

MON THRU FRI
(Sample after 9 a.m. if possible)

BR1

LAB USE ONLY

Lab. No.	
1778	RECEIVED AT LAB: 2.17.94 ...
	ANALYZED: 2/18/94 7:30
(M) C MB PC	ANALYZED BY: [signature]

BACTERIOLOGICAL RESULTS

MEMBRANE FILTER METHOD:

- ☐ 1. Bacteriologically Suitable for Drinking, <1 coliform bacteria organism/100 ml.*
- ☐ 2. Contaminated with _____ coliform bacteria organisms/100 ml.**
- ☒ 3. Contaminated with TNTC / (confluent) growth (with)/without coliform bacteria.
- ☒ 4. Fecal coliform: (Present) / Absent

MULTIPLE TUBE METHOD -- MPN METHOD

- ☐ 1. Bacteriologically Suitable for Drinking, -10/10 tubes.*
- ☐ 2. Contaminated with +____/10 tubes.**

* If suitable for drinking, no animal or human fecal pollution.

** If contaminated, the water supply should be disinfected and retested before used as drinking water or household purposes. Consult your county sanitarian for disinfection procedures.

20.00 ✓

PAYMENT MUST ACCOMPANY SAMPLE
(Prices subject to change without notice)

APPENDIX G

GROUNDWATER QUALITY DATA FROM 1972, 1994, AND 1995

[redacted] WELLS
GROUND WATER SAMPLE RESULTS - September 1995

All Common, Nutrient and Metal parameter values in mg/l

Sample #	Owner	Formation	Location Latitude	Longitude	Legal	Temp (°C)	pH	Conduc.	Alk.	CO3	F	HCO3	SO4	Ammonia as N	Nitrate+Nitrite as N	TKN	TP	OP	Al	As	B	Ba	Be	Ca	Cd	Co
						Field Parameters			Commons					Nutrients					Metals Scan (ICP)							
[redacted]	[redacted]	Km	[redacted]	[redacted]	[redacted]	6.5	8.1	0.002	270	0	0.7	320	620	0	0.09	0.7	0	0	0.1	0	NS	0	0	48	NS	0
BSGW 10-4/23	B.S. Mead. Vill. #1	Qal			6S/3E/38 accc	5.9	8.2	0.002	230	0	0.1	280	10	0	1.2	0.5	0	0	0	0	NS	0	0	62	NS	0
[redacted]	[redacted]	Qal	[redacted]	[redacted]	[redacted]	5.8	8.4	0.003	210	0	0	260	0	0	0.94	0.6	0	0	0.2	0	NS	0	0	68	NS	0
BSGW 10-4/25	B.S. Hidden Village	Km			6S/3E/35 cacb	7.7	10.5	0.002	220	0	1.3	270	20	0	0.11	0.9	0	0	0.8	0	NS	0	0	0	NS	0
[redacted]	[redacted]	Qal			[redacted]	6.1	8.8	0.003	200	0	0.1	260	0	0	1.4	0.8	0	0	0	0	NS	0	0	62	NS	0

Metals Scan Continued

Sample #	Owner	Formation	Location Latitude	Longitude	Legal	Temp (°C)	pH	Conduc.	Alk.	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Si	Sr	Tl	V	Zn
[redacted]	[redacted]	Km	[redacted]	[redacted]	[redacted]	6.5	8.1	0.002	270	0	1.80	0	26	0.03	0	38	0	0	0	0	NS	NS	0	0	0.15
BSGW 10-4/23	B.S. Mead. Vill. #1	Qal			6S/3E/38 accc	5.9	8.2	0.002	230	0	0	0	14	0	0	0	0	0	0	0	NS	NS	0	0	0
[redacted]	[redacted]	Qal	[redacted]	[redacted]	[redacted]	5.8	8.4	0.003	210	0	0.11	0	13	0	0	0	0	0	0	0	NS	NS	0	0	0
BSGW 10-4/25	B.S. Hidden Village	Km			6S/3E/35 cacb	7.7	10.5	0.002	220	0	0.23	0	0	0	0	100	0	0	0	0	NS	NS	0	0	0
[redacted]	[redacted]	Qal			[redacted]	6.1	8.8	0.003	200	0	0	0	14	0	0	0	0	0	0	0	NS	NS	0	0	0

NS = Not Sampled

Alkalinity as Mg/l $CaCO_3$

Conductivity as micro-mohs/cm

Samples analyzed by Intermountain Labs - Bozeman

DOMESTIC WELLS

GROUND WATER SAMPLE RESULTS - September 1995

All Common, Nutrient and Metal parameter values in mg/l

Field Parameters → Commons → Nutrients → Metals Scan (ICP) →

Sample #	Owner	Formation	Location Latitude	Longitude	Legal	Temp (°C)	pH	Conduc.	TDS (mg/l)	Alk.	Cl	CO3	F	HCO3	SO4	NH3	NO3	TKN	TP	Al	As	B	Ba	Be	Ca	Cd	Co
BSGW 9-27/1	Cronin	Kl	N45/16.015	W111/16.507	6S/4E/31 deba	6.5	7.4	0.568	482.8	269	4.5	36	0.29	233	22.7	0.07	0.01	0.01	0.00	0.00	0.005	0.04	0.03	0	68.8	0	0
BSGW 9-27/2	Kass	Kk			6S/4E/31 adda	8.4	7.9	0.002	1.7	177	3.0	124	0.19	0.01	8.00	0.01	3.66	0.01	0.01	0.006	0.02	0.01	0.26	0	27.5	0	0.005
BSGW 9-27/3	Miner	Kf	N45/15.951	W111/17.080	6S/4E/31 caca	10.5	8.1	0.233	198	143	1.1	102	0.15	0.01	19.1	0.01	0.04	0.01	0.01	0.01	0	0.02	0.02	0	39.7	0	0
BSGW 9-28/4	Chalmers	Km/Kmu	N45/15.038	W111/19.693	7S/3E/02 cacb	7.2	8.2	0.264	224	199	1.9	118	0.26	0.01	9.60	0.01	0.18	0.01	0.01	0.07	0	0.26	0.04	0	16.2	0	0
BSGW 9-28/5	Stoner #1	Kf	N45/15.420	W111/19.444	7S/3E/02 bacd	6.7	8.5	0.379	322	225	1.3	130	0.23	0.01	72.8	0.02	0.03	0.01	0.04	0.005	0.02	0.06	0	0	25.8	0.005	0.005
BSGW 9-28/6	Roepneck	Kf	N45/16.745	W111/19.607	6S/3E/35 bdca	5.7	8.9	0.630	451	207	1.4	98	0.29	0.01	171	0.07	0.02	0.01	0.21	0.05	0	0.09	0	0	0	0.01	0
BSGW 9-28/7	Kester	Kf	N45/15.706	W111/19.420	6S/3E/35 cdda	5.4	8.2	0.270	230	161	2.5	122	0.36	0.01	45.2	0.01	0.22	0.01	0.09	0.25	0	0.08	0.005	0	5.09	0.005	0
BSGW 9-28/8	K. Gerrard	Kf (art.)			6S/3E/35 dccc	6.0	9.3	0.373	317	249	2.0	98	0.3	0.01	58.2	0.07	0.03	0.01	0.06	0.01	0.02	0.10	0.005	0	3.25	0.005	0
BSGW 9-28/9	Smith	Qls/Kc	N45/15.679	W111/17.529	6S/3E/36 dddc	5.0	8.0	0.403	343	227	1.6	150	0.27	0.01	107	0.11	0.05	0.01	0.01	0	0	0.17	0.01	0	57.1	0	0.005
BSGW 9-28/10	Smith/Delze	Kc	N45/15.884	W111/17.616	6S/3E/36 ddab	6.6	10.2	0.486	413	383	3.5	140	0.22	0.01	8.60	0.23	0.01	0.01	0.04	0.10	0	0.31	0.02	0	0.07	0.005	0
BSGW 9-28/11	Hanson	Kf	N45/16.013	W111/16.930	6S/4E/31 caac	7.2	9.7	0.499	424	397	2.3	124	1.04	0.01	14.9	0.16	0.01	0.01	0.02	0.02	0	0.31	0.005	0	0	0.005	0
BSGW 9-29/12	Toet	Kf			6S/3E/27 cabc	6.9	8.6	0.003	2.6	243	2.3	96	0.37	0.01	23.3	0.04	0.01	0.01	0.01	0.006	0.03	0.19	0.07	0	18.3	0.005	0.005
BSGW 9-29/13	N. Fork #6	Kk			6S/3E/26 bbdb	5.3	8.0	0.004	3.4	209	1.8	128	0.26	0.01	17.0	0.01	0.15	0.01	0.02	0	0.005	0.02	0.08	0	55.4	0	0.005
BSGW 9-30/14	Stoner N. Fk	Qg/Kf?			6S/3E/27 dabd	6.0	8.6	0.003	2.6	170	1.4	110	0.33	0.01	0.01	0.10	0.01	0.01	0.03	0.20	0	0.14	0.07	0	5.62	0.005	0
BSGW 9-30/15	Foster	Kf	N45/16.782	W111/19.317	6S/3E/26 dbcc	7.1	8.1	0.004	3.4	181	2.1	102	0.27	0.01	52.9	0.02	0.01	0.01	0.01	0	0	0.050	0.04	0	70.0	0.005	0.005
BSGW 9-30/16	Kansub	Qal/Kmu			6S/4E/31 dbca	6.8	8.1	0.004	3.4	183	2.8	110	0.14	0.01	14.0	0.01	0.02	0.01	0.01	0.07	0	0.04	0.07	0	61.6	0	0.005
BSGW 9-30/17	Brandt	Qal/Kl			6S/4E/31 dacb	7.4	8.0	0.004	3.4	237	7.2	104	0.26	0.01	9.50	0.01	1.25	0.01	0.01	0	0.005	0.04	0.09	0	66.4	0	0.005
BSGW 9-30/18	Close	Kmu			7S/3E/02 ccab	10.6	8.0	0.003	2.6	233	2.0	106	0.66	0.01	52.1	0.22	0.02	0.01	0.02	0	0	0.04	0.04	0	43.9	0	0.005
BSGW 9-30/19	Close #2	Kf (art.)	N45/14.76	W111/19.513	7S/3E/02 caac	6.6	9.9	0.004	3.4	191	2.4	118	0.48	0.01	6.10	0.05	0.02	0.01	0.01	0.07	0.02	0.24	0.005	0	1.19	0.005	0
BSGW 9-30/20	McBride	Kf	N45/15.176	W11116.713	7S/3E/02 daba	7.2	8.2	0.003	2.6	229	1.9	88	0.17	0.01	34.7	0.01	1.19	0.01	0.01	0.005	0	0.04	0.02	0	56.4	0	0.005
BSGW 9-30/21	Tom Gerrar	Kmu			6S/3E/26 bdda	6.9	8.2	0.003	2.6	204	3.2	108	0.44	0.01	29.9	0.15	0.01	0.1	0.05	0.11	0	0.20	0.02	0	10.8	0.005	0

Metals Scan Continued →

Sample #	Owner	Formation	Location Latitude	Longitude	Legal	Temp (°C)	pH	Conduc.	TDS (mg/l)	Alk.	Cu	Fe	K	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Si	Sr	Tl	V	Zn
BSGW 9-27/1	Cronin	Kl	N45/16.015	W111/16.507	6S/4E/31 deba	6.5	7.4	0.568	482.8	269	0.005	0.73	6.43	30.2	0.07	0.005	14.2	0	0	0	0	3.46	0.75	0.005	0.02	0.02
BSGW 9-27/2	Kass	Kk			6S/4E/31 adda	8.4	7.9	0.002	1.7	177	0.02	0.006	2.67	36.4	0	0.006	6.3	0	0	0.005	0	3.78	0.23	0.006	0.02	0.11
BSGW 9-27/3	Miner	Kf	N45/15.951	W111/17.080	6S/4E/31 caca	10.5	8.1	0.233	198	143	0.27	0.28	1.65	11.5	0.005	0.005	12.5	0	0.050	0	0	4.97	0.15	0.005	0.005	0.05
BSGW 9-28/4	Chalmers	Km/Kmu	N45/15.038	W111/19.693	7S/3E/02 cacb	7.2	8.2	0.264	224	199	0.01	0.10	1.69	2.97	0.01	0.005	66.7	0	0	0	0.005	6.37	0.18	0.005	0.005	0.02
BSGW 9-28/5	Stoner #1	Kf	N45/15.420	W111/19.444	7S/3E/02 bacd	6.7	8.5	0.379	322	225	0.005	0.01	1.03	3.36	0.16	0.005	90.7	0	0.005	0	0	9.12	0.09	0.005	0.005	0.02
BSGW 9-28/6	Roepneck	Kf	N45/15.745	W111/19.607	6S/3E/35 bdca	5.7	8.9	0.530	451	207	0.006	0.02	0.13	0	0.005	0	183	0	0	0.005	0	11.80	0.01	0.006	0.005	0.01
BSGW 9-28/7	Kester	Kf	N45/15.706	W111/19.420	6S/3E/35 cdda	5.4	8.2	0.270	230	161	0.005	0.12	1.08	0.98	0.005	0.005	82.5	0	0	0.005	0	10.2	0.03	0.005	0.005	0.02
BSGW 9-28/8	K. Gerrard	Kf (art.)			6S/3E/35 dccc	6.0	9.3	0.373	317	249	0	0.01	0.70	0.47	0.006	0.006	130	0	0.005	0	0.005	7.29	0.02	0.005	0.005	0.005
BSGW 9-28/9	Smith	Qls/Kc	N45/15.679	W111/17.529	6S/3E/36 dddc	5.0	8.0	0.403	343	227	0.005	0.41	3.49	21.5	0.22	0	47.4	0	0	0	0.005	6.26	0.60	0.005	0.02	0.01
BSGW 9-28/10	Smith/Delze	Kc	N45/15.884	W111/17.616	6S/3E/36 ddab	6.6	10.2	0.488	413	383	0.01	0.17	0.41	0	0.005	0	172	0	0	0.005	0	4.16	0.02	0.005	0.005	0.005
BSGW 9-28/11	Hanson	Kf	N45/16.013	W111/16.930	6S/4E/31 caac	7.2	9.7	0.499	424	397	0.005	0.02	0.95	0	0.005	0.005	180	0	0	0	0	3.89	0.005	0.005	0.005	0.005
BSGW 9-29/12	Toet	Kf			6S/3E/27 cabc	6.9	8.6	0.003	2.6	243	0.006	0.02	1.27	6.31	0.03	0.010	81.3	0	0	0.005	0.010	5.74	0.20	0.006	0.005	0.01
BSGW 9-29/13	N. Fork #6	Kk			6S/3E/26 bbdb	5.3	8.0	0.004	3.4	209	0.01	1.15	1.98	28.5	0.05	0.005	4.36	0	0	0	0	4.38	0.13	0.005	0.01	0.02
BSGW 9-30/14	Stoner N. Fk	Qg/Kf?			6S/3E/27 dabd	6.0	8.6	0.003	2.6	170	0.005	0.69	1.27	1.26	0.02	0	63.3	0	0.005	0	0	6.52	0.06	0.005	0.006	0.03
BSGW 9-30/15	Foster	Kf	N45/16.782	W111/19.317	6S/3E/26 dbcc	7.1	8.1	0.004	3.4	181	0.005	0.24	2.60	11.2	0.04	0.005	11.7	0	0	0	0	9.58	0.29	0.005	0.01	0.01
BSGW 9-30/16	Kafaub	Qal/Kmu			6S/4E/31 dbca	6.8	8.1	0.004	3.4	183	0.006	0.10	2.38	14.4	0.01	0	13.6	0	0	0.006	0	5.67	0.23	0.005	0.005	0.01
BSGW 9-30/17	Brandt	Qal/Kl			6S/4E/31 dacb	7.4	8.0	0.004	3.4	237	0.005	0.005	2.14	17.7	0	0.005	17.2	0	0	0	0	8.41	0.21	0.005	0.005	0.02
BSGW 9-30/18	Close	Kmu			7S/3E/02 ccab	10.6	8.0	0.003	2.6	233	0.006	0.19	7.69	30.0	0.02	0.006	30.2	0	0	0	0	4.02	0.66	0.005	0.01	0.21
BSGW 9-30/19	Close #2	Kf (art.)	N45/14.76	W111/19.513	7S/3E/02 caac	6.6	9.9	0.004	3.4	191	0.02	0.06	1.21	0	0.005	0.005	82.7	0	0	0.010	0.005	7.44	0.02	0.005	0.005	0.005
BSGW 9-30/20	McBride	Kf	N45/15.176	W11118.713	7S/3E/02 daba	7.2	8.2	0.003	2.6	229	0.006	0.10	1.24	17.7	0.005	0.006	26.6	0	0	0.005	0.005	6.10	0.21	0.005	0.005	0.06
BSGW 9-30/21	Tom Gerrar	Kmu			6S/3E/26 bdda	6.9	8.2	0.003	2.6	204	0.005	1.73	1.15	0.88	0.16	0.005	88.0	0	0.005	0	0	6.67	0.07	0.005	0.005	0.38

Alkalinity as Mg/l CaCo3

Conductivity as micro-mohs/cm

Values of 0.005 denote analyses <0.01 mg/l

Samples analyzed by State Lab - Helena

BIG SKY WATER AND SEWER DISTRICT #363
WATER TESTING PROGRAM

MONITORING WELLS: WATER ANALYSIS 1995

WELL # 1	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY	0	32	3.0	ND	0.03	ND	7.4	0.32	1.1	21	440
FEBRUARY	ND	7	2.0	ND	ND	19.00	7.8	ND	ND	24	540
MARCH	ND	ND	12.0	0.01	ND	5.10	7.5	ND	ND	32	520
APRIL	ND	ND	3.0	ND	ND	4.30	7.2	ND	1.8	22	460
MAY	ND	ND	ND	ND	ND	2.00	8.1	ND	1.0	26	400
JUNE	ND	ND	2.0	ND	ND	0.09	8.1	0.09	3.6	33	440
JULY	ND	24	ND	ND	ND	0.12	7.5	0.39	0.5	19	510
AUGUST	ND	38	3.0	ND	0.08	0.55	7.5	ND	1.9	18	490
SEPTEMBER	ND	40	5.0	ND	0.08	0.12	7.3	0.74	2.2	15	450
OCTOBER	ND	46	12.0	ND	0.1	0.57	8.0	1.4	2.5	20	500
NOVEMBER											
DECEMBER											

WELL # 2	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY	0	17	1.0	ND	ND	0.74	7.8	0.98	3.2	19	17
FEBRUARY	ND	18	2.0	0.01	ND	0.21	7.7	1.4	1.2	33	380
MARCH	ND	4	2.0	ND	ND	0.16	7.7	0.69	ND	20	390
APRIL	2	ND	2.0	ND	ND	0.49	7.8	0.2	1.8	14	320
MAY	ND	ND	2.0	ND	ND	ND	8.2	0.93	0.87	20	300
JUNE	ND	ND	3.0	ND	ND	ND	8.1	1.2	3.6	32	370
JULY	ND	ND	ND	ND	ND	0.55	7.6	2.6	1.0	19	370
AUGUST	ND	ND	ND	ND	ND	2.9	8.0	0.15	5.7	16	440
SEPTEMBER	ND	33	4.0	ND	0.05	0.66	7.8	2.7	4.1	13	360
OCTOBER	ND	7	ND	ND	ND	0.8	8.1	3.6	5.1	12	350
NOVEMBER											
DECEMBER											

WELL # 3	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY	0	4	1.0	ND	ND	0.32	8.0	0.07	ND	12	320
FEBRUARY	ND	4	ND	0.01	ND	2.3	7.9	ND	ND	19	330
MARCH	ND	5	2.0	ND	ND	1.6	7.9	ND	ND	29	380
APRIL	ND	5	3.0	ND	ND	0.58	7.8	ND	1.6	29	350
MAY	ND	ND	1.0	ND	ND	0.31	8.2	ND	0.66	24	320
JUNE	ND	ND	1.0	ND	ND	0.62	8.2	0.08	1.2	29	360
JULY	ND	ND	2.0	ND	ND	0.37	7.7	ND	ND	20	410
AUGUST	ND	ND	ND	ND	ND	0.31	7.9	ND	ND	18	350
SEPTEMBER	ND	ND	2.0	ND	ND	0.33	7.9	ND	0.7	14	340
OCTOBER	ND	15	5.0	ND	ND	0.29	8.2	0.08	ND	16	360
NOVEMBER											
DECEMBER											

WELL # 4	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY	790	16	10.0	0.27	0.35	ND	7.6	3.8	9.6	52	520
FEBRUARY	2100	17	27.0	0.84	1.7	ND	7.3	5.2	5.3	52	400
MARCH	1900	13	34.0	1.00	1.5	ND	7.4	5.1	3.8	51	410
APRIL	900	21	20.0	0.72	2.6	ND	7.5	4.6	12.0	37	360
MAY	8	7	11.0	1.00	1.6	ND	8.0	10	8.0	32	350
JUNE	4	ND	11.0	1.10	1.7	ND	7.5	5.2	7.5	33	330
JULY	ND	8	1.0	0.80	0.54	0.07	7.5	6.1	7.0	24	340
AUGUST	ND	5	6.0	0.70	0.81	0.31	7.7	5.2	11.0	25	340
SEPTEMBER	ND	18	3.0	ND	0.05	0.67	7.5	0.24	1.3	26	390
OCTOBER	ND	5	ND	ND	0.06	0.56	8.2	0.5	1.1	27	370
NOVEMBER											
DECEMBER											

ALL RESULTS IN mg/L EXCEPT FOR FECAL COLIFORMS AND pH

BIG SKY WATER AND SEWER DISTRICT #363
WATER TESTING PROGRAM

MONITORING WELLS: WATER ANALYSIS 1995

WELL # 5	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY	0	18	3.0	ND	0.02	40	7.0	0.08	0.1	44	620
FEBRUARY	2	38	5.0	0.02	0.06	5.3	7.2	0.19	0.1	48	410
MARCH	ND	4	6.0	ND	ND	6.7	7.2	0.39	0.3	43	440
APRIL	20	6	5.0	ND	0.05	5.7	7.4	0.7	3	22	360
MAY	4	ND	5.0	0.05	0.05	0.08	7.8	1.7	1.7	27	320
JUNE	ND	ND	1.0	0.05	ND	ND	7.3	1.5	3	29	330
JULY	ND	ND	3.0	ND	ND	0.12	7.5	0.65	3.5	22	300
AUGUST	ND	13	1.0	ND	ND	0.27	7.9	ND	2.5	27	390
SEPTEMBER	ND	13	6.0	ND	ND	0.11	8	0.5	1	30	390
OCTOBER	ND	24	10.0	ND	0.06	0.27	8.3	0.44	1.2	30	420
NOVEMBER											
DECEMBER											

WELL # 7	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
JANUARY	0	8	2.0	ND	ND	1.2	8.2	ND	0.2	ND	300
FEBRUARY	ND	5	2.0	ND	ND	1.2	7.9	ND	0.1	10	310
MARCH	ND	4	2.0	ND	ND	1.5	7.9	ND	ND	9	310
APRIL	ND	ND	3.0	ND	ND	2.6	7.7	ND	1.5	8	290
MAY	ND	ND	ND	ND	ND	5.1	8.1	0.09	0.47	12	280
JUNE	ND	8	2.0	ND	ND	7.6	7.8	0.11	1.0	ND	370
JULY	ND	ND	ND	ND	ND	6.5	8.1	ND	ND	16	400
AUGUST	ND	ND	ND	ND	ND	5.0	8.0	ND	1.0	13	420
SEPTEMBER	ND	7	3.0	ND	ND	3.6	7.8	0.07	0.6	9.2	350
OCTOBER	ND	ND	3.0	ND	0.05	3.2	8.1	0.12	0.6	11	400
NOVEMBER											
DECEMBER											

ALL RESULTS IN mg/L EXCEPT FOR FECAL COLIFORMS AND pH

Reference no. for this report	Well location	Depth of well or elevation (feet)	Date of collection	Temperature, °C	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Silica	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Iron (Fe)	Manganese (Mn)	Dissolved solids D (calculated)	Hardness as $CaCO_3$ Carbonate	Hardness as $CaCO_3$ Noncarbonate	Sodium adsorption ratio (me/l) 1/	Specific conductance (micromohs at 25°C)	pH
	Cabin, household, and business wells																					
1	06.04.31 dba	55	8/18/70	7	62	14	12	261	0	5	2.0	1.1	0.1	1.8	0.00	0.05	359	212	0	0.3	427	7.6
2	07.04.08 aaa	86	8/18/70	8	.0	.0	170	311	46	27	2.0	.0	.6	2.1	.00	.00	559	—	0	.0	600	9.2
3	06.04.32 dac_1	31	8/18/70	13	88	27	3.6	164	0	192	1.7	1.8	.7	1.7	.21	.00	482	134	199	.0	615	7.6
4	07.03.02 add	58	8/20/70	8	64	17	5.0	267	0	25	2.7	.9	.1	2.1	.88	.03	384	218	12	.1	428	7.8
5	06.04.31 cab	30	8/20/70	8	56	14	17	265	0	13	2.0	.5	.2	2.0	.00	.00	370	195	0	.5	422	7.8
6	06.04.32 dac_2	6	8/20/70	9	63	17	3.6	155	0	105	.3	1.6	.2	1.4	.08	.00	348	126	103	.1	445	7.7
7	06.04.32 ddb	62	8/20/70	8	88	26	3.9	166	0	202	2.3	2.4	.7	1.8	.00	.00	493	136	191	.0	605	7.8
8	06.04.31 add	24	9/4/70	6	26	25	6.2	200	0	1	8.3	1.5	.2	3.2	.48	.01	272	164	4	.2	349	7.7
9	07.04.16 ccd	32	9/4/70	9	23	29	14	261	0	1	8.6	1.3	.6	.9	2.60	.03	342	176	0	.4	481	8.1
10	07.04.16 cab	14	9/4/70	9	40	12	12	183	0	20	21	1.2	.2	1.0	.25	.11	291	148	0	.4	298	7.5
11	07.04.16 bcb	30	9/4/70	8	45	19	6.5	251	0	7	11	2.0	.2	1.2	.04	.01	343	191	0	.2	368	8.2
12	07.04.08 dcd	68	9/4/70	7	50	9.3	32	256	0	25	22	2.9	.3	.5	.02	.00	398	162	0	1.1	400	8.0
13	07.04.17 ada	—	9/4/70	7	47	19	7.0	227	0	28	9.2•	1.8	.3	.2	.16	.01	340	186	9	.2	362	7.8
14	(not sampled)																					
15	07.04.17 acd	—	9/5/70	7	36	22	10	244	0	3	5.8	1.1	.2	.9	1.25	.24	319	179	0	.3	418	7.5
16	07.04.05 add	8	9/5/70	10	52	35	21	329	0	25	9.3	11.0	.1	4.9	.05	.01	487	269	3	.5	622	7.6
17	06.04.31 dab	51	9/6/70	7	5.8	2.2	120	301	4	21	6.7	.9	.8	1.4	.56	.01	464	23	0	10.7	453	8.4
18	06.04.31 dad	72	9/6/70	7	57	16	10	279	0	1	19	2.4	.3	1.3	.04	.08	385	208	0	.3	443	8.0
19	07.04.05 daa	30	9/6/70	9	64	16	20	289	0	33	19	2.7	.3	1.7	.03	.01	446	226	0	.5	480	7.6
20	06.04.32 add	22	9/6/70	11	80	32	6.5	317	0	75	9.4	2.0	.6	.7	.01	.01	523	260	69	.1	608	7.8
21	06.04.32 ddd	17	9/6/70	8	30	22	15	190	0	50	16	2.1	.4	.1	.45	.05	326	156	8	.5	370	7.6
	Consultant's test wells 2/																					
1	06.03.35 caa	45	8/7/70	—	49.6	14.6	2.4	223	0	5.3	—	0.5	.01	.8	—	—	148	198	—	—	—	7.9
4	06.03.36 caa	24	8/7/70	—	56	18.5	—	256	—	2.9	—	1.0	—	1.2	.12	—	282	216	—	—	—	7.8
5	06.03.35 dbd	44	8/20/70	—	37	29.2	—	274	—	19.8	—	1.5	—	.5	.14	—	330	212	—	—	—	7.7
6	06.03.36 bdd	51	10/1/70	—	49	19.8	—	220	—	7.4	—	.7	—	1.5	—	—	192	202	—	—	—	7.7
8	06.03.30 aba	81	10/1/70	—	7.2	7.5	—	55	—	5.3	—	.3	.17	.06	.03	.005	38	48	—	—	—	8.0
	Springs																					
1	07.04.05 aad	—	9/7/70	5	54	15	25	269	0	28	22	2.7	.4	.2	.01	.01	417	198	0	.7	439	7.9
2	07.04.08 ddc	—	9/4/70	7	71	16	42	359	0	21	25	9.7	.4	1.4	.02	.01	546	243	0	1.1	535	7.8
3	07.03.02 acb	6,420	9/5/70	11	31	3.8	10	120	0	18	27	1.5	.2	.7	.12	.03	212	94	0	.4	222	7.5
4	06.04.31 dab	6,000	9/6/70	11	58	14	6.7	249	0	3	14	.5	.2	.3	.16	.01	345	203	0	.2	374	7.9

[1] Milliequivalents per liter (milliequivalents per liter is the milligrams per liter of a dissolved ion divided by the gram-equivalent weight of the ion).

[2] Analyses by Northern Testing Laboratories, Inc., Great Falls, MT. Other analyses by Montana Bureau of Mines and Geology water-quality laboratory, Butte.

Table 4.–Chemical analyses of ground water in the West Fork area (milligrams per liter (mg/l), except as indicated)

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FAX (406) 252-6069 • 1-800-735-4489

LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4873
DATE: 02/14/94 jmw

WATER ANALYSIS

Well No. 7 !
Sampled 01/26/94
Submitted 01/27/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	502	01/28/94
5-Day Biochemical Oxygen Demand	2	01/27/94
Ortho-phosphate as P	0.01	02/10/94
Total Phosphorus as P	0.01	02/08/94
Nitrate plus Nitrite as N	1.24	01/31/94
pH	7.8 s.u.	01/28/94
Ammonia as N	<0.1	01/28/94
Total Kjeldahl Nitrogen	2.0	02/02/94
Chloride	6	01/28/94
Total Dissolved Solids @ 180°C	313	01/28/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4872
DATE: 02/14/94 jmw

WATER ANALYSIS

Well No. ~~6~~ 2
Sampled 01/26/94
Submitted 01/27/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	374	01/28/94
5-Day Biochemical Oxygen Demand	2	01/27/94
Ortho-phosphate as P	0.02	02/10/94
Total Phosphorus as P	0.07	02/08/94
Nitrate plus Nitrite as N	3.83	01/31/94
pH	7.2 s.u.	01/28/94
Ammonia as N	0.3	01/28/94
Total Kjeldahl Nitrogen	1.0	01/31/94
Chloride	37	01/28/94
Total Dissolved Solids @ 180°C	310	01/28/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4870 dup
DATE: 02/14/94 jmw

QUALITY ASSURANCE - DUPLICATE ANALYSIS

Well No. 3 X 4
Sampled 01/26/94
Submitted 01/27/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	360	01/28/94
5-Day Biochemical Oxygen Demand	N/A	N/A
Ortho-phosphate as P	0.02	02/10/94
Total Phosphorus as P	0.03	02/08/94
Nitrate plus Nitrite as N	0.46	01/31/94
pH	7.7 s.u.	01/28/94
Ammonia as N	<0.1	01/28/94
Total Kjeldahl Nitrogen	1.0	01/31/94
Chloride	17	01/28/94
Total Dissolved Solids @ 180°C	308	01/28/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4870
DATE: 02/14/94 jmw

WATER ANALYSIS

Well No. ~~3~~ 5 ~~7~~ 4
Sampled 01/26/94
Submitted 01/27/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	358	01/28/94
5-Day Biochemical Oxygen Demand	2	01/27/94
Ortho-phosphate as P	0.02	02/10/94
Total Phosphorus as P	0.03	02/08/94
Nitrate plus Nitrite as N	0.45	01/31/94
pH	7.7 s.u.	01/28/94
Ammonia as N	<0.1	01/28/94
Total Kjeldahl Nitrogen	1.0	01/31/94
Chloride	17	01/28/94
Total Dissolved Solids @ 180°C	299	01/28/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4869
DATE: 02/14/94 jmw

WATER ANALYSIS

Well No. 2 #5
Sampled 01/26/94
Submitted 01/27/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	50	01/28/94
5-Day Biochemical Oxygen Demand	4	01/27/94
Ortho-phosphate as P	0.02	02/10/94
Total Phosphorus as P	0.05	02/08/94
Nitrate plus Nitrite as N	0.40	01/31/94
pH	7.6 s.u.	01/28/94
Ammonia as N	1.9	01/28/94
Total Kjeldahl Nitrogen	3.1	01/31/94
Chloride	24	01/28/94
Total Dissolved Solids @ 180°C	327	01/28/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4868
DATE: 02/14/94 jmw

WATER ANALYSIS

Well No. 11
Sampled 01/26/94
Submitted 01/27/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	344	01/28/94
5-Day Biochemical Oxygen Demand	9	01/27/94
Ortho-phosphate as P	0.02	02/10/94
Total Phosphorus as P	0.14	02/08/94
Nitrate plus Nitrite as N	<0.05	01/31/94
pH	7.4 s.u.	01/28/94
Ammonia as N	0.6	01/28/94
Total Kjeldahl Nitrogen	1.4	01/31/94
Chloride	15	01/28/94
Total Dissolved Solids @ 180°C	393	01/28/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4871 spi
DATE: 02/14/94 jmw

QUALITY ASSURANCE - SPIKED ANALYSIS

Well No. 5 3
Sampled 01/26/94
Submitted 01/27/94

Constituent	% Recovery	Date Analyzed
Total Suspended Solids	N/A	N/A
5-Day Biochemical Oxygen Demand	N/A	N/A
Ortho-phosphate as P	95	02/10/94
Total Phosphorus as P	110	02/08/94
Nitrate plus Nitrite as N	92	01/31/94
pH	N/A	N/A
Ammonia as N	115	01/28/94
Total Kjeldahl Nitrogen	92	01/31/94
Chloride	93	01/28/94
Total Dissolved Solids @ 180°C	N/A	N/A

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Rural Improvement District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4871
DATE: 02/14/94 jmw

WATER ANALYSIS

Well No. 5 3
Sampled 01/26/94
Submitted 01/27/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	86	01/28/94
5-Day Biochemical Oxygen Demand	11	01/27/94
Ortho-phosphate as P	0.04	02/10/94
Total Phosphorus as P	0.40	02/08/94
Nitrate plus Nitrite as N	<0.05	01/31/94
pH	7.5 s.u.	01/28/94
Ammonia as N	5.0	01/28/94
Total Kjeldahl Nitrogen	8.5	01/31/94
Chloride	36	01/28/94
Total Dissolved Solids @ 180°C	317	01/28/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-7386
DATE: 03/16/94 lm

WATER ANALYSIS

Well #1
Sampled 03/02/94
Submitted 03/03/94

Constituent	mg/l(ppm)	Date Analyzed
Chloride	8	03/15/94
Total Dissolved Solids @ 180° C	261	03/07/94
pH	8.1 s.u.	03/04/94
Total Suspended Solids	808	03/08/94
5-Day Biochemical Oxygen Demand	3	03/03/94
Ortho-phosphate as P	0.05	03/04/94
Total Phosphorus as P	0.05	03/04/94
Ammonia as N	<0.1	03/04/94
Nitrate plus Nitrite as N	<0.05	03/07/94
Total Kjeldahl Nitrogen	1.0	03/07/94

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LABORATORY REPORT

TO:	Terry Threlkeld	LAB NO.:	94-7390
ADDRESS:	Water & Sewer Dist. #363	DATE:	03/16/94 lm
	P.O. Box 57		
	Big Sky, MT 59716		

WATER ANALYSIS

Well #6
Sampled 03/02/94
Submitted 03/03/94

Constituent	mg/l(ppm)	Date Analyzed
Chloride	31	03/15/94
Total Dissolved Solids @ 180° C	333	03/07/94
pH	7.7 s.u.	03/04/94
Total Suspended Solids	86	03/08/94
5-Day Biochemical Oxygen Demand	2	03/03/94
Ortho-phosphate as P	0.06	03/04/94
Total Phosphorus as P	0.09	03/04/94
Ammonia as N	0.4	03/04/94
Nitrate plus Nitrité as N	0.38	03/07/94
Total Kjeldahl Nitrogen	1.1	03/07/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-7390 dup
DATE: 03/16/94 lm

QUALITY ASSURANCE-DUPLICATE ANALYSIS

Well #6 2
Sampled 03/02/94
Submitted 03/03/94

Constituent	mg/l(ppm)	Date Analyzed
Chloride	29	03/15/94
Total Dissolved Solids @ 180° C	330	03/07/94
pH	7.8 s.u.	03/04/94
Total Suspended Solids	86	03/08/94
5-Day Biochemical Oxygen Demand	N/A	N/A
Ortho-phosphate as P	0.05	03/04/94
Total Phosphorus as P	0.10	03/04/94
Ammonia as N	0.4	03/04/94
Nitrate plus Nitrite as N	0.37	03/07/94
Total Kjeldahl Nitrogen	1.2	03/07/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-7387
DATE: 03/16/94 lm

WATER ANALYSIS

Well #3
Sampled 03/02/94
Submitted 03/03/94

Constituent	mg/l(ppm)	Date Analyzed
Chloride	41	03/15/94
Total Dissolved Solids @ 180° C	324	03/07/94
pH	7.4 s.u.	03/04/94
Total Suspended Solids	22	03/08/94
5-Day Biochemical Oxygen Demand	3	03/03/94
Ortho-phosphate as P	0.06	03/04/94
Total Phosphorus as P	0.09	03/04/94
Ammonia as N	0.9	03/04/94
Nitrate plus Nitrite as N	<0.05	03/07/94
Total Kjeldahl Nitrogen	4.6	03/07/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-7388
DATE: 03/16/94 lm

WATER ANALYSIS

Well #4
Sampled 03/02/94
Submitted 03/03/94

Constituent	mg/l(ppm)	Date Analyzed
Chloride	41	03/15/94
Total Dissolved Solids @ 180° C	328	03/07/94
pH	7.5 s.u.	03/04/94
Total Suspended Solids	200	03/08/94
5-Day Biochemical Oxygen Demand	10	03/03/94
Ortho-phosphate as P	0.10	03/04/94
Total Phosphorus as P	0.96	03/04/94
Ammonia as N	5.4	03/04/94
Nitrate plus Nitrite as N	<0.05	03/07/94
Total Kjeldahl Nitrogen	8.2	03/07/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-7389
DATE: 03/16/94 lm

WATER ANALYSIS

Well #5
Sampled 03/02/94
Submitted 03/03/94

Constituent	mg/l(ppm)	Date Analyzed
Chloride	23	03/15/94
Total Dissolved Solids @ 180° C	310	03/07/94
pH	7.8 s.u.	03/04/94
Total Suspended Solids	1110	03/08/94
5-Day Biochemical Oxygen Demand	2	03/03/94
Ortho-phosphate as P	0.04	03/04/94
Total Phosphorus as P	0.07	03/04/94
Ammonia as N	<0.1	03/04/94
Nitrate plus Nitrite as N	0.53	03/07/94
Total Kjeldahl Nitrogen	0.4	03/07/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-7391
DATE: 03/16/94 lm

WATER ANALYSIS

Well #7
Sampled 03/02/94
Submitted 03/03/94

Constituent	mg/l(ppm)	Date Analyzed
Chloride	20	03/15/94
Total Dissolved Solids @ 180° C	426	03/07/94
pH	7.6 s.u.	03/04/94
Total Suspended Solids	86	03/08/94
5-Day Biochemical Oxygen Demand	<1	03/03/94
Ortho-phosphate as P	0.05	03/04/94
Total Phosphorus as P	0.09	03/04/94
Ammonia as N	0.4	03/04/94
Nitrate plus Nitrite as N	0.37	03/07/94
Total Kjeldahl Nitrogen	2.1	03/07/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-7391 spi
DATE: 03/16/94 lm

QUALITY ASSURANCE-SPIKED ANALYSIS

Well #7
Sampled 03/02/94
Submitted 03/03/94

Constituent	% Recovery	Date Analyzed
Chloride	(1)	03/15/94
Total Dissolved Solids @ 180° C	119	03/07/94
pH	N/A	N/A
Total Suspended Solids	N/A	N/A
5-Day Biochemical Oxygen Demand	N/A	N/A
Ortho-phosphate as P	86	03/04/94
Total Phosphorus as P	105	03/04/94
Ammonia as N	84	03/04/94
Nitrate plus Nitrite as N	87	03/07/94
Total Kjeldahl Nitrogen	109	03/07/94

(1) Insufficient sample submitted for spiked analysis.

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-7392
DATE: 03/16/94 lm

WATER ANALYSIS

Leroy Well
Sampled 03/02/94
Submitted 03/03/94

Constituent	mg/l(ppm)	Date Analyzed
Chloride	25	03/15/94
Total Dissolved Solids @ 180° C	319	03/07/94
pH	7.9 s.u.	03/04/94
Total Suspended Solids	10	03/08/94
5-Day Biochemical Oxygen Demand	2	03/03/94
Ortho-phosphate as P	0.03	03/04/94
Total Phosphorus as P	0.10	03/04/94
Ammonia as N	<0.1	03/04/94
Nitrate plus Nitrite as N	<0.05	03/07/94
Total Kjeldahl Nitrogen	0.4	03/07/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-7393
DATE: 03/16/94 lm

WATER ANALYSIS

Hanson House
Sampled 03/02/94
Submitted 03/03/94

Constituent	mg/l(ppm)	Date Analyzed
Chloride	8	03/15/94
Total Dissolved Solids @ 180° C	294	03/07/94
pH	7.9 s.u.	03/04/94
Total Suspended Solids	<1	03/08/94
5-Day Biochemical Oxygen Demand	<1	03/03/94
Ortho-phosphate as P	0.05	03/04/94
Total Phosphorus as P	0.12	03/04/94
Ammonia as N	<0.1	03/04/94
Nitrate plus Nitrite as N	<0.05	03/07/94
Total Kjeldahl Nitrogen	0.3	03/08/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-7394
DATE: 03/16/94 lm

WATER ANALYSIS

Kelly House
Sampled 03/02/94
Submitted 03/03/94

Constituent	mg/l(ppm)	Date Analyzed
Chloride	7	03/15/94
Total Dissolved Solids @ 180° C	254	03/07/94
pH	8.2 s.u.	03/04/94
Total Suspended Solids	14	03/08/94
5-Day Biochemical Oxygen Demand	<1	03/03/94
Ortho-phosphate as P	0.03	03/04/94
Total Phosphorus as P	0.06	03/04/94
Ammonia as N	<0.1	03/04/94
Nitrate plus Nitrite as N	0.10	03/07/94
Total Kjeldahl Nitrogen	0.2	03/08/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-7395
DATE: 03/16/94 lm

WATER ANALYSIS

Miner Guest
Sampled 03/02/94
Submitted 03/03/94

Constituent	mg/l(ppm)	Date Analyzed
Chloride	6	03/15/94
Total Dissolved Solids @ 180° C	282	03/07/94
pH	7.9 s.u.	03/04/94
Total Suspended Solids	18	03/08/94
5-Day Biochemical Oxygen Demand	<1	03/03/94
Ortho-phosphate as P	0.05	03/04/94
Total Phosphorus as P	0.13	03/04/94
Ammonia as N	<0.1	03/04/94
Nitrate plus Nitrite as N	0.58	03/07/94
Total Kjeldahl Nitrogen	0.2	03/08/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12639
DATE: 04/11/94 lm

WATER ANALYSIS

Well No. 1
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	1	03/31/94
5-Day Biochemical Oxygen Demand	1	03/30/94
Ortho-phosphate as P	0.27	04/04/94
Nitrate plus Nitrite as N	12.2	04/01/94
pH	7.4 s.u.	03/31/94
Total Phosphorus as P	0.49	04/06/94
Ammonia as N	<0.1	04/01/94
Total Kjeldahl Nitrogen	0.3	03/31/94
Chloride	31	03/31/94
Total Dissolved Solids @ 180° C	519	04/04/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12640
DATE: 04/11/94 lm

WATER ANALYSIS

Well No. 2
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	58	03/31/94
5-Day Biochemical Oxygen Demand	3	03/30/94
Ortho-phosphate as P	0.07	04/07/94
Nitrate plus Nitrite as N	0.09	04/01/94
pH	7.7 s.u.	03/31/94
Total Phosphorus as P	0.07	04/06/94
Ammonia as N	0.3	04/01/94
Total Kjeldahl Nitrogen	0.6	03/31/94
Chloride	29	03/31/94
Total Dissolved Solids @ 180° C	324	04/04/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12641
DATE: 04/11/94 lm

WATER ANALYSIS

Well No. 3
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	122	03/31/94
5-Day Biochemical Oxygen Demand	1	03/30/94
Ortho-phosphate as P	0.05	04/07/94
Nitrate plus Nitrite as N	0.23	04/01/94
pH	7.8 s.u.	03/31/94
Total Phosphorus as P	0.11	04/06/94
Ammonia as N	<0.1	04/01/94
Total Kjeldahl Nitrogen	<0.1	04/04/94
Chloride	26	03/31/94
Total Dissolved Solids @ 180° C	320	04/04/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12642
DATE: 04/11/94 lm

WATER ANALYSIS

Well No. 4
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	21	03/31/94
5-Day Biochemical Oxygen Demand	17	03/30/94
Ortho-phosphate as P	0.03	04/07/94
Nitrate plus Nitrite as N	<0.05	04/01/94
pH	7.8 s.u.	03/31/94
Total Phosphorus as P	0.74	04/06/94
Ammonia as N	5.8	04/01/94
Total Kjeldahl Nitrogen	8.2	04/04/94
Chloride	32	03/31/94
Total Dissolved Solids @ 180° C	338	04/04/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12643
DATE: 04/11/94 lm

WATER ANALYSIS

Well No. 5
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	52	03/31/94
5-Day Biochemical Oxygen Demand	6	03/30/94
Ortho-phosphate as P	0.04	04/04/94
Nitrate plus Nitrite as N	<0.05	04/01/94
pH	7.4 s.u.	03/31/94
Total Phosphorus as P	0.09	04/06/94
Ammonia as N	1.6	04/01/94
Total Kjeldahl Nitrogen	2.4	04/04/94
Chloride	44	03/31/94
Total Dissolved Solids @ 180° C	370	04/04/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12644
DATE: 04/11/94 lm

WATER ANALYSIS

Well No. 7
Sampled 03/29/94
Submitted 03/30/94

Constituent	mg/l (ppm)	Date Analyzed
Total Suspended Solids	26	03/31/94
5-Day Biochemical Oxygen Demand	2	03/30/94
Ortho-phosphate as P	0.02	04/04/94
Nitrate plus Nitrite as N	<0.05	04/01/94
pH	8.0 s.u.	03/31/94
Total Phosphorus as P	0.02	04/06/94
Ammonia as N	<0.1	04/01/94
Total Kjeldahl Nitrogen	0.8	04/04/94
Chloride	5	03/31/94
Total Dissolved Solids @ 180° C	270	04/04/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-17011
DATE: 05/04/94 lm

WATER ANALYSIS

Well No. 1
Sampled 04/25/94
Submitted 04/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	21	05/03/94
Total Dissolved Solids @ 180° C	484	04/28/94
pH	7.2 s.u.	04/27/94
Total Suspended Solids	36	04/28/94
5-Day Biochemical Oxygen Demand	<1	04/27/94
Total Kjeldahl Nitrogen	<0.1	04/28/94
Nitrate plus Nitrite as N	9.68	04/29/94
Ammonia as N	<0.1	04/29/94
Total Phosphorus as P	0.04	04/28/94
Ortho-phosphate as P	0.02	04/27/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-17012
DATE: 05/04/94 lm

WATER ANALYSIS

Well No. 2
Sampled 04/25/94
Submitted 04/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	33	05/03/94
Total Dissolved Solids @ 180° C	341	04/28/94
pH	7.4 s.u.	04/27/94
Total Suspended Solids	392	04/28/94
5-Day Biochemical Oxygen Demand	2	04/27/94
Total Kjeldahl Nitrogen	0.8	04/28/94
Nitrate plus Nitrite as N	0.10	04/29/94
Ammonia as N	0.6	04/29/94
Total Phosphorus as P	0.03	04/28/94
Ortho-phosphate as P	0.03	04/27/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-17013
DATE: 05/04/94 lm

WATER ANALYSIS

Well No. 3
Sampled 04/25/94
Submitted 04/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	28	05/03/94
Total Dissolved Solids @ 180° C	317	04/28/94
pH	7.5 s.u.	04/27/94
Total Suspended Solids	60	04/28/94
5-Day Biochemical Oxygen Demand	<1	04/27/94
Total Kjeldahl Nitrogen	<0.1	04/28/94
Nitrate plus Nitrite as N	0.06	04/29/94
Ammonia as N	<0.1	04/29/94
Total Phosphorus as P	0.04	04/28/94
Ortho-phosphate as P	0.02	04/27/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-17014
DATE: 05/04/94 lm

WATER ANALYSIS

Well No. 4
Sampled 04/25/94
Submitted 04/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	33	05/03/94
Total Dissolved Solids @ 180° C	300	04/28/94
pH	7.4 s.u.	04/27/94
Total Suspended Solids	74	04/28/94
5-Day Biochemical Oxygen Demand	10	04/27/94
Total Kjeldahl Nitrogen	7.6	04/28/94
Nitrate plus Nitrite as N	<0.05	04/29/94
Ammonia as N	5.6	04/29/94
Total Phosphorus as P	1.7	04/28/94
Ortho-phosphate as P	0.04	04/27/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-17015
DATE: 05/04/94 lm

WATER ANALYSIS

Well No. 5
Sampled 04/25/94
Submitted 04/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	31	05/03/94
Total Dissolved Solids @ 180° C	331	04/28/94
pH	7.4 s.u.	04/27/94
Total Suspended Solids	40	04/28/94
5-Day Biochemical Oxygen Demand	6	04/27/94
Total Kjeldahl Nitrogen	3.3	04/28/94
Nitrate plus Nitrite as N	0.83	04/29/94
Ammonia as N	2.5	04/29/94
Total Phosphorus as P	0.04	04/28/94
Ortho-phosphate as P	0.02	04/27/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-17016
DATE: 05/04/94 lm

WATER ANALYSIS

Well No. 7
Sampled 04/25/94
Submitted 04/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	8	05/03/94
Total Dissolved Solids @ 180° C	260	04/28/94
pH	7.8 s.u.	04/27/94
Total Suspended Solids	178	04/28/94
5-Day Biochemical Oxygen Demand	2	04/27/94
Total Kjeldahl Nitrogen	<0.1	04/28/94
Nitrate plus Nitrite as N	0.05	04/29/94
Ammonia as N	<0.1	04/29/94
Total Phosphorus as P	0.04	04/28/94
Ortho-phosphate as P	0.01	04/27/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23258
DATE: 06/09/94 jmw

WATER ANALYSIS

Well No. 1
Sampled 05/25/94
Submitted 05/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	30	06/02/94
Total Dissolved Solids @ 180°C	502	05/31/94
pH	7.1 s.u.	05/27/94
Total Suspended Solids	428	05/26/94
Total Kjeldahl Nitrogen	1.4	06/02/94
Ammonia as N	1.0	06/03/94
Nitrate plus Nitrite as N	<0.05	06/03/94
Total Phosphorus as P	0.13	05/31/94
Ortho-phosphate as P	0.02	05/27/94
5-Day Biochemical Oxygen Demand	2	05/26/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23259
DATE: 06/08/94 jmw

WATER ANALYSIS

Well No. 2
Sampled 05/25/94
Submitted 05/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	32	06/02/94
Total Dissolved Solids @ 180°C	362	05/31/94
pH	7.4 s.u.	05/27/94
Total Suspended Solids	84	05/26/94
Total Kjeldahl Nitrogen	1.4	06/02/94
Ammonia as N	0.9	06/03/94
Nitrate plus Nitrite as N	0.30	06/03/94
Total Phosphorus as P	0.12	05/31/94
Ortho-phosphate as P	0.05	05/27/94
5-Day Biochemical Oxygen Demand	2	05/26/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23260
DATE: 06/08/94 jmw

WATER ANALYSIS

Well No. 3
Sampled 05/25/94
Submitted 05/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	26	06/02/94
Total Dissolved Solids @ 180°C	329	05/31/94
pH	7.5 s.u.	05/27/94
Total Suspended Solids	288	05/26/94
Total Kjeldahl Nitrogen	<0.1	06/02/94
Ammonia as N	<0.1	06/03/94
Nitrate plus Nitrite as N	<0.05	06/03/94
Total Phosphorus as P	0.07	05/31/94
Ortho-phosphate as P	0.03	05/27/94
5-Day Biochemical Oxygen Demand	1	05/26/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23261
DATE: 06/08/94 jmw

WATER ANALYSIS

Well No. 4
Sampled 05/25/94
Submitted 05/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	38	06/02/94
Total Dissolved Solids @ 180°C	359	05/31/94
pH	7.4 s.u.	05/27/94
Total Suspended Solids	34	05/26/94
Total Kjeldahl Nitrogen	7.6	06/02/94
Ammonia as N	5.7	06/03/94
Nitrate plus Nitrite as N	<0.05	06/03/94
Total Phosphorus as P	1.33	05/31/94
Ortho-phosphate as P	0.38	05/27/94
5-Day Biochemical Oxygen Demand	10	05/26/94

ENERGY LABORATORIES

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23262
DATE: 06/08/94 jmw

WATER ANALYSIS

Well No. 5
Sampled 05/25/94
Submitted 05/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	36	06/02/94
Total Dissolved Solids @ 180°C	377	05/31/94
pH	7.3 s.u.	05/27/94
Total Suspended Solids	96	05/26/94
Total Kjeldahl Nitrogen	2.7	06/02/94
Ammonia as N	2.0	06/03/94
Nitrate plus Nitrite as N	0.61	06/03/94
Total Phosphorus as P	0.13	05/31/94
Ortho-phosphate as P	0.04	05/27/94
5-Day Biochemical Oxygen Demand	4	05/26/94

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23263
DATE: 06/08/94 jmw

WATER ANALYSIS

Well No. 7
Sampled 05/25/94
Submitted 05/26/94

Constituent	mg/l (ppm)	Date Analyzed
Chloride	7	06/02/94
Total Dissolved Solids @ 180°C	275	05/31/94
pH	7.7 s.u.	05/27/94
Total Suspended Solids	242	05/26/94
Total Kjeldahl Nitrogen	<0.1	06/02/94
Ammonia as N	<0.1	06/03/94
Nitrate plus Nitrite as N	<0.05	06/03/94
Total Phosphorus as P	0.05	05/31/94
Ortho-phosphate as P	0.02	05/27/94
5-Day Biochemical Oxygen Demand	2	05/26/94

LAB. NO. 3776

MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES
Public Health Lab, W.F. Cogswell Building, Helena, Montana 59620
Phone: 444-2642

D0000090

SAMPLING PROCEDURE: Received 1-27-94 Reported 1-30-94

1. Remove screen. Allow water to run 2-3 minutes. If you have a water softener use an outside tap.
2. Fill bottle to neck—without touching inside (this leaves ½ inch air space. Do not rinse out bottle.
3. Fill out sampling information below and return to lab within 48 hours.
4. Enclose $14.00 check or money order to cover cost. Results will not be sent until fee is paid.

DATE Collected 1-26-94 Time 11:57

Owner of Water Source

Location of Water Source BIG SKY (*Nearest City*)

County GALLATIN

Type of Supply *(Circle One)* Cistern (Well) Spring River No. 7 (*Other (Please Specify)*)

Collector of Sample: Threlkeld Phone No. 995-2660

Person to Receive Report *(Please Print)*:

NAME: Terry Threlkeld / RID 305

Street or RFD: P.O. Box 160066

City: BIG SKY MT Zip: 59716

DO NOT WRITE BELOW THIS LINE

TOTAL COLIFORM

Multiple Tube | Membrane Filter

FECAL COLIFORM <1/100 ml

ABSENT – HEAVY TURBIDITY NOTED

~~Multiple Tube~~ | Membrane Filter

☐ Satisfactory At This Time

☐ Contaminated

Water supply should be disinfected and retested before it is used as drinking water or for household purposes. Consult your county sanitarian for treatment procedures.

REMARKS:

Acct ✓

LAB. NO. [illegible]

·ONTANA DEPARTMENT OF HEALT' AND ENVIRONMENTAL SCIENCES

Public Health Lab, W.F. Cogswell Building, Helena, Montana 59620
Phone: 444-2642

SAMPLING PROCEDURE: *Received* 1-27-94 *Reported* 1-30-94

1. Remove screen. Allow water to run 2-3 minutes. If you have a water softener use an outside tap.
2. Fill bottle to neck—without touching inside (this leaves ½ inch air space. Do not rinse out bottle.
3. Fill out sampling information below and return to lab within 48 hours.
4. Enclose $14.00 check or money order to cover cost. Results will not be sent until fee is paid.

DATE Collected 1-26-94 Time 12:22 no #5 Rec'd - Rec'd #6

Owner of Water Source ____

Location of Water Source Big Sky (Nearest City)

County Gallatin

Type of Supply *(Circle One)* Cistern (Well) Spring River No 6 2 Other *(Please Specify)*

Collector of Sample: Threlkeld Phone No. 995-2660

Person to Receive Report *(Please Print)*:

NAME: Tony Threlkeld RO 305

Street or RFD: P.O. Box 160066

City: Big Sky MT Zip: 59716

DO NOT WRITE BELOW THIS LINE

TOTAL COLIFORM

Multiple Tube ____ *Membrane Filter* ____

FECAL COLIFORM (+)

4 SPREADING TYPE COLONIES /100ml

~~*Multiple Tube*~~ *Membrane Filter*

☐ Satisfactory At This Time

☐ Contaminated

Water supply should be disinfected and retested before it is used as drinking water or for household purposes. Consult your county sanitarian for treatment procedures.

REMARKS:
HEAVY TURBIDITY

[illegible]

Acct

LAB. NO. 3773

MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES

Public Health Lab, W.F. Cogswell Building, Helena, Montana 59620

Phone: 444-2642

SAMPLING PROCEDURE: *Received* 1-27-94 *Reported* 1-30-94

1. Remove screen. Allow water to run 2-3 minutes. If you have a water softener use an outside tap.
2. Fill bottle to neck—without touching inside (this leaves ½ inch air space. Do not rinse out bottle.
3. Fill out sampling information below and return to lab within 48 hours.
4. Enclose $14.00 check or money order to cover cost. Results will not be sent until fee is paid.

DATE Collected 1/26/94 Time 12:30

Owner of Water Source

Location of Water Source BIG SKY (*Nearest City*)

County GALLATIN

Type of Supply *(Circle One)* Cistern (Well) Spring River No 4 Other *(Please Specify)*

Collector of Sample: Threlkeld Phone No. 995-2600

Person to Receive Report *(Please Print)*:

NAME: Terry Threlkeld / BID 305

Street or RFD: P.O Box 160066

City: BIG SKY MT Zip: 59716

DO NOT WRITE BELOW THIS LINE

TOTAL COLIFORM

Multiple Tube *Membrane Filter*

FECAL COLIFORM (+)

2600 /100ml

~~*Multiple Tube*~~ *(Membrane Filter)*

☐ Satisfactory At This Time

☐ Contaminated

Water supply should be disinfected and retested before it is used as drinking water or for household purposes. Consult your county sanitarian for treatment procedures.

REMARKS:

HEAVY TURBIDITY

Acct ✓

LAB. NO. ______

'ONTANA DEPARTMENT OF HEALT'
AND ENVIRONMENTAL SCIENCES
Public Health Lab, W.F. Cogswell Building, Helena, Montana 59620
Phone: 444-2642

SAMPLING PROCEDURE: *Received* 1-27-94 *Reported* 1-30-94

1. Remove screen. Allow water to run 2-3 minutes. If you have a water softener use an outside tap.
2. Fill bottle to neck—without touching inside (this leaves ½ inch air space. Do not rinse out bottle.
3. Fill out sampling information below and return to lab within 48 hours.
4. Enclose $14.00 check or money order to cover cost. Results will not be sent until fee is paid.

DATE Collected 1/26/94 Time 12:48

Owner of Water Source ______

Location of Water Source BIG SKY (*Nearest City*)

County GALLATIN

Type of Supply *(Circle One)* Cistern (Well) Spring River No 36 *Other (Please Specify)*

Collector of Sample: Threlkeld Phone No. 993-2660

Person to Receive Report *(Please Print)*:

NAME: Tom Threlkeld R.O 305

Street or RFD: P.O. Box 160066

City: Big Sky MT Zip: 59716

DO NOT WRITE BELOW THIS LINE

TOTAL COLIFORM

______ *Multiple Tube* ______ *Membrane Filter*

FECAL COLIFORM ⊕ Spreading-type colonies

100/100 ml *Multiple Tube* ______ *Membrane Filter*

☐ Satisfactory At This Time

☐ Contaminated
Water supply should be disinfected and retested before it is used as drinking water or for household purposes. Consult your county sanitarian for treatment procedures.

REMARKS:
HEAVY TURBIDITY

Acct

LAB. NO. 3780

'ONTANA DEPARTMENT OF HEALTI
AND ENVIRONMENTAL SCIENCES

Public Health Lab, W.F. Cogswell Building, Helena, Montana 59620
Phone: 444-2642

SAMPLING PROCEDURE: Received 1-27-94 Reported 1-30-94

1. Remove screen. Allow water to run 2-3 minutes. If you have a water softener use an outside tap.
2. Fill bottle to neck—without touching inside (this leaves ½ inch air space. Do not rinse out bottle.
3. Fill out sampling information below and return to lab within 48 hours.
4. Enclose $14.00 check or money order to cover cost. Results will not be sent until fee is paid.

DATE Collected 1/26/94 Time 1:00

Owner of Water Source

Location of Water Source BIG SKY
Nearest City

County GALLATIN

Type of Supply *(Circle One)* Cistern (Well) Spring River No. 2 *Other (Please Specify)*

Collector of Sample: Threlkeld Phone No. 995-2660

Person to Receive Report *(Please Print)*:

NAME: Terry Threlkeld / RID 365

Street or RFD: P.O. Box 160066

City: BIG SKY MT Zip: 59716

DO NOT WRITE BELOW THIS LINE

TOTAL COLIFORM

Multiple Tube *Membrane Filter*

(FECAL COLIFORM) (+)

4 SPREADING-TYPE COLONIES / 100 ml

~~*Multiple Tube*~~ (*Membrane Filter*)

☐ Satisfactory At This Time

☐ Contaminated

Water supply should be disinfected and retested before it is used as drinking water or for household purposes. Consult your county sanitarian for treatment procedures.

REMARKS:
HEAVY TURBIDITY

Acct ✓

LAB. NO. [illegible]

**MONTANA DEPARTMENT OF HEALTH
AND ENVIRONMENTAL SCIENCES**
Public Health Lab, W.F. Cogswell Building, Helena, Montana 59620
Phone: 444-2642

SAMPLING PROCEDURE: *Received* 1-27-94 *Reported* 1-30-94

1. Remove screen. Allow water to run 2-3 minutes. If you have a water softener use an outside tap.
2. Fill bottle to neck—without touching inside (this leaves ½ inch air space. Do not rinse out bottle.
3. Fill out sampling information below and return to lab within 48 hours.
4. Enclose $14.00 check or money order to cover cost. Results will not be sent until fee is paid.

DATE Collected 1-26-94 Time 1:10

Owner of Water Source

Location of Water Source BIG SKY (*Nearest City*)

County GALLATIN

Type of Supply *(Circle One)* Cistern (Well) Spring River No. Y1 Other *(Please Specify)*

Collector of Sample: Threlkeld Phone No. 995 2160

Person to Receive Report *(Please Print)*:

NAME: Terry Threlkeld / RW 305

Street or RFD: C / P.O. Box 160066

City: BIG SKY MT Zip: 59716

DO NOT WRITE BELOW THIS LINE

TOTAL COLIFORM

Multiple Tube	Membrane Filter
(FECAL COLIFORM)	<1/100 ml
ABSENT - VERY HEAVY TURBIDIT	
~~Multiple Tube~~	(Membrane Filter)

☐ Satisfactory At This Time

☐ Contaminated — Water supply should be disinfected and retested before it is used as drinking water or for household purposes. Consult your county sanitarian for treatment procedures.

REMARKS:

(LK)

Acct ✓

ONTANA DEPART 'T OF HEALTH AND ENVIRONMENTAL SCIENCES
BLIC HEALTH LABO...TORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
)6) 444-2642 FAX #(406) 444-1802

MAR 8 - 1994

ease Press Firmly

REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

VSID: B0000090 CITY/SYSTEM: BIG SKY RID 305 FECAL COUNTY: GALLATIN

Collected by: Terry Threlkeld Date: 3-2-94 Hour: NOON Received: 3-2-94 3

Operator: Operator Certification No. Reported: 3-5-94

	Sample Site No. or Repeat Location**	Cl RES P.P.M.	Lab. No.	RESULTS — LAB USE ONLY Total Coliform	Fecal	HPC
	⑦ Well No. 5		015862	Turbid	<1/100 mls	
	⑧ MINER GUEST		015863		<1/100 mls	
	⑨ WELL No. 6		015861	Heavy turbidity	<1/100 mls	
	⑩ WELL No. 7		015865	Heavy turbidity	<1/100 mls	

stem Contract No.
995-2660

RID 305 - BIG SKY
C/O TERRY THRELKELD
PO BOX 160066
BIG SKY, MT 59716

RESULTS of the examination of samples at the time received indicated that the water v

( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED

Certified Analyst: dL ✓

*SEE BACK OF FORM FOR EXPLANATION

:ONTANA DEPART IT OF HEALTH AND ENVIRONMENTAL SCIENCES
UBLIC HEALTH LABO...TORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
-06) 444-2642 FAX #(406) 444-1802

.AR 8 - 1994

'ease Press Firmly

REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

WSID: B0000090 CITY/SYSTEM: BIG SKY RID 305 FECAL COUNTY: GALLATIN

...by: Terry Threlkeld Date: 3/2/94 Hour: NOON Received: 3-2-94 330p

...perator: Operator Certification No. Reported: 3-5-94

	Sample Site No. or Repeat Location**	Cl RES P.P.M.	Lab. No.	RESULTS — LAB USE ONLY Total Coliform	Fecal	HPC
	(1) HANSON HOUSE		015856	Turbid	<1/100 mls	
	(2) KELLY HOUSE		015857		<1/100 mls	
	(3) LEROY WELL		015858	Turbid	<1/100 mls	
	(4) WELL No 4		015859		1178/100 mls	
	(5) WELL No 3		015860	Heavy turbidity	<1/100 mls	
	(6) WELL No 1		015861	Excessive turbidity	<1/100 mls	

ystem Contract No.
995-2660

RID 305 - BIG SKY
C/O TERRY THRELKELD
PO BOX 160066
BIG SKY, MT 59716

*SEE BACK OF FORM FOR EXPLANATION

RESULTS of the examination of samples at the time received indicated that the water

( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED ____________

Certified Analyst: [illegible]

ONTANA DEPART IT OF HEALTH AND ENVIRONMENTAL SCIENCES
BLIC HEALTH LABORATORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
3) 444-2642 FAX #(406) 444-1802

ease Press Firmly

REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

SID: B0000090 CITY/SYSTEM: BIG SKY RID 305 FECAL COUNTY: GALLATIN

Terry Threlkeld Date: 3-16-94 Hour: 11:28 Received: 3-16-94 3p

Operator Operator Certification No Reported: 3-19-94

	Sample Site No. or Repeat Location**	Cl RES P.P.M.	Lab. No.	RESULTS — LAB USE ONLY Total Coliform	Fecal	HPC
	(13) WELL No. 1		016797	turbid	<1/100	
	(14) LEROY WELL		016798	turbid	<1/100	

System Contract No. 995-2660

RID 305 - BIG SKY
C/O TERRY THRELKELD
PO BOX 160066
BIG SKY, MT 59716

*SEE BACK OF FORM FOR EXPLANATION

RESULTS of the examination of samples at the time received indicated that the water w
( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

✓

DATE NOTIFIED

Certified Analyst: [signature]

.ONTANA DEPART NT OF HEALTH AND ENVIRONMENTAL SCIENCES
JBLIC HEALTH LAB... TORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
06) 444-2642 FAX #(406) 444-1802

ease Press Firmly

REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

WSID: B0000090 CITY/SYSTEM: BIG SKY RID 305 FECAL COUNTY: GALLATIN

...ed by: Terry Threlkeld Date: 3/16/94 Hour: 10:40 Received: 3-16-94 Reported: 3-19-94

...ied Operator: Operator Certification No.

Sample Type	Sample Site No. or Repeat Location**	Cl RES P.P.M.	Lab. No.	RESULTS — LAB USE ONLY Total Coliform	Fecal	HPC
	(7) WELL No. 7		036791	heavy turbidity	<1/100	
	(8) WELL No. 6		036792	Excessive Turbidity	<1/100	
	(9) WELL No. 5		036793	heavy turbidity	<1/100	
	(10) WELL No. 4		036794		2100/100	
	(11) WELL No. 3		036795	turbid	<1/100	
	(12) WELL No. 7		036796	turbid	<1/100	

System Contract No.
995-2660

RID 305 - BIG SKY
C/O TERRY THRELKELD
PO BOX 160066
BIG SKY, MT 59716

RESULTS of the examination of samples at the time received indicated that the water
( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED

*SEE BACK OF FORM FOR EXPLANATION

Certified Analyst: [signature]

ONTANA DEPAR' ENT OF HEALTH AND ENVIRONMENTAL SCIENCES
BLIC HEALTH LAB. ATORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
)6) 444-2642 FAX #(406) 444-1802

ease Press Firmly

REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

SID: B0000090 CITY/SYSTEM: BIG SKY RID 305 FECAL COUNTY: GALLATIN

Collected by: Terry Threlkeld Date: 4/25/94 Hour: 10:19 Received: 4-25-94

Certified Operator: Operator Certification No. Reported: 4-29-94

Sample Type	Sample Site No. or Repeat Location**	Cl RES P.P.M.	Lab. No.	RESULTS — LAB USE ONLY Total Coliform	Fecal	HPC
	(7) WELL No 1		C18341	< 1fc/100 ml excessive turbidity		
	(8) WELL No 2		C18342	< 1.2fc/100 ml excessive turbidity		
	(9) WELL No 7		C18343	< 1.2fc/100 ml excessive turbidity		
	(10) WELL No 5		C18344		5 fc/100 ml	
	(11) WELL No 4		C18345		170 fc/100 ml	
	12) Well No 3 (marked (9) on Bottle)		C18346		< 1fc/100 ml	

System Contract No.
995-2660

RID 305 - BIG SKY6
C/O TERRY THRELKELD
PO BOX 160066
BIG SKY, MT 59716

RESULTS of the examination of samples at the time received indicated that the water w
( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED

*SEE BACK OF FORM FOR EXPLANATION

Certified Analyst: DD

ONTANA DEPAR' NT OF HEALTH AND ENVIRONMENTAL SCIENCES
JBLIC HEALTH LABORATORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
)6) 444-2642 FAX #(406) 444-1802

ease Press Firmly

REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

VSID: 30000090 CITY/SYSTEM: BIG SKY WSD 363 FECAL COUNTY: GALLATIN

ected by: TERRY THRELKELD Date: 5/25/94 Hour: Received: 5-25-94

ified Operator: Operator Certification No. Reported: 5/28/94

Sample Type*	Sample Site No. or Repeat Location**	Cl RES P.P.M.	Lab. No.	RESULTS — LAB USE ONLY: Total Coliform	Fecal	HPC
	① WELL No 1		023170	Excessive turbidity	<1/100mls	
	② WELL No 2		023172	Excessive turbidity	<1	
	③ WELL No 3		023173	Excessive turbidity	<1	
	④ WELL No 4		023173	Excessive turbidity	5/100	
	⑤ WELL No 5		023174	Ex turbidity	<1	
	⑥ WELL No 7		023175	Ex turbidity	<1	

stem Contract No. 995-4166

WATER SEWER DISTRICT 363
C/O TERRY THRELKELD
PO BOX 160066
BIG SKY, MT 59716

RESULTS of the examination of samples at the time received indicated that the water w

( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED

*SEE BACK OF FORM FOR EXPLANATION

Certified Analyst: JP

APPENDIX H

WATER CONSERVATION ORDINANCES AND LETTERS

ORDINANCE NO. 94-1001

AN ORDINANCE LIMITING THE USE OF INDIVIDUAL WASTEWATER TREATMENT SYSTEMS AND ESTABLISHING REQUIREMENTS FOR CONNECTION TO THE PUBLIC WASTE WATER TREATMENT SYSTEM OPERATED AND MAINTAINED BY THE BIG SKY COUNTY WATER AND SEWER DISTRICT #363.

PREAMBLE

1. The Big Sky County Water and Sewer District #363 ("sewer district") was formed to protect the public health and to operate, maintain and upgrade the public wastewater treatment system ("public system") for the Big Sky area.

2. The use of the public wastewater treatment system is crucial for the protection of ground water and surface water quality and for the protection of the public health.

BE IT ORDAINED by the Board of Directors of the Big Sky County Water and Sewer District #363 as follows:

1. <u>Definitions</u>. For the purposes of this ordinance, the following definitions apply:

   (a) "Person" means any individual, corporation, partnership, firm, company, association, or other organized group;

   (b) "Permit" means a sanitary connection permit issued by the sewer district;

   (c) "Individual waste water treatment system" means any privy, privy vault, septic tank, drain field, cesspool, or other individual facility for the treatment or disposal of waste water;

   (d) "District manager" means the person employed by the district to oversee the operation and maintenance of the public system.

   (e) "District Board" means the Board of Directors of the Big Sky County Water and Sewer District #363.

2. <u>Connection to the public system</u>. The owner of any residence, commercial establishment, public institution, or any other structure within the sewer district requiring the disposal of wastewater shall, at his own expense, properly connect to the public system.

3. <u>Permit</u>. No person may connect to the public system without first obtaining a written permit from the sewer district.

4. <u>Application for a permit</u>. Any person who wishes to obtain a permit must submit an application on forms provided by the sewer district. The application shall be in writing, shall be signed and verified by the owner of the property which is to be connected to the sewer system, and shall contain the following:

(a) the name and address of the owner;

(b) the legal description of the parcel which is to be connected to the public system;

(c) the size, type, and proposed use of the building which the owner intends to construct to connect to the public system;

(d) the load anticipated to be placed on the public system by the proposed use of the building, including when appropriate;

(i) when the building is residential, the number of anticipated residents; or

(ii) for all other uses, the anticipated load shall be listed in anticipated total gallons or liters of sewage flow.

5. <u>Individual waste water treatment systems</u>.

(a) A person may not construct or maintain any individual waste water treatment system within the boundaries of the sewer district after the date of enactment of this ordinance, except as provided in subsection (b) of this section.

(b) If a sewer main for the public system does not pass within 500 feet of a person's property line, a person may install an individual waste water treatment system, provided that:

(i) any individual waste water treatment system that is installed pursuant to this section must comply with all applicable state regulations and county ordinances and must be properly permitted by county officials; and

(ii) any person with an individual waste water treatment system must connect to the public system within 180 days after a main for the pubic system is constructed within 500 feet of the person's property line, or within 180 days after an easement across intervening property is secured.

6. <u>Variance for Hardship</u>.

(a) A person may obtain a variance from the prohibition against the construction of an individual wastewater treatment system as described in sections 2 and 5 of this ordinance by submitting an application to the district manager, on forms provided by the sewer district, requesting a variance from the provisions of sections 2 and 4 and a showing that compliance with those provisions will impose a hardship.

(b) In order to establish a hardship justifying a variance under this section, the applicant must show that:

(i) the hardship is unique and peculiar to the applicant's land and is different from any hardship that the ordinance may impose on all properties in the district;

(ii) the hardship is caused by conditions beyond the applicant's control;

(iii) the failure to grant the variance will result in a loss to the applicant of virtually all value for any of the uses to which the property could reasonably be put; and

(iv) the granting of the variance will not violate the spirit of this ordinance and will not jeopardize the goals of water quality protection embodied in the ordinance.

(c) Economic hardship is characterized by a decrease in property value or other financial loss will not, of itself, constitute hardship for the purpose of securing a variance under this section;

(d) The district manager must present the variance request and his recommendation to the district board at its next regularly scheduled meeting after receiving a complete application for variance.

(e) The district board must either approve or deny the variance application within 45 days of receiving the recommendation of the district manager.

7. <u>Change of use</u>. Any person who proposes to change his current property use so as to increase the amount of contribution to the public system must submit an application to the district manager on forms provided by the sewer district and receive his approval from the district manager before changing the use of his property.

8. <u>Denial of permits</u>. The district manager may deny a permit for connection to the public system or an application for change of use if:

(a) the applicant's proposed connection fails to comply with state law and regulations;

(b) the public system has reached its capacity for the treatment and disposal of sewage; or

(c) a state, federal, or local order specifically precludes the connection of additional service to the public system.

9. <u>Appeals</u>. If the district manager denies a permit application or a change of use application, the applicant may file an appeal with the district board within 30 days after the denial is issued. The district board must act upon the appeal within 45 days of receiving it.

10. <u>Penalty</u>. Any person violating any provision of this ordinance shall be guilty of a misdemeanor and shall be subject to a criminal penalty of up to six months in jail and a fine of $500.

ORDINANCE NO. 94-1002

AN ORDINANCE REQUIRING THE INSTALLATION OF WATER CONSERVATION DEVICES ON FAUCETS, SHOWER HEADS, AND TOILETS IN ANY NEW CONSTRUCTION AND IN ANY REMODELING OF BUILDINGS IN THE BIG SKY COUNTY WATER AND SEWER DISTRICT # 363.

BE IT ORDAINED by the Board of Directors of the Big Sky County Water and Sewer District No. 363 as follows:

1. Purpose. The purpose of this ordinance is to implement water conservation performance standards in the construction of new buildings requiring plumbing and plumbing fixtures and in the remodeling of existing buildings in which plumbing or plumbing fixtures are modified. The implementation of water conservation performance standards will both conserve water and reduce the load on the wastewater treatment plant operated by Sewer District No. 363.

2. Definitions.

   (a) "Person" means any individual, corporation, partnership, firm, company, association, or local, state, or federal governmental agency.

   (b) "Permit" means a permit to install plumbing or plumbing fixtures in a building within the district.

   (c) "District" means the Big Sky County Water and Sewer District No. 363 or its authorized representatives.

   (d) "Modification" means replacement of shower heads, faucets, or water closets which do not require or are a part of changes to the physical structure of the unit within which they have been originally installed.

3. Application. This ordinance applies to all new construction and all remodeling involving the replacement of plumbing fixtures in all residential, hotel, motel, industrial, or commercial use or in other occupancies which the Board of Directors determines to use significant quantities of water.

4. **Water Efficiency Standards.**

(a) The maximum water use allowed in gallons per flush (gpf) for any of the following water closets installed after the effective date of this ordinance is:

(i) gravity tank-type toilets....................................1.6 gpf
(ii) flush-o-meter tank toilets.................................1.6 gpf
(iii) electromechanical hydraulic toilets...................1.6 gpf
(iv) blowout toilets..3.5 gpf
(v) urinal...1.0 gpf
(vi) gravity tank-type 2-piece toilet which bears the label "commercial use only"......................................3.5 gpf

(b) The maximum water use for showerheads installed after the effective date of this ordinance is 2.5 gallons per minute (gpm) which measures at a flowing water pressure of 80 pounds per square inch.

(c) The maximum water use allowed for any of the following faucets installed after the effective date of this ordinance is:

(i) lavatory faucets...2.5 gpm
(ii) lavatory replacement aerators..........................2.5 gpm
(iii) kitchen faucets..2.5 gpm
(iv) kitchen replacement aerators............................2.5 gpm
(v) metering faucets..0.25 gpm

(d) No urinal or water closet that operates on a continuous flow or continuous flush basis is permitted.

5. **Public Restrooms.** Except where designed and installed for use by the physically handicapped, lavatory faucets located in restrooms intended for use by the general public must be equipped with a metering valve designed to close by spring or water pressure when left unattended.

6. **Permits.**

(a) No person may construct a new building requiring plumbing or plumbing fixtures without first obtaining a permit from the district. The application for a permit under this ordinance may be submitted on the application form required under section 4 of Ordinance No. 94-1001, relating to connection to the waste water treatment system. No variance is available from the water conservation performance standards described in this ordinance.

(b) No permit shall be required for the modification of existing plumbing fixtures. Any person proposing the modification of existing fixtures shall notify the district no later than five days before commencing the modification. The modification of fixtures must conform to the water conservation performance standards described in this ordinance.

7. **Inspections**. Any person completing new construction or modifications to plumbing fixtures shall notify the district as soon as the new construction or modification is ready for inspection. The district may inspect the modification within 72 hours of notification.

8. **Penalty**. Any person violating any provision of this ordinance shall be guilty of a misdemeanor and shall be subject to a criminal penalty of up to six months in jail and a fine of $500.

9. **Effective Date**. The effective date of this ordinance is February 21, 1995.

William A. Ogle, President

William F. Neece, Secretary

BIG SKY
MONTANA

BIG SKY OF MONTANA
Ski and Summer Resort
P.O. Box 160001
Big Sky, Montana
59716

(406) 995-5000
Fax (406) 995-5001

National Reservations
(800) 548-4486

Group/Convention Sales
(800) 548-4487
Fax (406) 995-5003

BOYNE USA RESORTS
Big Sky, MT
Boyne Mountain, MI
Boyne Highlands, MI
Brighton, UT

Mr. Chip Hamilton
Big Sky Water and Sewer District No. 363
P.O. Box 160057
Big Sky, MT 59716

October 4, 1994

Dear Chip:

We at Big Sky of Montana Ski and Summer Resort are aware and concerned about the use of water and its subsequent impact on a waste water treatment facility.

Therefore, as a show of good faith that Boyne is willing to help to this end, we would like to go on record with the water and sewer district as volunteering to retrofit the resort hotel and managed condominiums to meet 1994 standards, in lieu of a published compulsive policy to do so.

We intend to get as much of this accomplished as possible by December 1, 1994 (up to 50%) and have the project 100% completed by the end of the winter season.

Please feel free to call me with any questions you may have regarding this issue.

Sincerely,

JOHN E. KIRCHER
General Manager
Big Sky of Montana

:mbw

SEWER DISTRICT #363

PO Box 160057 • Big Sky, Montana 59716 • (406) 995-4166 • FAX: 995-4899

October 5, 1994

Handled
Talk to me?
Bob

Mr. Bob Schaap
Lone Mountain Ranch
P.O. Box 160069
Big Sky, MT 59716

Dear Bob:

I would like to ask a favor of you, if it is within your province to grant it. Would the Lone Mountain Ranch be willing to install high efficiency showerheads in all of their bath areas?

Big Sky Resort, John Kircher and Golden Eagle Lodge, Tim Ryan, have agreed to convert all of their showers to the 2.5 gallon per minute or less heads by the end of the '94-95 ski season. With your cooperation on this, we could have 100% of the nightly rental businesses within the District comply with the State of Montana's requests on this item.

Thank you, I look forward to hearing from you.

Sincerely,

Z. Hamilton

Z.O. Hamilton, Manager

c.c. Wayne Hill

ZOH/pbp

Chip - we completed this project several years ago. All guest cabins, crew housing & our house have low flow shower heads. What about using resort tax moneys as an incentive to encourage replacement of toilets to low flow models?

Bob

October 6, 1994

Mr. Chip Hamilton
P.O. Box 160670
Big Sky, MT 59716

Dear Mr. Hamilton,

The Golden Eagle lodge converted its shower heads in all 42 rooms "High Efficiency" or "Low Flow" in the fall of 1993.

We work for several homeowners within the Big Sky Resort and will encourage all of these individual homes and condominiums to switch to "High Efficiency" shower heads. Golden Eagle Management will install the shower heads if the homeowners will invest in the initial purchase.

With any luck we can retrofit most of the units before this upcoming season.

Glad you're in Big Sky Chip, hope to see you soon!

Sincerely,

Tim Ryan

Tim Ryan

golden eagle
p.o. box 160008 • big sky, montana 59716
property management • condominium rentals • economy lodging
800-548-4488 FAX 406-995-2447 406-995-4800

APPENDIX I

SEWER REPAIRS COMPLETED

SCOPE OF WORK
WSD 363 SEWER REPAIR

1. Slipline 16" I.D. A.C. line from MH 297 to MH 298, 325 feet

2. Install new manhole metering station at the end of Low Dog Road including new concrete vault, excavation, road realignment, and moving building (outhouse size) from Meadow Village to site. Materials and electrical by RID 305.

3. Repair sewer pipe 235 feet up Yellowtail Road from Black Otter Road.

4. Repair infiltration at 44' (pipe crack), 49', 50' (joints) 10" PVC pipe, Mountain Village behind Hill Condos, MH 299 to MH 298

5. Excavate manholes at 6 sites, raise 2' each: MH 295 @ Lake
MH 296 @ Lake
MH 297 @ Lake
MH 139 @ HV
MH 111 @ Little Coyote
MH 289 @ L.Dog

6. Excavate manholes at Low dog Road, Two Moons Road, and Black Eagle Road that have been paved over, raise to grade (grade rings)

7. Repair leaking MH 298

8. MH 294 to MH 313, Stillwater Condos, repair broken pipe at 99 feet, crack from 172 to 178 feet, broken from 322 to 324 feet

9. MH 326 to MH 325, Turkey Leg Road, repair broken pipe 340 to 342 feet

10. MH 325 to MH 324, Turkey Leg Road, repair offset joint at 34 feet, broken pipe at 223 to 225 feet

11. Two Moons Road, MH 29 to MH 28, repair broken pipe at 125 to 131 feet

12. Two Moons Road, MH 26 to MH 27, repair offset joint at 56 feet (Repaired 9/30/93)

13. Two Moons Road, MH 27 to MH 28, repair cracked pipe at 211 feet (Repaired 9/30/93)

14. Two Moons Road, MH 21 to MH 20, repair cracked pipe at 10 to 22 feet (Repaired 9/30/93)

15. Two Moons Road, MH 20 to MH 19, repair broken pipe at 102 to 105 feet (Repaired 9/29/93)

16. Uncover and raise to grade MH between MH 49 and MH 13 on Curley Bear Road (Repaired 9/30/93)

17. Spotted Elk Road, MH 32 to MH 33, repair offset joint at 320 and 325 feet (Repaired 9/27/93)

18. Spotted Elk Road, MH 33 to MH 34, repair smashed pipe at 290 feet, offset joint at 395 feet (Repaired 9/27/93)

19. Spotted Elk Road, MH 34 to MH 35, repair cracked and broken joint at 124 feet (Repaired 9/28/93)

20. Spotted Elk Road, MH 35 to MH 36, repair broken pipe at 342 to 345 feet (Repaired 9/27/93)

21. Yellowtail Road, MH 43 to MH 44, repair broken pipe at 167 to 169 feet, 209 to 211 feet, 262 to 265 feet, joint problem at 356 to 359 feet (Repaired 9/23/93)

22. Yellowtail Road, MH 45 to MH 46, repair offset joint at 336 to 343 feet (Repaired 9/22/93)

23. Yellowtail Road, MH 46 to MH 3, repair offset joints at 125 to 130 feet, cracked pipe from 157 to 158 feet, rolled gaskets or joint problems at 202 to 207 feet, terminate service right at 208.5 feet (drain tile), fix joint at 210 feet (Repaired 9/22/93)

ETD 24. Mountain Mall, MH 317 to MH 316, repair broken pipe at 168 to 172 feet and at 370 feet

RID305\WORK.LST

RECEIVED
NOV 22 1994
HKM ASSOCIATES
4M357.102

1. LOCATION: BOBTAIL HORSE ROAD
MH 206 - MH 207
PROBLEM: COLLAPSED PIPE IMPEDING FLOW. SEWAGE BACKED UP INTO MH 207
PROBLEM FOUND: BROKEN PIPE FROM MONTANA POWER CONSTRUCTION AND A JOINT WITHOUT A COLLAR
REPAIRS DONE: REPLACE SECTIONS OF PIPE

2. LOCATION: LONE MOUNTAIN GUEST RANCH
MH 155 - MH 156
PROBLEM: BROKEN AND COMPRESSED PIPE
PROBLEM FOUND: COULD NOT FIND PROBLEM
REPAIRS DONE: NONE

3. LOCATION: LONE MOUNTAIN GUEST RANCH
MH 155
PROBLEM: LEAKING MANHOLE
PROBLEM FOUND: LEAKING MANHOLE DUE TO HIGH GROUNDWATER TABLE
REPAIRS DONE: REPLACE TAR AROUND THE MANHOLE RINGS AND GROUT LEAKING JOINTS IN THE BOTTOM OF THE CONE. DRAIN WATER AWAY FROM THE MANHOLE

4. LOCATION: LONE MOUNTAIN GUEST RANCH
MH 154 - MH 153
PROBLEM: BROKEN AND MISSING PIPE
PROBLEM FOUND: HOLES IN PIPE DUE TO IMPROPER BACKFILLING
REPAIRS DONE: REPLACE SECTIONS OF PIPE

5. LOCATION: CROW KING ROAD
MH 166 - MH 165
PROBLEM: OFFSET JOINT
PROBLEM FOUND: OFFSET JOINT AND BROKEN PIPE
REPAIRS DONE: REPLACE SECTION OF PIPE AND FLUSH DEBRIS FROM LINE

6. LOCATION: RAIN IN FACE ROAD
MH 212 - MH 208
PROBLEM: CRACKED AC PIPE THROUGHOUT LINE WITH ROOT INTRUSION AND INFILTRATION
PROBLEM FOUND: CRACKED PIPE AND OFFSET JOINTS
REPAIRS DONE: REPLACE SECTIONS OF THE LINE WITH 8" PVC (160' OF NEW PIPE INSTALLED)

7. LOCATION: CHIEF JOSEPH
MH 161 - MH 110
PROBLEM: OFFSET JOINT AND BROKEN PIPE
PROBLEM FOUND: OFFSET JOINT AND HOLE IN PIPE
REPAIRS DONE: REPLACE SECTION OF PIPE

8. LOCATION: LONE WALKER ROAD
MH 57 - MH 56
PROBLEM: PLUGGED LINE BACKING WASTEWATER INTO MANHOLES
PROBLEM FOUND: PLUGGED LINE
REPAIRS DONE: PUMP WATER AND FLUSH DEBRIS FROM LINE

9. LOCATION: WHITE OTTER ROAD
MH 335
PROBLEM: HOLES IN CONCRETE COLLAR
PROBLEM FOUND: HOLES IN CONCRETE COLLAR
REPAIRS DONE: GROUT AND SEAL HOLES

10 LOCATION: BLACK EAGLE ROAD
MH 312 - MH 312A
PROBLEM: HOLE IN TOP OF PIPE
PROBLEM FOUND: LARGE HOLE IN TOP OF PIPE DUE TO EXCAVATION BY THREE RIVERS PHONE COMPANY
REPAIRS DONE: REPLACE SECTION OF PIPE AND LOCATE AND EXPOSE UPPER MANHOLES

11 LOCATION: CHIEF JOSEPH ROAD
MH 180 - MH 179
PROBLEM: DEBRIS IN LINE
PROBLEM FOUND: DEBRIS IN LINE IMPEDING FLOW
REPAIRS DONE: CLEAN DEBRIS FROM LINE AND REPLACE CRACKED AC PIPE

12 LOCATION: BOBTAIL HORSE ROAD
MH 205 - MH 204
PROBLEM: CRACKED AND PULLED JOINTS
PROBLEM FOUND: CRACKED AND PULLED JOIN WITH SOIL AND ROOT INTRUSIONS
REPAIRS DONE: REPLACE SECTIONS OF PIPE

13 LOCATION: BOBTAIL HORSE ROAD
MH 206 - MH 205
PROBLEM: HOLE IN PIPE
PROBLEM FOUND: HOLE IN PIPE
REPAIRS DONE: REPLACE SECTION OF PIPE

14 LOCATION: LONE WALKER ROAD

PROBLEM: SEWER BACKING UP
PROBLEM FOUND: GRADE NOT STEEP ENOUGH TO CARRY FLOW CORRECTLY
REPAIRS DONE: LOCATE MAN HOLE 58 AND RAISE. FLUSH DEBRIS FROM LINE

15 LOCATION: LONE MOUNTAIN GUEST RANCH
MH 160 - MH 159
PROBLEM: INDENTED AND CRACKED PIPE
PROBLEM FOUND: INDENTED AND CRACKED PIPE
REPAIRS DONE: REPLACE SECTION OF LINE. LOCATE MH 160 AND FLUSH DEBRIS FROM LINE

16 LOCATION: RAIN IN FACE ROAD
MH 198 - MH 197
PROBLEM: CRACKED PIPE
PROBLEM FOUND: CRACKED PIPE
REPAIRS DONE: REPLACE SECTION OF PIPE

17 LOCATION: LONE MOUNTAIN GUEST RANCH
MH 159 - MH 158
PROBLEM: CRUSHED PIPE
PROBLEM FOUND: CRUSHED AND CRACKED PIPE
REPAIRS DONE: REPLACE SECTION OF PIPE

18 LOCATION: LONE MOUNTAIN GUEST RANCH
MH 158 - MH 157
PROBLEM: OFFSET JOINT
PROBLEM FOUND: PIPE CURVES UNDER A CONCRETE PAD USED TO STABLE HORSES
REPAIRS DONE: NONE

19 LOCATION: LONE WALKER ROAD
MH 58 - MH 57
PROBLEM: WASTE WATER BACKING UP INTO MH 58
PROBLEM FOUND: PROBABLE LOW AREA IN THE LINE
REPAIRS DONE: FLUSH THE LINE

20 LOCATION: LONE MOUNTAIN GUEST RANCH
MH 157 - MH 156
PROBLEM: COMPRESSED PIPE
PROBLEM FOUND: COMPRESSED PIPE
REPAIRS DONE: REPLACE SECTION OF PIPE

SCOPE OF FUTURE WORK
WSD 363 SEWER REPAIR

1. Black Eagle Road, MH 312B to MH 312C, repair wide joint
2. Black Eagle Road, MH 312 to MH 312A, repair broken joint ← completed
3. Black Eagle Road, MH 291A to MH 291, repair cracked and smashed pipe
4. Sitting Bull Road, MH 307 to MH 308, repair broken pipe
5. Sitting Bull Road, MH 307 to MH 306, repair leaking service connection, MH 307 repair leaking manhole
6. Sitting Bull Road, MH 304 to MH 305, repair cracked pipe
7. Sitting Bull Road, MH 302 to MH 303, repair cracked and broken pipe
8. Crow King Road, MH 167 to ?, repair broken pipe and wide joint
9. Crow King Road, MH 165 to MH 166, repair wide joint ← completed
10. Crow King Road, MH 165 to MH 162, repair offset joint
11. Crow King Road, MH 164 to MH 163, repair offset joint
12. Pinewood Hills, MH 127 to MH 126, repair broken and cracked pipe
13. Chief Joseph Trail, MH 163 to MH 162, repair broken pipe
14. Chief Joseph Trail, MH 161 to MH 162, repair crushed and broken pipe
15. Chief Joseph Trail, MH 161 to MH 110, repair offset joint ← completed
16. Chief Joseph Trail, MH 183 to MH 182, repair offset joint
17. Chief Joseph Trail, MH 182 to MH 180, repair offset joint
18. Chief Joseph Trail, MH 179 to MH 180, repair broken and plugged line ← complete
19. Off Little Coyote, MH 108 to MH 169, repair offset joint
20. Off Little Coyote, MH 103 to MH 173, repair offset joint

21. Bob Tail Horse, MH 207 to MH 206, repair plugged and broken pipe ← Completed

22. Bob Tail Horse, MH 205 to MH 206, repair offset joint ← Completed

23. Bob Tail Horse, MH 205 to MH 204, repair wide joint ← Completed

24. Rain in Face, MH 200 to MH 199, repair wide joint

25. Rain in Face, MH 196 to MH 197, repair broken joint ← Completed

26. Rain in Face, MH 189 to MH 190, repair offset joint

27. Rain in Face, MH 189 to MH 188, repair broken pipe

28. Rain in Face, MH 186 to MH 185, repair broken pipe

29. Rain in Face, MH 187 to MH 188, repair cracked pipe

30. Two Gun White Calf, MH 190 to MH 191, repair wide joint

31. Two Gun White Calf, MH 214 to MH 213, repair offset joint

32. Two Gun White Calf, MH 227 to MH 228, repair offset joint

33. Two Gun White Calf, MH 218 to MH 217, repair broken pipe

34. Two Gun White Calf, MH 218 to MH 217, repair broken pipe

35. Two Gun White Calf, MH 216 to MH 217, repair offset joint

36. Two Gun White Calf, MH 216 to MH 215, repair offset joint

37. Two Gun White Calf, MH 215 to MH 213, repair offset joint

38. Two Gun White Calf, MH 213 to MH 212, repair infiltration at joint

39. Two Gun White Calf, MH 212 to MH 208, repair infiltration at joint and offset joint

40. Two Gun White Calf, MH 208 to MH 88, repair offset joint

41. Two Gun White Calf, MH 227 to MH 228, repair offset joint and infiltration at joint

42. Two Gun White Calf, MH 223 to MH 86, repair offset joint

43. Dull Knife, MH 222 to MH 221, repair offset joint

44. Dull Knife, MH 221 to MH 219, repair offset joint

45. Crazy Horse, MH 219 to MH 220, repair offset joint

46. Lone Mountain Ranch, MH 159 to MH 160, repair broken pipe ← Completed

47. Lone Mountain Ranch, MH 159 to MH 158, repair crushed pipe ← Completed

48. Lone Mountain Ranch, MH 158 to MH 157, repair crushed pipe

49. Lone Mountain Ranch, MH 156 to MH 157, repair offset joint

50. Lone Mountain Ranch, MH 156 to MH 155, repair hole in pipe, infiltration and infiltration in manholes

51. Lone Mountain Ranch, MH 155 to MH 154, repair crushed pipe

52. Lone Mountain Ranch, MH 153 to MH 154, repair broken pipe

← Completed

RID305\FUTWORK.LST

APPENDIX J

SEWER FLOW MONITORING RESULTS

BIG SKY WATER AND SEWER DISTRICT #363

gpm

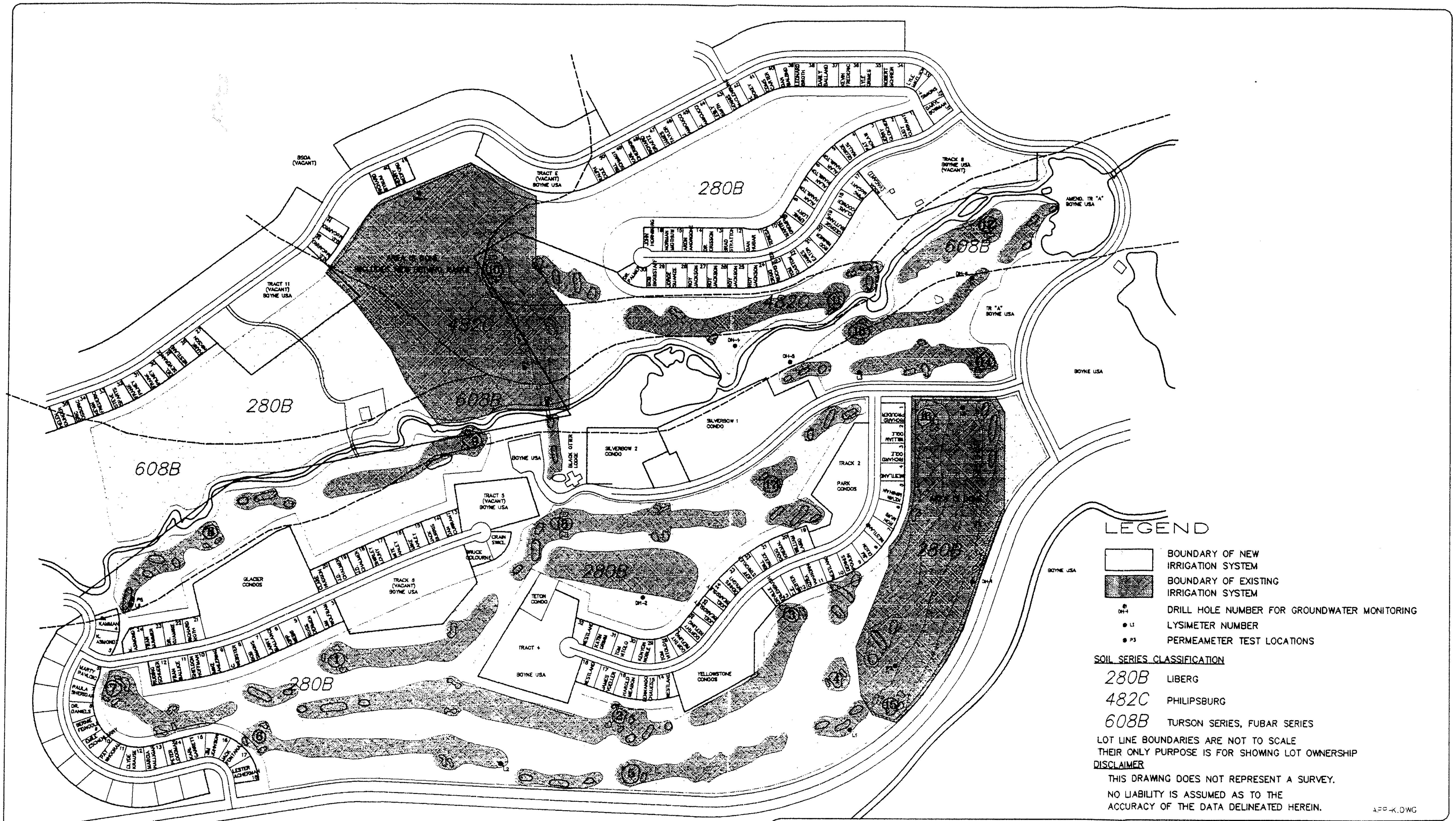
DATE	YELLOWTAIL MH #38	YELLOWTAIL MH #15	OGLE MH #15	SWEETGRASS MH #91	SWEETGRASS MH #86	WESTFORK MH #51	HIDDEN VILLAGE MH #131	LONE MNT MH #112	OUTFALL MH #230
20-Mar-95	0.00	8.23	8.23	1.10		1.10	3.45	1.34	
27-Mar-95	0.00	2.75	2.75	2.59		3.12	5.74	1.81	
7-Apr-95	9.75	17.33	7.58	0.00		3.55	10.00	39.00	
14-Apr-95	45.00	70.91	25.91	0.00		9.53	15.00	23.64	
24-Apr-95	38.71	46.15	7.44	0.00		5.00	7.79	16.80	
1-May-95	30.00	37.50	7.50		3.87	2.48	9.38	16.98	
5-May-95	23.46	32.43	8.97	2.00	10.30	3.00	15.00	19.67	
12-May-95	34.29	46.15	11.86	3.00		5.57		29.73	
19-May-95	1.47	21.13	19.66	1.00		5.57		30.00	
26-May-95	2.50	12.37	9.87			5.57		29.73	
2-Jun-95	2.50	15.00	12.50	1.00	0.00	5.57	5.29	13.24	
9-Jun-95	0.50	13.70	13.20	0.00	0.40	1.50	5.00	8.50	
16-Jun-95	0.50	14.70	14.20	0.00	0.00	1.50	5.00	9.93	
30-Jun-95								10.24	
7-Jul-95	0.00	11.19	11.19				5.49	10.34	57.14
21-Jul-95									

DATE	LOWDOG MH #286,284	TREATMENT FLUME	BLACKOTTER MH #15	OUTFALL MH #112	SITTING BULL WEST MH #300	SITTING BULL EAST MH #300	STILLWATER MH #313	SWEETGRASS MH #110
20-Mar-95	15.00	91.00		20.87	3.46	3.46	3.00	
27-Mar-95		85.00			2.50	2.50	39.00	
7-Apr-95		179.00			2.50	2.50	38.00	
14-Apr-95		233.00		90.91	4.00	4.00	40.00	
24-Apr-95	26.00	133.00		48.98	3.00	5.00	6.00	
1-May-95	50.00	135.00	23.08	50.00	3.00	5.00	6.29	8.96
5-May-95	31.58	162.00		83.33	3.00	5.00	8.96	
12-May-95	171.43	281.00		240.00	20.00	15.00	22.64	0.00
19-May-95	200.00	440.00	24.00	245.00	25.00	20.00	25.00	
26-May-95	187.50	330.00	22.73	240.00	8.00	6.00	11.50	
2-Jun-95	175.00	320.00			65.91	12.07	10.55	
9-Jun-95	145.00	268.00	22.73	171.43			7.57	
16-Jun-95	58.82	228.00	24.61	120.00	8.16	2.22	13.63	
30-Jun-95	27.27			60.60	9.09	1.00		
7-Jul-95	43.48	137.00	19.18	75.95				
21-Jul-95			17.00					

ALL MEASUREMENTS TAKEN BETWEEN 2:30 AM - 6:00 AM

APPENDIX K

GOLF COURSE IRRIGATION AREA AND MONITORING DATA



BIG SKY WASTEWATER TREATMENT FACILITY PLAN
GOLF COURSE IRRIGATION AREA

APPENDIX K

MSE-HKM ENGINEERING

4M357.102 | DEC 1995

GOLF COURSE MONITORING: Summer, 1996
Monitoring Wells

Drill Hole 1	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE + NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
10-Jul-97	ND	263	2	0.53	0.54	9.56	7.3	<0.1	0.60	28.0	527
23-Jul-97	<10	230	<6	0.18	0.22	9.87	7.4	<0.1	0.00	30.0	482
13-Aug-97	ND	136	ND	0.06	0.15	9.69	7.1	<0.1	ND	27.0	502
28-Aug-97											

Drill Hole 2	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE + NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
10-Jul-97	ND	8540	3	0.59	0.65	0.47	7.6	<0.1	0.60	4.0	288
23-Jul-97	<10	3030	<6	0.19	2.09	0.62	7.7	<0.1	2.60	4.0	252
13-Aug-97	ND	760	ND	0.15	0.86	0.74	7.7	<0.1	1.40	4.0	279
28-Aug-97											

Drill Hole 3	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE + NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
10-Jul-97											
23-Jul-97											
13-Aug-97											
28-Aug-97											

Drill Hole 4	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE + NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
10-Jul-97	ND	5	1	0.04	0.01	0.38	7.5	<0.1	0.00	4.0	167
23-Jul-97	<10	89	<6	0.08	0.12	1.12	7.5	<0.1	0.60	7.0	252
13-Aug-97	ND	111	ND	0.08	0.11	0.88	7.1	<0.1	0.50	7.0	264
28-Aug-97											

Drill Hole 5	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE + NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
10-Jul-97		476	2	0.11	0.10	<0.05	7.5	<0.1	0.30	6.0	311
23-Jul-97	<10	771	<6	0.11	0.79	<0.05	7.5	<0.1	1.50	5.0	305
13-Aug-97	ND	1060	ND	0.11	0.75	<0.05	7.2	<0.1	2.50	6.0	301
28-Aug-97											

Drill Hole 6	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE + NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
10-Jul-97		39	1	0.05	0.03	2.81	7.4	<0.1	0.30	9.0	312
23-Jul-97	<10	508	<6	0.12	0.99	2.46	7.5	<0.1	3.40	10.0	316
13-Aug-97	ND	20	ND	<0.01	0.05	1.38	7.2	<0.1	0.80	10.0	311
28-Aug-97											

GOLF COURSE MONITORING: Summer, 1997
Lysimeters

LYSIMETER #1

Sample Date	Monitoring Period (days)	Precipitation + Irrigation (ml)	Precipitation (ml)	Irrigation (ml)	Irrigation (inches)	Lysimeter Weight (lbs) Before Draining	Lysimeter Weight (lbs) After Draining	Drain Water Weight (lbs)	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE + NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
10-Jul-97		375.0	95.0	280.0	1.07	139.0	139.0	0.0											
23-Jul-97	13	270.0	205.0	65.0	0.25	134.0	134.0	0.0											
13-Aug-97	21	590.0	285.0	305.0	1.17	136.0	136.0	0.0											
28-Aug-97	15	270.0	210.0	60.0	0.23	130.0	130.0	0.0											

LYSIMETER #2

Sample Date	Monitoring Period (days)	Precipitation + Irrigation (ml)	Precipitation (ml)	Irrigation (ml)	Irrigation (inches)	Lysimeter Weight (lbs) Before Draining	Lysimeter Weight (lbs) After Draining	Drain Water Weight (lbs)	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE + NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
10-Jul-97		350.0	95.0	255.0	0.98	128.0	128.0	0.0											
23-Jul-97	13	257.0	205.0	52.0	0.20	125.0	125.0	0.0											
13-Aug-97	21	474.0	285.0	189.0	0.73	116.0	116.0	0.0											
28-Aug-97	15	390.0	210.0	180.0	0.69	116.0	116.0	0.0											

LYSIMETER #3

Sample Date	Monitoring Period (days)	Precipitation + Irrigation (ml)	Precipitation (ml)	Irrigation (ml)	Irrigation (inches)	Lysimeter Weight (lbs) Before Draining	Lysimeter Weight (lbs) After Draining	Drain Water Weight (lbs)	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE + NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
10-Jul-97		488.0	95.0	393.0	1.51	123.0	123.0	0.0											
23-Jul-97	13	795.0	205.0	590.0	2.28	130.0	126.0	4.0		104			0.14	<0.05		<0.1	1.5		
13-Aug-97	21	720.0	285.0	435.0	1.67	150.0	127.0	23.0		376			1.10	<0.05		<0.1	3.1		
28-Aug-97	15	668.0	210.0	458.0	1.76	134.0	126.0	8.0											

LYSIMETER #4

Sample Date	Monitoring Period (days)	Precipitation + Irrigation (ml)	Precipitation (ml)	Irrigation (ml)	Irrigation (inches)	Lysimeter Weight (lbs) Before Draining	Lysimeter Weight (lbs) After Draining	Drain Water Weight (lbs)	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE + NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
10-Jul-97		365.0	95.0	270.0	1.04	134.0	134.0	0.0											
23-Jul-97	13	417.0	205.0	212.0	0.81	138.0	138.0	0.0											
13-Aug-97	21	395.0	285.0	110.0	0.42	137.5	137.5	0.0											
28-Aug-97	15	287.0	210.0	77.0	0.30	132.0	132.0	0.0											

LYSIMETER #5

Sample Date	Monitoring Period (days)	Precipitation + Irrigation (ml)	Precipitation (ml)	Irrigation (ml)	Irrigation (inches)	Lysimeter Weight (lbs) Before Draining	Lysimeter Weight (lbs) After Draining	Drain Water Weight (lbs)	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE + NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
10-Jul-97		320.0	95.0	225.0	0.86	145.0	144.0	1.0		64			0.32	0.59		0.40	3.40		
23-Jul-97	13	244.0	205.0	39.0	0.15	140.0	140.0	0.0											
13-Aug-97	21	385.0	285.0	100.0	0.38	132.0	132.0	0.0											
28-Aug-97	15	315.0	210.0	105.0	0.40	130.0	130.0	0.0											

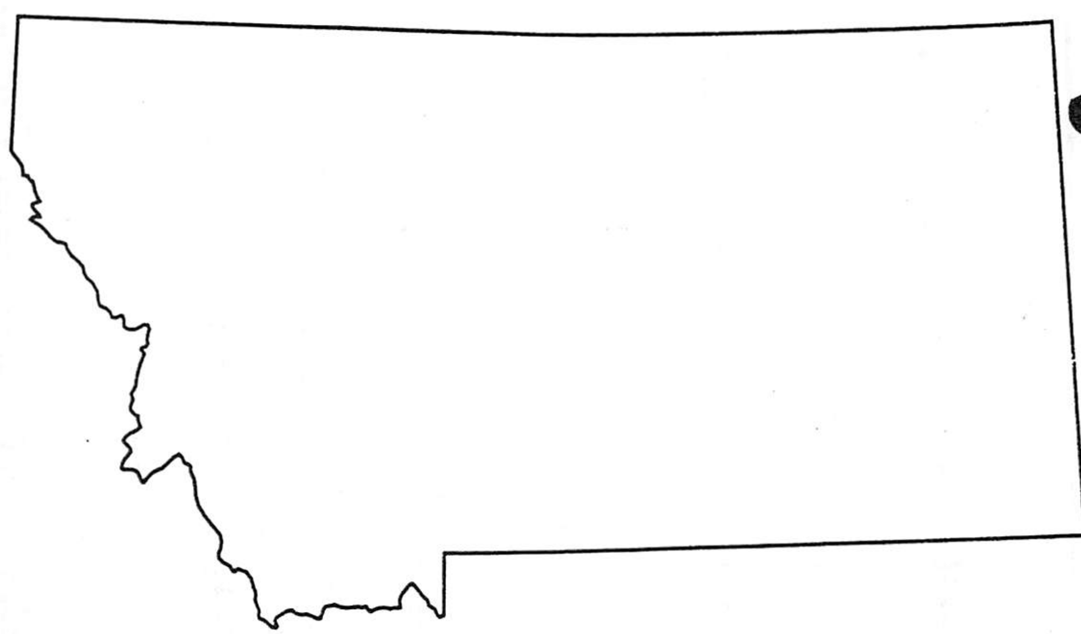
LYSIMETER #6

Sample Date	Monitoring Period (days)	Precipitation + Irrigation (ml)	Precipitation (ml)	Irrigation (ml)	Irrigation (inches)	Lysimeter Weight (lbs) Before Draining	Lysimeter Weight (lbs) After Draining	Drain Water Weight (lbs)	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE + NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	CHLORIDE	TOTAL DISSOLVED SOLIDS
10-Jul-97		545.0	95.0	450.0	1.73	125.0	125.0	0.0											
23-Jul-97	13	206.0	205.0	1.0	0.00	120.0	120.0	0.0											
13-Aug-97	21	380.0	285.0	95.0	0.36	121.0	121.0	0.0											
28-Aug-97	15	520.0	210.0	310.0	1.19	118.0	118.0	0.0											

APPENDIX L

GALLATIN RIVER STREAM FLOW RECORDS

Water Resources Data
Montana
Water Year 1994



U.S. GEOLOGICAL SURVEY WATER-DATA REPORT MT-94-1

Prepared in cooperation with the State of Montana
and with other agencies

06043500 GALLATIN RIVER NEAR GALLATIN GATEWAY, MT

LOCATION.--Lat 45°29'51", long 111°16'11" in SE1/4SE1/4SE1/4 sec.7, T.4 S., R.4 E., Gallatin County, Hydrologic Unit 10020008, on left bank 0.3 mi downstream from Spanish Creek, 7.3 mi south of Gallatin Gateway and at river mile 47.7.

DRAINAGE AREA.--825 mi^2.

PERIOD OF RECORD.--August 1889 to September 1894, June 1930 to September 1969, annual maximum, water years 1970-71, October 1971 to September 1981, October 1984 to current year. Monthly discharge only for some periods, published in WSP 1309. Published as West Gallatin River near Bozeman 1889-94.

REVISED RECORDS.--WSP 1389: 1892(M), 1893-94. WSP 1559: Drainage area. WDR MT-85-1 (M).

GAGE.--Water-stage recorder. Datum of gage is 5,167.67 ft above sea level. Prior to Oct. 20, 1932, nonrecording gages at several different sites and datums within 0.8 mi of present site.

REMARKS.--Records good except those for estimated daily discharges, which are fair. Diversions for irrigation of about 1,400 acres upstream from station. Several observations of water temperature and specific conductance were made during the year. U.S. Geological Survey satellite telemeter at station.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1993 TO SEPTEMBER 1994
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	560	505	398	378	335	349	344	789	2220	887	533	403
2	557	446	397	375	303	354	356	772	2150	866	559	399
3	552	484	371	371	324	355	377	768	1880	874	532	394
4	544	480	386	375	332	359	389	828	1930	822	517	403
5	552	455	392	382	326	351	342	915	1810	798	510	392
6	552	405	349	364	325	331	349	1180	1680	1030	500	385
7	547	484	341	327	322	310	347	1470	1700	1130	484	380
8	587	454	391	342	322	325	330	1850	1620	1070	480	377
9	566	421	413	360	325	323	327	2190	1490	914	482	370
10	567	470	400	370	327	328	334	2440	1370	856	467	367
11	566	440	404	e370	346	343	341	2590	1310	817	478	374
12	583	420	404	e380	344	328	372	3020	1430	778	498	375
13	579	422	356	e380	334	326	412	3770	1860	755	496	372
14	564	428	345	e360	326	341	406	3080	2680	737	471	388
15	578	418	370	364	332	352	373	2570	2030	722	463	393
16	585	424	393	367	340	371	421	2530	1840	699	457	378
17	557	430	366	366	348	378	537	2350	1690	677	446	371
18	538	438	338	358	351	354	654	2020	1570	662	440	368
19	526	370	381	356	340	355	774	2080	1510	651	433	366
20	511	386	357	344	328	306	957	2080	1460	631	430	365
21	506	398	357	325	329	343	1180	1860	1420	610	428	364
22	523	418	358	334	324	344	1480	1740	1430	596	424	362
23	512	350	359	342	327	336	1660	1840	1390	605	426	361
24	507	313	366	351	318	301	1540	1960	1280	670	417	356
25	494	e310	352	362	315	334	1390	2110	1180	623	411	352
26	486	303	358	359	336	324	1150	2220	1120	584	403	349
27	474	299	375	364	343	321	980	2290	1050	573	398	348
28	512	377	363	357	342	321	890	2470	993	584	400	347
29	423	415	356	343	---	306	797	2210	963	582	417	356
30	408	415	358	341	---	314	804	2040	935	561	405	388
31	478	---	383	317	---	327	---	2060	---	549	403	---
TOTAL	16494	12378	11537	11084	9264	10410	20613	62092	46991	22913	14208	11203
MEAN	532	413	372	358	331	336	687	2003	1566	739	458	373
MAX	587	505	413	382	351	378	1660	3770	2680	1130	559	403
MIN	408	299	338	317	303	301	327	768	935	549	398	347
AC-FT	32720	24550	22880	21990	18380	20650	40890	123200	93210	45450	28180	22220

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1889 - 1994, BY WATER YEAR (WY)*

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	456	383	323	307	304	310	503	1787	2897	1279	608	492
MAX	743	589	549	468	430	465	899	3135	5056	3669	1162	787
(WY)	1893	1960	1893	1893	1893	1960	1990	1976	1974	1975	1993	1968
MIN	238	247	214	200	220	206	263	873	643	345	269	233
(WY)	1932	1937	1935	1931	1935	1935	1937	1953	1934	1934	1934	1931

SUMMARY STATISTICS	FOR 1993 CALENDAR YEAR		FOR 1994 WATER YEAR		WATER YEARS 1889 - 1994*	
ANNUAL TOTAL	392297		249187			
ANNUAL MEAN	1075		683		806	
HIGHEST ANNUAL MEAN					1184	1976
LOWEST ANNUAL MEAN					408	1934
HIGHEST DAILY MEAN	5490	May 22	3770	May 13	8970	Jun 17 1974
LOWEST DAILY MEAN	210	Feb 17	299	Nov 27	174	Nov 21 1931
ANNUAL SEVEN-DAY MINIMUM	243	Jan 9	317	Mar 24	182	Jan 18 1931
INSTANTANEOUS PEAK FLOW			4110	May 13	9100	Jun 17 1974
INSTANTANEOUS PEAK STAGE			4.46	May 13	7.38	Jun 17 1974
INSTANTANEOUS LOW FLOW			a273	Mar 24	b117	Jan 19 1935
ANNUAL RUNOFF (AC-FT)	778100		494300		584200	
10 PERCENT EXCEEDS	3350		1670		2020	
50 PERCENT EXCEEDS	486		413		433	
90 PERCENT EXCEEDS	264		329		268	

*--During periods of operation (August 1889 to September 1894, June 30 to September 1969, October 1971 to September 1981, October 1984 to current year).
a--Gage height, 1.20 ft.
b--Gage height, 0.68 ft, result of freezeup.
e--Estimated.

APPENDIX M

CIRCULAR WQB-7 MONTANA NUMERIC WATER QUALITY STANDARDS

CIRCULAR WQB-7

MONTANA
NUMERIC WATER QUALITY STANDARDS

Montana Department of Environmental Quality
Water Quality Division ••• Technical Studies & Special Projects Section
1400 Broadway, Room A-206
Post Office Box 200901
Helena, Montana 59620
TELEPHONE: (406) 444-2406 ••• FAX: (406) 444-1374

August 3, 1995

August 3, 1995

CIRCULAR WQB-7

CIRCULAR WQB-7, Montana Numerical Water Quality Standards, is a compilation of the most recent Standards available for both Surface Waters and Ground Waters. Reference sources used to compile CIRCULAR WQB-7 are the Environmental Protection Agency (EPA) Region VIII's Clean Water Act Section 304(a) Criteria Chart, dated 07/01/1993, and Standards established as drinking water maximum contaminant levels (MCL's). It is anticipated that CIRCULAR WQB-7 will be added to, modified, and/or updated as additional or new information becomes available. Care should be exercised to ensure that the most recent version (by date) is used as a reference.

CIRCULAR WQB-7 is a complex document. Close attention must be paid to the frequent use of 'detailed notes of explanation'. They are used in both the table headings and individual line items, many times, both. Detailed notes of explanation follow the table portion of CIRCULAR WQB-7 and are found in the format of (n) where n is a number.

CIRCULAR WQB-7 uses the more restrictive value of either the 304(a) criteria or the drinking water MCL for Human Health Standards, whenever required, in order to be able to fully protect the concept of 'multi-use' of Montana's waters. For instance, if the human-health Standard for a particular pollutant has been established at 1,200 µg/L (micro-grams per Liter) and the same pollutant has an organoleptic (taste and/or odor) Standard established at 20 µg/L, then CIRCULAR WQB-7 would have the Standard set at the more limiting value of 20 µg/L. In similiar manner, whenever both Aquatic Life Standards and Human Health Standards exist for the same analyte, the more restrictive of these values will be used as the numeric Surface Water Quality Standard.

CIRCULAR WQB-7 sets Standards for surface and ground waters. In addition WQB-7 lists values which are to be used in conjunction with the non-degredation rules ARM 16.20.701 et seq to determine and evaluate degradation. Standards for 'Harmful' parameters will be used as nondegredation criteria for both surface waters and ground waters. For a given pollutant, the Human Health Standard is the same for both surface and ground water but the analysis method differs. Except where noted, the surface water analysis method is always 'total-recoverable' while the analysis method used for ground water will be 'dissolved'.

Special attention should be paid to the pollutants/conditions such as ammonia, hardness, and oxygen as the Standards are set over a range of values, or are computed using a complex formula, or depend upon special circumstances.

Alkalinity, chloride, hardness, sediment, sulfate, and total dissolved solids have 'Narrative Standards' and are referenced back to the Administrative Rules of Montana (ARM) 16.20.633(1) et seq and ARM 16.20.1003 et seq for further details and explanation.

The Standards for fecal coliform, color, dissolved gases, odor, pH, and temperature are dependent upon the water-use classifications as specified in ARM, Title 16, Chapter 20 - Water Quality, Sub-Chapter 6, SURFACE WATER QUALITY STANDARDS.

Except where indicated, values are listed as micro-grams-per-liter (µg/L). A '—' indicates that a Standard has not been adapted or information is currently unavailable. A '(n)' indicates that a detailed note of explanation is provided.

Pollutant Element / Chemical Compound or Condition	CASRN, NIOSH and SAX Numbers (25) (26) (27)	Category (1) (2)	Aquatic Life Standards (16) Acute (3)	Aquatic Life Standards (16) Chronic (4)	Bioconcentration Factor (BCF) (5)	Human Health Standards (17)	Trigger Value (22)	Required Reporting Value (19)
Acenaphthene §§ — § Acenaphthalene § Naphthyleneethylene § 1,8-Ethylenenaphthalene § 1,8-Ethylene Naphthalene § 1,2-Dihydroacenphthylene § Acenphthylene, 1,2-Dihydro-	83329 or 83-32-9 NIOSH: AB 1255500 SAX: AAE750	Harmful	—	—	242	20	N/A	10
Acenaphthylene (PAH) §§ — § Cyclopenta(De)Naphthalene	208968 or 208-96-8 NIOSH: AB 1254000 SAX: AAF500	Toxin	—	—	30	—	2.3	10
Acrolein §§ — § Biocide § Crolean § Aqualin § Aqualine § Propenal § SHA 00701 § 2-propenal § Acraldehyde § Acrylaldehyde § Acrylic Aldehyde § Ethylene Aldehyde	107028 or 107-02-8 NIOSH: AS 1050000 SAX: ADR000	Toxin	—	—	215	320	0.7	20
Acrylamide §§ 2-Propenamide § Propenamide § Acrylic Amide § Ethylenecarboxamide § RCRA Waste Number U007	79061 or 79-06-1 NIOSH: AS 3325000 SAX: ADS250	Carcinogen	—	—	—	0.08	N/A	—
Acrylonitrile §§ — § Ventox § ENT 54 § TL 314 § Fumigrain § Carbacryl § Cyanoethylene § Vinyl cyanide § Propenenitrile § 2-Propenenitrile § Acrylonitrile monomer § RCRA Waste Number U009	107131 or 107-13-1 NIOSH: AT 5250000 SAX: ADX500	Carcinogen	—	—	30	0.59	N/A	20
Alachlor §§ — § Lazo § Lasso § Alator § Alanex § Alochlor § Pillarzo § Metachlor § Chimiclor § SHA 090501 § Methachlor § 2-Chloro-N-(2,6-Diethyl)Phenyl-N-Methoxymethylacetamide § 2-Chloro-2',6'-Diethyl-N-(Methoxymethyl)Acetanilide	15972608 or 15972-60-8 NIOSH: AE 1225000 SAX: CFX000	Carcinogen	—	—	—	2	N/A	0.4
Aldicarb §§ Temik § Temic § Ambush § OMS 771 § Temik G 10 § Aldecarb § Carbamyl § SHA 098301 § Carbanolate § Sulfone Aldoxycarb § Union Carbide 21149 § RCRA Waste Number P070 § Propanal, 2-Methyl-2-(Methylthio)-, O-[(Methylamino)Carbonyl]Oxime	116063 or 116-06-3 NIOSH: UE 2275000 SAX: CBM500	Toxin	—	—	—	1	1	1
Aldicarb Sulfone §§ Aldoxycarb § Standak § UC 21865 § Sulfocarb § SHA 110801 § Propionaldehyde, 2-Methyl-2-(Methylsulfonyl)-, O-(Methylcarbomoyl)Oxime § 2-Methyl-2-(Methylsulfonyl)Propanal O-[(Methylamino)Carbonyl]Oxime	1646884 or 1646-88-4 NIOSH: UE 2080000 SAX: AFK000	Toxin	—	—	—	1	1	1
Aldicarb Sulfoxide §§ —	1646873 or 1646-87-3 NIOSH: — SAX: —	Toxin	—	—	—	4	1	1

Except where indicated, values are listed as micro-grams-per-liter (µg/L). A '—' indicates that a Standard has not been adapted or information is currently unavailable. A '(n)' indicates that a detailed note of explanation is provided.

Pollutant Element / Chemical Compound or Condition	CASRN, NIOSH and SAX Numbers (25) (26) (27)	Category (1) (2)	Aquatic Life Standards (16) Acute (3)	Aquatic Life Standards (16) Chronic (4)	Bioconcentration Factor (BCF) (5)	Human Health Standards (17)	Trigger Value (22)	Required Reporting Value (19)
Aldrin §§ — § HHDN § Altox § Drinox § Aldrex § Aldrite § Seedrin § Octalene § SHA 045101 § RCRA Waste Number P004 § Hexachlorohexahydro-endo-exo-Dimethanonaphthalene § 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-Hexahydro-1,4,5,8-Dimethanonaphthalene § 1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-Hexahydro-endo,exo- § 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-Hexa-Hydro-1,4:5,8-Endo,Exo-Dimethanonaphthalene § 1,2,3,4,10,10-Hexachloro-1,4,4a,5,8,8a-Hexahydro-1,4-endo-exo-5,8-Dimethanonaphthalene	309002 or 309-00-2 NIOSH: IO 2100000 SAX: AFK250	Carcinogen	1.5	—	4,670	0.0013	N/A	0.2
Alkalinity, total, as $CaCO_3$ §§ —	471341 or 471-34-1 NIOSH: — SAX: —	Narrative (18)	—	—	—	—	—	5,000
Alpha Emitters §§ — § Gross Alpha § Adjusted Gross Alpha	Multiple	Carcinogen / Radioactive	—	—	—	150 pico-curies/liter	N/A	—
Aluminum, pH 6.5 to 9.0 only (9) (6) §§ Al	7429905 or 7429-90-5 NIOSH: BD 0330000 SAX: AGX000	Toxin	750	87	—	—	30	100
Ammonia [total ammonia nitrogen (NH_3-N plus NH_4-N)] as mg/l N § Ammonia Anhydrous § Anhydrous Ammonia § Spirit of Hartshorn	7664417 or 7664-41-7 NIOSH: BO 0875000 SAX: AMY500	Toxin	(7)(8)	(7)(8)	—	—	10	50
Anthracene (PAH) §§ Paranaphthalene § Green Oil § Anthracin § Tetra Olive N2G	120127 or 120-12-7 NIOSH: CA 9350000 SAX: APG500	Toxin	—	—	30	9,600	0.04	0.2
Antimony (9) §§ Sb § Antimony Black § Antimony Regulus § C.I. 77050 § Stibium	7440360 or 7440-36-0 NIOSH: CC 4025000 SAX: AQB750	Toxin	—	—	1	6	0.4	3
Aroclor 1016 §§ PCB 1016 § PCB-1016 § Arochlor 1016 § Chlorodiphenyl (16% Cl) § Polychlorinated Biphenyl (Aroclor 1016)	12674112 or 12674-11-2 NIOSH: — SAX: —	Carcinogen	—	0.014	31,200	0.00044	N/A	1
Aroclor 1221 §§ PCB 1221 § PCB-1221 § Arochlor 1221 § Chlorodiphenyl (21% Cl) § Polychlorinated Biphenyl (Aroclor 1221)	11104282 or 11104-28-2 NIOSH: TQ 1352000 SAX: PJM000	Carcinogen	—	0.014	31,200	0.00044	N/A	15
Aroclor 1232 §§ PCB 1232 § PCB-1232 § Arochlor 1232 § Chlorodiphenyl (32% Cl) § Polychlorinated Biphenyl (Aroclor 1232)	11141165 or 11141-16-5 NIOSH: TQ 1354000 SAX: PJM250	Carcinogen	—	0.014	31,200	0.00044	N/A	1

Except where indicated, values are listed as micro-grams-per-liter (µg/L). A '—' indicates that a Standard has not been adapted or information is currently unavailable. A '(n)' indicates that a detailed note of explanation is provided.

Pollutant Element / Chemical Compound or Condition	CASRN, NIOSH and SAX Numbers (25) (26) (27)	Category (1) (2)	Aquatic Life Standards (16) Acute (3)	Aquatic Life Standards (16) Chronic (4)	Bioconcentration Factor (BCF) (5)	Human Health Standards (17)	Trigger Value (22)	Required Reporting Value (19)
Aroclor 1242 §§ PCB 1242 § PCB-1242 § Arochlor 1242 § Chlorodiphenyl (42% Cl) § Polychlorinated Biphenyl (Aroclor 1242)	53469219 or 53469-21-9 NIOSH: 1356000 SAX: PJM500	Carcinogen	—	0.014	31,200	0.00044	N/A	1
Aroclor 1248 §§ PCB 1248 § PCB-1248 § Arochlor 1248 § Chlorodiphenyl (48% Cl) § Polychlorinated Biphenyl (Aroclor 1248)	12672296 or 12672-29-6 NIOSH: TQ 1358000 SAX: PJM750	Carcinogen	—	0.014	31,200	0.00044	N/A	1
Aroclor 1254 §§ PCB 1254 § PCB-1254 § Arochlor 1254 § Chlorodiphenyl (54% Cl) § Polychlorinated Biphenyl (Aroclor 1254) § NCI C02664	11097691 or 11097-69-1 NIOSH: TQ 1360000 SAX: PJN000	Carcinogen	—	0.014	31,200	0.00044	N/A	1
Aroclor 1260 §§ PCB 1260 § PCB-1260 § Clophen A60 § Arochlor 1260 § Phenoclor DP6 § Chlorodiphenyl (60% Cl) § Polychlorinated Biphenyl (Aroclor 1260)	11096825 or 11096-82-5 NIOSH: TQ 1362000 SAX: PJN250	Carcinogen	—	0.014	31,200	0.00044	N/A	1
Aroclor 1262 §§ PCB 1262 § PCB-1262 § Arochlor 1262 § Chlorodiphenyl (62% Cl) § Polychlorinated Biphenyl (Aroclor 1262)	37324235 or 37324-23-5 NIOSH: TQ 1364000 SAX: PJN500	Carcinogen	—	0.014	31,200	0.00044	N/A	1
Aroclor 1268 §§ PCB 1268 § PCB-1268 § Arochlor 1268 § Chlorodiphenyl (68% Cl) § Polychlorinated Biphenyl (Aroclor 1268)	11100144 or 11100-14-4 NIOSH: TQ 1366000 SAX: PJN750	Carcinogen	—	0.014	31,200	0.00044	N/A	1
Aroclor 2565 §§ PCB 2565 § PCB-2565 § Arochlor 2565 § Polychlorinated Biphenyl (Aroclor 2565)	37324246 or 37324-24-6 NIOSH: TQ 1368000 SAX: PJO000	Carcinogen	—	0.014	31,200	0.00044	N/A	1
Aroclor 4465 §§ PCB 4465 § PCB-4465 § Arochlor 4465 § Polychlorinated Biphenyl (Aroclor 4465)	11120299 or 11120-29-9 NIOSH: TQ 1370000 SAX: PJO250	Carcinogen	—	0.014	31,200	0.00044	N/A	1
Polychlorinated Biphenyl (Kanechlor 300) §§ — § Kanechlor 300	37353632 or 37353-63-2 NIOSH: TQ 1372000 SAX: PJO500	Carcinogen	—	0.014	31,200	0.00044	N/A	1
Polychlorinated Biphenyl (Kanechlor 400) §§ — § Kanechlor 400 § KC-400	12737870 or 12737-87-0 NIOSH: TQ 1374000 SAX: PJO750	Carcinogen	—	0.014	31,200	0.00044	N/A	1
Polychlorinated Biphenyl (Kanechlor 500) §§ — § Kanechlor 500 § KC-500	37317412 or 37317-41-2 NIOSH: TQ 1376000 SAX: PJP000	Carcinogen	—	0.014	31,200	0.00044	N/A	1

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Pollutant Element / Chemical Compound or Condition	CASRN, NIOSH and SAX Numbers (25) (26) (27)	Category (1) (2)	Aquatic Life Standards (16) Acute (3)	Aquatic Life Standards (16) Chronic (4)	Bioconcentration Factor (BCF) (5)	Human Health Standards (17)	Trigger Value (22)	Required Reporting Value (19)
Polychlorinated Biphenyls, mixed §§ PCB's § Aroclor § Chlophen § Chlorextol § Chlorinated Biphenyl § Chlorinated Diphenyl § Chlorinated Diphenylene § Chloro Biphenyl § Chloro-1,1-Biphenyl § Clophen § Dykanol § Fenclor § Inerteen § Kanechlor § Montar § Noflamol § PCB (DOT) § Phenochlor § Polychlorobiphenyl § Pyralene § Pyranol § Santotherm § Sovol § Therminol FR-1	1336363 or 1336-36-3 NIOSH: TQ 1350000 SAX: PJL750	Carcinogen	—	0.014	31,200	0.00044	N/A	1
Arsenic, inorganic (9) §§ As § Arsenicals § Arsenic-75 § Arsenic Black § Colloidal Arsenic § Grey Arsenic § Metallic Arsenic	7440382 or 7440-38-2 NIOSH: CG 0525000 SAX: ARA750	Carcinogen	360	190	44	18	N/A	3
Asbestos, Chrysotile §§ — § 7-45 Asbestos § Asbestos (ACGIH) § Asbestos, White Dot § Avibest C § Calidria RG 100 § Calidria RG 144 § Calidria RG 600 § Cassir AK § Chrysotile Asbestos § Chrysotile (DOT) § Hooker Number 1 Chrysotile Asbestos § Metaxite § NCI C61223A § Plastibest 20 § Serpentine § Serpentine Chrysotile § Sylodex § White Asbestos	12001295 or 12001-29-5 NIOSH: CI 6478500 SAX: ARM268	Carcinogen	—	—	—	700,000 fibers/liter	N/A	—
Asbestos, Actinolite §§ — § Asbestos (ACGIH) § Actinolite Asbestos	77536664 or 77536-66-4 NIOSH: CI 6476000 SAX: ARM260	Carcinogen	—	—	—	700,000 fibers/liter	N/A	—
Asbestos, Amosite §§ — § Amosite Asbestos § Asbestos (ACGIH) § Mysorite § NCI C60253A	12172735 or 12172-73-5 NIOSH: CI 6477000 SAX: ARM262	Carcinogen	—	—	—	700,000 fibers/liter	N/A	—
Asbestos, Anthophylite §§ — § Anthophylite § Asbestos (ACGIH) § Azbolen Asbestos § Ferroanthophyllite	77536675 or 77536-67-5 NIOSH: CI 6478000 SAX: ARM264	Carcinogen	—	—	—	700,000 fibers/liter	N/A	—
Asbestos §§ — § Amianthus § Amosite (Obs.) § Amphibole § Asbestos Fiber § Fibrous Grunerite § NCI C08991 § Serpentine	1332214 or 1332-21-4 NIOSH: CI 6475000 SAX: ARM 250	Carcinogen	—	—	—	700,000 fibers/liter	N/A	—
Asbestos, Crocidolite §§ — § Amorphous Crocidolite Asbestos § Asbestos (ACGIH) § Blue Asbestos (DOT) § Crocidolite Asbestos § NCI C09007 § Crocidolite (DOT) § Fibrous Crocidolite Asbestos	12001284 or 12001-28-4 NIOSH: CI 6479000 SAX: ARM275	Carcinogen	—	—	—	700,000 fibers/liter	N/A	—
Asbestos, Tremolite §§ — § Asbestos (ACGIH) § Fibrous Tremolite § NCI C08991 § Tremolite Asbestos	77536686 or 77536-68-6 NIOSH: 6560000 SAX: ARM280	Carcinogen	—	—	—	700,000 fibers/liter	N/A	—

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Atrazine §§ — § Aatrex § Aktikon § Atrasine § Atred § Candex § Crisatrina § Crisazine § Cyazin § Fenamin § Fenamine § Zeaphos § Fenatrol § Gesaprim § Hungazin § Inakor § Primatol § Malermais § Radazin § Radizine § Shell Atrazine herbicide § Strazine § Triazine A 1294 § Vectal § Weedex A § Wonuk § Zeazin § Zeazine § SHA 080803 § 1-Chloro-3-Ethylamino-5-Isopropylamino-2,4,6-Triazine § s-Triazine, 2-Chloro-4-Ethylamino-6-Isopropylamino- § 2-Chloro-4-Ethylamino-6-Isopropylamino-s-Triazine § 6-Chloro-N-Ethyl-N'-(1-Methylethyl)-1,3,5-Triazine-2,4-Diamine	1912249 or 1912-24-9 NIOSH: XY 5600000 SAX: PMC325	Toxin	—	—	—	3	0.1	0.6
Barium (9) §§ Ba	7440393 or 7440-39-3 NIOSH: CA 8370000 SAX: BAH250	Toxin	—	—	—	1,000	2	5
Benzene §§ — § Phene § Benzol § Benzolene § Pyrobenzol § Carbon Oil § SHA 109301 § Coal Naphtha § Motor Benzol § Phenyl hydride § Cyclohexatriene § Caswell Number 077 § RCRA Waste Number U019 § EPA Pesticide Chemical Code 008801 § NCI C55276	71432 or 71-43-2 NIOSH: CY 1400000 SAX: BBL250	Carcinogen	—	—	5.2	5	N/A	0.5
Benzidine §§ — § p,p'-Bianiline § 4,4'-Bianiline § 4,4'-Biphenyldiamine § p,p'-Diaminobiphenyl § 4,4'-Diaminodiphenyl § RCRA Waste Number U021 § 4,4'-Biphenylenediamine § 4,4'-Diphenylenediamine § Biphenyl, 4,4'-Diamino- § 4,4'-Diamino-1,1'-Biphenyl § (1,1'-Biphenyl)-4,4'-Diamine § NCI C03361	92875 or 92-87-5 NIOSH: DC 9625000 SAX: BBX000	Carcinogen	—	—	87.5	0.0012	N/A	20
Benz[a]anthracene (PAH) §§ — § Tetraphene § Benzanthracene § Benzoanthracene § Naphthanthracene § 1,2-Benzanthrene § Benz(a)Anthracene § Benzo[a]Anthracene § Benzo(a)Anthracene § 1,2-Benzanthracene § Benzo(b)Phenanthrene § 1,2-Benzoanthracene § Benzanthracene, 1,2- § 1,2-Benz(a)Anthracene § 2,3-Benzophenanthrene § RCRA Waste Number U018	56553 or 56-55-3 NIOSH: CV 9275000 SAX: BBC250	Carcinogen	—	—	30	0.044	N/A	0.25
Benzo[b]Fluoranthene (PAH) §§ — § B(b)F § Benzo(b)Fluoranthene § Benzo(e)Fluoranthene § Benzo[e]Fluoranthene § 2,3-Benzfluoranthene § 3,4-Benzfluoranthene § 3,4-Benzofluoranthene § 2,3-Benzofluoranthene § 2,3-Benzofluoranthrene § Benz(e)Acephenanthrylene § Benz[e]Acephenanthrylene § 3,4-Benz(e)Acephenanthrylene	205992 or 205-99-2 NIOSH: CU 1400000 SAX: BAW250	Carcinogen	—	—	30	0.044	N/A	0.25

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Benzo[k]Fluoranthene (PAH) §§ — § Benzo(k)Fluoranthene § 8,9-Benzofluoranthene § Dibenzo(b,jk)Fluorene § 2,3,1'8'-Binaphthylene § 11,12-Benzofluoranthene § 11,12-Benzo(k)Fluoranthene	207089 or 207-08-9 NIOSH: DF 6350000 SAX: BCJ750	Carcinogen	—	—	30	0.044	N/A	0.25
Benzo(g,h,i)perylene (PAH) §§ 1,12-Benzoperylene § 1,12-Benzperylene § Benzo(ghi)Perylene	191242 or 191-24-2 NIOSH: DI 6200500 SAX: BCR000	Toxin	—	—	30	—	0.076	10
Benzo[a]Pyrene (PAH) §§ — § BaP § 3,4-BP § Benz(a)Pyrene § Benzo-a-Pyrene § 3,4-Benzpyrene § 6,7-Benzopyrene § 3,4-Benzopyrene § 3,4-Benz(a)Pyrene § Benzo(d,e,f)Chrysene § Benzo(def)Chrysene	50328 or 50-32-8 NIOSH: DJ 3675000 SAX: BCS750	Carcinogen	—	—	30	0.02	N/A	0.2
Beryllium (9) §§ Be § Beryllium-9 § Glucinum § RCRA Waste Number P015	7440417 or 7440-41-7 NIOSH: DS 1750000 SAX: BFO750	Carcinogen	—	—	19	40	N/A	1
Beta-Chloronaphthalene §§ 2-Chloronaphthalene § ß-Chloronaphthalene § Naphthalene, 2-Chloro- § RCRA Waste Number U047	91587 or 91-58-7 NIOSH: QJ 2275000 SAX: CJA000	Toxin	—	—	202	1,700	0.94	10
Beta Emitters (10) §§ — § Gross Beta	12587472 or 12587-47-2 NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	40 mrem ede/yr	N/A	—
Bis(2-Chloroethoxy)Methane §§ — § Bis(ß-Chloroethyl)Formal	111911 or 111-91-1 NIOSH: PA 3675000 SAX: BID750	Toxin	—	—	0.64	—	0.5	—
Bis(2-Chloroisopropyl) Ether §§ — § DCIP § NCI C50044 § RCRA Waste Number U027 § Dichlorodiisopropyl Ether § 2,2'-Oxybis(1-Chloropropane) § Bis (2-Chloroisopropyl) ether § Propane, 2,2'-Oxybis(2-Chloro- § Propane, 2,2'-Oxybis[1-Chloro- § 2',2'-Dichlorodiisopropyl Ether § Dichlorodiisopropyl Ether (DOT) § Bis(2-Chloro-1-Methylethyl) Ether	108601 or 108-60-1 NIOSH: KN 1750000 SAX: BII250	Toxin	—	—	2.47	1,400	0.8	10
Bis(Chloroethyl)Ether §§ — § BCEE § DCEE § Clorex § Chlorex § Chloroethyl Ether § Dichloroethyl Ether § Dichloroethyl Oxide § RCRA Waste Number U025 § Bis(Chloroethyl) Ether § Di(2-Chloroethyl) Ether § Bis (Chloroethyl) Ether § Bis(2-Chloroethyl) Ether § Bis(ß-Chloroethyl) Ether § ß,ß'-Dichloroethyl Ether § 2,2'-Dichloroethyl Ether § Bis (2-Chloroethyl) Ether § 1,1'-Oxybis(2-Chloro)Ethane § Ethane, 1,1'-Oxybis[2-Chloro- § beta,beta'-Dichloroethyl Ether § 1-Chloro-2-(beta-Chloroethoxy)Ethane	111444 or 111-44-4 NIOSH: KN 0875000 SAX: BIC750	Carcinogen	—	—	6.9	0.31	N/A	10

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Pollutant Element / Chemical Compound or Condition	CASRN, NIOSH and SAX Numbers (25) (26) (27)	Category (1) (2)	Aquatic Life Standards (16) Acute (3)	Aquatic Life Standards (16) Chronic (4)	Bioconcentration Factor (BCF) (5)	Human Health Standards (17)	Trigger Value (22)	Required Reporting Value (19)
Bis(Chloromethyl)Ether §§ — § BCME § bis-CME § Chloromethyl Ether § Oxybis(Chloromethane) § RCRA Waste Number P016 § Bis (Chloromethyl) Ether § sym-Dichlorodimethyl Ether § 1,1'-Dichlorodimethyl Ether § Dimethyl-1,1'-Dichloroether § Chloro(Chloromethoxy)Methane	542881 or 542-88-1 NIOSH: 1575000 SAX: BIK000	Carcinogen	—	—	0.63	0.0016	N/A	10
Bromodichloromethane (HM) §§ — § BDCM § NCI C55243 § Dichlorobromomethane § Methane, bromodichloro- § Dichloromonobromomethane § Monobromodichloromethane	75274 or 75-27-4 NIOSH: PA 5310000 SAX: BND500	Carcinogen	—	—	3.75	5.6	N/A	0.5
p-Bromodiphenyl Ether §§ — § p-Bromodiphenyl Ether § 4-Bromophenoxybenzene § 4-Bromodiphenyl Ether § 1-Bromo-4-Phenoxybenzene § p-Bromophenylphenyl Ether § 4-Bromophenyl Phenyl Ether § Benzene, 1-Bromo-4-Phenoxy-	101553 or 101-55-3 NIOSH: — SAX: —	Toxin with BCF >300	—	—	1,640	—	N/A	10
Bromoform (HM) §§ Tribromomethane § NCI C55130 § Methane, Tribromo- § Methenyl Tribromide § RCRA Waste Number U225	75252 or 75-25-2 NIOSH: PB 5600000 SAX: BNL000	Carcinogen	—	—	3.75	43	N/A	0.5
Bromomethane (HM) §§ Methyl Bromide § EDCO § Celfume § Dowfume § Methogas § SHA 053201 § Brom-O-Sol § Brom-O-Gas § Terr-O-Gas § Halon 1001 § Terr-O-Cide § Bromo-O-Gas § Bromo Methane § Methylbromide § Methyl Bromide § Methane, Bromo- § Monobromomethane § RCRA Waste Number U029	74839 or 74-83-9 NIOSH: PA 4900000 SAX: BNM500	Toxin	—	—	3.75	48	0.11	0.5
Butyl Benzyl Phthalate §§ — § BBP § Sicol 160 § Unimoll BB § Palatinol BB § Santicizer 160 § Butylbenzylphthalate § Butylbenzyl Phthalate § Benzyl Butyl Phthalate § n-Benzyl Butyl Phthalate § Benzyl n-Butyl Phthalate § Phthalic Acid, Benzyl Butyl Ester § Butyl Phenylmethyl 1,2-Benzenedicarboxylate § 1,2-Benzenedicarboxylic Acid, Butyl Phenylmethyl Ester § NCI C54375	85687 or 85-68-7 NIOSH: TH 9990000 SAX: BEC500	Toxin with BCF >300	—	—	414	3,000	N/A	10
Cadmium (9) §§ Cd § C.I. 77180 § Colloidal Cadmium	7440439 or 7440-43-9 NIOSH: EU 9800000 SAX: CAD000	Toxin	3.9 @ 100 mg/l hardness (12)	1.1 @ 100 mg/l hardness (12)	64	5	0.1	0.1
Carbofuran §§ — § Yaltox § Euradan § Furadan § Curaterr § Furacarb § SHA 090601 § Niagra 10242 § 2,2-Dimethyl-7-Coumaranyl N-Methylcarbamate § 2,2-Dimethyl-2,3-Dihydro-7-Benzofuranyl N-Methylcarbamate § Carbamic Acid, Methyl-, 2,3-Dihydro-2,2-Dimethyl-7-Benzofuranyl Ester	1563662 or 1563-66-2 NIOSH: FB 9450000 SAX: FPE000	Toxin	—	—	—	40	1	1

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			Acute (3)	Chronic (4)				
Carbon Tetrachloride §§ — § R 10 § Univerm § Freon 10 § Tetrasol § Fasciolin § Flukoids § Necatorina § Necatorine § Halon 104 § Tetraform § Carbon Tet § Benzinoform § Carbon Chloride § Perchloromethane § Tetrachloromethane § Methane Tetrachloroide § RCRA Waste Number U211	56235 or 56-23-5 NIOSH: FG 4900000 SAX: CBY000	Carcinogen	—	—	18.75	2.5	N/A	0.5
Cesium (10) §§ Cs	Cesium 134 13967709 or 13967-70-9 NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	40 mrem ede/yr	N/A	—
Cesium (10) §§ Cs	Cesium 137 10045973 or 10045-97-3 NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	40 mrem ede/yr	N/A	—
Cesium (10) §§ Cs	Cesium 137 12587472 or 12587-47-2 NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	40 mrem ede/yr	N/A	—
Cesium (10) §§ Cs	Cesium 144 — NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	40 mrem ede/yr	N/A	—
Chlordane §§ — § Belt § Niran § Dowchlor § Chlortox § Chlordan § Clordano § Chlor Kil § Toxichlor § Octa-Klor § Ortho-Klor § SHA 058201 § Gold Crest C-100 § Chlordane, Technical § RCRA Waste Number U036 § Octachloro-4,7-Methanohydroindane § Octachlorodihydrodicyclopentadiene § 1,2,4,5,6,7,8,8-Octachloro-3a,4,7,7a-Hexahydro § Octachloro-4,7-Methanotetrahydroindane-4,7-Methylene Indane § 4,7-Methanoindan, 1,2,4,5,6,7,8,8-Octachloro-3a,4,7,7a-tetrahydro- § 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-Hexahydro-4,7-Methano-Indene § 4,7-Methano-1H-Indene 1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-Hexahydro-	57749 or 57-74-9 NIOSH: PB 9800000 SAX: CDR750	Carcinogen	1.2	0.0043	14,100	0.0057	N/A	0.4
alpha-Chlordane §§ — § α-Chlordane § cis-Chlordan § cis-Chlordane § α(cis)-Chlordane § Chlordane, cis-Isomer	5103719 or 5103-71-9 NIOSH: PB 9705000 SAX: CDR675	Carcinogen	1.2	0.0043	14,100	0.0057	N/A	0.4
gamma-Chlordane §§ — § Chlordane, beta-Isomer	5103742 or 5103-74-2 NIOSH: — SAX: —	Carcinogen	1.2	0.0043	14,100	0.0057	N/A	0.4

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			Acute (3)	Chronic (4)				
trans-Nonachlor (Chlordane component) §§ — § Chlordane, trans-Isomer	39765805 or 39765-80-5 NIOSH: — SAX: —	Carcinogen	1.2	0.0043	14,100	0.0057	N/A	0.4
Chloride §§ —	16887006 or 16887-00-6 NIOSH: — SAX: —	Narrative (18)	860,000	230,000	—	—	N/A	1,000
Chlorine, total residual §§ Cl § Bertholite § Chlorine, molecular § Molecular Chlorine	7782505 or 7782-50-5 NIOSH: FO 2100000 SAX: CDV750	Toxin	19	11	—	—	100	—
p-Chloro-m-Cresol §§— § PCMC § Parol § Aptal § Baktol § Baktolan § Ottafact § Raschit § Rasen-Anicon § Parmetol § Candasetpic § Chlorocresol § Preventol CMK § RCRA Waste Number U039 § Parachlorometra Cresol § 4-Chloro-3-methylphenol § 2-Chloro-Hydroxytoluene § Phenol, 4-Chloro-3-methyl- § Chlorophenol, 4-, methyl, 3-	59507 or 59-50-7 NIOSH: GO 7100000 SAX: CFE250	Harmful	—	—	—	3,000	N/A	20
Chlorobenzene §§ Monochlorobenzene § MCB § Chlorobenzol § Chlorbenzene § Phenyl Chloride § Benzene Chloride § Benzene, Chloro- § Monochlorbenzene § RCRA Waste Number U037 § NCI C54886	108907 or 108-90-7 NIOSH: CZ 0175000 SAX: BBM750	Harmful	—	—	10.3	20	N/A	0.5
2-Chloroethyl Vinyl Ether §§ — § (2-Chloroethoxy)Ethene § RCRA Waste Number U042 § Vinyl ß-Chloroethyl Ether § Vinyl 2-Chloroethyl Ether	110758 or 110-75-8 NIOSH: KN 6300000 SAX: CHI250	Carcinogen	—	—	0.557	—	N/A	—
Chloroform (HM) §§ Trichloromethane § TCM § Freon 20 § Trichloroform § R-20 Refrigerant § Methenyl Chloride § Formyl Trichloride § Methyl Trichloride § Methane Trichloride § Methane, Trichloro- § Methenyl Trichloride § RCRA Waste Number U044 § NCI CO2686	67663 or 67-66-3 NIOSH: FS 9100000 SAX: CHJ500	Carcinogen	—	—	3.75	57	N/A	0.5
Chloroethane §§ — § Aethylis § Aethylis Chloridum § Anodynon § Chelen § Chlorethyl § Chloridum § Chloroethane § Chloryl § Chloryl Anesthetic § Ethyl Chloride § Ether Chloratus § Ether Hydrochloric § Ether Muriatic § Hydrochloric Ether § Kelene § Monochlorethane § Muriatic Ether § Narcotile § NCI C06224	75003 or 75-00-3 NIOSH: KH 7525000 SAX: EHH000	Toxin	—	—	—	—	0.52	—
2-Chlorophenol §§ — § o-Chlorophenol § Chlorophenol, 2- § Phenol, 2-Chloro- § Phenol, o-Chloro- § RCRA Waste Number U048	95578 or 95-57-8 NIOSH: SK 2625000 SAX: CJK250	Harmful	—	—	134	0.1	N/A	10

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4-Chlorophenyl Phenyl Ether §§ — §	7005723 or 7005-72-3 NIOSH: — SAX: —	Toxin with BCF >300	—	—	1,200	—	N/A	—
Chlorpyrifos §§ — § Ethion § Brodan § Eradex § Dursban § Lorsban § Pyrinex § NA 2783 § Piridane § DowCo 179 § SHA 059101 § Ethion, dry § Chlorothalonil § Chlorpyrifos-Ethyl § O,O-Diethyl O-3,5,6-Trichloro-2-Pyridyl Phosphorothioate § Phosphorothioic Acid, O,O-Diethyl O-(3,5,6-Trichloro-2-Pyridyl) Ester	2921882 or 2921-88-2 NIOSH: TF 6300000 SAX: DYE000	Toxin	0.083	0.041	—	—	0.025	1
Chromium (9) §§ Cr § Chrome	7440473 or 7440-47-3 NIOSH: GB 4200000 SAX: CMI750	Toxin	—	—	—	100	0.1	1
Chromium, trivalent (9) §§ Chromium (III)	16065831 or 16065-83-1 NIOSH: — SAX: —	Toxin	1,700 @ 100 mg/l hardness (12)	210 @ 100 mg/l hardness (12)	16	100	—	—
Chromium, hexavalent (9) §§ Chromium (VI)	18540299 or 18540-29-9 NIOSH: — SAX: —	Toxin	16	11	16	100	5	5
Chrysene (PAH) §§ — § Benz(a)Phenanthrene § Benzo(a)Phenanthrene § 1,2-Benzphenanthrene § 1,2-Benzophenanthrene § RCRA Waste Number U050 § 1,2,5,6-Dibenzonaphthalene	218019 or 218-01-9 NIOSH: GC0700000 SAX: CML810	Carcinogen	—	—	30	0.044	N/A	0.25
Coliform, fecal (13) (18) §§ —	N/A	Narrative - Surface Toxin - Ground	—	—	—	—, Surface 1 per 100mL, Ground	—, Surface 1 per 100mL, Ground	1 per 100mL, Surface 1 per 100mL, Ground
Color (13) §§ —	N/A	Harmful	—	—	—	—	N/A	5 UNITS
Conductance, specific (21) §§ —	N/A	Narrative	—	—	—		N/A	—
Copper (9) §§ Cu § Allbri Natural Copper § ANAC 110 § Arwood Copper § Bronze Powder § CDA 101 § CDA 102 § CDA 110 § CDA 122 § C.I. 77400 § C.I. Pigment Metal 2 § Copper Bronze § 1721 Gold § Gold Bronze § Kafar Copper § M1 (Copper) § M2 (Copper) § OFHC C_u § Raney Copper	7440508 or 7440-50-8 NIOSH: GL 5325000 SAX: CNI000	Toxin	18 @ 100 mg/l hardness (12)	12 @ 100 mg/l hardness (12)	36	1,000	0.5	1
Cyanide, total §§ — § Cyanide § Isocyanide § RCRA Waste Number P030 § Cyanides, includes soluble salts and complexes	57125 or 57-12-5 NIOSH: GS 7175000 SAX: COI500	Toxin	22	5.2	1	200	5	5

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Dalapon §§ — § Dalpon § Unipon § Dowpon § Radapon § Revenge § Basinex § Ded-Weed § Dalacide § Gramevin § Crisapon § Dalpon Sodium § Sodium Dalapon § 2,2-Dichloropropionic Acid § SHA 28902, for sodium salt § SHA 28901, for dalapon only § Propionic Acid, 2,2-Dichloro- § Sodium 2,2-Dichloropropionate § α-Dichloropropionic Acid § α,α-Dichloropropionic Acid § alpha-alpha-Dichloropropionic Acid	75990 or 75-99-0 NIOSH: UF 0690000 SAX: DGI400	Toxin	—	—	—	200	1.3	3
Dalapon, sodium salt §§ — § Dalpon § Unipon § Dowpon § Radapon § Revenge § Basinex § Ded-Weed § Dalacide § Gramevin § Crisapon § Dalpon Sodium § Sodium Dalapon § 2,2-Dichloropropionic Acid § SHA 28902, for sodium salt § SHA 28901, for dalapon only § Propionic Acid, 2,2-Dichloro- § Sodium 2,2-Dichloropropionate § alpha-alpha-Dichloropropionic Acid	127208 or 127-20-8 NIOSH: UF 1225000 SAX: DGI600	Toxin	—	—	—	200	1.3	3
Demeton §§ — § Systox § Bay 10756 § Bayer 8169 § Demox § Diethoxy Thiophosphoric Acid Ester of 2-Ethylmercaptoethanol § O,O-Diethyl 2-Ethylmercaptoethyl Thiophosphate § O,O-Diethyl O(and S)-2-(Ethyl-Thio)Ethyl Phosphorothioate Mixture § E 1059 § ENT 17,295 § Mercaptophos § Systemox § Systox § ULV § Demeton-O + Demeton-S	8065483 or 8065-48-3 NIOSH: TF 3150000 SAX: DAO600	Toxin	—	0.1	—	—	—	—
Di(2-Ethylhexyl)Adipate §§ Hexanedioic Acid § DEHA § BEHA § Bisoflex DOA § Effemoll DOA § Ergoplast AdDO § Flexol A 26 § PX-238 § Reomol DOA § Vestinol OA § Wickenol 158 § Kodaflex DOA § Monoplex DOA § NCI C54386 § Octyl Adipate § Dioctyl Adipate § Di-2-Ethylhexyl Adipate § Di (2-Ethylhexyl) Adipate § Bis(2-Ethylhexyl) Adipate § Adipic Acid, Bis(2-Ethylhexyl) Ester § Hexanedioic Acid, Bis(2-Ethylhexyl) Ester	103231 or 103-23-1 NIOSH: AU 9700000 SAX: AEO000	Toxin	—	—	—	400	0.5	6
Di(2-Ethylhexyl)Phthalate (PAE) §§ Bis(2-Ethylhexyl)Phthalate § BEHP § DEHP § Octoil § Fleximel § Flexol DOP § Kodaflex DOP § Ethylhexyl Phthalate § Diethylhexyl Phthalate § 2-Ethylhexyl Phthalate § Di(Ethylhexyl)phthalate § Di(2-Ethylhexyl)phthalate § Bis (2-Ethylhexyl) Phthalate § Bis(2-Ethylhexyl)-1,2-Benzene-Dicarboxylate § 1,2-Benzenedicarboxylic Acid, Bis(2-Ethylhexyl)Ester	117817 or 117-81-7 NIOSH: TI 0350000 SAX: BJS000	Carcinogen	—	—	130	6	N/A	6
n-Dioctyl Phthalate §§ — § DNOP § PX-138 § Vinicizer 85 § Dinopol NOP § n-Octyl Phthalate § Octyl Phthalate § Dioctyl Phthalate § Di-n-Octyl Phthalate § Di-sec-Octyl Phthalate § RCRA Waste Number U107 § 1,2-Benzenedicarboxylic Acid, Dioctyl Ester	117840 or 117-84-0 NIOSH: TI 1925000 SAX: DVL600	Carcinogen	—	—	—	—	N/A	6

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Pollutant Element / Chemical Compound or Condition	CASRN, NIOSH and SAX Numbers (25) (26) (27)	Category (1) (2)	Aquatic Life Standards (16)		Bioconcentration Factor (BCF) (5)	Human Health Standards (17)	Trigger Value (22)	Required Reporting Value (19)
			Acute (3)	Chronic (4)				
Dibenz[a,b]Anthracene (PAH) §§ — § DBA § DB(a,h)A § Dibenz(a,h)Anthracene § RCRA Waste Number U063 § Dibenzo(a,h)anthracene § 1,2:5,6-Benzanthracene § Dibenzo (a,h) Anthracene § 1,2,5,6-Dibenzanthracene § 1,2:5,6-Dibenz(a)Anthracene	53703 or 53-70-3 NIOSH: HN 2625000 SAX: DCT400	Carcinogen	—	—	30	0.044	N/A	0.5
1,2-Dibromo-3-Chloropopane §§ — § DBCP § Fumagon § Fumazone § NCI C00500 § Nemabrom § Nemafume § Nemagon § Nemagone § Nemagone Soil Fumigant § Nemanax § Nemapaz § Nemaset § Nematocide § Nematox § OS 1897 § OXY DBCP § SD 1897 § Caswell Number 287 § Dibromochloropropane § RCRA Waste Number U066 § 1-Chloro-2,3-Dibromopropane § Propane, 1,2-Dibromo-3-Chloro- § EPA Pesticide Chemical Code 011301	96128 or 96-12-8 NIOSH: TX 8750000 SAX: DDL800	Carcinogen	—	—	—	0.2	N/A	0.05
Dibromochloromethane (HM) §§ — § CDBM § NCI C55254 § Chlorodibromomethane § Methane, Dibromochloro- § Dibromomonochloromethane § Monochlorodibromomethane	124481 or 124-48-1 NIOSH: PA 6360000 SAX: CFK500	Carcinogen	—	—	3.75	4.1	N/A	0.5
Dibutyl Phthalate §§ — § DPB § Celluflex DPB § Elaol § Hexaplas M/B § Palatinol C § Polycizer DBP § PX 104 § Staflex DBP § Witcizer § SHA 028001 § Butylphthalate § N-Butylphthalate § Dibutyl Phthalate § Di-n-Butylphthalate § Di-n-Butylphthalate § Dibutyl-o-Phthalate § Di-n-Butyl Phthalate § RCRA Waste Number U069 § Phthalic Acid Dibutyl Ester § Dibutyl 1,2-Benzene Dicarboxylate § 1,2-Benzenedicarboxylic Acid Dibutyl Ester § 1,2-Benzenedicarboxylic Acid, Dibutyl Ester § Benzene-o-Dicarboxylic Acid Di-n-Butyl Ester	84742 or 84-74-2 NIOSH: TI 0875000 SAX: DEH200	Toxin	—	—	89	2,700	0.25	0.25
1,2-Dichlorobenzene §§ — § DCB § ODB § ODCB § Dizene § Cloroben § Chloroben § Chloroden § Termitkil § Dilatin DB § Dowtherm E § Dilantin DB § o-Dichlorobenzene § Orthodichlorobenzene § ortho-Dichlorobenzene § Special Termite Fluid § Benzene, 1,2-Dichloro- § RCRA Waste Number U070	95501 or 95-50-1 NIOSH: CZ 4500000 SAX: DEP600	Toxin	—	—	55.6	600	0.02	10
1,3-Dichlorobenzene §§ — § M-Dichlorobenzene § m-Dichlorobenzene § meta-Dichlorobenzene § Dichlorobenzene, 1,3- § Benzene, 1,3-Dichloro-	541731 or 541-73-1 NIOSH: CZ 4499000 SAX: DEP699	Toxin	—	—	55.6	400	0.006	10

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Pollutant Element / Chemical Compound or Condition	CASRN, NIOSH and SAX Numbers (25) (26) (27)	Category (1) (2)	Aquatic Life Standards (16)		Bioconcentration Factor (BCF) (5)	Human Health Standards (17)	Trigger Value (22)	Required Reporting Value (19)
			Acute (3)	Chronic (4)				
1,4-Dichlorobenzene §§ — § PDB § PDCB § NCI C54955 § Evola § Paradi § Paradow § Persia-Perazol § Paracide § Parazene § Paramoth § Santochlor § Paranuggets § di-Chloricide § Para Chrystals § p-Dichlorobenzene § Caswell Number 632 § Paradichlorobenzene § para-Dichlorobenzene § Benzene, 1,4-Dichloro- § RCRA Waste Number U070 § RCRA Waste Number U071 § RCRA Waste Number U072 § p-Chlorophenyl Chloride § EPA Pesticide Chemical Code 061501	106467 or 106-46-7 NIOSH: CZ 4550000 SAX: DEP800	Toxin	—	—	55.6	75	0.006	10
3,3'-Dichlorobenzidine §§ — § DCB § C.I. 23060 § Curithane C126 § Dichlorobenzidine § o,o'-Dichlorobenzidine § Dichlorobenzidine Base § Benzidine, 3,3'-Dichloro- § RCRA Waste Number U073 § 3,3'-Dichloro-4,4'-Diaminodiphenyl § 3,3'-Dichloro-(1,1'-Biphenyl)-4,4'-Diamine § 1,1'-Biphenyl-4,4'-Diamine, 3,3'-Dichloro-	91941 or 91-94-1 NIOSH: DD 0524000 SAX: DEQ400	Carcinogen	—	—	312	0.39	N/A	20
Dichlorodifluoromethane (HM) §§ — § F 12 § R 12 § FC 12 § Halon § CFC-12 § Arcton 6 § Electro-CF 12 § Eskimon 12 § Frigen 12 § Gentron 12 § Isceon 122 § Kaiser Chemicals 12 § Ledon 12 § Ucon 12 § Freon 12 § Propellant 12 § Refrigerant 12 § Fluorcarbon-12 § RCRA Waste Number U075 § Difluorodichloromethane § Methane, dichlorodifluoro-	75718 or 75-71-8 NIOSH: PA 8200000 SAX: DFA600	Toxin	—	—	3.75	6,900	0.05	0.5
p,p'-Dichlorodiphenyl Dichloroethane §§ — § TDE § DDD § Dilene § NCI C00475 § Rothane § Rhothane § 4,4'-DDD § p,p'-DDD § p,p'-TDE § 4',4'-D-DDD § RCRA Waste Number U060 § Tetrachlorodiphenylethane § Dichlorodiphenyldichloroethane § Dichlorodiphenyl Dichloroethane § 2,2-bis (4-Chlorophenyl)-1,1-Dichloroethane § 1,1-Dichloro-2,2-bis(p-Chlorophenyl) Ethane § 1,1-bis(4-Chlorophenyl)-2,2-Dichloroethane § 2,2-bis(p-Chlorophenyl)-1,1-Dichloroethane § Benzene, 1,1'(2,2-Dichloroethylidene)Bis[4-Chloro-	72548 or 72-54-8 NIOSH: KI 0700000 SAX: BIM500	Carcinogen	—	—	53,600	0.0083	N/A	0.01
p,p'-Dichlorodiphenyldichloroethylene §§ — § DDE § p,p'-DDE § 4,4'-DDE § NCI C00555 § Dichlorodiphenyldichloroethylene § Dichlorodiphenyldichloroethylene, p,p'- § 2,2'-bis(4-Chlorophenyl)-1,1-Dichloroethylene § 1,1'-(Dichloroethenylidene)bis(4-Chlorobenzene) § 2,2'-bis(p-Chlorophenyl)-1,1-Dichloroethylene § Benzene, 1,1'-(DichloroethenylideneBis[4-Chloro-	72559 or 72-55-9 NIOSH: KV 9450000 SAX: BIM750	Carcinogen	—	—	53,600	0.0059	N/A	0.01

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Pollutant Element / Chemical Compound or Condition	CASRN, NIOSH and SAX Numbers (25) (26) (27)	Category (1) (2)	Aquatic Life Standards (16) Acute (3)	Aquatic Life Standards (16) Chronic (4)	Bioconcentration Factor (BCF) (5)	Human Health Standards (17)	Trigger Value (22)	Required Reporting Value (19)
p,p'-Dichlorodiphenyltrichloroethane §§ — § DDT § 4,4'-DDT § Agritan § Anoflex § Arkotine § Azotox § Bosan Supra § Bovidermol § Chlorophenothan § Chlorophenothane § Chlorophenotoxum § Citox § Clofenotane § Dedelo § § Chlorophenothane § Diphenyltrichloroethane § Dichlorodiphenyltrichloroethane § 4,4'-Dichlorodiphenyltrichloroethane § Dichlorodiphenyltrichloroethane, p,p'- § 1,1,1-Trichloro-2,2,-bis(p-Chlorophenyl) Ethane § 1,1,1-Trichloro-2,2,-bis(p-Chlorophenyl)Ethane § 1,1,1-Trichloro-2,2,-Di(4-Chlorophenyl)-Ethane § 1,1-Bis-(p-Chlorophenyl)-2,2,2-Trichloroethane § 2,2-Bis-(p-Chlorophenyl)-1,1,1-Trichloroethane § Benzene, 1,1'-(2,2,2-Trichloroethylidene)Bis(4-Chloro-) § alpha,alpha-Bis(p-Chlorophenyl)-beta,beta,beta-Trichlorethane	50293 or 50-29-3 NIOSH: KJ 3325000 SAX: DAD200	Carcinogen	0.55	0.001	53,600	0.0059	N/A	0.06
1,1-Dichloroethane §§ Vinylidene Chloride § VDC § 1,1-DCE § NCI C04535 § 1,1-Dichloroethene § Vinylidene Chloride § 1,1-Dichloroethylene § Ethene, 1,1-Dichloro- § Vinylidene Dichloride § Ethylidene Dichloride § Dichloroethylene, 1,1- § RCRA Waste Number U076 § Ethylene, 1,1-Dichloro- § Chlorinated Hydrochloroic Ether	75343 or 75-34-3 NIOSH: KI 0175000 SAX: DFF809	Carcinogen	—	—	—	—	N/A	0.5
1,2-Dichloroethane §§ — § EDC § Brocide § 1,2-DCE § NCI C00511 § Dutch Oil § Dutch Liquid § Dichloremulsion § Di-Chlor-Mulsion § 1,2-Bichlorethane § 1,2-Dichlorethane § Ethane Dichloride § Ethylene Chloride § 1,2-Bichloroethane § Ethylene Dichloride § Dichloroethane, 1,2- § Ethane, 1,2-Dichloro- § RCRA Waste Number U077 § 1,2-Ethylene Dichloride § alpha,beta-Dichloroethane	107062 or 107-06-2 NIOSH: KI 0525000 SAX: DFF900	Carcinogen	—	—	1.2	3.8	N/A	0.5
1,1-Dichloroethene §§ Vinylidene Chloride § VDC § 1,1-DCE § Sconatex § NCI C54262 § 1,1-Dichloroethane § 1,1-Dichloroethene § Vinylidene Chloride § 1,1-Dichloroethylene § Vinylidene Dichloride § Ethene, 1,1-Dichloro- § Vinylidene Chloride II § RCRA Waste Number U078 § Dichloroethylene, 1,1- § Ethylene, 1,1-Dichloro-	75354 or 75-35-4 NIOSH: KV 9275000 SAX: DFI000	Carcinogen	—	—	5.6	5.7	N/A	0.5
cis-1,2-Dichloroethylene §§ — § 1,2-Dichloroethylene § cis-Dichloroethylene § cis-1,2-Dichloroethene § 1,2,cis-Dichloroethylene § ethylene, 1,2-Dichloro-, (z)-	156592 or 156-59-2 NIOSH: KV 9420000 SAX: DFI200	Toxin	—	—	—	70	0.002	0.5
trans-1,2-Dichloroethylene §§ — § trans-Dichloroethylene § RCRA Waste Number U079 § trans-1,2-Dichloroethane § trans-1,2-Dichloroethene § Dichloroethylene, trans- § trans-Acetylene Dichloride § 1,2-trans-Dichloroethylene § Ethene, 1,2-Dichloro-, (E)- § 1,2-Dichloroethylene, trans-	156605 or 156-60-5 NIOSH: KV 9400000 SAX: DFI600	Toxin	—	—	1.58	100	0.05	0.5

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Dichloromethane (HM) §§ Methylene Chloride § R 30 § DCM § Freon 30 § Aerothene MM § NCI C50102 § Solmethine § Methylene Chloride § Methane Dichloride § Methane, Dichloro- § 1,1-Dichloromethane § Methylene Bichloride § Methylene Dichloride	75092 or 75-09-2 NIOSH: PA 8050000 SAX: MDR000	Carcinogen	—	—	0.9	5	N/A	0.5
2,4-Dichlorophenol §§ — § DCP § 2,4-DCP § NCI C55345 § Dichlorophenol, 2,4- § Phenol, 2,4-Dichloro- § RCRA Waste Number U081	120832 or 120-83-2 NIOSH: SK 8575000 SAX: DFX800	Harmful	—	—	40.7	0.3 (5)	N/A	10
2,4-Dichlorophenoxyacetic Acid §§ — § 2,4-D § Salvo § Phenox § Farmco § Amidox § Miracle § Agrotect § Weedtrol § Herbidal § Ded-Weed § Lawn-Keep § Fernimine § Crop Rider § Aqua-Kleen § Dichlorophenoxyacetic Acid § 2,4-Dichlorophenoxy Acetic Acid § Dichlorophenoxyacetic Acid, 2,4- § Acetic Acid, (2,4-Dichlorophenoxy)- § 2,4-Dichlorophenoxyacetic Acid, salts and esters	94757 or 94-75-7 NIOSH: AG 6825000 SAX: DFY600	Toxin	—	—	—	70	0.2	1
1,2-Dichloropropane §§ — § NCI C55141 § Propylene Chloride § Propylene Dichloride § Caswell Number 324 § Propane, 1,2-Dichloro- § α,β-Propylene Dichloride § alpha,beta-Dichloropropane § RCRA Waste Number U083 § EPA Pesticide Chemical Code 029002	78875 or 78-87-5 NIOSH: TX 9625000 SAX: DGF600	Toxin	—	—	4.11	0.52	0.01	0.5
1,3-Dichloropropene §§ Telone II § Telone § NCI C03985 § Vidden D § Dichloropropene § α-Chloroallyl Chloride § γ-Chloroallyl Chloride § Dichloropropene, 1,3- § 1,3-Dichloropropylene § 1,3-Dichloro-2-Propene § Propene, 1,3-Dichloro- § Telone II Soil Fumigant § 3-Chloropropenyl Chloride § alpha,gamma-Dichloropropylene	542756 or 542-75-6 NIOSH: UC 8310000 SAX: CEF750	Toxin	—	—	1.91	10	0.5	0.5
cis-1,3-Dichloropropene §§ Telone II § 1,3-Dichloropropene § 1,3-Dichloropropylene § (Z)-1,3-Dichloropropene § cis-1,3-Dichloropropylene § 1-Propene, 1,3-Dichloro-, (Z)-	10061015 or 10061-01-5 NIOSH: UC 8325000 SAX: DGH200	Toxin	—	—	1.91	10	0.01	0.5
trans-1,3-Dichloropropene §§ Telone II § 1,3-Dichloropropene § 1,3-Dichloropropylene § (E)-1,3-Dichloropropene § trans-1,3-Dichloropropylene § 1-Propene, 1,3-Dichloro-, (E)-	10061026 or 10061-02-6 NIOSH: UC 8320000 SAX: DGH000	Toxin	—	—	1.91	10	0.05	0.5

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Pollutant Element / Chemical Compound or Condition	CASRN, NIOSH and SAX Numbers (25) (26) (27)	Category (1) (2)	Aquatic Life Standards (16)		Bioconcentration Factor (BCF) (5)	Human Health Standards (17)	Trigger Value (22)	Required Reporting Value (19)
			Acute (3)	Chronic (4)				
Dieldrin §§ — § Alvit § Quintox § Octalox § Illoxol § Dieldrex § NCI C00124 § Dieldrite § SHA 045001 § RCRA Waste Number P037 § 1,4:5,8-Dimethanonaphthalene § Hexachloroepoxyoctahydro-endo,exo-Dimethanonaphthalene § 3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a,7,7a-Octahydro-2,7:3,6-Dimethanonaphth(2,3-b)Oxirene § 2,7:3,6-Dimethanonaphth(2,3-b)Oxirene, 3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a,7,7a-Octahydro- § 1,2,3,4,10,10-Hexachloro-6,7-Epoxy-1,4,4a,5,6,7,8,8a-Octahydro-Endo,Exo-1,4:5,8-Dimethanonaphthalene	60571 or 60-57-1 NIOSH: IO 1750000 SAX: DHB400	Carcinogen	1.25	0.0019	4,670	0.0014	N/A	0.02
Diethyl Phthalate §§ — § Anozol § Neantine § Solvanol § NCI C60048 § Placidole E § Ethyl Phthalate § Diethylphthalate § Diethyl-o-Phthalate § RCRA WAste Number U088 § 1,2-Benzenedicarboxylic Acid, Diethyl Ester	84662 or 84-66-2 NIOSH: TI 1050000 SAX: DJX000	Toxin	—	—	73	23,000	0.25	0.25
Dimethyl Phthalate §§ — § DMP § NTM § ENT 262 § Mipax § Avolin § Fermine § Solvanom § Solvarone § Palatinol M § Methyl Phthalate § Dimethylphthalate § Phthalic Acid, Dimethyl Ester § Dimethyl Benzene-o-Dicarboxylate § Dimethyl 1,2-Benzenedicarboxylate § 1,2-Benzenedicarboxylic Acid, Dimethyl Ester	131113 or 131-11-3 NIOSH: TI 1575000 SAX: DTR200	Toxin	—	—	36	310,000	0.04	0.25
2,4-Dimethylphenol §§ — § m-Xylenol § 2,4-Xylenol § 4,6-Dimethylphenol § Caswell Number 907A § 2,4-Dimethyl Phenol § Phenol, 2,4-Dimethyl- § RCRA Waste Number U101 § 1-Hydroxy-2,4-Dimethylbenzene § 4-Hydroxy-1,3-Dimethylbenzene § EPA'Pesticide Chemical Code 086804	105679 or 105-67-9 NIOSH: ZE 5600000 SAX: XKJ500	Harmful	—	—	93.8	400	N/A	10
4,6-Dinitro-o-Cresol §§ — § Detal § Sinox § DNOC § Arborol § Capsine § Dinitrol § Trifocide § Antinonin § Winterwash § Dinitrocresol § Dinitro-o-Cresol § Caswell Number 390 § 2,4-Dinitro-o-Cresol § Dinitro-o-Cresol, 4,6- § o-Cresol, 4,6-dinitro- § RCRA Waste Number P047 § 2-Methyl-4,6-Dinitrophenol § 4,6-Dinitro-2-Methylphenol § 2,4-Dinitro-6-Methylphenol § 3,5-Dinitro-2-Hydroxytoluene § Phenol, 2-Methyl-4,6-Dinitro-	534521 or 534-52-1 NIOSH: GO 9625000 SAX: DUT400	Toxin	—	—	5.5	13	16	50
2,4-Dinitrophenol §§ — § Nitro § Aldifen § Kleenup § 2,4-DNP § Chemox PE § Maroxol-50 § Solfo Black B § alpha-Dinitrophenol § Dinitrophenol, 2,4- § Phenol, 2,4-Dinitro- § Tertrosulphur Black PB § RCRA Waste Number P048 § 1-Hydroxy-2,4-Dinitrobenzene	51285 or 51-28-5 NIOSH: SL 2800000 SAX: DUZ000	Toxin	—	—	1.5	70	13	50

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2,4-Dinitrotoluene §§ — § 2,4-DNT § NCI C01865 § 2,4-Dinitrotoluol § Toluene, 2,4-Dinitro- § RCRA Waste Number U105 § Benzene, 1-Methyl-2,4-Dinitro-	121142 or 121-14-2 NIOSH: XT 1575000 SAX: DVH000	Carcinogen	—	—	3.8	1.1	N/A	10
2,6-Dinitrotoluene §§ — § 2,6-DNT § 2-Methyl-1,3-Dinitrobenzene § RCRA Waste Number U106	606202 or 606-20-2 NIOSH: XT 1925000 SAX: DVH400	Toxin	—	—	—	—	0.01	—
Dinoseb §§ — § DNBP § DBNF § Aretit § Basanite § Caldon § Sparic § Kiloseb § Spurge § Premerge § Dinitro § Hel-Fire § SHA 037505 § Dow General § Sinox General § RCRA Waste Number P020 § Dow General Weed Killer § Vertac General Weed Killer § 2-sec-Butyl-4,6-Dinitrophenol § Dinitro-Ortho-Sec-Butyl Phenol § 2-(1-Methylpropyl)-4,6-Dinitrophenol § 4,6-Dinitro-2-(1-Methyl-n-Propyl)Phenol § Phenol, 2-(1-Methylpropyl)-4,6-Dinitro-	88857 or 88-85-7 NIOSH: SJ 9800000 SAX: BRE500	Toxin	—	—	—	7	0.19	1.5
Dioxin §§ — § TCDD § TCDBD § NCI C03714 § Dioxine § Tetradioxin § 2,3,7,8-TCDD § 2,3,7,8-Tetrachlorodibenzo-p-Dioxin § 2,3,7,8-Tetrachlorodibenzo-1,4-Dioxin § Dibenzo[b,e][1,4]Dioxin, 2,3,7,8-Tetrachloro-	1746016 or 1746-01-6 NIOSH: HP 3500000 SAX: TAI000	Carcinogen	—	—	5,000	0.00000003	N/A	1
1,2-Diphenylhydrazine §§ — § Hydrazobenzene § NCI C01854 § N,N'-Bianiline § Benzene, Hydrazodi- § RCRA Waste Number U109 § (sym)-Diphenylhydrazine § Diphenylhydrazine, 1,2- § Hydrazine, 1,2-Diphenyl-	122667 or 122-66-7 NIOSH: MW 2625000 SAX: HHG000	Carcinogen	—	—	24.9	0.4	N/A	10
Diquat §§ — § Actor § Feglox § Deiquat § Reglone § Aquacide § Dextrone § Paraquat § Preeglove § SHA 032201 § Weedtrine-D § Diquat Dibromide § Ethylene Dipyridylium Dibromide § 1,1-Ethylene 2,2-Dipyridylium Dibromide § 5,6-Dihydro-Dipyrido(1,2a,1c)Pyrazinium Dibromide § 9,10-Dihydro-8a,10a-Diazoniaphenanthrene(1,1'-Ethylene-2,'-Bipyridylium)Dibromide	85007 or 85-00-7 NIOSH: JM 5690000 SAX: DWX800	Toxin	—	—	—	20	0.44	10

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			Acute (3)	Chronic (4)				
Endosulfan §§ — § NCI C00566 § Malixv § Ensure § Beosit § Endocel § Thiodan § Cyclodan § Crisulfan § Benzoepin § Thiosulfan § SHA 079401 § Chlorthiepin § RCRA Waste Number P050 § Endosulfan (mixed isomers) § Hexachlorohexahydromethano 2,4,3-Benzodioxathiepin-3-Oxide § 1,4,5,6,7,7-Hexachloro-5-Norbornene-2,3-Dimethanol Cyclic Sulfite § 5-Norbornene-2, 3-Dimethanol, 1,4,5,6,7,7-Hexachloro Cyclic Sulfite § 6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-Hexahydro-6,9-Methano-2,4,3-Benzodioxathiepin-3-Oxide § 6,9-Methano-2,4,3-Benzodioxathiepin, 6,7,8,9,10,10-Hexachloro-1,5,5a,6,9,9a-Hexahydro-, 3-Oxide	115297 or 115-29-7 NIOSH: RB 9275000 SAX: BCJ250	Toxin	0.11	0.056	270	110	see Cis and Trans isomers	see Cis and trans isomers
Endosulfan, I §§ — § Thiodan I § Endosulfan-I § Alpha-Endosulfan § alpha-Endosulfan	959988 or 959-98-8 NIOSH: — SAX: —	Toxin	0.11	0.056	270	110	0.014	0.015
Endosulfan, II §§ — § Thiodan II § Endosulfan-II § Beta-Endosulfan § beta-Endosulfan	33213659 or 33213-65-9 NIOSH: — SAX: —	Toxin	0.11	0.056	270	110	0.004	0.024
Endosulfan Sulfate §§ — § 6,9-Methano-2,3,4-Benzodioxathiepin, 6,7	1031078 or 1031-07-8 NIOSH: — SAX: —	Toxin	—	—	270	110	0.05	0.05
Endothall §§ — § Hydout § Hydrothal-47 § Aquathol § SHA 038901 § Accelerate § Tri-Endothal § Endothal Hydout § RCRA Waste Number P088 § 3,6-Endooxohexahydrophthalic Acid § Phthalic Acid, Hexahydro-3,6-endo-Oxy- § 7-Oxabicyclo(2,2,1)Heptane-2,3-Dicarboxylic Acid § 1,2-Cyclohexanedicarboxylic Acid, 3,6-endo-Epoxy-	145733 or 145-73-3 NIOSH: RN 7875000 SAX: EAR000	Toxin	—	—	—	100	1	2
Endrin §§ — § NCI C00157 § Endrex § Mendrin § Nendrin § Hexadrin § SHA 041601 § Compound 269 § RCRA Waste Number P051 § 1,2,3,4,10,10-Hexachloro-6,7-Epoxy-1,4,4(a)5,6,7,8,8a-Octahydro-endo § 3,4,5,6,9,9-Hexachloro-1a,2,2a,3,6,6a,7,7a-Octahydro-2,7:3,6-Dimethanonaphth[2,3-b]oxirene § 1,4:5,8-Dimethanonaphthalene, 1,2,3,4,10,10-Hexachloro-6,7-Epoxy-1,4,4a,5,6,7,8,8a-Octahydro-Endo,Endo-	72208 or 72-20-8 NIOSH: IO 1575000 SAX: EAT500	Toxin with BCF >300	0.09	0.0023	3,970	0.76	N/A	0.3
Endrin Aldehyde §§ —	7421934 or 7421-93-4 NIOSH: — SAX: —	Toxin with BCF >300	—	—	3,970	0.76	N/A	0.025
Epichlorohydrin §§ — § ECH § Epoxy Propane § α-Epichlorohydrin § Chloromethyloxirane § RCRA Waste Number U041 § γ-Chloropropyleneoxide § 2-Chloropropylene Oxide § Glycerol Epichlorhydrin § 2,3-Epoxypropyl Chloride § 1-Chlor-2,3-Epoxypropane § 3-Chlor-1,2-Epoxypropane	106898 or 106-89-8 NIOSH: TX 4900000 SAX: CGN750	Carcinogen	—	—	—	30	N/A	—

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Ethylbenzene §§ — § EB § NCI C56393 § Ethylbenzol § Phenylethane § Ethyl Benzene § Benzene, Ethyl	100414 or 100-41-4 NIOSH: DA 0700000 SAX: EGP500	Toxin	—	—	37.5	700	0.002	0.5
1,2-Dibromoethane §§ Ethylene Dibromide § DBE § EDB § Nephis § Kopfume § Celmide § E-D-Bee § Soilfume § Bromofume § Dowfume 40 § SHA 042002 § Pestmaster § Soilbrom-40 § Dibromoethane § Ethylene Bromide § Glycol Dibromide § 1,2-Dibromoethane § Dibromoethane, 1,2- § 1,2-Ethylene Dibromide § RCRA Waste Number U067	106934 or 106-93-4 NIOSH: KH 9275000 SAX: EIY500	Carcinogen	—	—	—	0.05	N/A	0.5
Fluoranthene §§ — § Idryl § Benzo(jk)Fluorene § Benzo(j,k)Fluorene § 1,2-Benzacenaphthene § RCRA Waste Number U120 § 1,2-(1,8-Naphthylene)Benzene § Benzene, 1,2-(1,8-Naphthalenediyl)-	206440 or 206-44-0 NIOSH: LL 4025000 SAX: FDF000	Toxin with BCF >300	—	—	1,150	300	N/A	10
Fluorene (PAH) §§ — § 9H-Fluorene § Diphenylenemethane § o-Biphenylenemethane § 2,2'-Methylenebiphenyl	86737 or 86-73-7 NIOSH: — SAX: —	Carcinogen	—	—	30	13,000	N/A	0.25
Fluorine §§ Flouride § Fluoride § Fluoride(1-) § Perfluoride § Fluoride Ion § Fluorine, Ion § Soluable Fluoride § RCRA Waste Number P056 § Hydrofluoric Acid, Ion(1-)	7782414 or 7782-41-4 NIOSH: LM 6475000 SAX: FEZ000	Toxin	—	—	—	4,000	5	100
Fluoride §§ Flourine § Fluoride § Fluoride(1-) § Perfluoride § Fluoride Ion § Fluorine, Ion § Soluable Fluoride § RCRA Waste Number P056 § Hydrofluoric Acid, Ion(1-)	16984488 or 16984-48-8 NIOSH: LM 6290000 SAX: FEX875	Toxin	—	—	—	4,000	5	100
Gamma Emitters (10) §§ —	Multiple	Carcinogen / Radioactive	—	—	—	40 mrem ede/yr	N/A	—
Gases, dissolved, total-pressure (20) §§ —	Multiple	Toxin	—	110% of saturation	—	—	—	—
Glyphosate §§ — § Jury § Honcho § Rattler § Weedoff § Roundup § Glifonox § n-(Phosphonomethyl)-Glycine § Glycine, n-(Phosphonomrthyl)- § Glyphosate plus inert ingrediants § MON 0573	1071836 or 1071-83-6 NIOSH: MC 1075000 SAX: PHA500	Toxin	—	—	—	700	6	50
Glyphosate Isopropylamine Salt §§ — § SHA 103601	38641940 or 38641-94-0 NIOSH: — SAX: —	Toxin	—	—	—	700	6	50

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Guthion §§ — § DBD § NCI C00066 § Carfene § Gothnion § Azinphos § Crysthyon § Gusathion § Bay 17147 § Methylazinphos § Methyl Guthion § Methyl-Guthion § Azinphos-Methyl § Azinphos Methyl § Caswell Number 374 § EPA Pesticide Chemical Code 058001 § o,o-Dimethylphosphorodithioate S-Ester § 3-Mercaptomethyl)-1,2,3-Benzotriazin-4(3H)-One § Benzotriazinedithiophosphoric Acid Dimethoxy Ester § 3-Dimethoxyphosphinothiomethyl-1,2,3-Benzotriazin-4(3H)-One § Phosphorodithioic Acid, O,O-Dimethyl Ester, S-Ester with 3-(Mercaptomethyl)-1,2,3-Benzotriazin-4(3H)-One	86500 or 86-50-0 NIOSH: TE 1925000 SAX: ASH500	Toxin	—	0.01	—	—	—	—
Hardness, total §§ —	N/A	Narrative (18)	—	—	—	—	N/A	1,000
Heptachlor §§ — § NCI C00180 § Drinox § Heptamul § Agroceris § Heptagran § SHA 04481 § Rhodiachlor § Velsicol-104 § RCRA Waste Number P059 § 3,4,5,6,7,8,8a-heptachlorodicyclopentadiene § Dicyclopentadiene, 3,4,5,6,7,8,8a-Heptachloro- § 1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-Tetrahydro-4,7-Methanol-1H-Indene § 4,7-Methano-1H-Indene, 1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-Tetrahydro- § 1(3a),4,5,6,7,8,8-Heptachloro-3a(1),4,7,7a-Tetrahydro-4,7-Methanoindene	76448 or 76-44-8 NIOSH: PC 0700000 SAX: HAR000	Carcinogen	0.26	0.0038	11,200	0.0021	N/A	0.2
Heptachlor Epoxide §§ — § HCE § Velsicol 53-CS-17 § Epoxyheptachlor § 1,4,5,6,7,8,8-Heptachloro-2,3-Epoxy-2,3,3a,4,7,7a-Hexahydro-4,7-Methanoindene § 2,5-Methano-2H-Indeno[1,2b]Oxirene, 2,3,4,5,6,7,7-Heptachloro-1a,1b,5,5a,6,6a-Hexahydro- (alpha, beta, and gamma isomers)	1024573 or 1024-57-3 NIOSH: PB 9450000 SAX: EBW500	Carcinogen	0.26	0.0038	11,200	0.001	N/A	0.1
Hexachlorobenzene §§ — § HCB § Amatin § Smut-Go § Sanocide § Anticarie § Bunt-Cure § Bunt-No-More § Perchlorobenzene § Phenyl Perchloryl § No Bunt Liquid § Julin's Carbon Chloride § Co-op Hexa § Hexa C.B. § Benzene, Hexachloro-	118741 or 118-74-1 NIOSH: DA 2975000 SAX: HCC500	Carcinogen	—	—	8,690	0.0075	N/A	0.2
Hexachlorobutadiene §§ — § HCBD § Dolan-Pur § Perchlorobutadiene § RCRA Waste Number U128 § 1,3-Hexachlorobutadiene § 1,3-Butadiene, Hexachloro- § 1,1,2,3,4,4-Hexachloro-1,3-Butadiene § 1,3-Butadiene, 1,1,2,3,4,4-Hexachloro-	87683 or 87-68-3 NIOSH: EJ 0700000 SAX: PCF000	Carcinogen	—	—	2.78	4.4	N/A	10
Hexachlorocyclohexane §§ — § BHC § DBH § HCH § HCCH § HEXA § Hexylan § Hexachlor § Gammexane § Hexachloran § Compound 666 § Benzenehexachloride § Benzene Hexachloride	608731 or 608-73-1 NIOSH: GV 3150000 SAX: BBP750	Carcinogen	—	—	130	0.039	N/A	0.1

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alpha-Hexachlorocyclohexane §§ — § Benzene Hexachloride-α-isomer § α-BHC § alpha-BHC § HCH-alpha § alpha-HCH § alpha-Lindane § α Hexachlorocyclohexane § alpha-Benzenehexachloride § Hexachlorocyclohexane-alpha § alpha-Hexachlorocyclohexane § Benzene Hexachloride-alpha-isomer § alpha-1,2,3,4,5,6-Hexachlorocyclohexane § Cyclohexane, alpha-1,2,3,4,5,6-Hexachloro- § 1-alpha,2-alpha,3-beta,4-alpha,5-beta,6-beta-Hexachlorocyclohexane § Cyclohexane, alpha-1,2,3,4,5,6-Hexachloro-, (1-alpha, 2-alpha, 3-beta, 4-alpha, 5-beta, 6-beta)-	319846 or 319-84-6 NIOSH: GV 3500000 SAX: BBQ000	Carcinogen	—	—	130	0.039	N/A	0.1
beta-Hexachlorocyclohexane §§ — § ß-BHC § beta-BHC § HCH-beta § beta-HCH § ß-Lindane § beta-Lindane § beta-Hexachlorobenzene § ß Hexachlorocyclohexane § Hexachlorocyclohexane-beta § Hexachlorocyclohexane, beta- § trans-alpha-Benzenehexachloride § Benzenehexachloride, trans-alpha- § beta-1,2,3,4,5,6-Hexachlorocyclohexane § Cyclohexane, 1,2,3,4,5,6-Hexachloro-, beta- § 1-alpha,2-beta,3-alpha,4-beta,5-alpha,6-beta-Hexachlorocyclohexane § Cyclohexane, 1,2,3,4,5,6-Hexachloro-, (1-alpha, 2-beta, 3-alpha, 4-beta, 5-alpha, 6-beta)-	319857 or 319-85-7 NIOSH: GV 4375000 SAX: BBR000	Carcinogen	—	—	130	0.14	N/A	0.1
delta-Hexachlorocyclohexane §§ — § δ-BHC § delta-BHC § HCH-delta § delta-HCH § Δ-BHC § Δ-Lindane § delta-Lindane § δ Hexachlorocyclohexane § delta-Benzenehexachloride § Hexachlorocyclohexane-delta § Hexachlorocyclohexane, delta- § Cyclohexane, delta-1,2,3,4,5,6-Hexachloro- § delta-1,2,3,4,5,6-Hexachlorocyclohexane § 1-alpha,2-alpha,3-alpha,4-beta,5-alpha,6-beta-Hexachlorocyclohexane § Cyclohexane, delta-1,2,3,4,5,6-Hexachloro-, (1-alpha, 2-alpha, 3-alpha, 4-beta, 5-alpha, 6-beta)-	319868 or 319-86-8 NIOSH: GV 4550000 SAX: BFW500	Toxin	—	—	130	—	0.009	0.1
gamma-hexachlorocyclohexane §§ Lindane § ΓBHC § γ-BHC § Gamene § Lintox § Lentox § Hexcide § Aparsin § Agrocide § Afcide § BHC-gamma § gamma-BHC § HCH-gamma § gamma-HCH § Γ Hexachlorocyclohexane § gamma-Hexachlorobenzene § gamma-Benzenehexachloride § gamma-Benzene Hexachloride § Hexachlorocyclohexane-gamma § Hexachlorocyclohexane (gamma) § Benzene Hexachloride-gamma-isomer § gamma-1,2,3,4,5,6-Hexachlorocyclohexane § Cyclohexane, 1,2,3,4,5,6-Hexachloro-, gamma-isomer § 1,2,3,4,5,6-Hexachlorocyclohexane, gamma-isomer § 1-alpha,2-alpha,3-beta,4-alpha,5-alpha,6-beta-Hexachlorocyclohexane § Cyclohexane, 1,2,3,4,5,6-Hexachloro-, (1-alpha, 2-alpha, 3-beta, 4-alpha, 5-alpha, 6-beta)	58899 or 58-89-9 NIOSH: GV 4900000 SAX: BBQ500	Carcinogen	1	0.08	130	0.19	N/A	0.1
Hexachlorocyclopentadiene §§ — § HEX § HCP § PCL § C-56 § HCCPD § NCI C55607 § Hexachloropentadiene § RCRA Waste Number U130 § Perchlorocyclopentadiene § 1,3-Cyclopentadiene, 1,2,3,4,5,5-Hexachloro-	77474 or 77-47-4 NIOSH: GY 1225000 SAX: HCE500	Harmful	—	—	4.34	1	N/A	1

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Hexachloroethane §§ — § Avlotane § Distokal § Distopan § Distopin § Egitol § Falkitol § Fasciolin § NCI C04604 § Phenohep § Mottenhexe § Perchloroethane § Hexachloroethylene § Ethane, Hexachloro- § Carbon Hexachloride § Ethane Hexachloride § Ethylene Hexachloride § RCRA Waste Number U131 § 1,1,1,2,2,2-Hexachloroethane	67721 or 67-72-1 NIOSH: KI 4025000 SAX: HCI000	Carcinogen	—	—	86.9	19	N/A	10
Hydrogen Sulfide §§ — § Stink Damp § Sulfur Hydride § Hydrogen Sulphide § Dihydrogen Sulfide § Hydrosulfuric Acid § Sulfurated Hydrogen § RCRA Waste Number U135 § Dihydrogen Monosulfide § Hydrogen Sulfuric Acid	7783064 or 7783-06-4 NIOSH: MX 1225000 SAX: HIC500	Toxin	—	2	—	—	200	200
Indeno(1,2,3-cd)pyrene (PAH) §§ — § o-Phenylenepyrene § 2,3-Phenylenepyrene § 2,3-o-Phenylenepyrene § RCRA Waste Number U137 § Indeno (1,2,3-cd) Pyrene § 1,10-(o-Phenylene)Pyrene § 1,10-(1,2-Phenylene)Pyrene	193395 or 193-39-5 NIOSH: NK 9300000 SAX: IBZ000	Carcinogen	—	—	30	0.044	N/A	0.5
Iodine (10) §§ I	Iodine 129 15046841 or 15046-84-1 NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	40 mrem ede/yr	N/A	—
Iodine (10) §§ I	Iodine 131 10043660 or 10043-66-0 NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	40 mrem ede/yr	N/A	—
Iodine (10) §§ I	Iodine 133 — NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	40 mrem ede/yr	N/A	—
Iron (9) §§ Fe § Ancor EN 80/150 § Carbonyl Iron § Armco Iron	7439896 or 7439-89-6 NIOSH: NO 4565500 SAX: IGK800	Harmful	—	1,000	—	300 45mg/l, significant	N/A	10
Isophorone §§ — § Isoforon § NCI C55618 § Isoacetophorone § alpha-Isophorone § 1,1,3-Trimethyl-3-Cyclohexene-5-One § 3,5,5-Trimethyl-2-Cyclohexene-1-One § 3,5,5-Trimethyl-2-Cyclohexone	78591 or 78-59-1 NIOSH: GW 7700000 SAX: IHO000	Carcinogen	—	—	4.38	360	N/A	10
Lead (9) §§ Pb § C.I. 77575 § C.I. Pigment Metal 4 § Glover § Lead Flake § Lead 22 § Omaha § Omaha & Grant § SI § SO	7439921 or 7439-92-1 NIOSH: OF 7525000 SAX: LCF000	Toxin	82 @ 100 mg/l hardness (12)	3.2 @ 100 mg/l hardness (12)	49	15	0.1	3

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Malathion §§ — § Formal § Sumitox § Emmatos § Celthion § Forthion § Malacide § Kop-Thion § Calmathion § Carbethoxy § NCI C00215 § Carbethoxy Malathion § SHA 057701 § Phosphothion § S-1,2-Bis(Ethoxycarbonyl)Ethyl-O,O-Dimethyl Thiophosphate § O,O-Dimethyl-S-(1,2-Dicarbethoxyethyl) Dithiophosphate § O,O-Dimethyl S-1,2-Di(Ethoxycarbamyl)Ethyl Phosphorodithioate § Succinic Acid, mercapto-, diethyl ester, S-Ester with O,O-Dimethyl Phosphorodithioate	121755 or 121-75-5 NIOSH: WM 8400000 SAX: CBP000	Toxin	—	0.1	—	—	—	—
Manganese (9) §§ Mn § Colloidal Manganese § Magnacat § Tronamang	7439965 or 7439-96-5 NIOSH: OO 9275000 SAX: MAP750	Harmful	—	—	—	50	N/A	5
Mercury (9) §§ Hg § Colloidal Mercury § Mercury, Metallic § NCI C60399 § Quick Silver § RCRA Waste Number U151	7439976 or 7439-97-6 NIOSH: OV 4550000 SAX: MCW250	Toxin with BCF >300	2.4	0.012	5,500	0.14	N/A	0.6
Methoxychlor §§ — § DMDT § Metox § Moxie § Methoxcide § NCI C00497 § Methoxy-DDT § Dimethoxy-DDT § RCRA Waste Number U247 § 1,1,1-Trichloro-2,2-Bis(p-Methoxyphenyl)Ethane § Benzene, 1,1'-(2,2,2-Trichloroethylidene)Bis[4-Methoxy- § 1,1'-(2,2,2-Trichloroethylidene)Bis[4-Methoxybenzene] § Ethane, 1,1,1-Trichloro-2,2-Bis(p-Methoxyphenyl)-	72435 or 72-43-5 NIOSH: KJ 3675000 SAX: DOB400	Toxin	—	0.03	—	40	0.04	1
Methyl Chloride §§ Chloromethane § Arctic § Monochloromethane § RCRA Waste Number U045	74873 or 74-87-3 NIOSH: PA 6300000 SAX: CHX500	Toxin	—	—	3.75	—	0.08	—
Mirex §§ — § NCI C06428 § Dechlorane § Bichlorendo § Ferriamicide § Perchloropentacyclodecane § Dodecachloropentacyclodecane § Hexachlorocyclopentadiene Dimer § Cyclopentadiene, Hexachloro-, Dimer § Perchloropentacyclo(5.2.1.0[sup 2,6].0[sup 3,9].0[sup 5,8])Decane § Dodecachlorooctahydro-1,3,4-Metheno-2H-Cyclobuta (c,d)Pentalene § 1,1a,2,2,3,3a,4,5,5,5a,5b,6-Dodecachlorooctahydro-1,3,4-Metheno-1H-Cyclobuta(cd)Pentalene § 1,3,4-Metheno-1H-Cyclobuta[cd]Pentalene, 1,1a,2,2,3,3a,4,5,5,5a,5b,6,-Dodecachlorooctahydro-	2385855 or 2385-85-5 NIOSH: PC 8225000 SAX: MQW500	Toxin	—	0.001	—	—	0.01	0.1
Naphthalene §§ — § Mighty 150 § NCI C52904 § Naphthene § White Tar § Moth Balls § Naphthalin § Tar Camphor § Caswell Number 587 § RCRA Waste Number U165 § EPA Pesticide Chemical Code 055801	91203 or 91-20-3 NIOSH: QJ 0525000 SAX: NAJ500	Toxin	—	—	10.5	—	0.04	10

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Pollutant Element / Chemical Compound or Condition	CASRN, NIOSH and SAX Numbers (25) (26) (27)	Category (1) (2)	Aquatic Life Standards (16)		Bioconcentration Factor (BCF) (5)	Human Health Standards (17)	Trigger Value (23)	Required Reporting Value (19)
			Acute (3)	Chronic (4)				
Nickel (9) §§ Ni § C.I. 77775 § Ni 270 § Nickel 270 § Ni 0901-S § Ni 4303T § NP 2 § Raney Alloy § Raney Nickel	7440020 or 7440-02-0 NIOSH: QR 5950000 SAX: NCW500	Toxin	1,400 @ 100 mg/l hardness (12)	160 @ 100 mg/l hardness (12)	47	100	0.5	20
Nitrate (as Nitrogen[N]) §§ NO_3	14797558 or 14797-55-8 NIOSH: — SAX: —	Toxin	(8)	(8)	—	10,000	10, Surface 2,500, Ground	10
Nitrite (as Nitrogen[N]) §§ NO_2	14797650 or 14797-65-0 NIOSH: — SAX: —	Toxin	(8)	(8)	—	1,000	4	10
Nitrate plus nitrite (as Nitrogen[N]) §§ NO_3 + NO_2	17778880 or 17778-88-0 NIOSH: — SAX: —	Toxin/Harmful	(8)	(8)	—	10,000	10, Surface 2,500, Ground	10
Nitrobenzene §§ — § NCI C60082 § Mirbane Oil § Nitrobenzol § Oil of Mirbane § Benzene, Nitro- § Essence of Myrbane § RCRA Waste Number U169	98953 or 98-95-3 NIOSH: DA 6475000 SAX: NEX000	Toxin	—	—	2.89	17	1.9	10
o-Nitrophenol §§ — § 2-Nitrophenol § 2-Hydroxynitrobenzene	88755 or 88-75-5 NIOSH: SM 2100000 SAX: NIE500	Toxin	—	—	2.33	—	0.45	—
4-Nitrophenol §§ — § 4-Hydroxynitrobenzene § NCI C55992 § p-Nitrophenol (DOT) § RCRA Waste Number U170	100027 or 100-02-7 NIOSH: SM 2275000 SAX: NIF000	Toxin	—	—	3.31	—	2.4	—
N-Nitrosodi-N-Propylamine §§ — § DPN § DPNA § NDPA § Dipropylnitrosamine § N-Nitrosodipropylamine § Di-n-Propylnitrosamine § RCRA WAste Number U111 § Dipropylamine, N-Nitroso- § N-Nitrosodi-n-propylamine § N-Nitroso-di-n-propylamine § 1-Propanamine, N-Nitroso-n-Propyl-	621647 or 621-64-7 NIOSH: JL 9700000 SAX: DWU600	Carcinogen	—	—	1.13	0.05	N/A	10
N-Nitrosodimethylamine §§ Dimethylnitrosamine § DMN § NDMA § DMNA § Nitrosodimethylamine § Dimethylnitrosoamine § N-Nitrosodimethylamine § RCRA Waste Number P082 § N,N-Dimethylnitrosamine § Methylamine, N-Nitrosodi- § Dimethylamine, N-Nitroso- § N-Methyl-N-Nitrosomethanamine § Methamine, N-Methyl-N-Nitroso- § Methanamine, N-Methyl-N-Nitroso-	62759 or 62-75-9 NIOSH: IQ 0525000 SAX: DSY400	Carcinogen	—	—	0.026	0.0069	N/A	10

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N-Nitrosodiphenylamine §§ — § NDPA § NDPhA § Vultrol § Curetard A § NCI C02880 § Redax § TJP § Retarder J § Vulcalent A § Vulcatard § Vultrol § Nitrosodiphenylamine § Diphenylnitrosamine § N,N-Diphenylnitrosamine § N-Nitroso-N-Phenylaniline § Diphenylamine, N-Nitroso- § Benzenamine, N-Nitroso-N-Phenyl-	86306 or 86-30-6 NIOSH: JJ 9800000 SAX: DWI000	Carcinogen	—	—	136	50	N/A	10
N-Nitrosopyrrolidene §§ — § NPYR § NO-pyr § N-N-pyr § 1-Nitrosopyrrolidene § Pyrrolidine, 1-Nitroso- § RCRA Waste Number U180 § Tetrahydro-N-Nitrosopyrrole § Pyrrole, Tetrahydro-N-Nitroso-	930552 or 930-55-2 NIOSH: UY 1575000 SAX: NLP500	Carcinogen	—	—	0.055	0.17	N/A	10
Odor (13) §§ —	N/A	Harmful	—	—	—	—	N/A	—
Oxamyl §§ — § D-1410 § DPX 1410 § Insecticide-Nematicide 1410 § Vydate § Thioxamyl § Methyl 2-(Dimethylamino)-N- § Vydate L, Insecticide/Nematicide § ({[Methylamino]Carbonyl}Oxy)-2-Oxoethanimidothioate § 2-Dimethylamino-1-(Methylthio)Glyoxal O-Methylcarbamoylmonoxime § S-Methyl 1-Dimethylcarbamoyl)-N ({Methylcarbamoyl}Oxy)Thioformimidate § Methyl N',N'-Dimethyl-N-({Methylcarbamoyl}Oxy)-1-Thiooxamimidate § N',N'-Dimethyl-N-[(Methylcarbamoyl)oxy]-1-Methylthiooxamimidic Acid	23135220 or 23135-22-0 NIOSH: RP 2300000 SAX: DSP600	Toxin	—	—	—	200	1	1
Oxygen, dissolved (20) §§ O_2 § Oxygen, Compressed § Oxygen, Refrigerated Liquid	7782447 or 7782-44-7 NIOSH: RS 2060000 SAX: OQW000	Toxin	(13) (15)	(15)	—	—	50	100
Parathion §§ — § DNTP § Niran § Phoskil § Paradust § Stathion § Strathion § Pestox Plus § Nitrostigmine § Parathion Ethyl § Parathion-ethyl § Ethyl Parathion § Diethylparathion § Caswell Number 637 § RCRA Waste Number P089 § EPA Pesticide Chemical Code 057501 § Diethyl 4-Nitrophenylphosphorothioate § Diethyl para-Nitrophenol Thiophosphate § Diethyl-p-Nitrophenyl Monothiophosphate § O,O-Diethyl O-4-Nitrophenyl Thiophosphate § Phosphorothioic Acid, O,O-Diethyl O-(4-Nitrophenyl) Ester	56382 or 56-38-2 NIOSH: TF 4920000, dry TF 4950000, liquid SAX: PAK250, dry SAX: PAK260, liquid	Toxin	0.065	0.013	—	—	0.06	1
Pentachlorobenzene §§ — § QCB § Benzene, Pentachloro- § RCRA Waste Number U183	608935 or 608-93-5 NIOSH: DA 6640000 SAX: PAV500	Toxin with BCF >300	—	—	2,125	3.5	N/A	0.1

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Pentachlorophenol §§ — § PCP § Penta § Durotox § Weedone § Chem-Tol § Lauxtol A § NCI C54933 § NCI C55378 § NCI C56655 § Permite § Dowcide 7 § Permacide § Penta-Kil § Permagard § Penchlorol § Chlorophen § Pentachlorphenol § Pentaclorofenolo § Thompson's Wood Fix § Phenol, Pentachloro- § 2,3,4,5,6-Pentachlorophenol § 1-Hydroxy-2,3,4,5,6-Pentachlorobenzene	87865 or 87-86-5 NIOSH: SM 6300000 SAX: PAX250	Carcinogen	20 @ pH of 7.8 (14)	13 @ pH of 7.8 (14)	11	1	N/A	0.05
pH (13) §§ —	N/A	Harmful - Surface Narrative - Ground	—	—	—	—	N/A	—
Phenanthrene (PAH) §§ — § Phenantrin	85018 or 85-01-8 NIOSH: SF 7175000 SAX: PCW250	Toxin	—	—	30	—	0.01	0.25
Phenol §§ — § Baker's P and S Liquid and Ointment § NCI C50124 § Benzenol § Monophenol § Oxybenzene § Phenic Acid § Carbolic Acid § Phenylic Acid § Hydroxybenzene § Hydroxybenzene § Phenyl Alcohol § Phenyl Hydrate § Phenylic Alcohol § Phenyl Hydroxide § Benzene, Hydroxy- § Monohydroxybenzene § RCRA Waste Number U188	108952 or 108-95-2 NIOSH: SJ 3325000 SAX: PDN750	Harmful	—	—	1.4	300	N/A	10
Phosphorus, inorganic (9) (20) §§ — § Ortho-phosphorus § phosphorus, Ortho-	14265442 or 14265-44-2 NIOSH: — SAX: —	Harmful	(8)	(8)	—	—	1	1
Picloram §§ — § ATCP § K-Pin § Tordon § Borolin § Amdon Grazon § NCI C00237 § Tordon 10K § Tordon 22K § Tordon 101 Mixture § 3,5,6-Trichloro-4-Aminopicolinic Acid § 4-Amino-3,5,6-Trichloropicolinic Acid	1918021 or 1918-02-1 NIOSH: TJ 7525000 SAX: AMU250	Toxin	—	—	—	500	0.14	1
Pyrene (PAH) §§ — § ß-Pyrine § beta-Pyrene § Benzo(def)Phenanthrene § Benzo[def]Phenanthrene	129000 or 129-00-0 NIOSH: UR 2450000 SAX: PON250	Carcinogen	—	—	30	9,600	N/A	0.25
Radium 226 §§ —	Radium 226 13982636 or 13982-63-6 NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	200 picocuries/liter. Note: The sum of Radium 226 and 228.	N/A	—
Radium 228 §§ —	Radium 228 15262201 or 15262-20-1 NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	200 picocuries/liter. Note: The sum of Radium 226 and 228.	N/A	—

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			Acute (3)	Chronic (4)				
Radon 222 §§ —	14859677 or 14859-67-7 NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	3000 picocuries/liter	N/A	—
Sediment, settelable solids, oils, grease, or floating solids (18) §§ — § Methylene Blue Active Substances, § Residue, non-filterable, § Residue, non-settleable, § Settleable matter, § Oil & Grease, § Total Organic Carbon, § Hydrocarbons	N/A	Narrative (13)	—	—	—	—	N/A	—
Selenium (9) §§ Se § C.I. 77805 § Colloidal Selenium § Elemental Selenium § Selenium Alloy § Selenium Base § Selenium Dust § Selenium Elemental § Selinium Homopolymer § Selenium Metal Powder, Non-Pyrophoric § Vandex	7782492 or 7782-49-2 NIOSH: VS 7700000 VS 8310000, colloidal SAX: SBO500 SAX: SBP000, colloidal	Toxin	20	5	6	50	0.6	1
Silver (9) §§ Ag § Argentum § C.I. 77820 § Shell Silver § Silver Atom	7440224 or 7440-22-4 NIOSH: VW 3500000 SAX: SDI500	Toxin	4.1 @ 100 mg/l hardness (12)	—	0.5	—	0.2	3
Simazine §§ — § CDT § Herbex § Framed § Bitemol § Radokor § A 2079 § Batazina § Cat (Herbicide) § CET § G 27692 § Geigy 27,692 § Gesaran § Gesatop 50 § Simazine 80W § Symazine § Taphazine § W 6658 § Zeapur § Princep § Aquazine § Herbazin § Tafazine § 2,4-bis(Ethylamino)-6-Chloro-s-Triazine § 1-Chloro, 3,5-Bisethylamino-2,4,6-Triazine § 2-Chloro-4,6-Bis(Ethylamino)-1,3,5-Triazine § 6-Chloro-N,N'-Diethyl-1,3,5-Triazine-2,4-Diyldiamine	122349 or 122-34-9 NIOSH: XY 5250000 SAX: BJP000	Carcinogen	—	—	—	4	N/A	0.3
Strontium 89 (10) §§ —	14158271 or 14158-27-1 NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	40 mrem ede/yr. Note: the sum of the dosage from Strontium 89 plus 90 cannot exceed this value.	N/A	—
Strontium 90 (10) §§ —	10098972 or 10098-97-2 NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	40 mrem ede/yr. Note: the sum of the dosage from Strontium 89 plus 90 cannot exceed this value.	N/A	—
Styrene §§ — § Styrol § Cinnamol § Cinnamene § Cinnamenol § NCI C02200 § Styrole § Strolene § Styron § Stropor § Vinylbenzol § Phenethylene § Phenylethene § Vinylbenzene § Ethenylbenzene § Phenylethylene § Benzene, Vinyl- § Styrene, Monomer	100425 or 100-42-5 NIOSH: WL 3675000 SAX: SMQ000	Toxin	—	—	—	100	0.008	0.5

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Sulfate §§ SO_4	14808798 or 14808-79-8 NIOSH: — SAX: SNS000	Narrative (18)	—	—	—	—	N/A	1,000
Temperature (13) §§ —	N/A	Harmful	—	—	—	—	N/A	—
1,2,4,5-Tetrachlorobenzene §§ — § RCRA Waste Number U207 § Tetrachlorobenzene, 1,2,4,5- § Benzene, 1,2,4,5-Tetrachloro-	95943 or 95-94-3 NIOSH: DB 9450000 SAX: TBN750	Toxin with BCF >300	—	—	1,125	2.3	N/A	0.1
1,1,2,2-Tetrachloroethane §§ — § TCE § Cellon § Westron § Bonoform § Tetrachloroethane § sym-Tetrachloroethane § RCRA Waste Number U209 § Acetylene Tetrachloride § Tetrachloroethane, 1,1,2,2- § Ethane, 1,1,2,2-Tetrachloro- § 1,1-Dichloro-2,2-Dichloroethane	79345 or 79-34-5 NIOSH: KI 8575000 SAX: ACK500	Carcinogen	—	—	5	1.7	N/A	0.5
Tetrachloroethylene §§ — § NCI C04580 § PCE § Perk § PERC § ENMA § Dow-Per § Perchlor § Perclene § Perklone § Didakene § Tetra Cap § Percosolve § Perchlorethylene § Perchloroethylene § Tetrachloroethene § Carbon Bichloride § Carbon Dichloride § RCRA Waste Number U210 § Ethylene Tetrachloride § Ethylene, Tetrachloro- § 1,1,2,2-Tetrachloroethylene	127184 or 127-18-4 NIOSH: KX 3850000 SAX: TBQ250	Carcinogen	—	—	30.6	5	N/A	0.5
Thallium (9) §§ Tl § Ramor	7440280 or 7440-28-0 NIOSH: XG 3425000 SAX: TEI000	Toxin	—	—	119	1.7	0.3	3
Toluene §§ — § Antisal 1a § NCI C07272 § Toluol § Tolu-Sol § Methacide § Methylbenzol § Methylbenzene § Phenylmethane § Phenyl-Methane § Methyl-Benzene § Benzene, Methyl § RCRA Waste Number U220	108883 or 108-88-3 NIOSH: XS 5250000 SAX: TGK750	Toxin	—	—	10.7	1,000	0.01	0.5
Total dissolved solids (20) §§ TDS § Solids, total dissolved	Multiple	Narrative (18)	—	—	—	—	N/A	10,000
Toxaphene §§ — § Attac 4-2 § Alltox § Alltex § Attac 6 § Toxakil § Agricide § Chem-Phene § Clor Chem T-590 § Compound 3956 § Crestoxo § Estonox § Geniphene § Gy-Phene § Hercules 3956 § Melipax § Motox § PCC § Phenacide § Phenatox § Toxadust § Camphechlor § Maggot Killer (F) § Toxaphene mixture § Chlorinated-Camphene § Camphene, Octachloro- § RCRA Waste Number P123	8001352 or 8001-35-2 NIOSH: XW 5250000 SAX: THH750	Carcinogen	0.73	0.0002	13,100	0.0073	N/A	1

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1,2,4-Trichlorobenzene §§ — § unsym-Trichlorobenzene § Trichlorobenzene, 1,2,4- § Benzene, 1,2,4-Trichloro-	120821 or 120-82-1 NIOSH: DC 2100000 SAX: TIK250	Toxin	—	—	114	70	0.02	0.5
1,1,1-Trichloroethane §§ — § α-T § Strobane § Inhibisol § 1,1,1-TCE § Tri-Ethane § Solvent 111 § Aerothene TT § Chloroethene § Chlorten § NCI C04626 § Methylchloroform § Methyl Chloroform § Chloroform, Methyl- § 1,1,1-Trichloroethene § alpha-Trichloroethane § Methyltrichloromethane § RCRA WAste Number U226 § Trichloroethane, 1,1,1- § Ethane, 1,1,1-Trichloro-	71556 or 71-55-6 NIOSH: KJ 2975000 SAX: TIM750	Carcinogen	—	—	5.6	200	N/A	0.5
1,1,2-Trichloroethane §§ — § 8-T § Vinyl Trichloride § Ethane Trichloride § beta-Trichloroethane § 1,2,2-Trichloroethane § RCRA Waste Number U227 § Trichloroethane, 1,1,2- § NCI C04579 § Ethane, 1,1,2-Trichloro- § Caswell Number 875A [NLM] § EPA Pesticide Chemical Code 081203 [NLM]	79005 or 79-00-5 NIOSH: KJ 3150000 SAX: TIN000	Carcinogen	—	—	4.5	5	N/A	0.5
Trichloroethylene §§ — § TCE § Triad § Vitran § Algylen § Dow-Tri § Lanadin § Vestrol § Anamenth § Benzinol § Tri-Plus § Tri-Clene § Trichlorethene § Trichloroethene § Trichloroethane § Trichlorethylene § Tetrachloroethene § Ethene, Trichloro- § Ethylene Trichloride § Ethylene, Trichloro- § Acetylene Trichloride § 1,1,2-Trichloroethylene § 1,2,2-Trichloroethylene § 1-Chloro-2,2-Dichloroethylene § 1,1-Dichloro-2-Chloroethylene	79016 or 79-01-6 NIOSH: KX 4550000 SAX: TIO750	Carcinogen	—	—	10.6	5	N/A	0.5
Trichlorofluoromethane (HM) §§ — § F 11 § FC 11 § Freon 11 § Arcton 9 § Eskimon 11 § Halocarbon 11 § Algofrene Type 1 § RCRA Waste Number U121 § Fluorocarbon Number 11 § NCI C04637 § Isotron 11 § Fluorotrichloromethane § Isceon 131 § Monofluorotrichloromethane § Ucon Refrigerant 11 § Trichloromonofluoromethane	75694 or 75-69-4 NIOSH: PB 6125000 SAX: TIP500	Toxin	—	—	3.75	10,000	0.07	0.5
2,4,5-Trichlorophenol §§ — § Nurelle § Dowcide B § Dowcide 2 § Collunosol § Preventol 1 § Trichlorophenol, 2,4,5- § RCRA Waste Number U230 § NCI C61187	95954 or 95-95-4 NIOSH: SN 1400000 SAX: TIV750	Harmful	—	—	110	1	N/A	10
2,4,6-Trichlorophenol §§ — § Omal § Dowcide 2S § Phenachlor § RCRA Waste Number U231 § Trichlorophenol, 2,4,6- § Phenol, 2,4,6-trichloro- § NCI C02904	88062 or 88-06-2 NIOSH: SN 1575000 SAX: TIW000	Carcinogen	—	—	150	21	N/A	10

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2 (2,4,5-Trichlorophenoxy) Proprionic Acid §§ — § Kuran § Propon § Silvex § Aqua-Vex § Ded-Weed § Sta-Fast § 2,4,5-TP § Color-Set § Weed-B-Gon § Double Strength § RCRA Waste Number U233 § 2,4,5-Trichlorophenoxypropionic Acid § α(2,4,5-Trichlorophenoxy)Propionic Acid § 2-(2,4,5-Trichlorophenoxy)-Proprionic Acid § Trichlorophenoxy Proprionic Acid, 2 (2,4,5- § (+/-)-2-(2,4,5-Trichlorophenoxy)propanoic Acid	93721 or 93-72-1 NIOSH: UF 8225000 SAX: TIX500	Toxin	—	—	—	10	0.075	0.1
Trihalomethanes, total §§ — § TTHMs	Multiple	Carcinogen	—	—	—	100	N/A	2
Tritium (10) §§ H^3	10028178 or 10028-17-8 NIOSH: — SAX: —	Carcinogen / Radioactive	—	—	—	40 mrem ede/yr	N/A	—
Turbidity (13) (20) §§ —	N/A	Harmful	—	—	—	—	N/A	1 NTU
Uranium, natural §§ U § Uranium Metal, Pyrophoric	7440611 or 7440-61-1 NIOSH: YR 3490000 SAX: UNS000	Carcinogen / Radioactive	—	—	—	300 picocuries per liter.	N/A	—
Vinyl Chloride §§ — § VC § VCM § Chlorethene § Chloroethene § Chlorethylene § Chloroethylene § Ethylene, Chloro- § Monochloroethylene § Ethylene Monochloride § RCRA Waste Number U043 § Vinyl Chloride Monomer § Vinyl C Monomer § Trovidur	75014 or 75-01-4 NIOSH: KU 9625000 SAX: VNP000	Carcinogen	—	—	1.17	2	N/A	0.5
Xylenes §§ — § Xylol § Violet 3 § Mixed Xylenes § Methyl Toluene § Dimethylbenzene § RCRA Waste Number U239 § NCI C55232 § Total equals the sum of meta, ortho, and para.	1330207 or 1330-20-7 NIOSH: ZE 2100000 SAX: XGS000	Toxin	—	—	—	10,000	0.5	1.5
Xylenes §§ — § Xylol § Violet 3 § Mixed Xylenes § Methyl Toluene § Dimethylbenzene § RCRA Waste Number U239 § Total equals the sum of meta, ortho, and para.	1330207 or 1330-20-7 NIOSH: ZE 2100000 SAX: XGS000	Toxin	—	—	—	10,000	0.5	1.5
Xylenes §§ — § Xylol § Violet 3 § Mixed Xylenes § Methyl Toluene § Dimethylbenzene § RCRA Waste Number U239 § Total equals the sum of meta, ortho, and para.	1330207 or 1330-20-7 NIOSH: ZE 2100000 SAX: XGS000	Toxin	—	—	—	10,000	0.5	1.5
m-Xylene §§ — § m-Xylol § 1,3-Xylene § meta-Xylene § m-Dimethylbenzene § m-Methyltoluene § 1,3-Dimethylbenzene § 1,3-Dimethyl Benzene	108383 or 108-38-3 NIOSH: ZE 2275000 SAX: XHA000	Toxin	—	—	—	10,000	0.004	1.5

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o-Xylene §§ — § o-Xylol § 1,2-Xylene § ortho-Xylene § o-Methyltoluene § o-Dimethylbenzene § 1,2-Dimethylbenzene § 1,2-Dimethyl Benzene	95476 or 95-47-6 NIOSH: ZE 2450000 SAX: XHJ000	Toxin	—	—	—	10,000	0.004	1.5
p-Xylene §§ — § p-Xylol § Chromar § Scintillar § 1,4-Xylene § para-Xylene § p-Methyltoluene § p-Dimethylbenzene § 1,4-Dimethylbenzene § 1,4-Dimethyl Benzene	106423 or 106-42-3 NIOSH: ZE 2625000 SAX: XHS000	Toxin	—	—	—	10,000	0.002	1.5
Zinc (9) §§ Zn § Blue Powder § C.I. 77945 § C.I. Pigment Black 16 § C.I. Pigment Metal 6 § Emanay Zinc Dust § Granular Zinc § Jasad § Merrillite § Pasco § Zinc, Powder or Dust, non-Pyrophoric § Zinc, Powder or Dust, Pyrophoric	7440666 or 7440-66-6 NIOSH: ZG 8600000 SAX: ZBJ000	Toxin	120 @ 100 mg/l hardness (12)	110 @ 100mg/l hardness (12)	47	5,000	5	10

CIRCULAR WQB-7
DETAILED NOTES OF EXPLANATION

Frequently used Acronyms:

§§ abc...	Name of Primary Synonym as listed in the EPA's data base IRIS.
§ abc...	Name of Additional Synonyms from various sources including IRIS.
BCF	Bio-concentration Factor.
CFR	Code of Federal Regulations.
EDE/YR	Effective dose equivalent per year.
E.P.A.	Environmental Protection Agency.
FPH	A factor in the formula for determining ammonia Standards for Freashwater Aquatic Life.
FT	A factor in the formula for determining ammonia Standards for Freashwater Aquatic Life.
HM	Halomethanes.
MDL	Method Detection Limit. The MDL is calculated from the standard deviation of replicate measurements, and is defined as the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.
MREM	Milli Roentgen-Equivalent-Man.
N/A	Not applicable.
n.d.	Not determined.
NTU	Nephelometric Turbidity Unit.
PAH	Polynuclear Aromatic Hydrocarbons.
PCB	Polychlorinated Biphenyls.

CIRCULAR WQB-7
DETAILED NOTES OF EXPLANATION

TCAP A factor in the formula for determining ammonia Standards for Freashwater Aquatic Life.

(1) Based on EPA's categories and include parameters determined to be to toxic (toxin), carcinogenic (carcinogen), or harmful. Harmful parameters include nutrients, biological agents, and those parameters which cause taste and/or odor effects or physical effects.

(2) Carcinogens: chemicals classified by EPA as carcinogens for an oral route of exposure; Standards are based upon the incremental risk of causing one additional instance of cancer in one hundred thousand persons, except for arsenic, where the basis is one additional instance of cancer in one thousand persons. Includes those parameters in classifications A (Human Carcinogen),B1 or B2 (Probable Human Carcinogens), and C (Possible Human Carcinogen).

(3) No sample shall exceed these concentrations.

(4) No four-day (96-hour) or longer period average concentration shall exceed these values.

(5) All bioconcentration factors (BCF's) were developed by the EPA as part of the Standards development as mandated by Section 304(a) of the Federal Clean Water Act. Values shown are current as of 07/01/1993.

(6) No sample shall exceed these concentrations.

Standards for metals (except aluminum) in surface water are based upon the analysis of samples following a "total recoverable" digestion procedure (Section 9.4, "Methods for Analysis of Water and Wastes", 1983, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, EPA-600/4-79-020, or equivalent).

Standards for metals in ground water are based upon the dissolved portion of the sample (after filtration through a 0.45 μm membrane filter, as specified in "Methods for Analysis of Water and Wastes", 1983, Environmental Monitoring and Support Laboratory, U.S. Environmental Protection Agency, EPA-600/4-79-020, or equivalent).

For aluminum, both surface and ground water analyses will be based on the dissolved method of analysis.

(7) Freshwater Aquatic Life Standards for total ammonia nitrogen (mg/l NH_3-N plus NH_4-N) are expressed as a function of pH and temperature. The Acute equation and the Chronic equation are as follows:

$Acute^{a,c} = 0.822 \times (0.52/FT/FPH/2)$	where	FT	$= 10^{0.03(20-TCAP)}$	if $TCAP \leq T \leq 30$
			$= 10^{0.03(20-T)}$	if $0 \leq T < TCAP$
		FPH	$= 1$	if $8 \leq pH \leq 9$
			$= (1 + 10^{7.4-pH})/1.25$	if $6.5 \leq pH < 8$

CIRCULAR WQB-7
DETAILED NOTES OF EXPLANATION

TCAP	= 20° C	if Salmonids or other sensitive cold-water species present.
	= 25° C	if Salmonids and other sensitive cold-water species absent.

[a] The usual Acute averaging period of one hour is not appropriate if excursions of concentrations to greater than 1.5 times the average occur during the hour; in such cases, a shorter averaging period will be required.

Chronic[b,c] = 0.822 x (0.80/FT/FPH/RATIO) where FT and FPH are as above and:

RATIO	= 13.5	if $7.7 \leq pH \leq 9$
	$= 20(10^{7.7-pH}/1 + 10^{7.4-pH})$	if $6.5 \leq pH < 7.7$
TCAP	= 15° C	if Salmonids/other sensitive cold-water species present.
	= 20° C	if Salmonids/other sensitive cold-water species absent.

[b] Because these formulas are non-linear in pH and temperature, the Standard is the average of separate evaluations of the formulas reflective of the fluctuations of flow, pH, and temperature within the averaging period; it is not appropriate to apply the formula to average pH, temperature and flow.

[c] These formulas yield the allowable concentration of NH_3-N. To convert these values to the total ammonia as nitrogen (mg/l NH_3-N plus NH_4-N) which is the usual way that analytical results are expressed the following formula must be used.

Total ammonia as nitrogen = $NH_3\text{-N} \times 1 + 10^{PKA-pH}$

Where PKA = 0.09018 + 2729.92/T

and T = degrees centigrade + 273.2

(8) A plant nutrient, excessive amounts of which may cause violations of Administrative Rules of Montana (ARM) 16.20.633.(1)(e).

(9) Approved methods of sample preservation, collection, and analysis for determining compliance with the standards set forth in WQB-7 are found in:

1) 40 CFR Part 136 "Guidelines Establishing Test Procedures For the Analysis Of Pollutants", July 1, 1992, and;
2) The Environmental Protection Agency's (EPA) Methods for the Determination of Metals in Environmental Samples, EPA/600 4-91/010, dated June 1991, or equivalent, as determined by the Department.

CIRCULAR WQB-7
DETAILED NOTES OF EXPLANATION

(10) Radionuclide photon-emitters consisting of either beta or gamma emitters and are classified as carcinogenic. Their associated Standard is based upon a 4 mrem ede/yr exposure. This exposure is based upon daily ingestion of 2 liters of water. The emitters covered under this Standard are:

- Cesium, radioactive
- Iodine, radioactive
- Strontium -89 and -90, radioactive
- Tritium
- Gamma photon emitters

(11) Chemicals which are not individually classified as carcinogens but which are contained within a class of chemicals with carcinogenicity as the basis for the Standard derivation for that class of chemicals; an individual carcinogenicity assessment for these chemicals is pending.

(12) Freshwater Aquatic Life Standards for these metals are expressed as a function of total hardness (mg/l, $CaCO3$). The values displayed in the chart correspond to a total hardness of 100 mg/l. The hardness relationship is as follows:

Acute = exp{ma[ln(hardness)]+ba} Chronic = exp{mc[ln(hardness)]+bc}

	ma	ba	mc	bc
cadmium	1.128	-3.828	0.7852	-3.490
copper	0.9422	-1.464	0.8545	-1.465
chromium (III)	0.8190	3.688	0.8190	1.561
lead	1.273	-1.460	1.273	-4.705
nickel	0.8460	3.3612	0.8460	1.1645
silver	1.72	-6.52	------	------
zinc	0.8473	0.8604	0.8473	0.7614

Note: If the hardness is <25mg/L as $CaCO_3$, the number 25 will be used in the calculation. If the hardness is greater than or equal to 400 mg/L of $CaCO_3$, 400 mg/L will be used in the calculation.

(13) Conditional limitations based upon Water-Use Classifications. See Administrative Rules of Montana (ARM), Title 16, Chapter 20 - Water Quality, Sub-Chapter 6 - SURFACE WATER QUALITY STANDARDS. For groundwater see the Administrative Rules of Montana (ARM) 16.20.633(1) et seq and ARM 16.20.1003 et seq.

(14) Freshwater Aquatic Life Standard for pentachlorophenol are expressed as a function of pH. Values displayed in the chart correspond to a pH of 7.8 and are calculated as follows:

Acute = exp[1.005(pH) - 4.830] Chronic = exp[1.005(pH) - 5.290]

(15) Freshwater Aquatic Life Standard for dissolved oxygen are as follows:

<u>Standards for Waters Classified</u> <u>Standards for Waters classified</u>

CIRCULAR WQB-7
DETAILED NOTES OF EXPLANATION

	A-1, B-1, B-2, C-1, and C-2		B-3, C-3, and I	
	Early Life Stages[1,2]	Other Life Stages	Early Life Stages[2]	Other Life Stages
30 Day Mean	N/A[3]	6.5	N/A[3]	5.5
7 Day Mean	9.5 (6.5)	NA	6.0	NA
7 Day Mean Minimum	N/A[3]	5.0	N/A[3]	4.0
1 Day Minimum[4]	8.0 (5.0)	4.0	5.0	3.0

[1] These are water column concentrations recommended to achieve the required <u>inter-gravel</u> dissolved oxygen concentrations shown in parentheses. For species that have early life stages exposed directly to the water column, the figures in parentheses apply.

[2] Includes all embryonic and larval stages and all juvenile forms to 30-days following hatching.

[3] N/A (Not Applicable).

[4] All minima should be considered as instantaneous concentrations to be achieved at all times.

(16) Aquatic Life Standards apply to surface waters only.

(17) For surface waters the Standard is the more restrictive of either the Aquatic Life Standard or the Human Health Standard. For groundwaters the standards are based on the dissolved portion (after filtration through a 0.45 micro filter) of the contaminating substance as specified in the EPA publication, EPA 600/4-79-020, "Methods for Chemical Analysis of Water and Wastes."

(18) The Narrative Standards are located in the Administrative Rules of Montana (ARM) 16.20.633(1) et seq and ARM 16.20.1003 et seq.

(19) The required 'Reporting Value' is the Department's best determination of a level of analysis that should be achieved in routine sampling. It is based on levels actually achieved at both commercial and government laboratories

in Montana using accepted methods. 'Reporting Value' is the detection level that must be achieved in reporting ambient or compliance monitoring results to the Department. Higher detection levels may be used if it has been demonstrated that the higher detection levels will be less than 10% of the expected level of the sample.

(20) Applicable to surface waters only.

(21) Applicable to ground waters only.

(22) Estimated Detection Levels (EDL's) are used as "Trigger Values" whenever MDL's are unavailable. Trigger Values are used to determine whether-or-not a given increase in the concentration of Toxic parameters is significant or non-significant as per the non-degredation rules.

(23) Levels of individual petrochemicals in the water column should not exceed 0.010 of the lowest continious flow 96-hour LC_{50} to several important freshwater species, each having a demonstrated high susceptibility to oils and petrochemicals.

(24) Settleable and suspended solids should not reduce the depth of the compensation point for photosynthetic activity by more than 10 percent from the seasonally established norm for aquatic life.

(25) CASRN is an acronym for the American Chemical Society's Chemical Abstracts Service Registry Number.

(26) NIOSH RTECS number is a unique number used for accession to the National Institute For Occupational Safety and Health (NIOSH) Registry of Toxic Effects of Chemical Substances.

(27) SAX number in the format AAA123 is a unique number for identification of materials in the Dangerous Properties of Industrial Materials, authors N. Irving Sax and Richard J. Lewis, publisher Van Nostrand Reinhold.

APPENDIX N

MEMORANDUM ON TREATMENT SYSTEM EVALUATION

MEMORANDUM

TO: Mr. Chip Hamilton
Big Sky County Water & Sewer District

FROM: Ray Armstrong

DATE: February 6, 1995
F:\WP\04\M357102\JAR04053.MEM

SUBJECT: Treatment Process Evaluation

I. INTRODUCTION

The purpose of this memorandum is to summarize the results of a work session held on January 26, 1995 between the Big Sky County Water & Sewer District and HKM Associates. The work session was held to review advantages and disadvantages of several different treatment alternatives. This memorandum provides the documentation of the criteria used to select the recommended treatment alternative.

II. PLANT TYPES FOR CONSIDERATION

A key criteria in selecting treatment processes for consideration is whether a biological nutrient removal treatment plant will be required. If nutrient removal is accomplished by a land application system, such as spray irrigation, it will not be necessary to construct a treatment plant with nutrient removal capabilities.

The degree of nutrient removal required is governed by the method of disposal, i.e. spray irrigation, rapid infiltration basins, or discharge to a surface water and the nondegradation rules. For spray irrigation systems, the nondegradation rules, Section 16.20.713f, requires that the system be designed to limit the application of nutrients to the agronomic rate. As discussed in the facility plan, the irrigation rate at Big Sky will be controlled by the hydraulic loading capacity rather than the nitrogen loading. Based on the state's design criteria of designing for the wettest year in 10, a total irrigation area of approximately 608 acres would be required for the disposal of the 20 year design flow. Even with the construction of a new golf course, an additional disposal method would be required for the 20 year design flows. Alternative disposal options, for flows in excess of the irrigation capacity, include disposal to groundwater through rapid infiltration basins or disposal by snowmaking. Disposal by either rapid infiltration basins or snowmaking would require nutrient removal in order to meet nondegradation criteria.

Based on the need for nutrient removal for flows in excess of the golf course irrigation capacity, we recommend that the treatment processes considered for Big Sky have nutrient removal capabilities or have the ability to be modified for nutrient removal when the irrigation capacity of the golf course is exceeded.

Table 1 shows the matrix that was used to narrow the list of potential treatment alternatives.

Processes that appear capable of meeting low nutrient discharge levels for both nitrogen and phosphorus are listed below:

- Three sludge process with chemical addition
- Modified bardenpho
- Sequencing batch reactors
- Phase isolation ditches

Additional processes that were investigate but not selected for further analysis include:

- MLE process
- A2/O process
- Modified UCT/VIP process

While these three processes are used for nitrogen and phosphorus removal, they generally cannot achieve total nitrogen levels below 8 mg/l. The single anoxic zone in these processes limit nitrogen removal.

III. PROCESS DESCRIPTION

Three Sludge Process with Chemical Addition

The three sludge process involves three separate processes for nitrogen removal. Phosphorus removal is accomplished with chemical precipitation and filtration. Each process requires a reaction tank and a clarifier. Therefore in order to provide a two train system, six separate clarifiers and six reaction tanks would be required. This process also requires the addition of methanol as a supplemental carbon source during the denitrification stage. Costs associated with this type of system are high due to the number of tanks required and chemical costs associated with adding methanol for denitrification and alum for phosphorus removal. The three sludge process is rarely used due to the high costs involved. The three sludge process is not considered an economically viable option for Big Sky and is not evaluated further.

Oxidation Ditch - Modified Bardenpho Process

The modified Bardenpho process provides anaerobic, anoxic and aerobic stages for removal of phosphorus, nitrogen, and carbon. The modified Bardenpho process consists of a 5 stage process as shown in Figure 1. The first anaerobic stage is

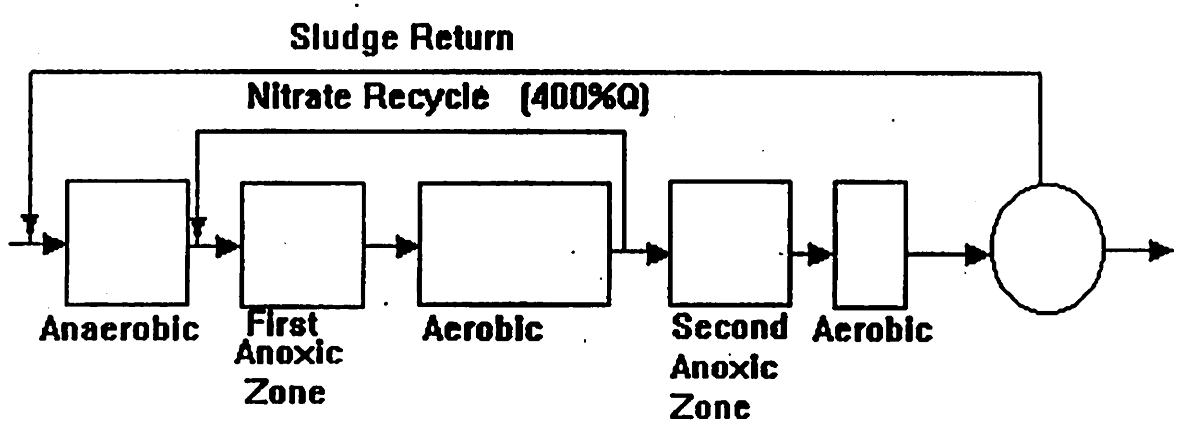
TABLE 1
INITIAL PROCESS SELECTION MATRIX
(Source: WEF Manual of Practice No. 8)F:\WP\041\M35710\JAR04005.TBL

Process	Effluent Quality[a]							
	Secondary[b]	5 mg/L BOD	5 mg/L TSS[c]	Nitrification	10 mg/L Nitrate Nitrogen	3 mg/L Total Nitrogen[c]	1.0 mg/L Total Phosphorus[c]	0.5 mg/L Total Phosphorus[c]
Activated sludge	X	M	X	M				
Extended aeration (oxidation ditch)	X	M	X	X	M			
A/O™	X	M	X	M			M	
Modified Ludzack-Ettinger (MLE)	X	M	X	X	X			
Operationally modified activated sludge	X	M	X	M	M		M	
PhoStrip™	X	M	X	M	M		X	X
University of Cape Town (UCT) and VIP	X	M	X	X	X		M	
A²/O™	X	M	X	X	X		M	
Trickling filters	X			M				
Fluidized bed[d]	M			M	X	X		
Postaeration anoxic tank[d]					X	X		
Two-sludge process[d]	X	M	X	X	X	X		
Three-sludge process with chemical addition[d]	X	M	X	X	X	X	X	X
Denitrification filters[d]			X		X	X		
Bardenpho™	X	M	X	X		M		
Modified Bardenpho™	X	M	X	X		M	M	
Simpre™	X	M	X	X	X	M		
Bionutre™	X	M	X	X	X	M	M	
OWASA nutrification	X	M	X	X	M		M	
Sequencing batch reactors	X	M	X	M	X	M	M	
Phase isolation ditches	X	M	X	M	M	M	M	
Chemical addition (alum, lime, or iron salts)							X	X

[a]X-process capable of producing effluent meeting indicated standard. M-process should be capable of meeting indicated standard with proper design, acceptable influent characteristics, and/or tertiary filtration.
[b]20-30 mg/L effluent BOD_5 and total suspended solids (TSS).
[c]Filtration recommended to meet indicated standards.
[d]Requires methanol addition for denitrification.

Figure 1

Modified Bardenpho Process



provided to enhance phosphorus removals. In the first anoxic zone nitrates recycled from the aerobic zone are reduced to nitrogen gas. The aerobic stage follows the first anoxic zone. In the aerobic stage, oxygen is provided to remove BOD_5 that was not removed in the first anoxic zone. Ammonia is also oxidized to nitrate in the aerobic stage. In the second anoxic stage endogenous respiration is used to reduce the remaining nitrate. The last stage is an aerobic process that oxidizes any traces of ammonia and assures any released phosphorus will be reabsorbed prior to final clarification. This stage also strips nitrogen gas that is generated in the second anoxic stage.

The final anoxic stage of the Bardenpho process yields two important process enhancements over single anoxic zone processes. The first is an additional degree of denitrification and consequently lower effluent total nitrogen concentrations. Second, the nitrate load to the final clarifier is reduced, which in turn reduces the potential for nitrate interference of phosphorus removal caused by nitrates in the return sludge.

The modified Bardenpho process would consist of two process trains. Each process train would have a separate clarifier and return sludge pumping.

Sequencing Batch Reactors (SBR)

The SBR is a fill-and-draw, variable reactor volume technology. As a fill-and-draw system, all the treatment phases occur in a single basin. The various anoxic, aerobic, and anaerobic stages are controlled through the intermittent use of the blowers. The sequence of cycles in an SBR designed for BOD_5 removal and phosphorus and nitrogen removal is shown in Figure 2.

At flows below the design value, the reactor contents can be retained for longer periods to achieve higher levels of treatment.

Phase Isolation Ditches

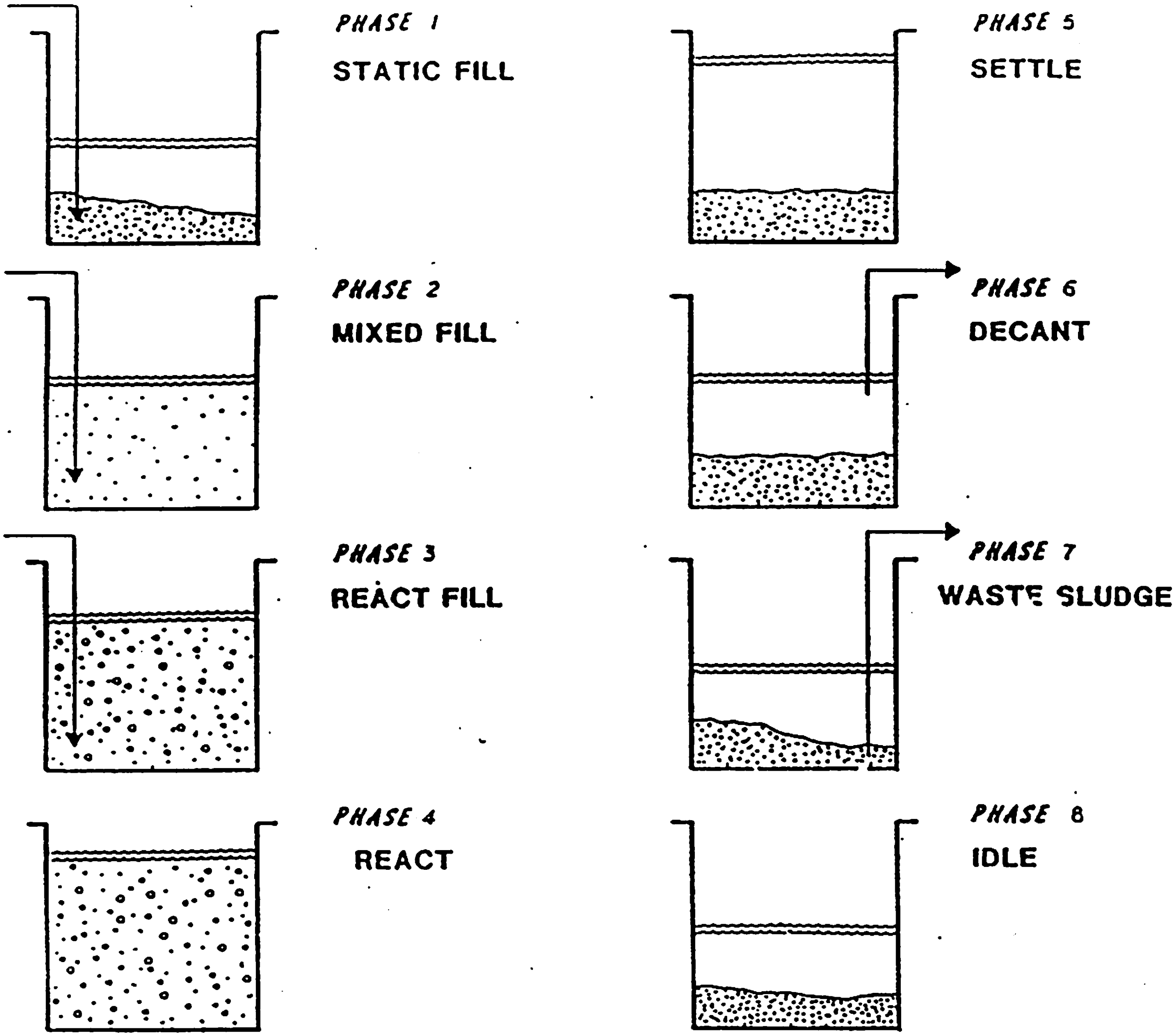
The phase isolation ditch process involves the use of two or more oxidation ditches to create sequential aerobic, anoxic and anaerobic conditions. An initial anaerobic zone is used for phosphorus removal. The wastewater feed is alternated between the two tanks to provide a carbon source for the necessary microbial reaction. Phase isolation ditches are used in Europe with some success but few plants are operating in the U.S. Due to the lack of operational history and performance data the phase isolation ditch was not considered a good plant choice for Big Sky.

IV. PROCESS RELIABILITY

Process reliability refers to the ability of the system to consistently produce an effluent quality with low levels of BOD_5, TSS, total nitrogen and total phosphorus over a wide range of influent flows and strengths. Process reliability also refers to the ability of the system to withstand shock loads.

Figures 3 through 9 shows the published performance of 16 oxidation ditches for the removal of BOD_5 and TSS removal (EPA, 1992). Also shown is the published performance data for 14 sequencing batch reactors.

As the performance data indicates the oxidation ditch consistently reported lower BOD_5, TSS, and ammonia values. For example, in Figure 3 it is shown that for oxidation ditches 99% of the BOD_5 measurements were below 20 mg/l while for SBR's 90% of the measurements were below 20 mg/l. It is emphasized that both processes produce excellent water quality but the oxidation ditch process has been shown to be more consistent in maintaining treatment levels.



BIG SKY WASTEWATER FACILITY PLAN

CYCLES FOR SBR

FIGURE 2

HKM ASSOCIATES
ENGINEERS · PLANNERS

4M357.102 | MAY 1993

FIGURE 3

PROCESS RELIABILITY - BOD

WINTER

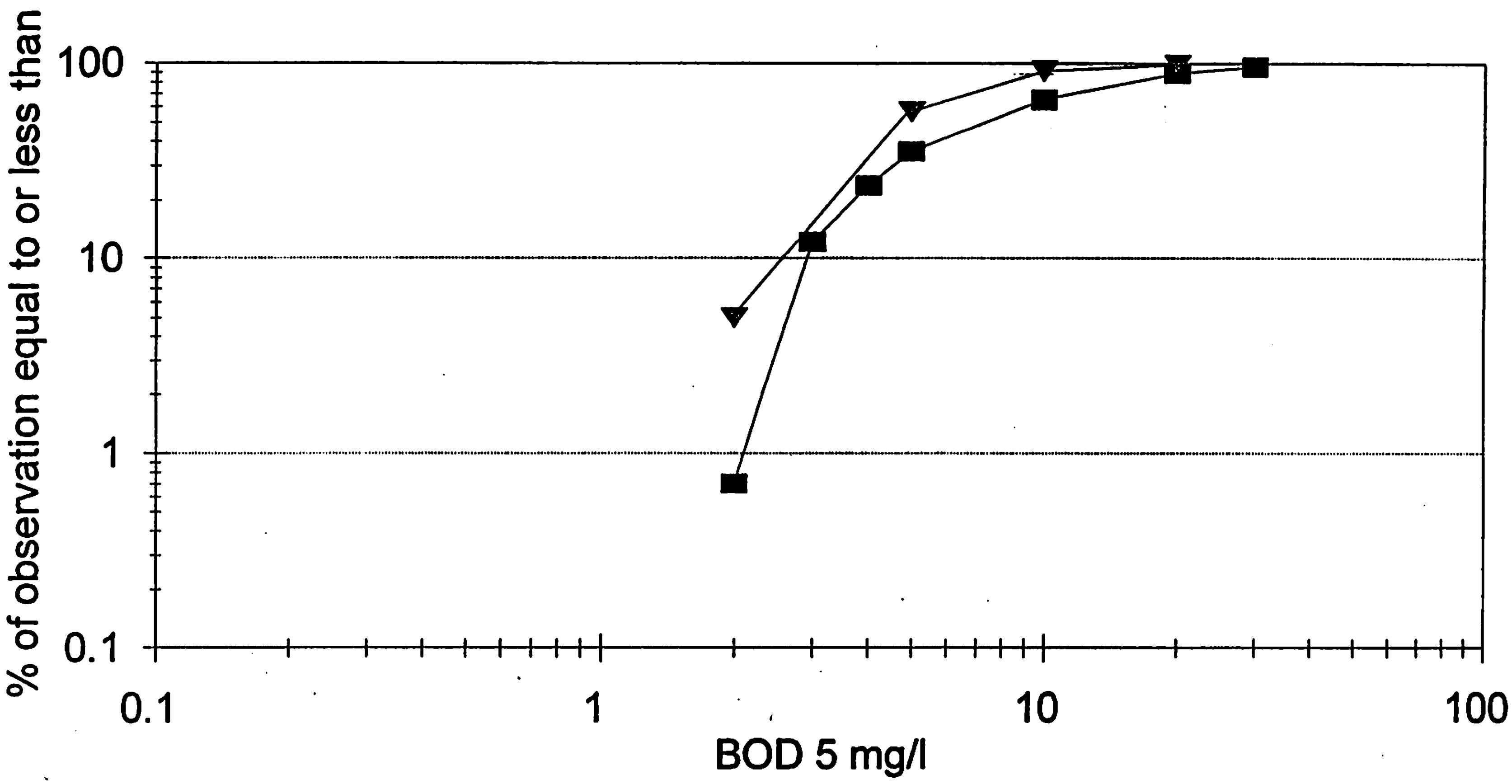


FIGURE 4

PROCESS RELIABILITY - BOD

SUMMER

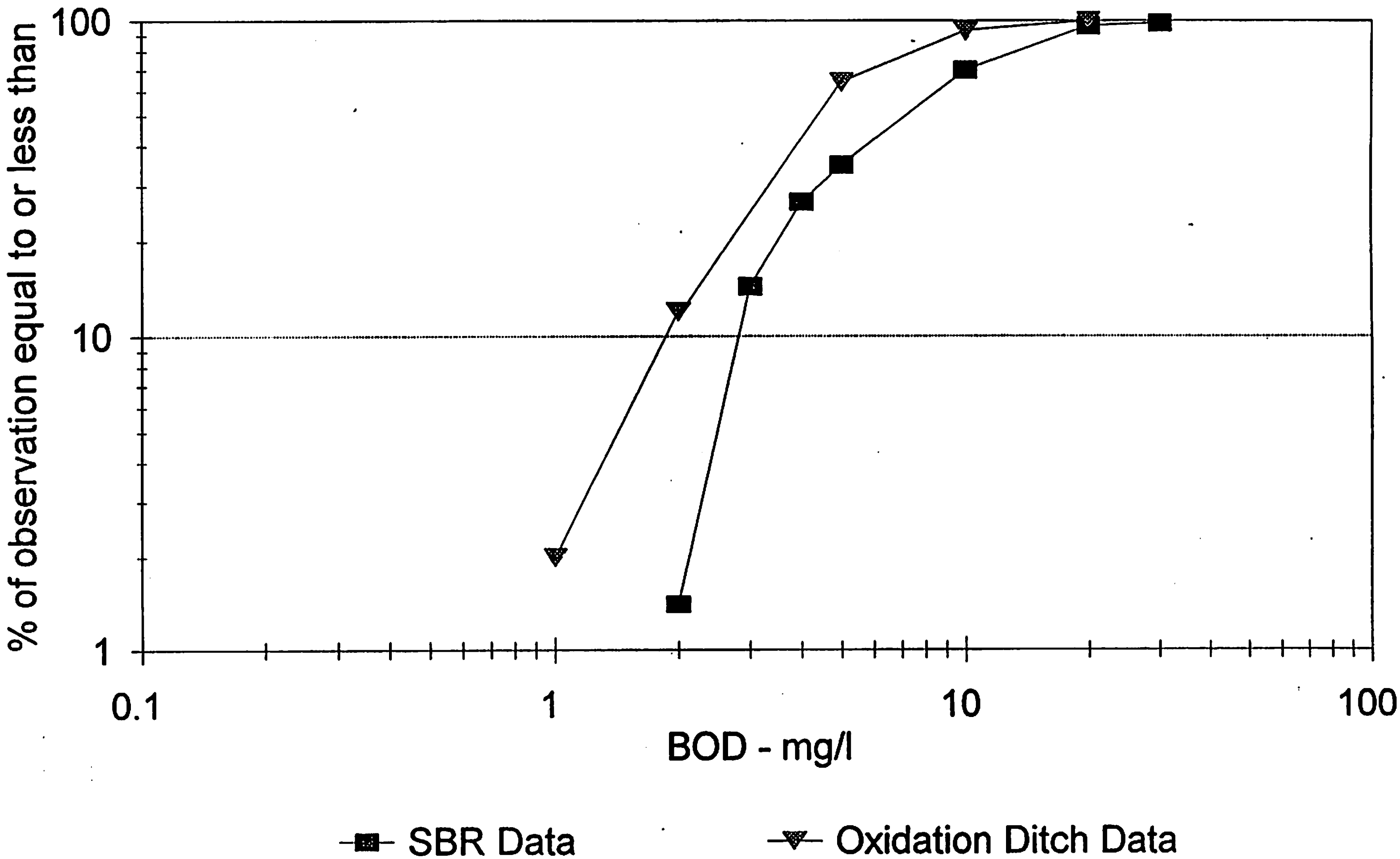


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FIGURE 5

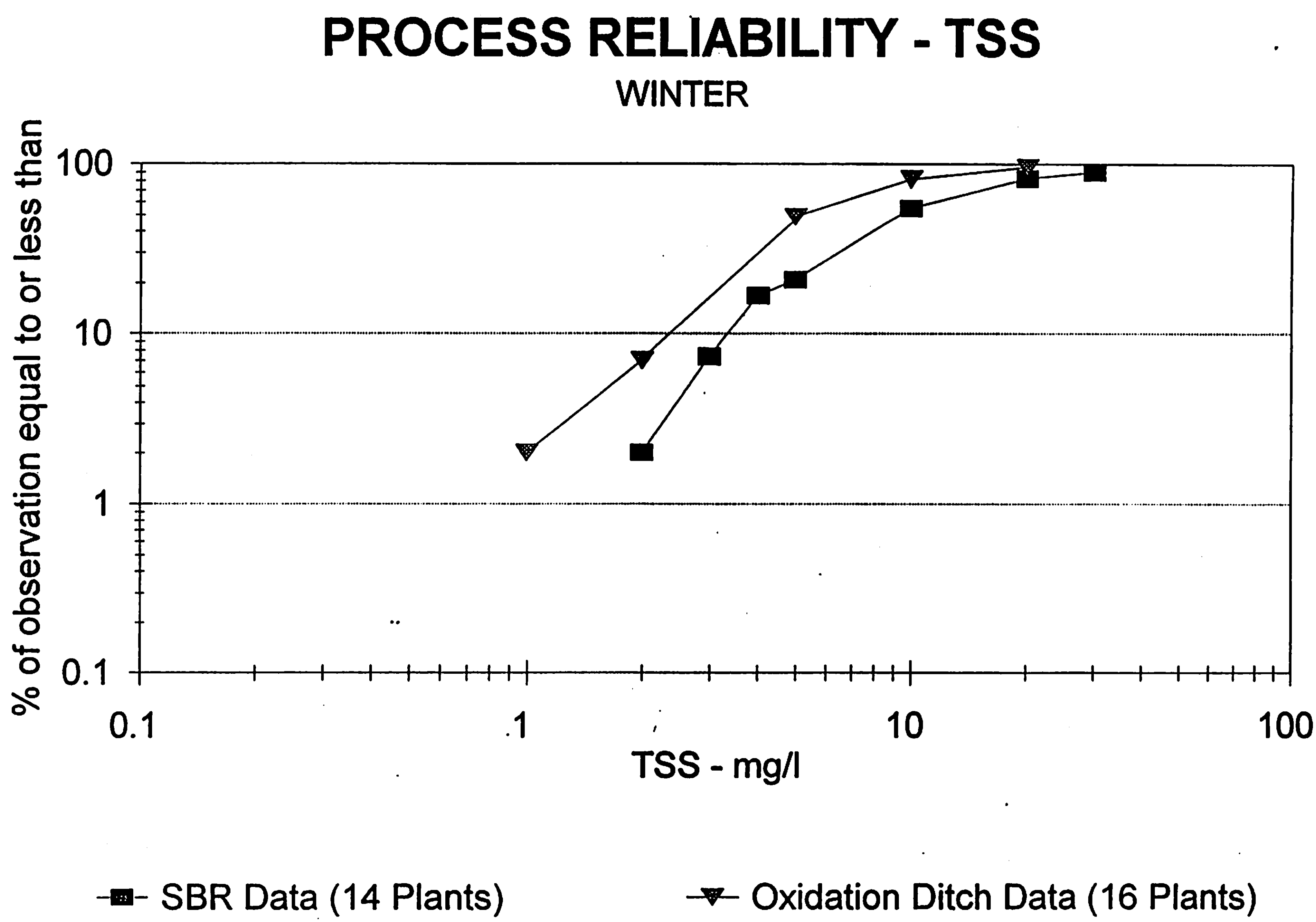
PROCESS RELIABILITY - TSS
WINTER
% of observation equal to or less than
100
10
1
0.1
0.1
1
10
100
TSS - mg/l
SBR Data (14 Plants)
Oxidation Ditch Data (16 Plants)

FIGURE 6

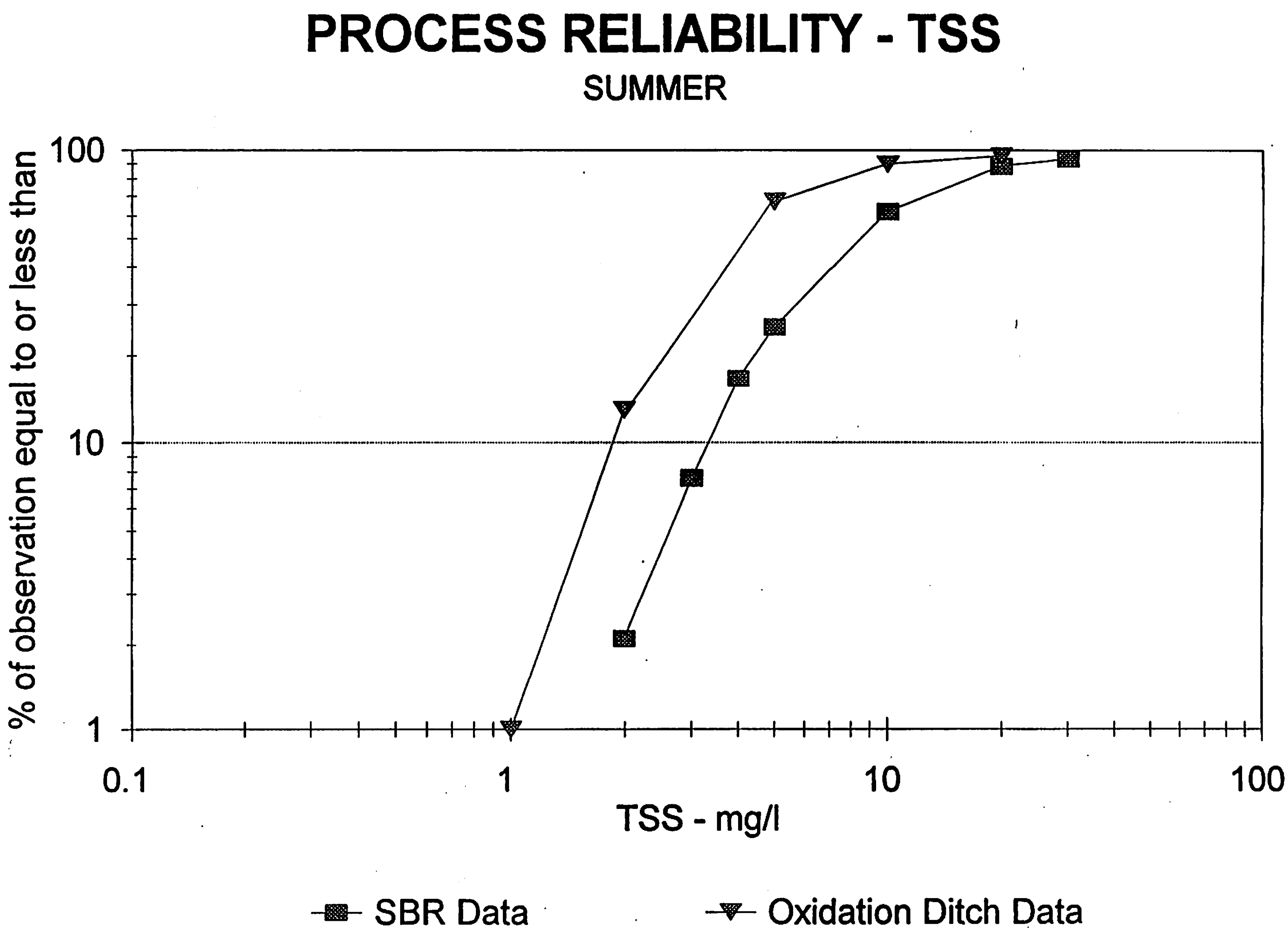

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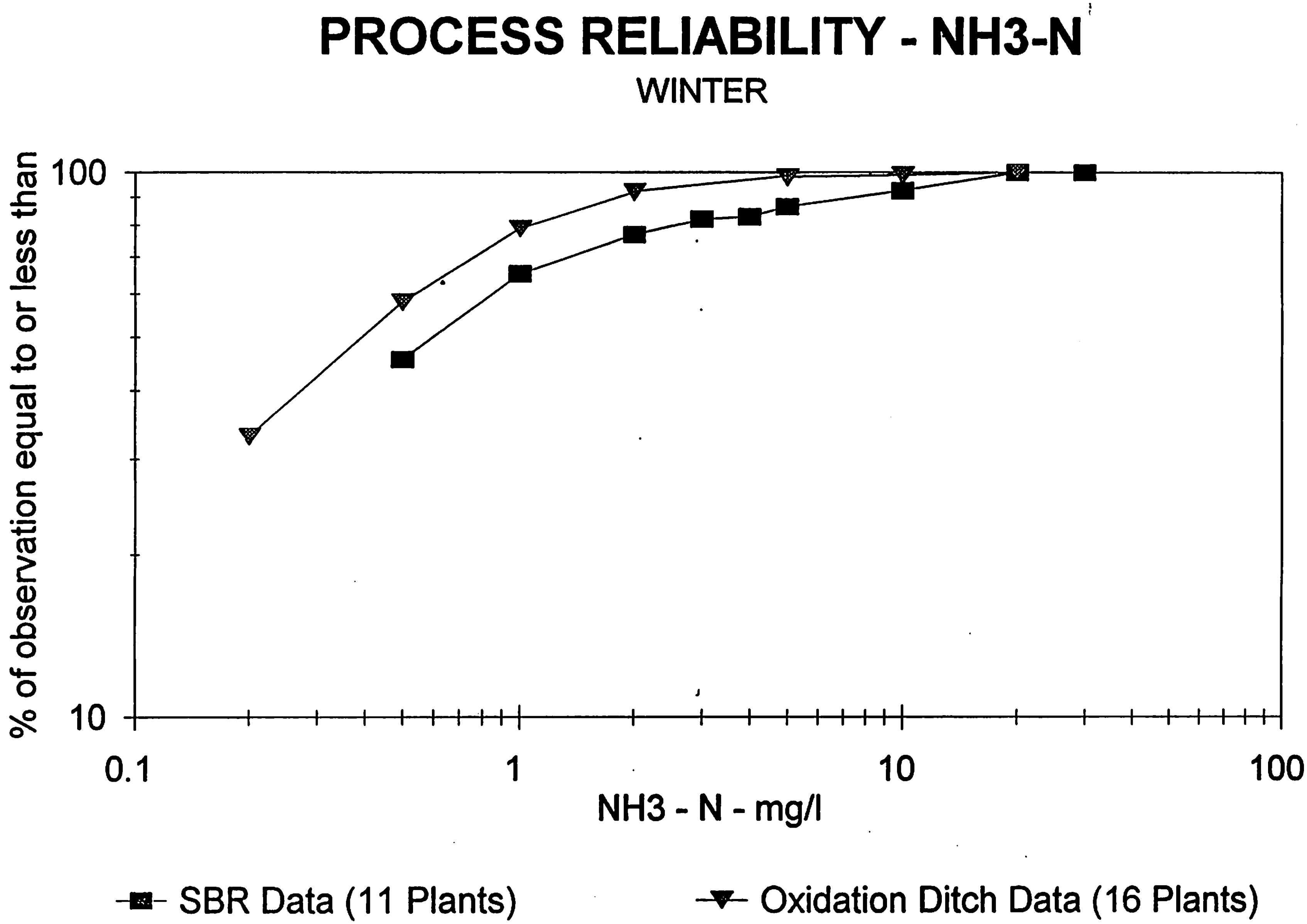
FIGURE 7



PROCESS RELIABILITY - NH3-N
WINTER
% of observation equal to or less than
100
10
0.1
1
10
100
NH3 - N - mg/l
SBR Data (11 Plants)
Oxidation Ditch Data (16 Plants)

FIGURE 8

PROCESS RELIABILITY - AMMONIA

SUMMER

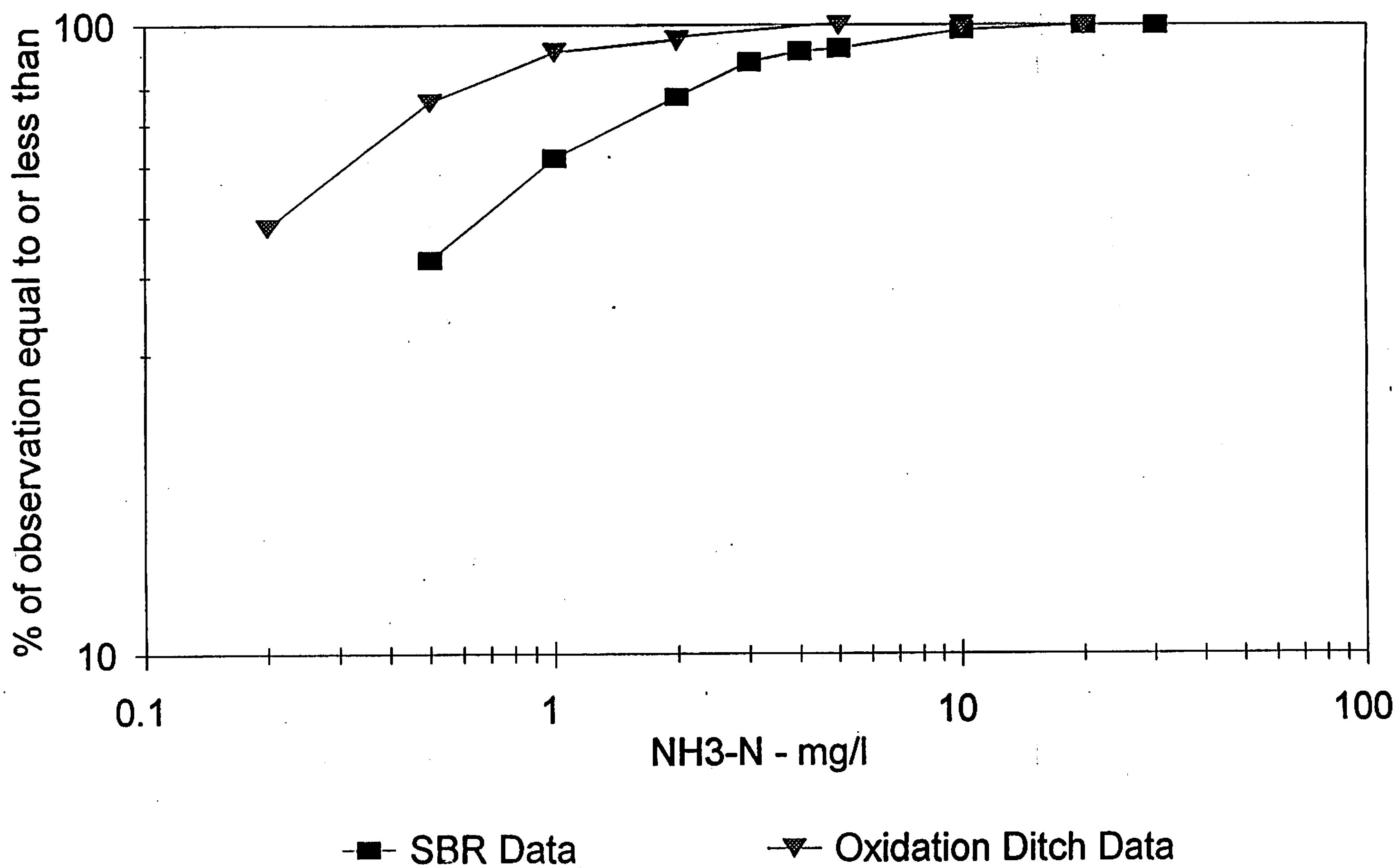
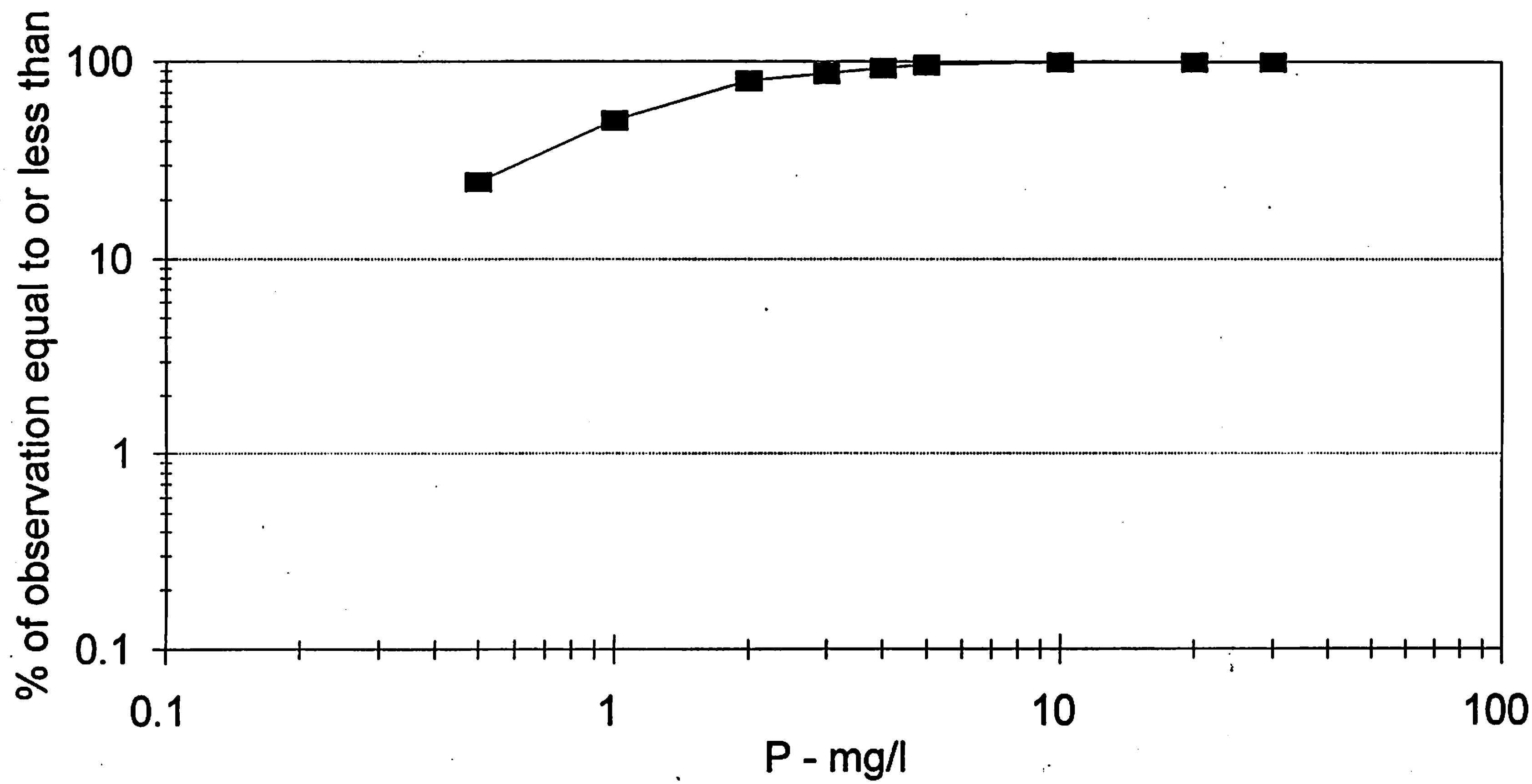


FIGURE 9

SBR UNIT RELIABILITY - PHOSOPHORUS

WINTER



V. CONSTRUCTION COSTS

Relative construction costs for the various treatment processes have been estimated based on published construction costs and cost data obtained from manufacturers. As shown in Figure 10 the reported construction cost for the modified Bardenpho oxidation ditch is significantly higher than for the SBR process.

VI. PROCESS SELECTION

The following criteria were judged to be the most important in the process selection:

- Capital Cost
- O&M Cost
- Effluent Water Quality
- Aesthetics (sight, odors, noise levels)
- Operator skill level required
- Expandability
- Future regulatory flexibility

The seven criteria were weighted based on input from the District and HKM's engineers. The matrix used to establish the weighting is shown in Figure 11. Once the criteria weighting was established, the ability of the SBR and oxidation ditch to meet the criteria was compared. As shown in Figure 12 the final ranking of alternative was the oxidation ditch with 241 points and the SBR with 226 points.

While the oxidation ditch was ranked slightly ahead of the SBR in the ranking process we recommend the SBR system as the selected alternative. The oxidation ditch received a higher ranking primarily because the oxidation ditch does appear to produce a higher quality effluent (Figures 3 through 9). However it is important to note that the SBR also produces a high quality effluent at a much lower cost.

Either the SBR or oxidation ditch would meet the treatment needs of Big Sky. We have recommended the SBR system due to the lower initial capital cost. The oxidation ditch should still be considered a viable treatment option that could be utilized if costs, treatment requirements, or plant design flows and loads change.

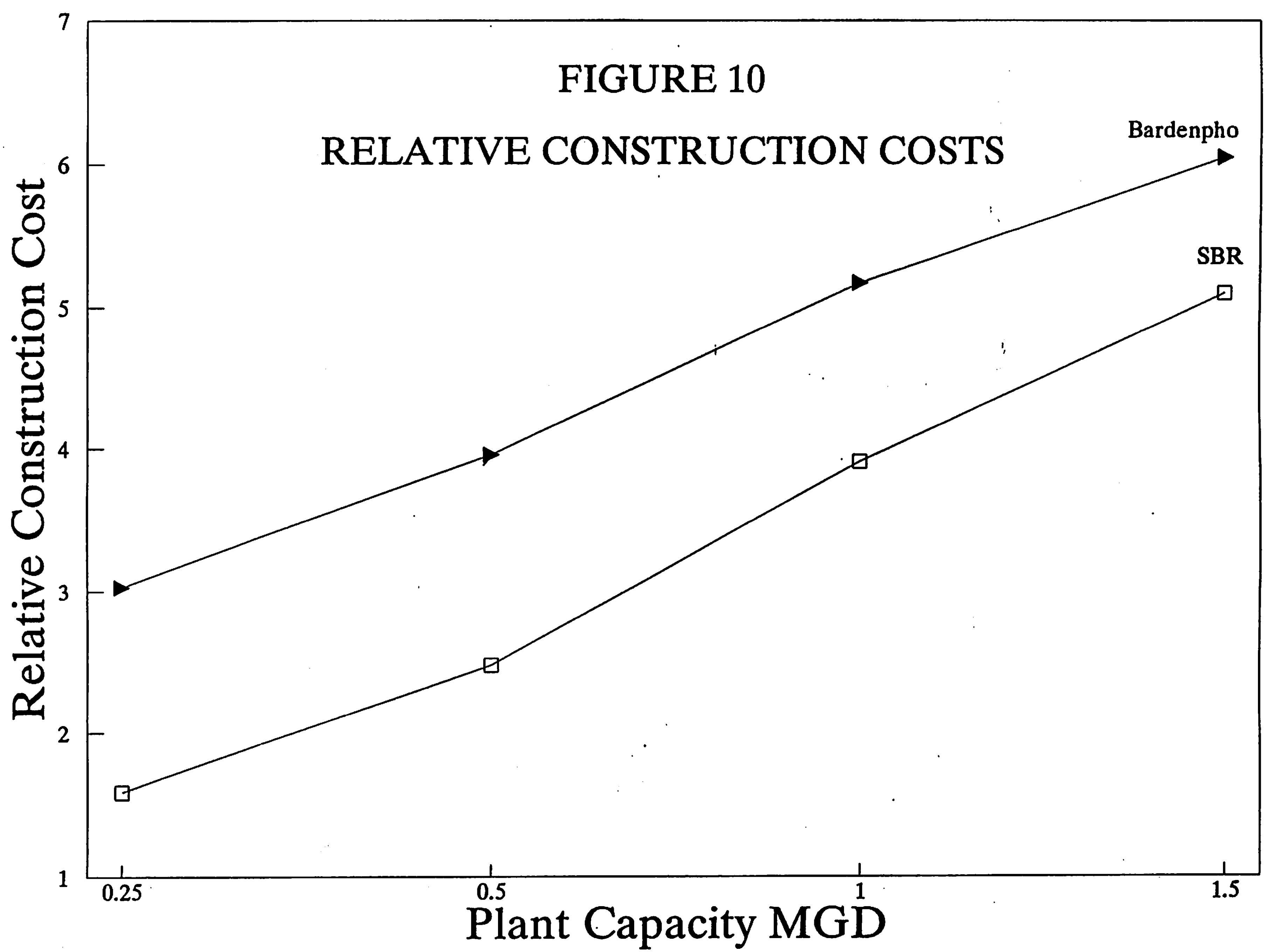


FIGURE 10
RELATIVE CONSTRUCTION COSTS
Bardenpho
SBR
Relative Construction Cost
Plant Capacity MGD
7
6
5
4
3
2
1
0.25
0.5
1
1.5

FIGURE 11

A.	COST - CAPITAL	8
B.	O & M COST	5
C.	EFFLUENT WATER QUALITY	20
D.	AESTHETICS	7
E.	OPERATOR SKILL LEVEL	6
F.	EXPANDABILITY	9
G.	FUTURE REGULATORY FLEXIBILITY	3

DISTRICT RANKING

	B	C	D	E	F	G
A	1A/1B	4C	2D	4A	4F	2A
B		4C	3B	4E	2B	1B/1G
C			4C	3C	2C	2C
D				1D/1E	2F	1D/1G
E					3F	1E/1G
F						1F/1G

HKM RANKING

	B	C	D	E	F	G
A	3A	4C	2D	3A	2F	2A
B		4C	2D	2B	3F	1B/1G
C			4C	3C	3C	4C
D				2D	1D/1F	3D
E					2E	3E
F						2F

HOW IMPORTANT

4 - MAJOR PREFERENCE
3 - MEDIUM PREFERENCE
2 - MINOR PREFERENCE
1 - LETTER/LETTER - NO PREFERENCE
EACH SCORED ONE POINT

FIGURE 12

DESIRED CRITERIA

FUNCTION FOR STUDY:

ALTERNATIVES		FIRST RANKING	CAPITAL COST	O & M COST	EFFLUENT WATER QUALITY	AESTHETICS	OPERATOR SKILL LEVEL	EXPANDABILITY	FUTURE REGULATORY FLEXIBILITY		TOTAL	FINAL RANKING
RELATIVE WEIGHTS			8	5	20	7	6	9	3			
1 SBR			5 / 40	3 / 15	4 / 80	4 / 28	3 / 18	4 / 36	3 / 9		226	
2 OXIDATION DITCH			4 / 32	3 / 15	5 / 100	4 / 28	4 / 24	3 / 27	5 / 15		241	
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												

EXCELLENT - 5 VERY GOOD - 4 GOOD - 3 FAIR - 2 POOR - 1 (VEST)

REFERENCES

U.S. Environmental Protection Agency (EPA). 1992. Evaluation of Oxidation Ditches for Nutrient Removal. U.S. Department of Commerce, National Technical Information Service.

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APPENDIX O

SNOWMAKING PILOT TEST RESULTS
DELTA ENGINEERING

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Evaluation of Snowfluent® Process for Treatment of Municipal Wastewater at Big Sky, Montana

RD - 09 - 10/1997

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Ottawa, Ontario - 1997

Executive Summary

The purpose of this study was to evaluate the effectiveness of Delta Engineering's Snowfluent® technology at the Big Sky County Water & Sewer District. This Atomizing Freeze Crystallization (AFC™) technology will allow the District to process and dispose of wastewater during the busy winter months. This will minimize the storage requirements for wastewater during the winter months and the land required to irrigate it during the summer.

Approximately 600,000 gallons of wastewater were processed using the Mobile Snowfluent® Wastewater Treatment Plant during the month of March, 1997. The snow was deposited on lined and unlined storage areas. Samples of raw sewage, fresh snow, aged snow and meltwater were secured at appropriate times throughout the study period.

The performance of the Snowfluent® treatment on key environmental contaminants such as Fecal Coliforms and Ammonia was excellent, with removal rates of 100% and 98.4% respectively. The BOD_5 and Phosphorous removals at 75% and 32-45% were lower than what is typically achieved with the Snowfluent® technology. However, sampling difficulties and air born contamination appear to be the most likely causes for this decrease in the expected performance. Also, the planned disposal method of exfiltration to the soils will handle any BOD_5 and Phosphorous that is not precipitated by the Snowfluent® process.

Based on the results of this study and the performance of Snowfluent® at other sites in full scale operation, Snowfluent® would be a suitable treatment option in the winter time for the Big Sky County Sewer & Water District.

3.0 Background

Sewage treatment for small communities, seasonal resort development and small industries is an expensive undertaking throughout North United States and Canada. One of the least expensive methods of treating sewage or waste is the facultative lagoon system. While such lagoons provide adequate and flexible waste treatment for many municipalities, major disadvantages of the lagoons in some situations are the large amount of land required and their poor removal efficiencies during winter months. The land requirement varies with serviced population and discharge mode. Storage requirements normally vary from four to twelve months, which can result in the removal of excessive acreage of land from production or tourism development.

Wastewater treatment options were being considered for Big Sky's Mountain Village as part of the Long Range Facility Plan. A scenario being considered involves the majority of wastewater being stored over the winter for disposal by irrigation on a golf course in the summer. The costs and land requirements associated with spray irrigation make a solution conducive to reducing both of these restrictions attractive. The Snowfluent® process could accomplish both cost reduction and land requirement reductions by reducing winter storage requirements resulting in less wastewater treated by spray irrigation annually.

The following report contains results and discussion of a testing program carried out at the Big Sky Water & Sewer facility at Big Sky Montana. The project involved treating the ski resort's wastewater with Snowfluent® - Atomizing Freeze Crystallization (**AFC™**) technology. The objective of the program was to verify previous performance data of the Snowfluent® system in order to evaluate its potential to be incorporated into the Long Range Facility plan. Snowfluent® would offer the possibility of reducing winter storage requirements. The report includes a description of the field experiment along with a summary of results and discussion.

Delta Engineering has noted high levels of treatment in series of tests done at municipal fluid wastes with very minimal pretreatment i.e. settling of solids. The first permanent Snowfluent® plant located in Maine has completed its 3rd year of operation. A Second permanent plant, in Canada, was opened in Westport in 1996. Efficiency of treatment at these plants were reported as very high. Two additional plants in Mars Hill, Maine and Swift Current, Saskatchewan will start up in the fall of 1997.

If the test data can be verified, the Big Sky Country Water & Sewer District would consider locating a snowmaking process at the Mountain Village to treat winter flows. In addition to the snowmaking system at the Mountain Village, the district would consider locating a snowmaking disposal system in the vicinity of Meadow Village.

Snowmaking in the Meadow Village area would utilize effluent from the advanced treatment plant. Again the use of winter Snowmaking would reduce storage requirements and would provide an additional disposal method.

Snowfluent® Field Experiment
Big Sky, Montana 1997

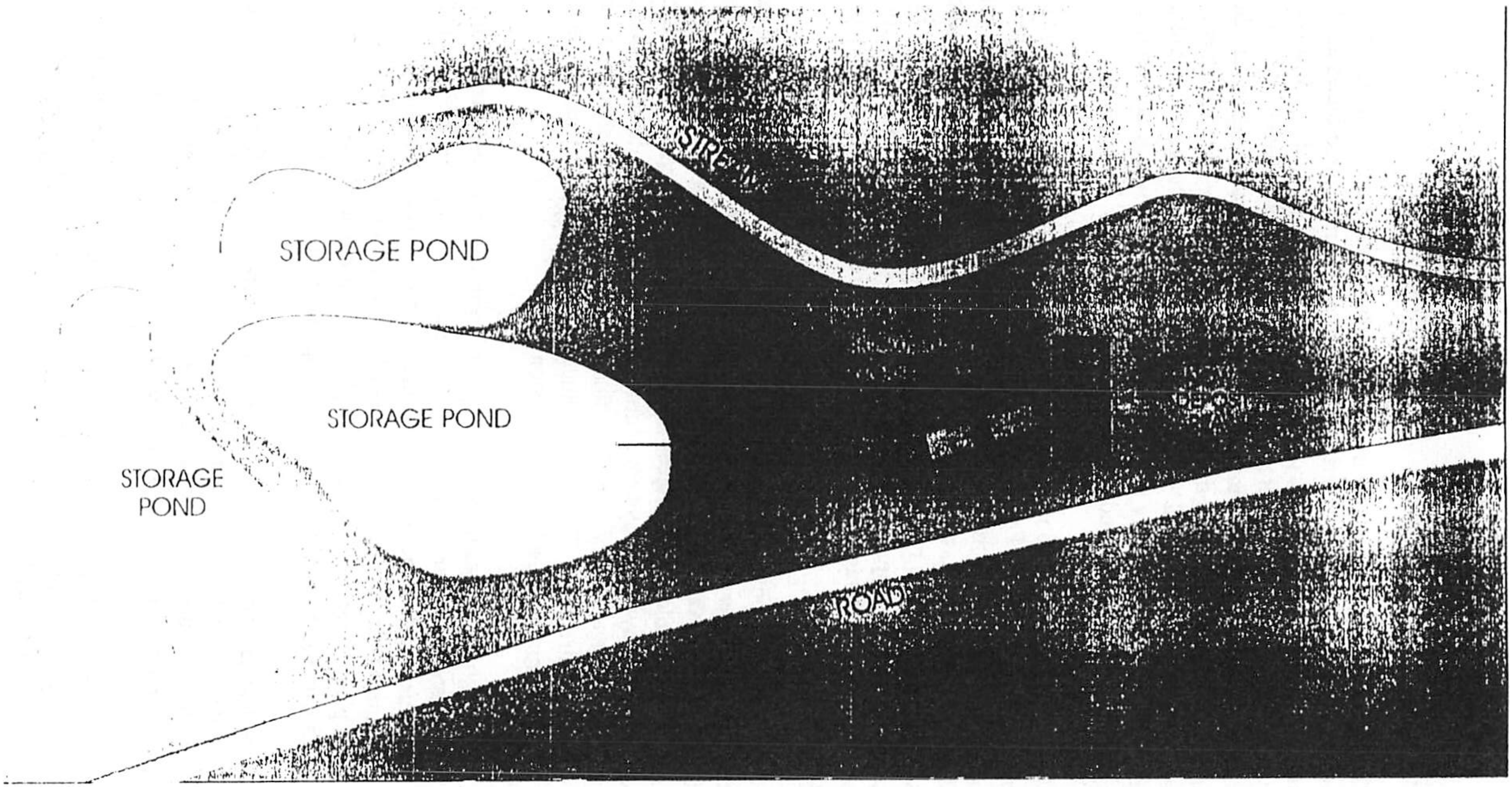

Fig. 3

6.0 Monitoring Program

The sampling program was designed to achieve two goals. The first goal was to assess the efficiency of the treatment process, and the second was to assess impacts on the environment from the treatment process.

The applied water, fresh snow, aged snow, meltwater and groundwater were to be sampled and analyzed , on a regular basis, for the following parameters: *fecal coliforms,* Total Suspended Solids, BOD_5, Orthophosphate, Total Phosphorous, Nitrate & Nitrite, Ammonia, Total Kjeldahl Nitrogen, Alkalinity, Conductivity, and Sulfate.

The guidelines for sampling were developed and provided to draw attention to items of specific interest for the Snowfluent® process.

The major elements planned for monitoring in a Big Sky Snowfluent® test were:

- containment lagoon effluent
- fresh and aged snow
- meltwater
- groundwater

The goals of the pilot plant test at Big Sky, Montana were defined as follows:

- Determine the snowmelt concentrations for BOD_5, TKN, Ammonia NH_3 and NH_4^+, NO_3 and NO_2, TP, Fecal Coliforms, pH, TSS, Sulfate as well as Conductivity and Alkalinity
- Determine any impacts of the snowmelt to the groundwater
- Determine the run-off concentrations if a surface runoff system is utilized
- Provide enough background data to evaluate the feasibility of constructing a snowmaking system at either the Mountain Village, Mcadow Village or both locations.

The monitoring program for the Snowfluent® field experiment at Big Sky were prepared. This program is briefly summarized in Table 2.

Lagoon effluent and fresh snow usually are sampled every second day during the snow production. The suggestion of aged snow sampling weekly was based on previous experience with Snowfluent® experiments.

During the initial 2 weeks of melting conditions it was proposed to sample the meltwater from the lined pond every other day.

Duplicate samples should be collected and analyzed for the same parameters listed above.

Table 2

Test Program				
Sampling Element	**Sampling Location**	**Sampling Time (Frequency)**	**Type of Sample**	**Parameter**
Lagoon Effluent	Lagoon or Snowfluent™ Piping System	During the production (Every second day)	Composite	TSS, BOD5, PO4 , TP, NO3 & NO2, NH3, TKN, SO4 Alkalinity, Conductivity, pH Fecal Coliforms
"Fresh" Snow	Snowpack	During the production (Every second day)	Grab / Composite	TSS, BOD5, PO4 , TP, NO3 & NO2, NH3, TKN, SO4 Alkalinity, Conductivity, pH Fecal Coliforms
"Aged" Snow	Snowpack	First Two Weeks (Every second day)	Grab / Composite	TSS, BOD5, PO4 , TP, NO3 & NO2, NH3, TKN, SO4 Alkalinity, Conductivity, pH Fecal Coliforms
"Aged" Snow	Snowpack	To the end of melting season (weekly)	Grab / Composite	TSS, BOD5, PO4 , TP, NO3 & NO2, NH3, TKN, SO4 Alkalinity, Conductivity, pH Fecal Coliforms
Meltwater	Snow Disposal Area	During the melting (Every second day)	Composite	TSS, BOD5, PO4 , TP, NO3 & NO2, NH3, TKN, SO4 Alkalinity, Conductivity, pH Fecal Coliforms
Groundwater	Snow Disposal Area	During the melting & after experiment (3 times)	Grab	BOD5, PO4 , TP, NO3 & NO2, NH3, TKN, SO4 Alkalinity, Conductivity, pH

After the first 2 weeks of sampling , the sampling program could be reduced to one per week.

7.0 Field Experiment - Procedures

The field experiment at Big Sky began at the beginning of March 1997 and finished at the end of May, when all the snow had melted. During the production of the snow, the temperatures did not allow the test to proceed in a continuous form. Most temperatures below 0 °C occurred during the night. Therefore, the site was illuminated for operation during non daylight hours.

The snowmaking program was run intermittently between March 5 - March 17, 1997. Snow was made typically at night, when the temperatures were cold enough to process.

A temporary Snowfluent® installation (mobile unit) was set up at a site close to the aeration pond. The wastewater was pumped to the atomizing nozzles at a rate of approximately 80 gpm.

Significant quantities of wastewater from the Big Sky treatment lagoons were converted into snow. It was estimated that about 2300 m^3 of wastewater was converted to about 4200 m^3 of man made snow. Approximately 2100 m^3 were placed in the lined containment area and 2100 m^3 were placed on the unlined containment area.

The meltwater was accepted to infiltrate into the ground. This allowed impact on the groundwater to be evaluated. No runoff to the surface streams occurred from the snowmaking test site.

Three shallow monitoring wells were installed inside the unlined plot and two within the lined plot. A shallow collection ditch was constructed at the plots periphery.

Qualitative tests of the wastewater, converted snow, and meltwater were performed by Big Sky Country Water & Sewer District.

The testing of snow began on the first day of the test on Mar 5, 1997 and finished on March 16, 1997.

Analyses of Fresh Snow and Raw Wastewater

Fresh snow was sampled the morning after the previous nights' production and was collected off the top of the pile. A sterilized plastic scoop was used to transfer the snow into 500 ml, 2000 ml and into bacteriological sample bottles. All samples were transported to the lab in a cooler promptly after being taken.

The samples of wastewater were taken on the same days. This allowed a direct comparison of applied water and snow on the pile. Processed wastewater was sampled from the storage pond within 10 feet of the intake hose for the submersible pump. Samples were drawn through a hole bored in the ice.

The results of fresh snow and wastewater analyses are presented in Table 3.

Analyses of Aged Snowpack

The aged snow samples were obtained from the testing pit on the lined section of the plot. Aged Snow was collected off the bottom 1-2 feet of the snowpack and was obtained by digging into the snow pile to reach a fresh wall of snow. The photo of the sampled area is presented on Fig. 6. On Fig. 7, the sample pit is shown. The aged snow was sampled approximately every second day and then generally on a weekly basis until the final snowmelt.

Meltwater

In the 3rd phase of Snowfluent® experiment at Big Sky the meltwater was sampled and analyzed. During the melting phase of the project the samples were collected off the lined portion of the test site. The testing of the meltwater began when the meltwater was observed in the lined containment pond.

Meltwater was intended to be collected out of a shallow discharge ditch which was fed by meltwater off the liner. The reason for this was to allow time for proper separation of the precipitated contaminants from the meltwater. The liner posed a problem in that the meltwater would collect in pools coused by the uneven ground suface and would not readily drain down the shallow ditch that was constructed for that purpose.
It was found by engineering personnel at Big Sky, that if the liner was pulled up prior to testing and close to the pile to form a pool where the water could collect, the fresh sample could then be drawn. Care was taken not to scrape the liner while the sample was collected.
Samples were collected 2-3 times weekly during late April and throughout most of May.

All of the samples were transported to the lab within hours in a cooler. The last snow melt samples was taken on Friday, May 23. By Monday, May 26 the pile of snow was almost gone. Very little remained to sample and that was extremely dirty with dust and other debris resulting from the start of storage pond construction.

Groundwater

It was planned to collect the groundwater samples from the monitoring wells on a weekly basis during snowmelt. However, the 5 shallow groundwater monitoring wells that were installed never did produce enough water to sample. The only well that did have water in it was the monitoring well in the middle of the unlined plot. But, there was not enough for proper sampling and analysis.

Fig. 6 Snowfluent® Deposit Site. Field Experiment, Big Sky, Montana 1997

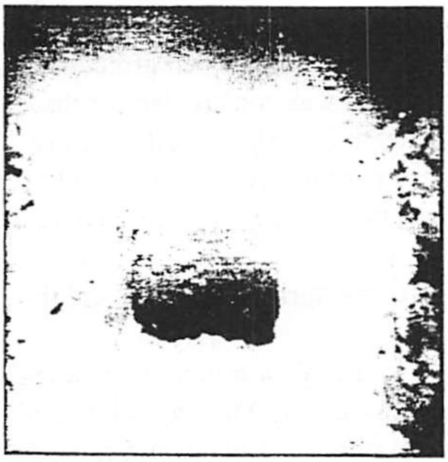

Figure 7, Aged snow sample pit.

7.0 Results

The quality of snow produced during the field experiment was excellent. The wastewater droplets froze rapidly and thoroughly. The consistency of snow approached that of sugar in the size of granules and its ability to be poured like sugar. Odors were minimal. No complaints regarding odors or noise were received due to the operation of the mobile plant.

Raw Wastewater and Fresh Snow

Table 3 contains data from raw wastewater and the fresh snow.

The bacterial level of *Fecal Coliforms* in the "fresh" snow were typically undetectable. The rapid freezing of small droplets create favorable conditions for killing bacteria and other microorganisms.

Total Suspended Solids (TSS) increased from 21.5 to 43 mg/l (median value). This instantaneous increases in suspended solids is the result of insoluble carbonates forming during the freezing process.

The typical BOD_5 in the lagoon wastewater was 33 mg/l during the snow production. At the same time the median value of BOD_5 in "fresh" snow was 34 mg/l. Similar results were noted previously in other Snowfluent® operations. Since no separation has occurred yet, significant reduction of BOD_5 is not usually expected at this stage of the process.

Total phosphorous remains at the same level as expected, in the wastewater and in the fresh snow: 7.1 and 7.2 mg/l respectively. Orthophosphate levels in fresh snow decreased to the level of 50% of that in the wastewater and was reported as median value of 2.1 mg/l. This indicates the formation of calcium phosphate particulate during freezing.

The pH in the lagoon wastewater ranged from 7.3 to 7.8 during the tests. The levels in the snow were typically 9.1 to 9.8. This increase in pH is a result of the removal of carbon dioxide during the atomizing and freezing process and is typical for wastewater after Atomizing Freeze Crystallization.

About 50% of ammonia as nitrogen was released during the snowmaking. The median value of ammonia in the lagoon wastewater was 56 mg/l. In fresh snow this value was reduced to the median value of 23.5 mg/l. This phenomenon can be explained by the fact that raising the wastewater pH level to about 9.1 , after atomization, decreases the percentage of ammonium ions. Thus, more nitrogen was present in the form of ammonia NH_3 and more ammonia could be volatilized during the snow production.

The values of TKN were noted to be lower than the ammonia levels. This is in error because TKN is the total of NH_3 - N and organic nitrogen and therefore can not be lower.

Table 3

Snowfluent® Field experiment - Big Sky 1997

Phase I - Chemical and Bacteriological Analyses of Wastewater and Fresh Snow

	FECAL COLIFORMS col/100 ml	TOTAL SUSPENDED SOLIDS mg/l	BOD5 mg/l	ORTHOPHOSPHATE AS PHOSPHORUS mg/l	TOTAL PHOSPHORUS mg/l	NITRATE & NITRITE AS NITROGEN mg/l	pH	AMMONIA AS NITROGEN mg/l	TOTAL KJELDAHL NITROGEN mg/l	ALKALINITY mg/l	CONDUCTIVITY umhos/cm	SULFATE mg/l
Wastewater												
5-Mar	13,000	22	37	4.40	7.8	0.34	7.5	40	7.1	270	690	26
7-Mar	9,500	30	36	4.30	7.4	ND	7.3	56	18	270	710	39
9-Mar	6,400	21	31	4.10	2.5	ND	7.5	56	27	270	690	29
11-Mar	6,200	26	28	4.90	6.7	ND	7.8	57	44	260	650	27
13-Mar	7,400	8	34	4.60	7.4	ND	7.5	60	22	260	670	26
16-Mar	500	17	25	3.70	6.4	0.063	7.6	25	13	160	380	17
average	7166.7	20.7	31.8	4.3	6.4	0.0671	7.5	49.0	21.9	248.3	631.7	27.3
median	6900.0	21.5	32.5	4.4	7.1	0.0	7.5	56.0	20.0	265.0	680.0	26.5
Snowpack "Fresh"												
5-Mar	12	37	33	2.20	7.1	ND	9.1	28	11	260	600	19
7-Mar	ND	38	27	0.70	7.3	0.1	9.5	19	14	210	520	21
9-Mar	ND	48	35	3.80	8.2	ND	9.1	31	16	240	540	24
11-Mar	ND	100	7	0.42	3.8	0.11	9.8	4.4	5.4	100	150	ND
13-Mar	ND	36	39	3.80	6.4	ND	9	53	28	260	600	25
16-Mar	ND	88	38	2.00	7.2	ND	9.1	7.2	8.1	69	140	ND
average	2.0	57.8	30.0	2.1	6.7	0.0	9.3	23.8	13.7	190.0	425.0	14.8
median	0.0	43.0	34.0	2.1	7.2	0.0	9.1	23.5	12.5	225.0	530.0	20.0

Delta Engineering
Ottawa

This inconsistency could be the result of the laboratory not getting full digestion on the TKN values.

Decreasing levels of Alkalinity and Conductivity are the result of insoluble salts forming during the freezing process.

Nitrates and nitrites in the raw wastewater, as well as in the fresh snow were undetectable or at very low levels.

Aged Snow

Table 4 contains data from the chemical and bacteriological analyses of the aged snow. This data is also presented in graphical form in Appendix B_1.

The Fecal Coliforms continued to remain at non detectable levels for all but two of the aged snow samples.

Up to the beginning of April, the concentrations of ammonia in the snowpack were still at a similar level to the "fresh snow". Since April 16th, the concentration of ammonia in the snow significantly decreased to a level of 0.88 mg/l, at the end of melting season in May. At the same time, some oxidation of nitrogen was noted, as shown by nominal increases in nitrate and nitrite levels. It should be noted that these levels of nitrate and nitrite at < 0.05 mg/l are insignificantly small because the maximum contamination level for drinking water is 10 mg/l.

As the snowpack was aging, the total suspended solids were increasing. This can be explained by the fact that rejected solid particles from the ice crystals were slowly eluted by infiltration meltwater or rain.

The BOD_5 of snow at the end of melting season was also lower than in the fresh snow. This phenomenon was also noted for such parameters as alkalinity, conductivity and sulfate. The reduction of these contaminants in the snow during the melting season is the result of metamorphism of snow, as well as snowpack "washing" by the meltwater and the rainwater. Precipitated salts are rejected by the growing ice crystal during the metamorphosis of the snowpack. These salts are moved down in the snowpack by both rainwater and meltwater. The change in the aged snow samples between April 2nd and April 16th are an excellent example of this washing of the snowpack.

The levels of orthophosphate and Total Phosphorus varied up and down during the aging process. The exact reason for this is currently unknown, but some results, such as the 9.8 mg/l for orthophosphate on April 16th, with a Total Phosphorous only 9.3 mg/l are suspect. Orthophosphates are part of Total Phosphorus and thus must necessarily be less than or no greater than the value of total P. Both of these results were significantly higher than the results on samples taken before and after this date.

Table 4

Snowfluent™ Field experiment - Big Sky 1997

Phase II, Chemical and Bacteriological Analyses of Aged Snow

Snowpack - 'Aged'	FECAL COLIFORMS	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	ALKALINITY	CONDUCTIVITY	SULFATE
	col/100 ml	mg/l	mg/l	mg/l	mg/l	mg/l		mg/l	mg/l	mg/l	umhos/cm	mg/l
5-Mar-97	ND	44	34	1.9	6.6	ND	9.2	34	10.2	230	570	26
7-Mar-97	ND	42	44	1.6	7.7	ND	9.3	34	18	220	490	22
9-Mar-97	ND	21	61	2.7	7.6	ND	9.5	27	16	210	480	23
11-Mar-97	ND	42	32	2.2	8.9	ND	9.5	34	20	200	450	24
13-Mar-97	ND	18	60	2.9	4.6	ND	9.6	21	21	170	460	29
16-Mar-97	ND	37	17	3.2	8.1	ND	9.4	76	33	230	550	27
20-Mar-97	ND	48	35	3.70	6.7	ND	9.3	20	42	180	480	26
26-Mar-97	ND	72	33	2.60	4.3	ND	9.2	94	63	310	88	40
2-Apr-97	ND	90	66	2.10	4.0	0.04	8.9	17.64	28.1	220	610	26
16-Apr-97	94	75	29	9.80	9.3	0.05	9.3	7.4	13.12	80	120	ND
24-Apr-97	ND	90	10	3.00	6.3	0.01	8.7	3.07	4.57	85	130	ND
1-May-97	ND	78	5	0.99	5.5	0.01	9.3	1.38	3.08	62	99	ND
12-May-97	ND	63	12	1.90	3.4	0.02	9.5	0.88	2.9	60	70	ND
average	14.6	55.4	32.2	3.0	6.4	0.0	9.3	28.4	21.2	173.6	353.6	18.6
median	0.0	48.0	33.0	2.6	6.6	0.0	9.3	21.0	18.0	200.0	460.0	24.0

Meltwater

The chemical and bacteriological analyses of the meltwater are contained in Table 5. This data is also presented in a graphic form in Appendix B. Table 6 contains summary data on the Total Reductions achieved with Snowfluent®.

The Fecal Coliforms continued to remain very low and were typically non-detectable throughout the melting period. These results are an example of the disinfecting properties that are normally experienced with Snowfluent®.

Total Suspended Solids varied from four samples with 0 mg/l to the final sample at 84 mg/l. There are a couple of reasons for these variations. As discussed previously, the sampling technique that was necessary to obtain sufficient quantities of meltwater (raising the liner to pool the water) may have caused some settled material to be disturbed and as such be reintroduced to the sample. Also, there was significant airborne dust from nearby construction that was settling out at times on the snow deposit site and the adjacent pooled water.

The BOD_5 median value was 8.0 mg/l. While this represented a 75.4 % reduction from the raw water. Snowfluent® typically develops much lower levels (< 2 mg/l) of BOD_5 in the meltwater (See the attached results from Westport). As with the TSS, external factors and sampling may have contributed to the higher levels of BOD_5.

Orthophosphate and Total Phosphorous levels were reduced by between 32-45% respectively. Again, for the same reasons as above, this performance is not on par with other applications (See the attached results from Westport). However, since the intention is to infiltrate the meltwater into the soils, any phosphorous compounds that are not precipitated on the surface will be adsorbed by the top strata of the soils matrix.

The results on the nitrogen contaminants were outstanding, with a 98.4% reduction in ammonia and an 88% reduction in the TKN. The median ammonia level of 0.9 mg/l, while higher than what would be expected from a full scale operation, is still very acceptable for discharge. Due to the absence of bacteria and the cold temperatures, there was no nitrification of the ammonia, hence no increases in nitrate or nitrite - N were detected in the meltwater.

During the latter stages of the snowpack aging process, the alkalinity, conductivity and sulfate in the meltwater were also significantly reduced by 70%, 75% and 100% respectively. These are all indicative of the significant separation of contaminants that normally occurs with the Snowfluent® technology. In the case normally soluble salts such as sulphates, chlorides etc., concentration effect causes precipitation and release of heat of crystallization. Resolubilization does not occur unless the heat of solution is regained. This allows for an immediate separation of such salts from the water fraction by using the exfiltration effect of the soil matrix. Plants growing in this immediate area readily access these normally soluble salts. At Carrabassett Valley Sanitary District in Maine, USA,

Table 5

Snowfluent® Field Experiment - Big Sky 1997

Phase III: Snowmelt - Chemical and Bacteriological Analyses

Snowmelt	FECAL COLIFORMS	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	pH	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	ALKALINITY	CONDUCTIVITY	SULFATE
	col/100 ml	mg/l	mg/l	mg/l	mg/l	mg/l		mg/l	mg/l	mg/l	umhos/cm	mg/l
24-Apr-97	ND	28	7	2.4	4.2	0.04	7.7	0.78	1.31	50	140	ND
28-Apr-97	ND	0	11	3.4	4.3	0.04	8.1	4.25	5.65	90	210	ND
30-Apr-97	ND	8	1	2.4	4.3	0.02	7.6	0.83	2.5	44	100	ND
5-May-97	ND	0	19	1.6	2.2	0.02	7.6	0.89	2.9	70	130	ND
6-May-97	ND	0	8	3.0	4.7	0.02	7.9	0.78	2.16	70	140	ND
7-May-97	1	9	7	2.6	3.9	0.02	7.7	0.96	2.36	50	120	ND
9-May-97	ND	23	6	3.0	3.3	0.02	7.9	0.94	2.12	100	180	ND
12-May-97	ND	10	7	3.4	3.6	0.02	7.9	1.27	2.23	80	170	ND
14-May-97	ND	34	8	3.0	3.4	0.03	8.4	0.93	3.17	120	200	ND
16-May-97	ND	0	6	3.4	3.3	0.02	8.7	0.63	1.85	100	180	ND
19-May-97	ND	6	10	3.4	4.0	0.01	8.0	0.89	2.26	100	170	ND
21-May-97	ND	8	9	2.6	3.3	0.01	8.1	0.63	2.48	80	140	ND
23-May-97	ND	84	12	3.5	4.0	0.01	8.2	0.84	3.06	110	170	ND
average	ND	16.1	8.5	2.9	3.7	0.0	8.0	1.1	2.6	81.8	157.7	ND
median	ND	8.0	8.0	3.0	3.9	0.0	7.9	0.9	2.4	80.0	170.0	ND

Table 6

Total Reduction after Snowfluent® Operation

Big Sky, Montana, 1997

	FECAL COLIFORMS (col/100 ml)	TOTAL SUSPENDED SOLIDS	BOD5	ORTHOPHOSPHATE AS PHOSPHORUS	TOTAL PHOSPHORUS	NITRATE & NITRITE AS NITROGEN	AMMONIA AS NITROGEN	TOTAL KJELDAHL NITROGEN	ALKALINITY	CONDUCTIVITY	SULFATE
wastewater											
	[illegible]	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	umhos/cm	mg/l
average	7166.7	20.7	31.8	4.3	6.4	0.0671	49.0	21.9	248.3	631.7	27.3
median	6900	21.5	32.5	4.4	7.1	0.0	56.0	20.0	265.0	680.0	26.5
meltwater											
	[illegible]	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	umhos/cm	mg/l
average	0	16.1	8.5	2.9	3.7	0.0	1.1	2.6	81.8	157.7	0.0
median	0	8.0	8.0	3.0	3.9	0.0	0.9	2.4	80.0	170.0	0.0
Reduction											
	%	%	%	%	%	%	%	%	%	%	%
average	100.0	22.2	73.3	32.6	42.2	100.0	97.8	88.1	67.1	75.0	100.0
median	100.0	62.8	75.4	31.8	45.1		98.4	88.0	69.8	75.0	100.0

comparative spray irrigation to Snowfluent® in side by side simultaneous operations have shown 40 to 50 mg/l of SO_4 for example compared to 1-2 mg/l in the ground water adjacent to the Snowfluent® meltwater application area.

APPENDIX P

DRAFT DISCHARGE PERMIT

Minor Lagoon
Permit No.: MT-0030384

MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY

AUTHORIZATION TO DISCHARGE UNDER THE

MONTANA POLLUTANT DISCHARGE ELIMINATION SYSTEM (MPDES)

In compliance with Mont. Code Annot. Section 75-5-101 *et seq.* and ARM Title 17, Chapter 30, Subchapters 5, 6, 7, and 13.

Big Sky County Water and Sewer District 363
P.O. Box 160670
Big Sky, MT 59716

is authorized to discharge from its **domestic wastewater treatment facilities**,

to receiving waters named **Gallatin River**,

in accordance with discharge point(s), effluent limitations, monitoring requirements and other conditions set forth herein. Authorization for discharge is limited to those outfalls specifically listed in the permit. Specified load allocations support and serve to define total maximum daily loads for the receiving waters affected.

This permit shall become effective on the date of issuance.

This permit and the authorization to discharge shall expire at midnight, **September 30, 2003**.

FOR THE MONTANA DEPARTMENT OF
ENVIRONMENTAL QUALITY

____
Frederick C. Shewman, P. E.
Supervisor, MPDES Permits
Permitting & Compliance Division

Dated this____day of __________.

TABLE OF CONTENTS

I. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

A. Definitions.

1. The "**30-day (and monthly) average,**" other than for fecal coliform bacteria is the arithmetic average of all samples collected during a consecutive 30-day period or calendar month, whichever is applicable. Geometric means shall be calculated for fecal coliform bacteria. 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,**" other than for fecal coliform bacteria, is the arithmetic mean of all samples collected during a consecutive 7-day period or calendar week, whichever is applicable. Geometric means shall be calculated for fecal coliform bacteria. 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 in the month that have at least four days. For example, if a calendar week overlaps two months, the weekly average is calculated only in the month that contains four or more days of that week.

3. The "**Annual Average Load**" is the arithmetic mean of all 30-day or monthly average loads reported during the calendar year for a monitored parameter.

4. "**BOD_5**" is the five-day measure of pollutant parameter biochemical oxygen demand.

5. "**Bypass**" means the intentional diversion of waste streams from any portion of a treatment facility.

6. A "**Daily Maximum Limit**" specifies the maximum allowable discharge of a pollutant during a calendar day. Expressed as units of mass, the daily discharge is cumulative mass discharged over the course of the day. Expressed as a concentration, it is the arithmetic average of all measurements taken that day.

7. "**Department**" means the Montana Department of Environmental Quality (MDEQ).

8. "**Director**" means the Director of the United States Environmental Protection Agency's Water Management Division.

9. "**EPA**" means the United States Environmental Protection Agency.

10. A "**grab**" sample, for monitoring requirements, is defined as a single dip-and-take sample collected at a representative point in the discharge stream.

11. An "**instantaneous**" measurement, for monitoring requirements, is defined as a single reading, observation, or measurement.

12. The term "**interference**" means a discharge which, alone or in conjunction with other contributing discharges

    a. Inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal;

    AND

    b. Therefore causes a violation of any requirement of the POTW's MPDES permit (including an increase in the magnitude or duration of a violation) or causes the prevention of sewage sludge use or disposal in compliance with the following statutes and regulations: Section 405 of the Clean Water Act; 40 CFR Part 503 - Standards for the Use and Disposal of Sewage Sludge; Resource Conservation and Recovery Act (RCRA); 40 CFR Part 258 - Criteria for Municipal Solid Waste Landfills; and/or any State regulations regarding the disposal of sewage sludge.

13. "**Load limits**" are mass-based discharge limits expressed in units such as lb/day.

14. A "**mixing zone**" is a limited area of a surface water body or aquifer where initial dilution of a discharge takes place and where water quality changes may occur. Also recognized as an area where certain water quality standards may be exceeded.

15. "**Nondegradation**" means the prevention of a significant change in water quality that lowers the quality of high-quality water for one or more parameters. Also, the prohibition of any increase in discharge that exceeds the limits established under or determined from a permit or approval issued by the Department prior to April 29, 1993.

16. The term "**pass through**" means a discharge which ~~exits the P~~OTW into waters of the State of Montana in quantities or concentrations which, alone or in conjunction with other discharges, is a cause of a violation of any requirement of the POTW's MPDES permit (including an increase in the magnitude or duration of a violation).

17. "**POTW**" means a publicly-owned treatment works.

18. "**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.

19. "**Sewage Sludge**" is any solid, semi-solid or liquid residue that contains materials removed from domestic sewage during treatment. Sewage sludge includes, but is not limited to, primary and secondary solids and sewage sludge products.

20. The term "**TMDL**" means the total maximum daily load limitation of a parameter, representing the estimated assimilative capacity for a water body before other designated uses are adversely affected. Mathematically, it is the sum of wasteload allocations for point sources, load allocations for non-point and natural background sources, and a margin of safety.

21. "**TSS**" is the pollutant parameter total suspended solids.

22. "**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.

B. Description of Discharge Points

The authorization to discharge provided under this permit is limited to those outfalls specifically designated below as discharge locations. Discharges at any location not authorized under an MPDES permit is a violation of the Montana Water Quality Act and could subject the person(s) responsible for such discharge to penalties under the Act. Knowingly discharging from an unauthorized location or failing to report an unauthorized discharge within a reasonable time from first learning of an unauthorized discharge could subject such person to criminal penalties as provided under Section 75-5-632 of the Montana Water Quality Act.

Outfall Serial Number	Description of Discharge Point
001	At the end of the discharge pipe emptying to the Gallatin River, located approximately 45°15'58" N latitude, 111°15'02" W longitude. The mixing zone for the facility consists of a distance in the Gallatin River equal to 10 river widths.

C. Specific Effluent Limitations

Wastewater Effluent Limitations

Effective immediately and lasting through September 30, 2003, the quality of effluent discharged by the facility shall, as a minimum, meet the limitations as set forth below:

Outfall 001

Parameter	Concentration (mg/l) [1]		Allocated Annual Average Load [2] (lb/day)
	7-Day Average	30-Day Average	
BOD_5	45	30	80
Total Suspended Solids	45	30	80
Phosphorus, Total (as P)	0.5[3]	0.75	1.34
Nitrogen, Total (as N)[4]	5.0[5]	7.5	13.4
Fecal Coliform Bacteria (Organisms/100 ml of effluent)	2.2 [6]		Not Applicable

(1) See the definitions in Part I.A for explanation of terms.
(2) Calculations are based on the 30-day average values of flow and concentration.
(3) Not to exceed an instream increase of 0.001 mg/l based on effluent and instream flow volumes and a 0.0 mg/l total phosphorous background concentration.
(4) Total nitrogen as N includes the sum of: nitrate+nitrite as N and total Kjeldahl nitrogen as N.
(5) Not to exceed an instream increase of 0.01 mg/l based on effluent and instream flow volumes and a 0.0 mg/l total nitrogen background concentration.
(6) No single sample may exceed 23 coliform organisms per 100 milliliters of effluent sample. This limitation applies from the period beginning April 1 and ending October 31.

Effluent flows are also limited in the permit to insure that the instream total phosphorous concentration is not exceeded by more than 0.001 mg/l total P. The effluent flow limitations are based on the monthly 7Q10 instream flows as follows:

Outfall 001 Effluent Flow Volumes

Month	7Q10 Monthly Flow (cfs)	Effluent Volume (gpm)
January	155	140
February	162	145
March	166	150
April	180	160
May	332	300

June	586	525
July	340	305
August	258	230
September	244	220
October	220	195
November	174	155
December	152	135

Effluent pH shall remain between 6.0 and 9.0 unless a variation is due to natural biological processes. For compliance purposes, any single analysis and/or measurement beyond this limitation shall be considered a violation of the conditions of this permit.

The arithmetic mean of the BOD_5 for effluent samples collected in a period of 30 consecutive days shall not exceed 15% of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period (85% removal). This is in addition to the concentration limitations on BOD_5.

The instantaneous maximum for Oil & Grease in any grab sample shall be 15 mg/*l*.

Disinfection will be by ultra-violet light.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

There shall be no discharge which causes visible oil sheen in the receiving stream.

There shall be no acute toxicity in the effluent discharged by the facility and no chronic toxicity outside the boundaries of the mixing zone.

The tabulated load threshold values establish baseline allocations for discharges existing prior to April 29, 1993, as defined under ARM 17.30.702 (16). Numerical water quality criteria, as well as narrative standards and prohibitions presented in ARM 17.30.637 may preclude discharge at these limits if water quality violations will result.

D. Self-Monitoring Requirements

1. Wastewater Discharge Monitoring - Outfall 001

a. As a minimum, upon the effective date of this permit, the following constituents shall be monitored at the frequency and with the type of measurement indicated; samples or measurements shall be representative of the volume and nature of the monitored discharge. If no discharge occurs during the entire monitoring period, it shall be stated on the Discharge Monitoring Report Form (EPA No. 3320-1) that no discharge or overflow occurred.

Outfall 001 - Effluent Monitoring

Parameter	Frequency	Type [(1)]
Effluent Flow Rate [(2)]	Monthly	Instantaneous
BOD_5	Monthly	Grab
Total Suspended Solids	Monthly	Grab
pH	Monthly	Instantaneous
Fecal Coliform Bacteria [(3)] (organisms/100 ml)	Monthly	Grab
Total Phosphorus (as P)	Monthly	Grab
Total Ammonia (as N)	Monthly	Grab
Nitrate + Nitrite (as N)	Monthly	Grab
Total Kjeldahl Nitrogen (as N)	Monthly	Grab
Total Nitrogen (as N) [(4)]	Monthly	Calculated
Monthly and Annual Average Load, BOD_5	Monthly/Annually	Calculated
Monthly and Annual Average Load, TSS	Monthly/Annually	Calculated
Monthly and Annual Average Load, Phosphorus	Monthly/Annually	Calculated
Monthly and Annual Average Load, Nitrogen	Monthly/Annually	Calculated

(1) See the definitions in Part I.A. of the permit.
(2) If no discharge occurs during the reporting period, "no discharge" shall be recorded on the DMR report form.
(3) Fecal coliform monitoring is required only from April 1 to October 31 each year.
(4) Calculated by finding the sum of [Nitrate + Nitrite] and [Total Kjeldahl Nitrogen] concentrations.

Instream Monitoring

Parameter	Frequency	Type [(1)(5)]
Flow Rate, gpm	Monthly[(2)]	Calculated

(1) See the definitions in Part I.A. of the permit.
(2) Flow shall be calculated from daily data reported from the USGS gauging station No. 06043500 located 0.3 miles downstream from Spanish Creek. The flow at Outfall 001 will be calculated using the following formula: Ungaged flow = ungaged area (557 sq miles) divided by the gauged area (825 sq miles) exponent 0.85 times the gauged flow.

b. In addition to reporting the concentration values, the monthly loads expressed in lb/day shall be calculated and reported for BOD_5, total suspended solids, total phosphorus, and total nitrogen. The monthly loads shall be calculated using the monthly average effluent flow rate and monthly average parameter concentration as shown in the following equations:

Monthly Load (lb/day) = Parameter Concentration (mg/l) × Effluent Flow Rate (gpm) × (0.012)

OR

= Parameter Concentration (mg/l) × Effluent Flow Rate (mgd) × (8.338)

Once per year on the December Discharge Monitoring Report (DMR) form, the Annual Average Load values shall be reported.

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. Sludge samples shall be collected at a location representative of the quality of sludge immediately prior to use-disposal practice.

B. Monitoring Procedures. Monitoring must be conducted according to test procedures approved under Part 136, Title 40 of the Code of Federal Regulations, unless other test procedures have been specified in this permit. See Part I.C. for any applicable sludge monitoring procedures. All flow-measuring and flow-recording devices used in obtaining data submitted in self-monitoring reports must indicate values within 10 percent of the actual flow being measured.

C. Penalties for Tampering. The Montana Water Quality 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 $25,000, or by imprisonment for not more than six months, or by both.

D. Reporting of Monitoring Results. Self-monitoring results will be reported monthly. Monitoring results obtained during the previous reporting period shall be summarized and reported on a Discharge Monitoring Report Form (EPA No. 3320-1), postmarked no later than the 28th day of the month following the completed reporting period. If no discharge occurs during the reporting period, "no discharge" shall be reported on the report form. Legible copies of these, and all other reports required herein, shall be signed and certified in accordance with the "Signatory Requirements" (see Part IV.G of this permit), and submitted to the Department at the following address:

Montana Department of Environmental Quality
Water Protection Bureau
P.O. Box 200901
Helena, Montana 59620-0901
Phone: (406) 444-3080

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 approved analytical methods as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report. 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 initials or name(s) of the individual(s) who performed the sampling or measurements;

3. The date(s) analyses were performed;

4. The time analyses were initiated;

5. The initials or name(s) of individual(s) who performed the analyses;

6. References and written procedures, when available, for the analytical techniques or methods used; and,

7. The results of such analyses, including the bench sheets, instrument readouts, computer disks or tapes, etc., used to determine these results.

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 Department at any time. Data collected on site, copies of Discharge Monitoring Reports, and a copy of this MPDES 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 report serious incidents of noncompliance 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 Water Protection Bureau at (406) 444-3080 or the Office of Disaster and Emergency Services at (406) 444-6911. The following examples are considered serious incidents:

a. Any noncompliance which may seriously endanger health or the environment;

b. Any unanticipated bypass which exceeds any effluent limitation in the permit (See Part III.G of this permit, "Bypass of Treatment Facilities".);

c. Any upset which exceeds any effluent limitation in the permit (See Part III.H of this permit, "Upset Conditions".).

2. 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.

3. The Department may waive the written report on a case-by-case basis if the oral report has been received within 24 hours by the Water Protection Bureau, by phone, at (406) 444-3080.

4. Reports shall be submitted to the addresses in Part II.D of this permit, "Reporting of Monitoring Results".

J. <u>Other Noncompliance Reporting</u>. Instances of noncompliance not required to be reported within 24 hours shall be reported at the time that monitoring reports for Part II.D of this permit are submitted. The reports shall contain the information listed in Part II.I.2 of this permit.

K. <u>Inspection and Entry</u>. The permittee shall allow the head of the Department or the Director or an authorized representative thereof, 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 this 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, 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 the Department and the Director advance notice of any planned changes at the permitted facility or of an activity which may result in permit noncompliance.

B. Penalties for Violations of Permit Conditions. The Montana Water Quality Act provides that any person who violates a permit condition of the Act is subject to civil or criminal penalties not to exceed $25,000 per day or one year in prison, or both, for the first conviction, and $50,000 per day of violation or by imprisonment for not more than two years, or both, for subsequent convictions. MCA 75-5-611(a) also provides for administrative penalties not to exceed $10,000 for each day of violation and up to a maximum not to exceed $100,000 for any related series of violations. Except as provided in permit conditions on Part III.G of this permit, "Bypass of Treatment Facilities" and Part III.H of this permit, "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 appropriate 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. However, the permittee shall operate, as a minimum, one complete set of each main line unit treatment process whether or not this process is needed to achieve permit effluent compliance.

F. Removed Substances. Collected screenings, grit, solids, sludges, or other pollutants removed in the course of treatment shall be 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 shall not be directly blended with or enter either the final plant discharge and/or waters of the United States. Any sludges removed from the facility shall be disposed of in accordance with 40 CFR 503, 258 or other applicable rule. EPA and MDEQ shall be notified at least 180 days prior to such disposal taking place.

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 Parts III.G.2 and III.G.3 of this permit.

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 ten (10) 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 of this permit, "Twenty-four Hour Reporting".

3. Prohibition of bypass.

a. Bypass is prohibited and the Department 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 judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and,

(3) The permittee submitted notices as required under Part III.G.2 of this permit.

b. The Department may approve an anticipated bypass, after considering its adverse effects, if the Department determines that it will meet the three conditions listed above in Part III.G.3.a of this permit.

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 Part III.H.2 of this permit are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review (i.e., Permittees will have the opportunity for a judicial determination on any claim of upset only in an enforcement action brought for noncompliance with technology-based permit effluent limitations).

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.I of this permit, "Twenty-four Hour Notice of Noncompliance Reporting"; and,

d. The permittee complied with any remedial measures required under Part III.D of this permit, "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. Industrial Wastes

1. Each significant industrial user must be identified as to qualitative and quantitative characteristics of the discharge as well as production data. A significant industrial user is defined as an industrial user discharging to a publicly-owned treatment works (POTW) that satisfies any of the following:

a. has a process wastewater flow rate of 25,000 gallons or more per average work day;

b. has a flow greater than five percent of the average dry-weather hydraulic or organic load carried by the municipal system receiving the waste;

c. has in its waste a toxic pollutant in toxic amounts as defined under Section 307(a) of the Clean Water Act of 1977, as amended, or is otherwise limited by a new or revised standard developed under Section 307(b) of the Clean Water Act; or

d. is found by the Department to have a significant impact on the treatment works or the quality of effluent from the POTW.

2. The permittee must notify the Department of any new introductions by new or existing significant industrial users or any substantial change in pollutants from any significant industrial user. Such notice must contain the information described in Part III.I.1 of this permit and be forwarded no later than sixty (60) days following the introduction or change.

3. Pretreatment Standards (40 CFR 403.5) developed pursuant to Section 307 of the Clean Water Act require that under no circumstances shall the permittee allow the introduction of the following pollutants to the waste treatment system from any source of nondomestic discharge:

a. Pollutants which create a fire or explosion hazard in the POTW;

b. Pollutants which will cause corrosive structural damage to treatment works, but in no case, discharges with a pH lower than 5.0, unless the POTW is designed to accommodate such discharges;

c. Solid or viscous pollutants in amounts which will cause obstruction to the flow in sewers, or other interference with the operation of the POTW;

d. Any pollutant, including oxygen demanding pollutants (BOD, etc.), released in a discharge of such volume or strength as to cause interference in the POTW; or,

e. Heat in amounts which will inhibit biological activity in the POTW resulting in interference, but in no case, heat in such quantities that the temperature at the treatment works influent exceeds 40°C. (104°F.) unless the POTW is designed to accommodate such heat;

f. Pollutants which cause interference or pass through.

4. In addition to the general limitations expressed above, more specific pretreatment limitations have been and will be promulgated for specific industrial categories under Section 307 of the Clean Water Act. (See 40 CFR, Subchapter N, Parts 400 through 500, for specific information).

5. The permittee shall provide adequate notice to the Department of:

   a. Any new introduction of pollutants into the treatment works from an indirect discharger (i.e., industrial user) which would be subject to Sections 301 or 306 of the Clean Water Act if it were directly discharging those pollutants;

   b. Any substantial change in the volume or character of pollutants being introduced into the treatment works by a source introducing pollutants into the treatment works at the time of issuance of the permit; and

   c. For the purposes of this section, adequate notice shall include information on:

      (1) The quality and quantity of effluent to be introduced into such treatment works; and

      (2) Any anticipated impact of the change on the quantity or quality of effluent to be discharged from such publicly owned treatment works.

6. At such time as a specific pretreatment limitation becomes applicable to an industrial user of the permittee, the Department may, as appropriate, do the following:

   a. Amend the permittee's MPDES discharge permit to specify the additional pollutant(s) and corresponding effluent limitation(s) consistent with the applicable national pretreatment limitation;

   b. Require the permittee to specify, by ordinance, contract, or other enforceable means, the type of pollutant(s) and the maximum amount which may be discharged to the permittee's facility for treatment. Such requirement shall be imposed in a manner consistent with the POTW program development requirements of the General Pretreatment Regulations at 40 CFR 403; and/or,

   c. Require the permittee to monitor its discharge for any pollutant which may likely be discharged from the permittee's facility, should the industrial user fail to properly pretreat its waste.

7. The Department retains, at all times, the right to take legal action against the industrial user and/or the treatment works, in those cases where a permit violation has occurred because of the failure of an industrial user to discharge at an acceptable level. If the permittee has failed to properly delineate maximum

acceptable industrial contributor levels, the Department will look primarily to the permittee as the responsible party.

IV. GENERAL REQUIREMENTS

A. Planned Changes. The permittee shall give notice to the Department 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 could significantly change the nature or increase the quantity of pollutant discharged. This notification applies to pollutants which are not subject to effluent limitations in the permit; or,

2. There are any planned substantial changes to the existing sewage sludge management practices of storage and disposal. The permittee shall give the Department notice of any planned changes at least 180 days prior to their implementation.

B. Anticipated Noncompliance. The permittee shall give advance notice to the Department 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 revoked, modified 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 must be submitted at least 180 days before the expiration date of this permit.

E. Duty to Provide Information. The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for revoking, modifying and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Department, 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 Department, it shall promptly submit such facts or information with a narrative explanation of the circumstances of the omission or incorrect submittal and why they weren't supplied earlier.

G. Signatory Requirements. All applications, reports or information submitted to the Department shall be signed and certified.

1. All permit applications shall be signed by either a principal executive officer or ranking elected official.

2. All reports required by the permit and other information requested by the Department shall be signed by a person described above or by a duly authorized representative of that person. A person is considered a duly authorized representative only if:

   a. The authorization is made in writing by a person described above and submitted to the Department; and,

   b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility, such as the position of plant manager, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters. (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 Part IV.G.2 of this permit 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 Part IV.G.2 of this permit must be submitted to the Department 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 Montana Water Quality 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 $25,000 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 40 CFR Part 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Department. As required by the Clean Water 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 institution 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 Clean Water Act.

K. Property or Water Rights. The issuance of this permit does not convey any property or water 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 Department at least 30 days in advance of the proposed transfer date;

2. The notice includes a written agreement between the existing and new permittees containing a specific date for transfer of permit responsibility, coverage, and liability between them;

3. The Department does not notify the existing permittee and the proposed new permittee of an intent to revoke or modify and reissue the permit. If this notice is not received, the transfer is effective on the date specified in the agreement mentioned in Part IV.M.2 of this permit; and

4. Required annual and application fees have been paid.

N. Fees. The permittee is required to submit payment of an annual fee as set forth in ARM 17.30.201. If the permittee fails to pay the annual fee within 90 days after the due date for the payment, the Department may:

1. Impose an additional assessment consisting of 15% of the fee plus interest on the required fee computed at the rate established under 15-31-510(3), MCA, or

2. Suspend the processing of the application for a permit or authorization or, if the nonpayment involves an annual permit fee, suspend the permit, certificate or authorization for which the fee is required. The Department may lift suspension at any time up to one year after the suspension occurs if the holder has paid all outstanding fees, including all penalties, assessments and interest imposed under this sub-section. Suspensions are limited to one year, after which the permit will be terminated.

O. Reopener Provisions. This permit may be reopened and modified (following proper administrative procedures) to include the appropriate effluent limitations (and compliance schedule, if necessary), or other appropriate requirements if one or more of the following events occurs:

1. Water Quality Standards: The water quality standards of 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. Water Quality Standards are Exceeded: If it is found that water quality standards or trigger values in the receiving stream are exceeded either for parameters included in the permit or others, the department may modify the effluent limits or water management plan.

3. TMDL or Wasteload Allocation: TMDL requirements or a wasteload allocation is developed and approved by the Department and/or EPA for incorporation in this permit.

4. Water Quality Management Plan: A revision to the current water quality management plan is approved and adopted which calls for different effluent limitations than contained in this permit.

5. Sewage Sludge: There have been substantial changes (or such changes are planned) in sludge use or disposal practices; applicable management practices or numerical limitations for pollutants in sludge have been promulgated which are more stringent than the requirements in this permit; and/or it has been determined that the permittee's sludge use or disposal practices do not comply with existing applicable state or federal regulations.

6. Toxic Pollutants: A toxic standard or prohibition is established under Section 307(a) of the Clean Water Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit.

Public Notice

APPLICANT NAME:	Big Sky County Water and Sewer District 363
APPLICANT ADDRESS:	P.O. Box 160670 Big Sky, MT 59716
APPLICANT STATUS:	New Permit
FACILITY LOCATION:	Section 36, T6S, R3E
PERMIT NUMBER:	MT-0030384
EXPIRATION DATE:	September 30,2003
RECEIVING WATERS:	Gallatin River

This application is for a new discharge permit for the wastewater treatment facility which serves Big Sky, Montana. The application is for the discharge of treated domestic wastewater. The wastewater treatment facility consists of KEYBOARD() with a total surface area of KEYBOARD() acres.

Discharge is to the Gallatin River, which is classified "B-1" by the Montana Surface Water Quality Standards. Waters classified B-1 are considered suitable for drinking, culinary and food processing purposes, after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply. Degradation which will impact established beneficial uses will not be allowed. Effluent limitations will ensure that the Montana Nondegradation Rules, Montana Surface Water Quality Standards and National Secondary Treatment Standards will be met. Effluent load limits in this permit have been specified to support and define the total maximum daily loads (TMDL's) for the Gallatin River.

The proposed permit requires periodic self-monitoring of discharge quality and quantity with the reporting of results monthly. This permit and Statement of Basis will be submitted to EPA for approval of the TMDL under Section 303(d) of the Clean Water Act. The recommended expiration date for the permit is September 30, 2003.

FACT SHEET/STATEMENT OF BASIS
for Proposed Permit Limits (Permit Renewal)

PERMITTEE: Big Sky County Water and Sewer District 363

PERMIT NO.: MT-0030384

RECEIVING WATERS: Gallatin River

POPULATION: 5,000 to 9,900

A. Wastewater Effluent Limitations

1. Final Effluent Limitations

Outfall 001 - Effluent Limitations

Parameter	Concentration (mg/l) (1)		Allocated Annual Average Load (2) (lb/day)	Rationale
	7-Day Average	30-Day Average		
BOD_5	45	30	80	Secondary Treatment Standards (40 CFR 133.102)
Total Suspended Solids	45	30	80	Secondary Treatment Standards (40 CFR 133.102)
Phosphorus, Total (as P)	0.5(3)	0.75	1.34	Nondegradation (ARM, 17.30.715(1)(c))
Nitrogen, Total (as N)(4)	5.0(5)	7.5	13.4	Nondegradation (ARM, 17.30.715(1)(c))
Fecal Coliform Bacteria (organisms/100 ml)	2.2 (6)	(3)	Not Applicable	Circular WQB-2,1995 Appendix B-1 Standards for Spray Irrigation of Wastewater

(1) See the definitions in Part I.A for explanation of terms.
(2) Calculations are based on the 30-day average values of flow and concentration.
(3) Not to exceed an instream increase of 0.001 mg/l based on effluent and instream flow volumes and a 0.0 mg/l total phosphorous background concentration.
(4) Total nitrogen as N includes the sum of: nitrate+nitrite as N and total Kjeldahl nitrogen as N.
(5) Not to exceed an instream increase of 0.01 mg/l based on effluent and instream flow volumes and a 0.0 mg/l total nitrogen background concentration.
(6) No single sample may exceed 23 coliform organisms per 100 milliliters of effluent sample. This limitation applies from the period beginning April 1 and ending October 31.

Effluent flows are also limited in the permit to insure that the instream total phosphorous concentration is not exceeded by more than the trigger value of 0.001 mg/l total P and the instream total nitrogen limit is not exceeded by more than the trigger value of 0.01 mg/l. The effluent flow limitations are based on the monthly 7Q10 instream flows as follows.

Outfall 001 Effluent Flow Volume Limits

Month	7Q10 Monthly Flow (cfs)	Effluent Volume (gpm)
January	155	140
February	162	145
March	166	150
April	180	160
May	332	300
June	586	525
July	340	305
August	258	230
September	244	220
October	220	195
November	174	155
December	152	135

Effluent pH shall remain between 6.0 and 9.0 unless a variation is due to natural biological processes. For compliance purposes, any single analysis and/or measurement beyond this limitation shall be considered a violation of the conditions of this permit (ARM 17.30.623(c)).

The arithmetic mean of the BOD_5 for effluent samples collected in a period of 30 consecutive days shall not exceed 15% of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period (85% removal). This is in addition to the concentration limitations on BOD_5 (40 CFR 133.102).

The instantaneous maximum for Oil & Grease in any grab sample shall be 15 mg/*l* (ARM 17.30.637(1)(b)).

Disinfection will be by ultra-violet light (Application).

There shall be no discharge of floating solids or visible foam in other than trace amounts (ARM 17.30.637(1)(b)).

There shall be no discharge which causes visible oil sheen in the receiving stream (ARM 17.30.637(1)(b)).

There shall be no acute toxicity in the effluent discharged by the facility and no chronic toxicity outside the boundaries of the mixing zone (ARM 17.30.637(1)(d)).

The tabulated load threshold values establish baseline allocations for discharges existing prior to April 29, 1993, as defined under ARM 17.30.702 (16). Numerical water quality criteria, as well as narrative standards and prohibitions presented in ARM 17.30.637 may preclude discharge at these limits if water quality violations will result.

D. Self-Monitoring Requirements

1. Wastewater Discharge Monitoring - Outfall 001

a. As a minimum, upon the effective date of this permit, the following constituents shall be monitored at the frequency and with the type of measurement indicated; samples or measurements shall be representative of the volume and nature of the monitored discharge. If no discharge occurs during the entire monitoring period, it shall be stated on the Discharge Monitoring Report Form (EPA No. 3320-1) that no discharge or overflow occurred.

Outfall 001 - Effluent Monitoring

Parameter	Frequency	Type [(1)]
Effluent Flow Rate [(2)]	Monthly	Instantaneous
BOD_5	Monthly	Grab
Total Suspended Solids	Monthly	Grab
pH	Monthly	Instantaneous
Fecal Coliform Bacteria [(3)] (organisms/100 ml)	Monthly	Grab
Total Phosphorus (as P)	Monthly	Grab
Total Ammonia (as N)	Monthly	Grab
Nitrate + Nitrite (as N)	Monthly	Grab
Total Kjeldahl Nitrogen (as N)	Monthly	Grab
Total Nitrogen (as N) [(4)]	Monthly	Calculated
Monthly and Annual Average Load, BOD_5	Monthly/Annually	Calculated
Monthly and Annual Average Load, TSS	Monthly/Annually	Calculated
Monthly and Annual Average Load, Phosphorus	Monthly/Annually	Calculated
Monthly and Annual Average Load, Nitrogen	Monthly/Annually	Calculated

[(1)] See the definitions in Part I.A. of the permit.
[(2)] If no discharge occurs during the reporting period, "no discharge" shall be recorded on the DMR report form.
[(3)] Fecal coliform monitoring is required only from April 1 to October 31 each year.
[(4)] Calculated by finding the sum of [Nitrate + Nitrite] and [Total Kjeldahl Nitrogen] concentrations.

Instream Monitoring

Parameter	Frequency	Type [(1)(5)]
Flow Rate, gpm	Monthly[(2)]	Calculated

(1) See the definitions in Part I.A. of the permit.

(2) Flow shall be calculated from daily data reported from the USGS gauging station No. 06043500 located 0.3 miles downstream from Spanish Creek. The flow at Outfall 001 will be calculated using the following formula: Ungaged flow = ungaged area (557 sq miles) divided by the gauged area (825 sq miles) exponent 0.85 times the gauged flow.

b. In addition to reporting the concentration values, the monthly loads expressed in lb/day shall be calculated and reported for BOD_5, total suspended solids, total phosphorus, and total nitrogen. The monthly loads shall be calculated using the monthly average effluent flow rate and monthly average parameter concentration as shown in the following equations:

Monthly Load (lb/day) = Parameter Concentration (mg/*l*) × Effluent Flow Rate (gpm) × (0.012)

OR

= Parameter Concentration (mg/*l*) × Effluent Flow Rate (mgd) × (8.338)

Once per year on the December Discharge Monitoring Report (DMR) form, the Annual Average Load values shall be reported.

C. Past Discharge Data

New facility

D. Proposed Facility

The proposed facility consists of an oxidation ditch modified Bardenpho system to provide nutrient removal and tertiary levels of treatment and an aerated lagoon and snowmaking system for the Mountain Village, Big Sky MT. Effluent disposal will utilize a combination of a point source discharge to the Gallatin River, irrigation on the existing golf course and snowmaking using the Snowfluent process. A six inch discharge line will be constructed from the treatment plant site to the Gallatin River. The maximum discharge volume will approximate 0.7 million gallons per day (MGD) which is slightly less than the allowable discharge limit in the highest flow month of June. The annual allowable discharge is limited to the sum of the monthly discharges and is 223 gpm. Any wastewater discharged to the Gallatin River would be treated in the oxidation ditch, filtered and disinfected with ultra-violet light. Disinfection with ultra-violet light will prevent the formation of chlorination by-products in the discharge.

E. Nondegradation Water Quality Standards Discussion

The limits for both nitrate and phosphorous were based on monthly instream flows at the 7Q10 using the following formula:

$$TV = \frac{Q_1 * C_1 + Q_2 * C_2}{Q_1 + Q_2}$$

$$Q_2 = \frac{Q_1}{0.499}$$

C_1 = background concentration, mg/*l* (0.0 mg/l)
C_2 = allowable discharge concentration, mg/*l* (0.5 mg/l total P)
TV = Trigger value which is the allowable increase in-stream concentration for toxic pollutant (Circular WQB-7 and ARM 17.30.715(1)(c))(0.001 mg/l total P)
Q_1 = Monthly $_7Q_{10}$ = 7-day, 10-year, monthly low-flow value for the receiving stream (CFS)
Q_2 = maximum flow of discharge (CFS)

The load allocation is based on the average daily flow of 223 gpm and in equal to 1.34 lbs/day of phosphorous, 13.4 lbs/day of nitrogen, 80 lbs/day BOD and 80 lbs/day TSS.

Fecal Coliform Bacteria Limits

The fecal coliform limit of 2.2 organisms /100 mg of effluent is based on the Department's Circular WQB-2, 1995 edition, Appendix B-1, "Standards for Spray Irrigation of wastewater". This limit is the treatment level necessary to irrigate the wastewater on the golf course which will be the main disposal option.

Total Residual Chlorine Limits

There is no chlorine limit as disinfection will be by ultra-violet light for wastewater discharged to the river.

Ammonia Toxicity Limits

There is no ammonia limit because the ammonia concentration is part of the total nitrogen analysis and is limited to 5 mg/l in the effluent. This is an increase in the river of 0.01 mg/l which will not cause ammonia toxicity.

Nondegradation

Load allocations calculated from discharge conditions satisfying Montana Nondegradation Rules requirements will help define and serve to support the TMDL for the Gallatin River and define baseline allocations for this facility.

The Gallatin River in the area of discharge is listed on Montana's 303(d) list and is given a low priority for TMDL development. The water body number for the affected segment is **MT41H001-1**.

Whole Effluent Toxicity Limits

Biomonitoring and WET testing will not be required at this facility at this time for the following reasons:

- the discharge rate, excluding the I/I contribution and clean winter water, amounts to less than 1 mgd,
- the potential for toxins in the effluent is low because of dilution, aeration, high relative retention time in the lagoon, and
- the lack of significant industrial contributors.

F. Mixing Zone

The facility qualifies for a standard mixing zone because the discharge is less than 1 MGD and the dilution ratio in the lowest flow month is greater than 100:1. The mixing zone is defined as the 10 times the streams width. Based on best professional judgment, given the low concentration of pollutants in the effluent, the high dilution rate, the river gradient in the area and the presence of islands down stream it is believed that the effluent will be total mixed and non detectable within this distance.

G. Miscellaneous Discussion

Wasteload allocations (functionally equivalent to TMDL's) were defined for this facility based on nonsignificance threshold values defined under Montana Nondegradation Rules (ARM 17.30.700).

PREPARED BY Terry Webster, June 1998

Signature

Date Finalized

DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER PROTECTION BUREAU
Metcalf Building, Helena, Montana 59620
(406)444-3080

ENVIRONMENTAL ASSESSMENT (EA)

Division/Bureau: Permitting & Compliance Division, MPDES Permits

Project or Application: Big Sky county Water and Sewer District 363; New MPDES Permit No. MT-0030384

Description of Project: This application is for a new wastewater discharge permit. The Montana, Sewage Treatment Plant. Discharge is to the Gallatin River, which is classified "B-1" by the Montana Surface Water Quality Standards. The Gallatin River in the area of discharge is listed on Montana's 303(d) list and is given a low priority for TMDL development. The waterbody number for the affected segment is MT41H001-1.

Benefits and Purpose of Proposal:
Adequate treatment of domestic and industrial wastewater before discharging to surface streams.

Description and analysis of reasonable alternatives whenever alternatives are reasonably available and prudent to consider:
None

Listing and appropriate evaluation of mitigation, stipulations and other controls enforceable by this or another government agency:
None

Recommendation: Grant the permit.

If an EIS is needed, and if appropriate, explain the reasons for preparing the EA:
EIS not needed.

If an EIS is not required, explain why the EA is an appropriate level of analysis:
The EA is sufficient to cover the pertinent issues on this facility and the community.

Other groups or agencies contacted or which may have overlapping jurisdiction:
None

Individuals or groups contributing to this EA:
State of Montana, DEQ Permitting & Compliance Division

EA prepared by: Terry Webster Date: June 1998

POTENTIAL IMPACT ON PHYSICAL ENVIRONMENT

	Major	Moderate	Minor	None	Unknown	Att Pages
1. Terrestrial and aquatic life and habits				X		
2. Water quality, quantity, and distribution				X		
3. Geology and soil quality, stability, and moisture				X		
4. Vegetation cover, quantity, and quality				X		
5. Aesthetics				X		
6. Air quality				X		
7. Unique endangered, fragile, or limited environmental resource				X		
8. Demands on environmental resources; water, air, and energy				X		
9. Historical and archaeological sites				X		

Cumulative and Secondary Impact: None

POTENTIAL IMPACT ON HUMAN ENVIRONMENT

	Major	Moderate	Minor	None	Unknown	Att Pages
1. Social structures and more				X		
2. Cultural uniqueness and diversity				X		
3. Local and state tax base and tax revenue				X		
4. Agricultural or industrial production				X		
5. Human health				X		
6. Access to and quality of recreational and wilderness activities				X		
7. Quantity and distribution of employment				X		
8. Distribution of population				X		
9. Demands for governmental services			X			
10. Industrial and commercial activity			X			
11. Locally adopted environmental plans and goals				X		

Cumulative and Secondary Impact: None