WASTEWATER FACILITY PLAN
for
BIG SKY, MONTANA

HKM ASSOCIATES
ENGINEERS·PLANNERS

P.O. Box 1090
20 E. Olive Street
Bozeman, Montana 59771

Home Office: P.O. Box 31318
• 2727 Central Avenue
• Billings, Montana 59107

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1.0 SUMMARY

The wastewater collection and treatment system serving Big Sky was evaluated for its ability to transport and treat current flows and 20-year projected flows. The system currently serves approximately 1928.7 single family equivalents (SFE). Wastewater flow records show the average daily flow ranged from 189,299 gallons per day in 1989 to 320,500 gallons per day in 1993. The highest flows have historically occurred during the spring and early summer indicating substantial infiltration and inflow into the collection system. High flows also occur on weekends and holidays during the ski season.

The collection system consists of approximately 213.99 inch●diameter●miles of sanitary sewer with diameters from 6 inches to 24 inches. The entire collection system is a gravity flow system. Infiltration and inflow (I/I) into the collection system has been a major problem during the spring of the year.

In 1993, it is estimated that I/I averaged approximately 174,000 gallons per day. The majority of the I/I problem occurs in the spring of the year during the snowmelt period. In order to reduce the I/I problem, the Sewer District undertook a major repair program in the summer and fall of 1993. The early results, during the spring of 1994, indicate a reduction of I/I flows of approximately 38 percent. However, the flows observed during the spring of 1994 may not be a good indicator of the success of the I/I reduction program. The spring runoff occurred much earlier than normal and the runoff period was short.

The District should continue to monitor the I/I flows and continue a program of trying to eliminate as much I/I as possible. Typical infiltration allowances for collection systems range from 200 gallons per day per inch·diameter·mile for new lines to 1000 gallons per day per inch·diameter·mile for older systems. If the 38 percent reduction in I/I during high groundwater periods is maintained, the I/I in Big Sky's collection system will amount to 541 gallons per day per inch·diameter·mile. While it may be possible to eliminate additional I/I flow, it is not expected that dramatic flow reductions will occur. The majority of easily identified leaks were repaired during the summer of 1993.

The existing treatment system consists of an 8.2 million gallon (MG) hypalon lined aerated pond. Two unlined storage ponds are used to store treated water during the non-irrigation season. The storage ponds have capacities of 13.6 MG and 34.3 MG, for a total capacity of 47.9 MG. At the existing flow rates, approximately 62 MG of storage is required. It is estimated approximately 47 to 60 million gallons per year seeps out of the storage pond and into the groundwater. Water from the storage ponds is used to irrigate the golf course during the summer.

The recommended plan consists of providing tertiary levels of treatment by constructing a Sequencing Batch Reactor with effluent filtration. The treatment plant would be located adjacent to the existing storage ponds. The recommended plan for disposal consists of a combination of continued irrigation of the golf course in the summer and snowmaking in the fall and winter. The existing pump station used to irrigate the golf course would be upgraded to provide a firm capacity of 1,075 GPM. The irrigation system on the golf course would be expanded from the current 80 acres to 165 acres.

A total storage volume of 118 million gallons is required for this alternative. The existing ponds provide a storage volume of 56.1 million gallons which includes the existing aeration pond. The existing ponds would be drained, cleaned, and lined with a synthetic liner. An additional 62 million gallon lined storage pond would be constructed at the Michener Creek site. A 16-inch PVC line would allow water to be transferred between the existing storage ponds and the new ponds at Michener Creek. A low head pump station would pump water from the Michener Creek site to the existing storage ponds.

A new pump station, with three 350 HP pumps, would be constructed to pump from the existing storage basins to an intermediate surge tank located part way between the Meadow Village and the Mountain Village. A second pump station, with two 350 HP pumps, would pump from the surge tank to the snowmaking pumps located at Lake Levinsky. A new 14-inch steel line would be installed from the existing storage pond to the snowmaking pumps at Lake Levinsky.

The total project cost of the sequencing batch reactor, filter, pump stations, storage ponds, golf course upgrade and transfer line is estimated at approximately $13.1 million dollars. Depending on the outcome of current litigation between Boyne USA and RID 305, the average user charge could vary from $21.78 per month per account to $95.75 per month per account.

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 Owner Association, Inc. (BSOA) was issued a Certificate of Incorporation. The purposes of BSOA is stated in their 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 court decision, a 1971 agreement between Westland Enterprise (Simkins/Taylor land) and Big Sky of Montana, Inc., (Boyne USA successor in interest) was confirmed. The court 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, lands are entitled to free treatment for up to 1 million gallons per year until the year 2001. As of January 1, 1994, 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 March 1994, this litigation is unresolved.

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.

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 did approve 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..."

The Compliance Order also stated that "approximately 47 million gallons of partially treated sewage seeped from the treatment and disposal facility to State ground waters in 1991." However, the amount of seepage is not known with any accuracy since the actual volume applied to the golf course is not known.

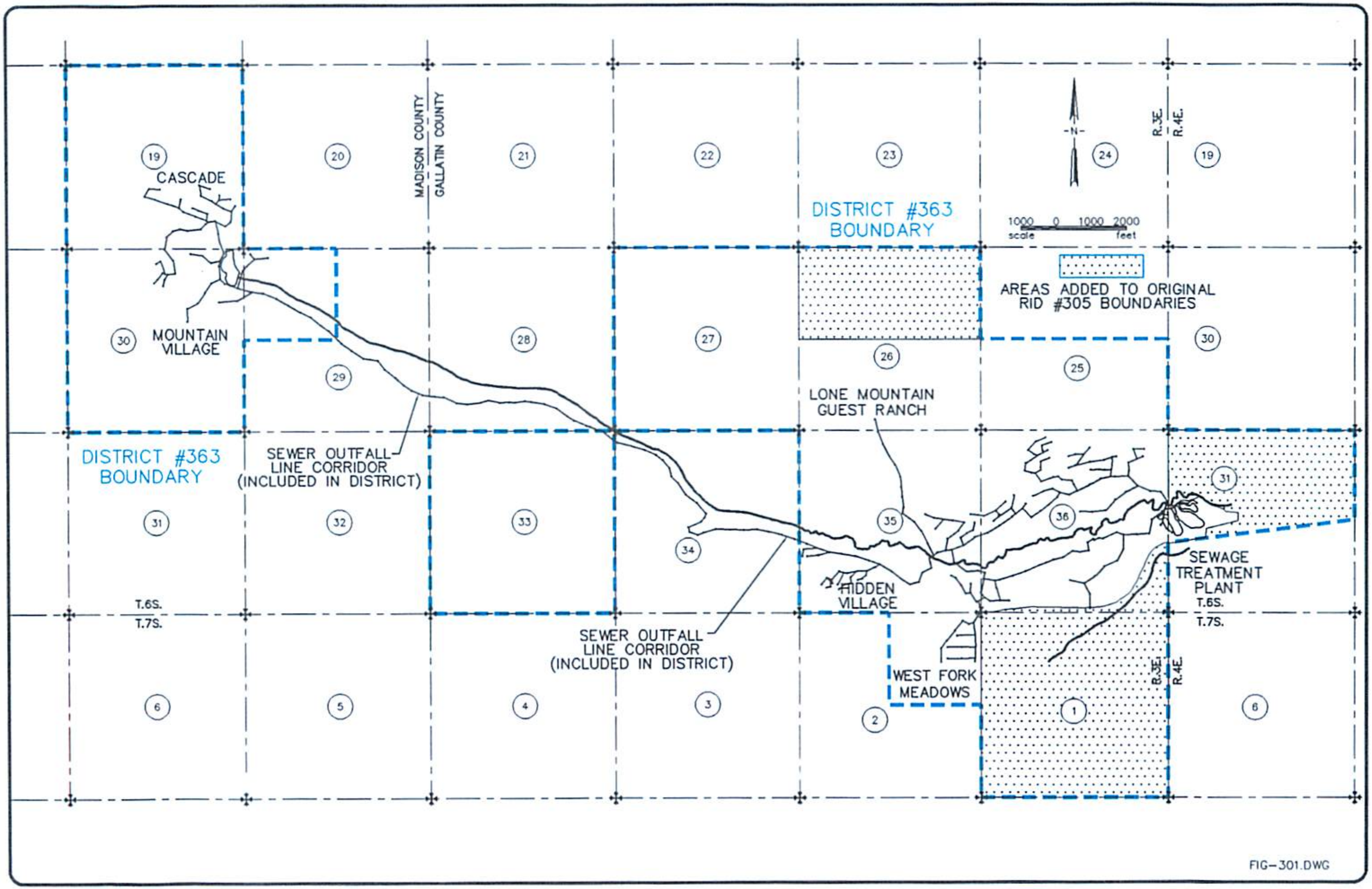
3.0 PLANNING AREA

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 County.

Water and Sewer District 363 was organized under Title 7, Chapter 13, Parts 22 and 23, MCA. The district 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 a County Water and Sewer District.

Figure 3.0-1 shows the boundaries of the County Water and Sewer District 363 and also the boundaries of RID 305 that existed prior to the creation of WSD 363. As indicated, WSD 363 has slightly expanded the previous RID boundary. The new planning area in WSD 363 consists of approximately 6,240 acres versus approximately 4,800 acres in the previous RID 305. The District expansion included the area of the existing wastewater treatment lagoons.

Land use and zoning at the resort is complicated by the fact that the resort lies in both Madison County and Gallatin County. 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 general development concepts for the area. It stopped short of formulating zoning ordinances and zoning maps. In 1993, a document was published 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.



BIG SKY WASTEWATER FACILITY PLAN

WATER AND SEWER DISTRICT BOUNDARY

FIGURE 3.0-1

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Development at the resort 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.

It is emphasized that, through the public hearing process, the lower basin area along US Highway 191 had the opportunity to be included in the district boundary. Lacking a consensus of support from the lower basin area, it was not included in the Water and Sewer District.

State and County records were reviewed to determine the number of approved subdivisions within the planning area. The District records were reviewed to determine the actual number of connections and Single Family Equivalents (SFE's) associated with each development. Table 3.0-1 lists the number of housing units which have sewer connections or which the District has legal commitments to provide connections to once they are developed. The table also lists the number of SFE's associated with each 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 Sewer District is obligated to serve.

TABLE 3.0-1
NUMBER OF SEWER CONNECTION COMMITMENTS IN THE PLANNING AREA

	COMMITMENTS		CURRENTLY OCCUPIED		
	TOTAL	SFE	OCCUP-IED	SFE	CONDO ASSN. (SFE)
1. 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	25	42.5	0	0	
B. Condominiums* (Units)					
Silverbow (TR 1 & 1A)	70	84.0	70	84.0	6.35
Yellowstone (TR 3 BLK 1)	42	48.6	42	48.6	6.35
Glacier (TR 7 BLK 2)	64	77.0	64	77.0	6.35
Broadwater (TR 9 BLK 5)	16	16.0	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	3.75
Tract 5 BLK 2	22	29.0	0	0	
Tract 6 BLK 2	50	65.9	0	0	
Tract 8 BLK 6	64	84.3	0	0	
Tract 11 BLK 4	60	79.0	0	0	
Hidden Village	144	242.0	142.0	242.0	4.75
Blue Grouse	120	158.4	0	0	
Sweetgrass Tract 2	113	149.5	0	0	
C. Hotels and Motels					
Golden Eagle (rooms)	42	28.0	42	28.0	
West Fork Hotel	29	19.3	29	19.3	
Lone Mountain Ranch	--	39.2	--	39.2	
D. Commercial***					
Meadow Center	--	6.75		6.8	
Golf Course	--	5.4		5.4	
Chase Montana Building	--	16.4		16.4	
Meadow Village Minor #91	--	7.0		7.0	
Tennis Courts	--	1.0		1.0	
Minor Sub-Camper Village	--	4.7		4.7	
SUBTOTAL FOR MEADOW VILLAGE AREA		1899.4		908.6	27.55
TOTAL SFE'S (+27.55)		1927.0		936.6	
WESTFORK CURRENT & PROJECTED		192.9		157.6	
WESTLANDS PROJECTED		1435.3		0	
SUBTOTAL WESTLANDS/WESTFORK		3555.2		1093.8	

TABLE 3.0-1 (CONTINUED)
NUMBER OF SEWER CONNECTION COMMITMENTS IN THE PLANNING AREA

	COMMITMENTS		CURRENTLY OCCUPIED		
	TOTAL	SFE	OCCU-PIED	SFE	CONDO ASSN. (SFE)
II. MOUNTAIN VILLAGE AREA					
A. Homes (Lots)					
Cascade	362	757.1	23	48.1	
B. Condominiums (Units)					
Hill-Cascade	180	180.0	180	136.8	
Skycrest-Cascade	335	475.7	35	49.7	
Tract 1-Cascade**	70	72.1	0	0	
Tract 2-Cascade**	110	113.3	0	0	
Tract 4-Cascade**	36	37.1	0	0	
Tract 5-Cascade**	338	348.1	0	0	
Stillwater	63	63.0	63	59.9	
Beaverhead	60	64.8	12	13.0	
Lake	135	156.5	29	33.6	
Arrowhead	25	61.3	25	61.3	
Bighorn	70	72.0	31	31.9	
Shoshone	94	94.0	94	94.0	
C. Hotels and Motels					
Huntley Lodge	204	125.9	204	125.9	
Mountain Lodge (Cascade)	84	51.8	84	51.8	
D. Employee Housing					
Dorm Space (156 beds)	85	39.0	85	39.0	
Married Housing	4	4.0	4	4.0	
E. Commercial***					
Estimated		170.0		85.9	
SUBTOTAL FOR MOUNTAIN VILLAGE		2885.7		834.9	
TOTAL MEADOW/MOUNTAIN VILLAGE		4812.7		1771.1	
TOTAL WITH WESTLANDS/WESTFORK		6440.9		1928.7	

* In addition to listed connections, there is a flow commitment to Westfork of 48,000 gpd peak flow and a commitment to Westlands of 43 mg/year.

** Condominiums are estimated at 12 units per acre on undeveloped tracts.

*** No increase in commercial development is projected for Meadow area. Approximately 50% increase is assumed for Mountain area.

TABLE 3.0-2 SINGLE FAMILY EQUIVALENT UNIT CONVERSION SCHEDULE (KERIN, 1990)	
USE[1] (1)	SFE'S PER UNIT (3)
Single-Family Residences, Townhouses and Condominiums:[2,3]	
- Two bedrooms or less	1.0
- Each bedroom in excess of two	0.4
- Each bath, or portion thereof, in excess of two	0.2
- Private jacuzzi or hot tub, each	0.35
Studio Apartments/Condominiums: (single room less than 500 S.F. with single bathroom):	0.7
Hotel, Motel or Lodge, per rental room:[2]	
- Jacuzzi, spa or hot tub, each	0.75
- Swimming pool	2.0
- Banquet rooms, per seat	0.03
- Conference rooms, per seat	0.02
Employee Housing:	
- Condominium Type, Per Unit	1.0
- Dormitory Type, Per Bed	0.25
Snack Bars and Delicatessens:[4]	
- 500 S.F. or less	1,9
- Each S.F. in excess of 500 S.F.	0.003
Convenience Type Food Stores and Shoppettes:	1.0
Cafeteria, Lounges and Bars, per seat:	0.07
Full Service Restaurants, per seat:	0.07
Self-Service laundromat, per washing machine:	1.3
Beauty Salon, Barber Shops, Hairdresser, per station:	0.35
Fire Stations, Maint. Bldgs., Machine Shops, Warehouses and Garages, per 1,000 S.F.:	0.15
Offices and Office Buildings, per 1,000 S.F.:	0.75
Retail Stores, per 1,000 S.F.:	0.5
Ski Areas, summation 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 S.F.:	1.5
Residential Swimming Pools w/controlled sewer connection, per 1,000 S.F. of pool area:	
- Single-Family	1.0
- Multi-Family	3.0

FOOTNOTES TO TABLE 3.0-2:

1 If 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.

2 For the purpose of SFE Unit determination, 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 determinations, 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.

3 For 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.

4 In 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 room, 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 leakage from the storage ponds, and 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

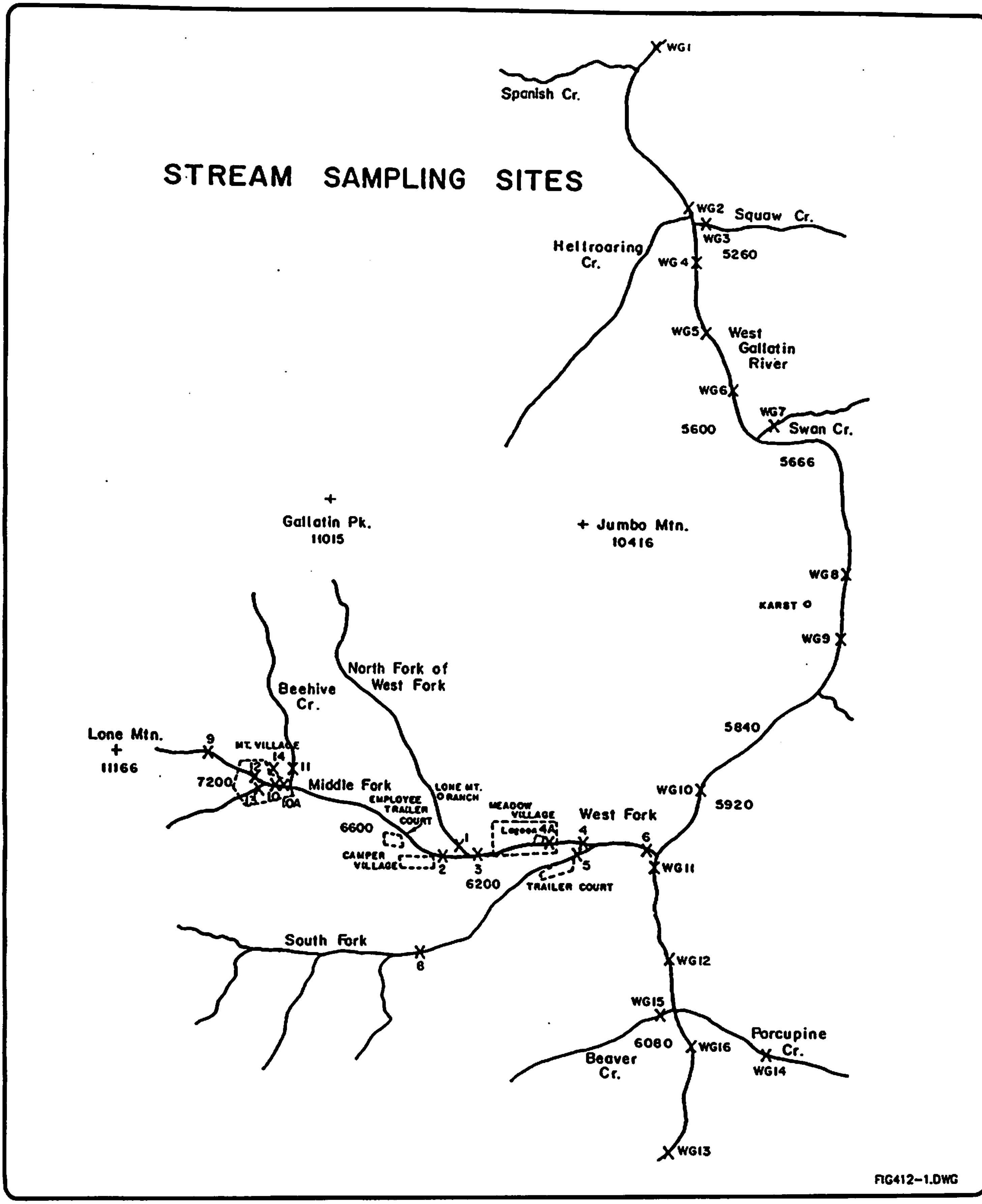
flow may infiltrate into interbeds where they outcrop beneath the terrace gravels. This is a potential pathway of contamination to the nearby shallow wells, although presently unconfirmed. The District currently has monitoring wells in place around the lagoons and regularly monitors the groundwater.

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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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		
	1/26/94		0.05	0.03	0.04	0.03	

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
	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

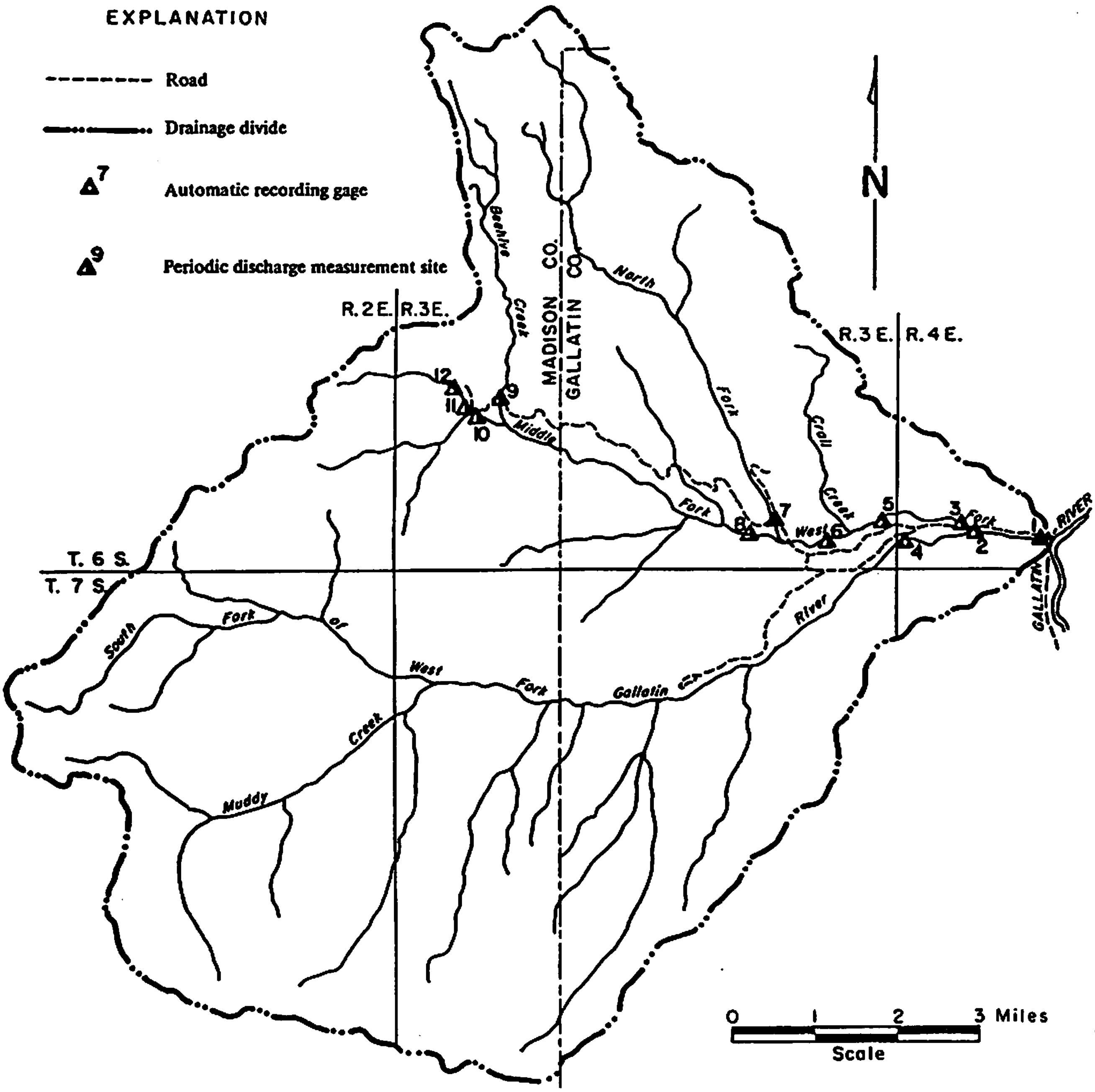
TABLE 4.1.2-5 MEAN FLOWS IN GALLATIN RIVER (cfs)					
Month	gaged site	ungaged site	Month	gaged site	ungaged site
January	306	219	July	1276	914
February	305	218	August	601	430
March	309	221	September	491	352
April	500	358	October	455	326
May	1765	1264	November	383	274
June	2908	2082	December	322	230

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 - North Fork Gaging Station	8/10/70	8.03
	10/2/70	29.70		10/1/70	5.63
	10/31/70	26.98		10/31/70	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 - Wes Fork Below Dawes Bridge	8/2/70	105.29	Station 8 - Middle Fork .4 Mile Above North Fork Junction	10/31/70	5.70
				2/26/71	4.96
				3/26/71	3.40
				4/26/71	11.77
				5/25/71	57.90

TABLE 4.1.2-6 STREAMFLOWS FOR WEST FORK DRAINAGE					
LOCATION	**DATE**	**DISCHARGE (cfs)**	**LOCATION**	**DATE**	**DISCHARGE (cfs)**
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 - South 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



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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West Fork mainstem drainages contribute 24,000 acre-feet (33.1 ft^3/s).

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).

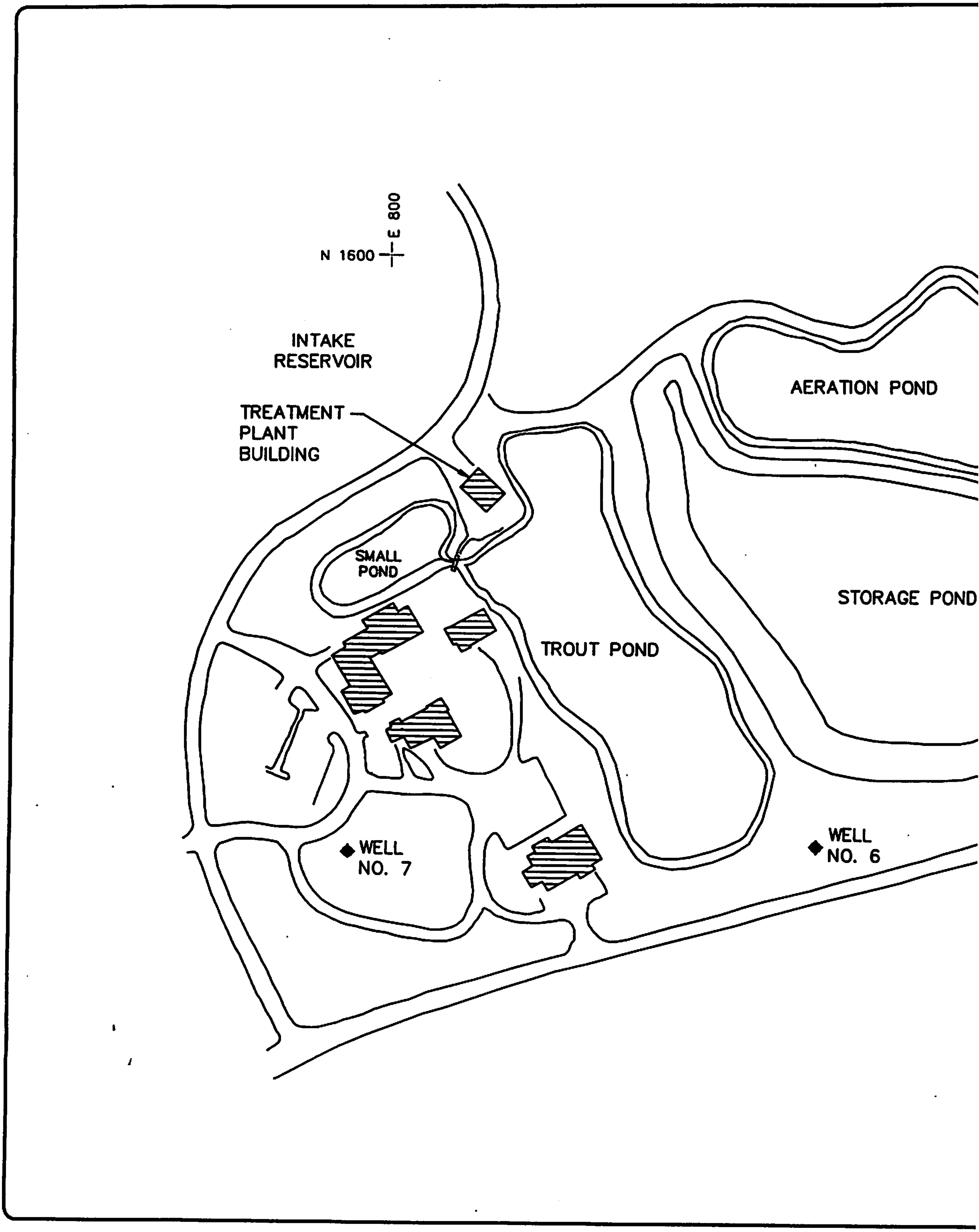
TABLE 4.1.3-1
GROUNDWATER SUMMARY

	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 is probably seepage from the wastewater plant storage ponds and the irrigation of the golf course.

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.

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.


E 800
N 1600
INTAKE
RESERVOIR
TREATMENT
PLANT
BUILDING
SMALL
POND
AERATION POND
STORAGE POND
TROUT POND
WELL
NO. 7
WELL
NO. 6

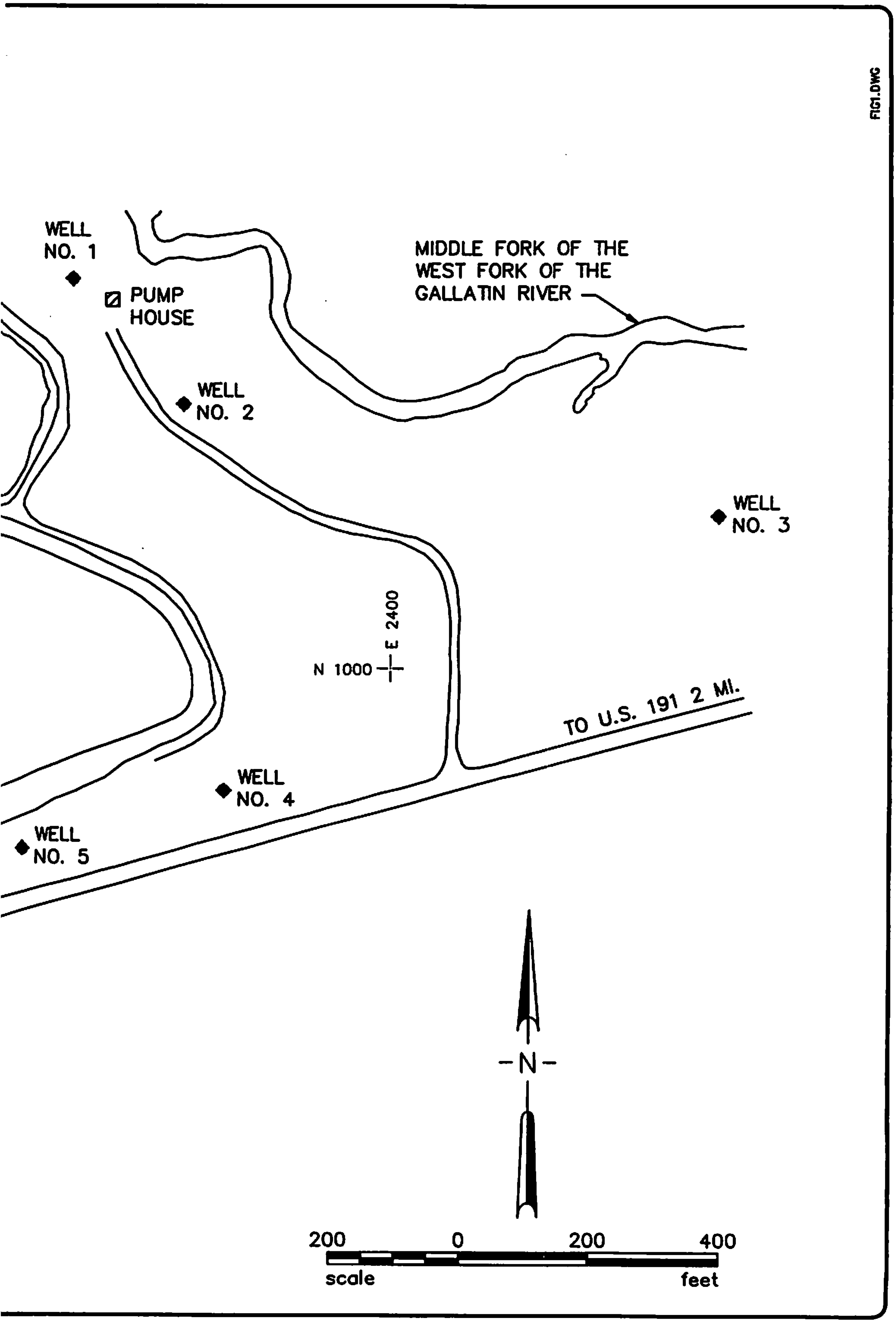


FIGURE 4.1.3-1

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BIG SKY WASTEWATER FACILITY PLAN

GROUNDWATER MONITORING WELL LOCATIONS

TABLE 4.1.3-2 BACKGROUND NITRATE CONCENTRATIONS IN GROUND WATER (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)
(10 YEAR RECURRENCE INTERVAL)
MEADOW VILLAGE

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

TABLE 4.1.4-6
CALCULATED MONTHLY PRECIPITATION (STATION MH17)
(10 YEAR RECURRENCE INTERVAL)
MOUNTAIN VILLAGE

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. <u>Population and habitat conditions</u>. 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 Density	This type of land use is characterized by a combination of open space land 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 Industrial	Allows for uses not inconsistent with community needs, including, but not 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.

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).

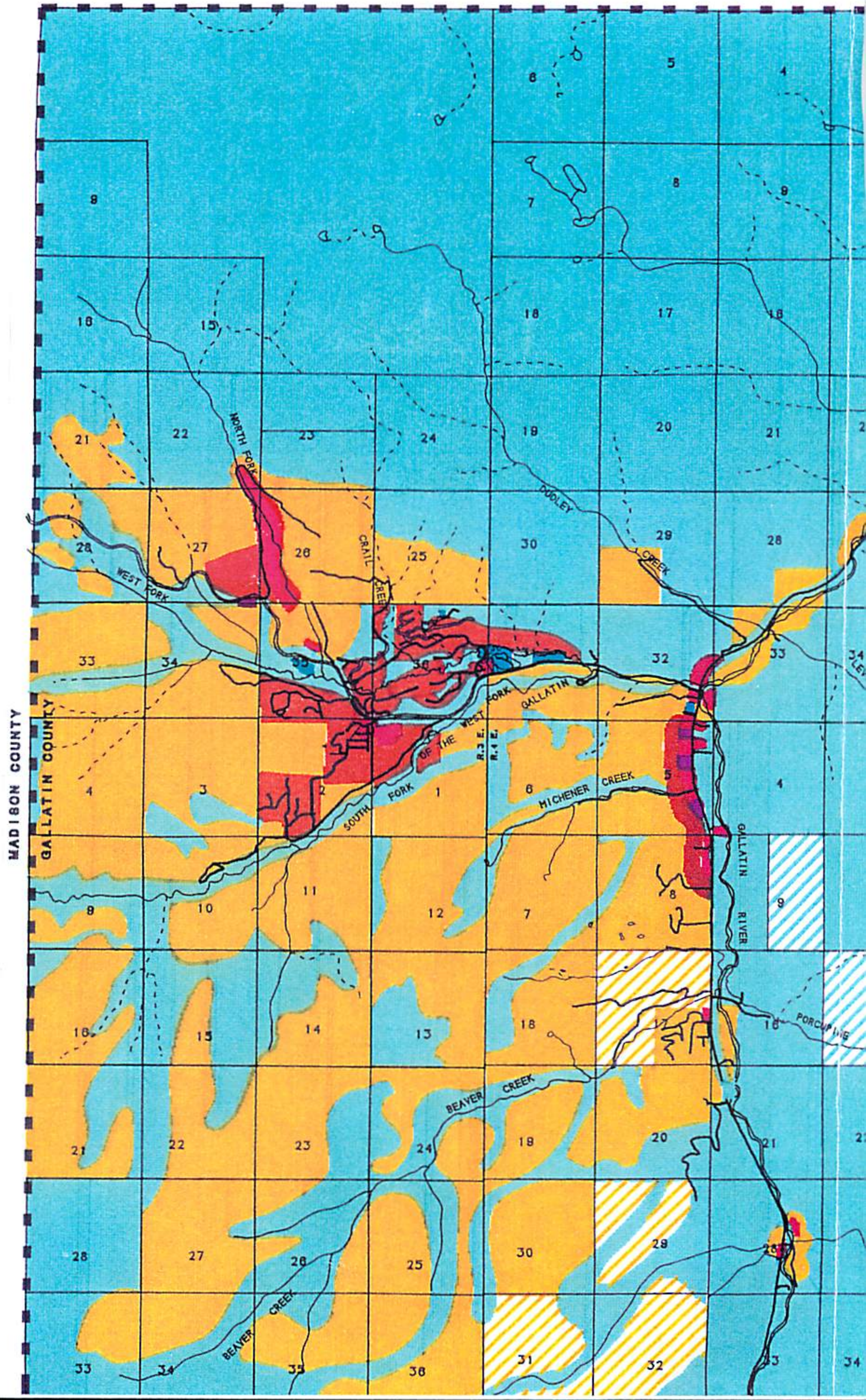
4.1.7 Flood Plain

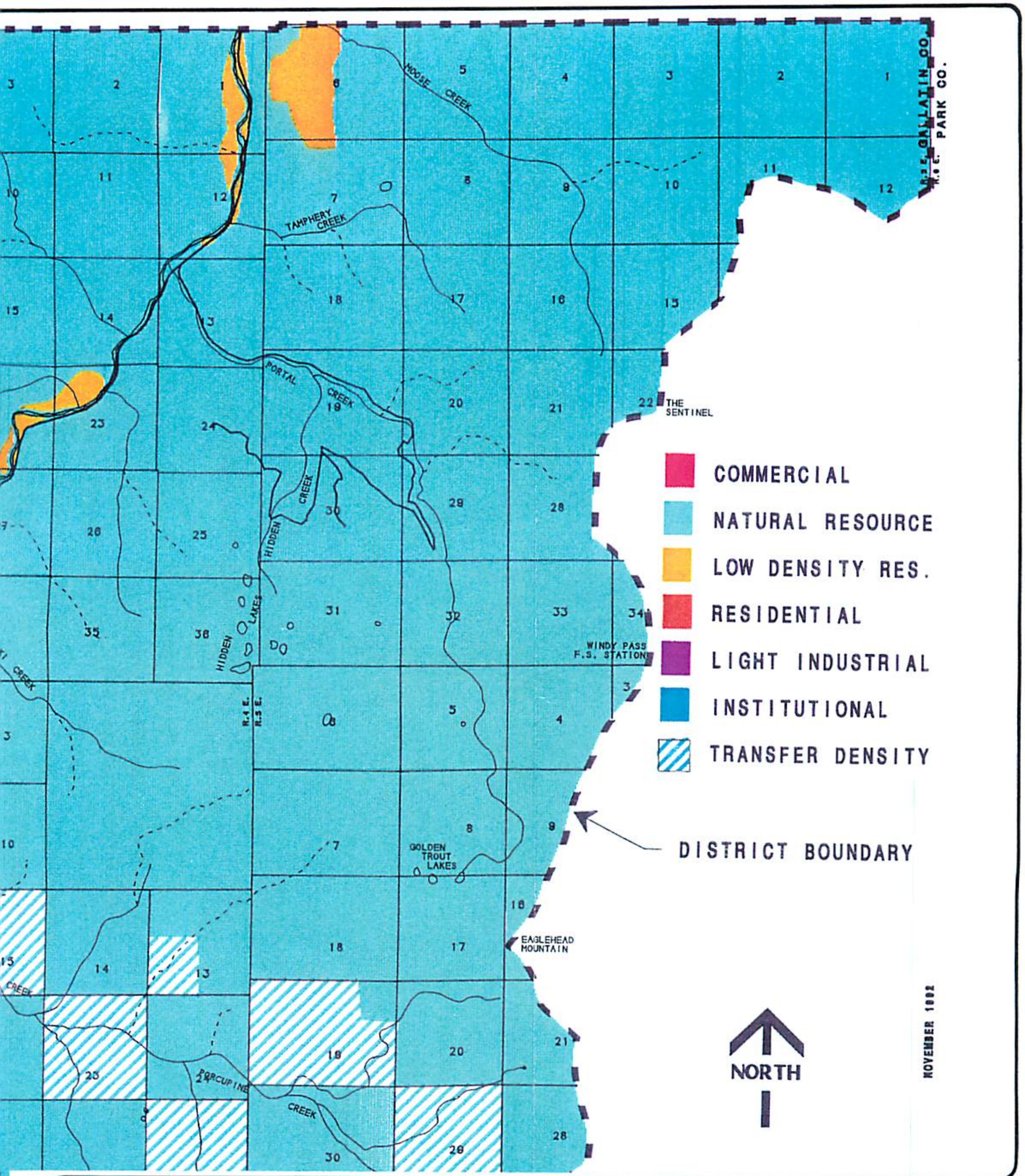
The 100 year flood plain in the vicinity of the existing lagoons is shown in Figure 4.1.7-1.

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.


MADISON COUNTY
GALLATIN COUNTY
NORTH FORK
CRAIL CREEK
WEST FORK
DUDLEY CREEK
SOUTH FORK OF THE WEST FORK GALLATIN
R.3 E.
R.4 E.
MICHENER CREEK
GALLATIN RIVER
PORCUPINE
BEAVER CREEK
BEAVER CREEK



BIG SKY WASTE WATER FACILITY PLAN
PROPOSED LAND USE MAP

FIGURE 4.1.6-1

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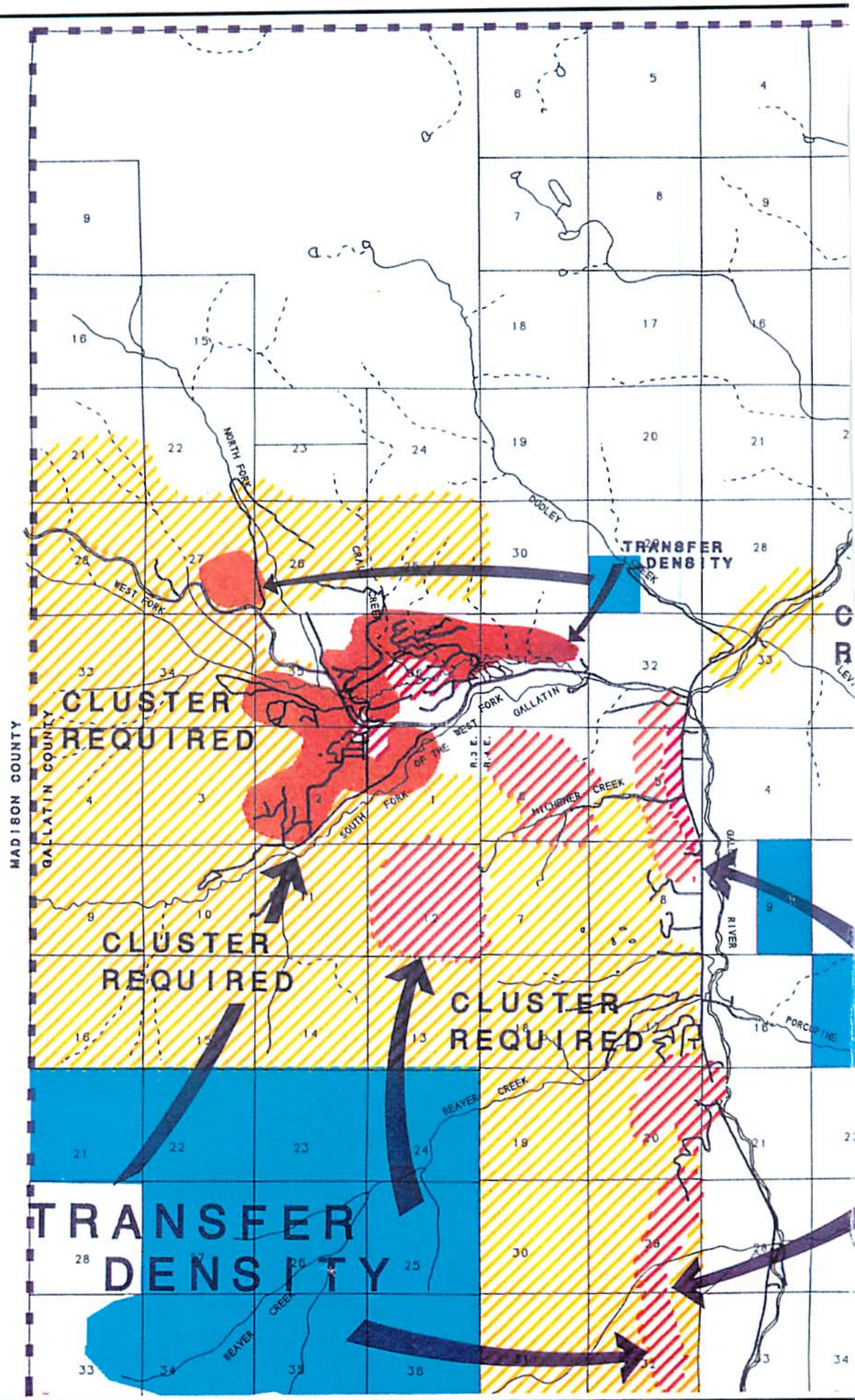
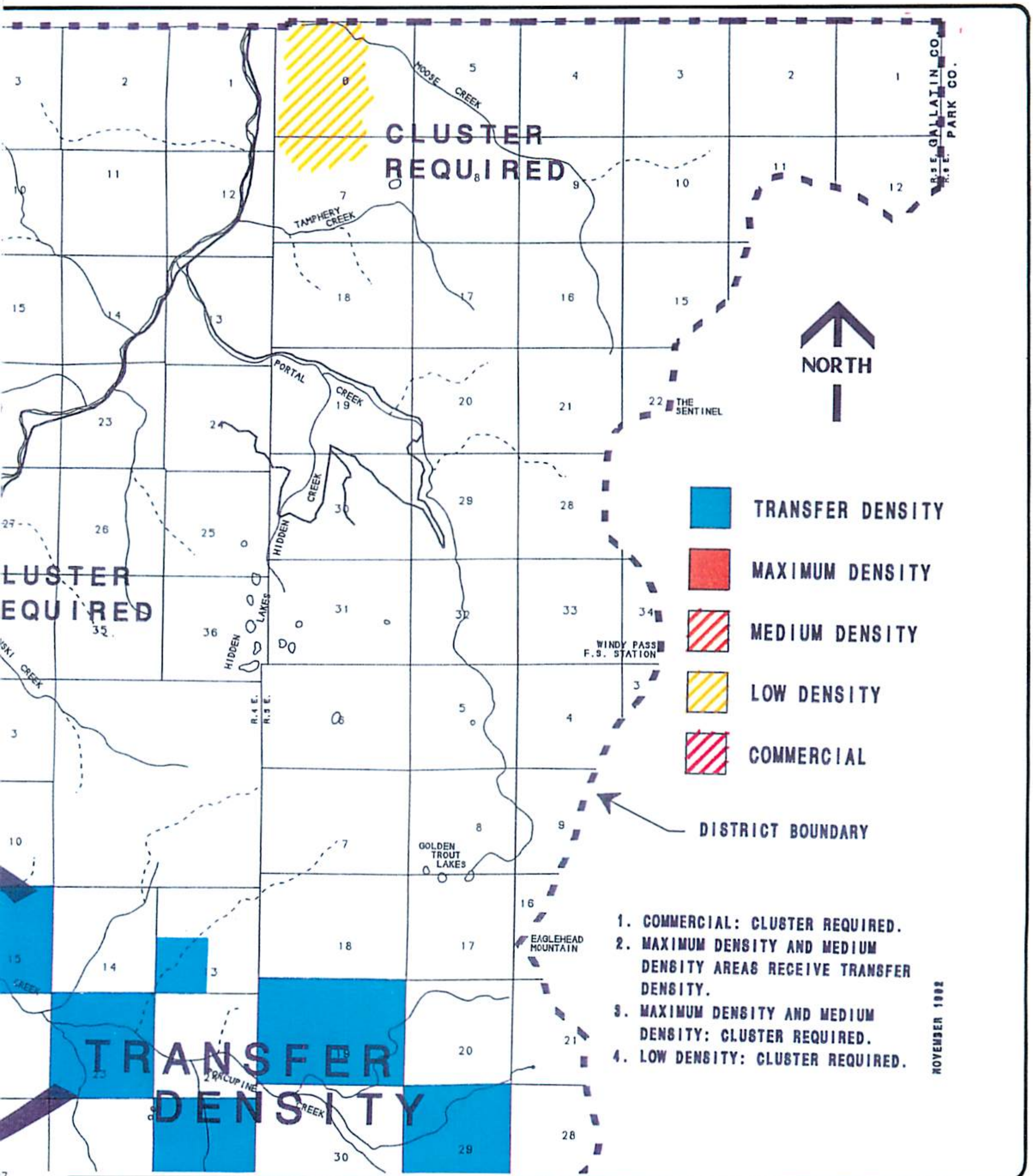

MADISON COUNTY
GALLATIN COUNTY
NORTH FORK
WEST FORK
DUDLEY
TRANSFER DENSITY
SOUTH FORK OF THE WEST FORK GALLATIN
R.3 E.
R.4 E.
MICHENER CREEK
CLUSTER REQUIRED
CLUSTER REQUIRED
CLUSTER REQUIRED
BEAVER CREEK
PORCUPINE
RIVER
TRANSFER DENSITY
BEAVER CREEK



BIG SKY WASTE WATER FACILITY PLAN
PROPOSED DEVELOPMENT REQUIREMENTS MAP

FIGURE 4.1.6-2

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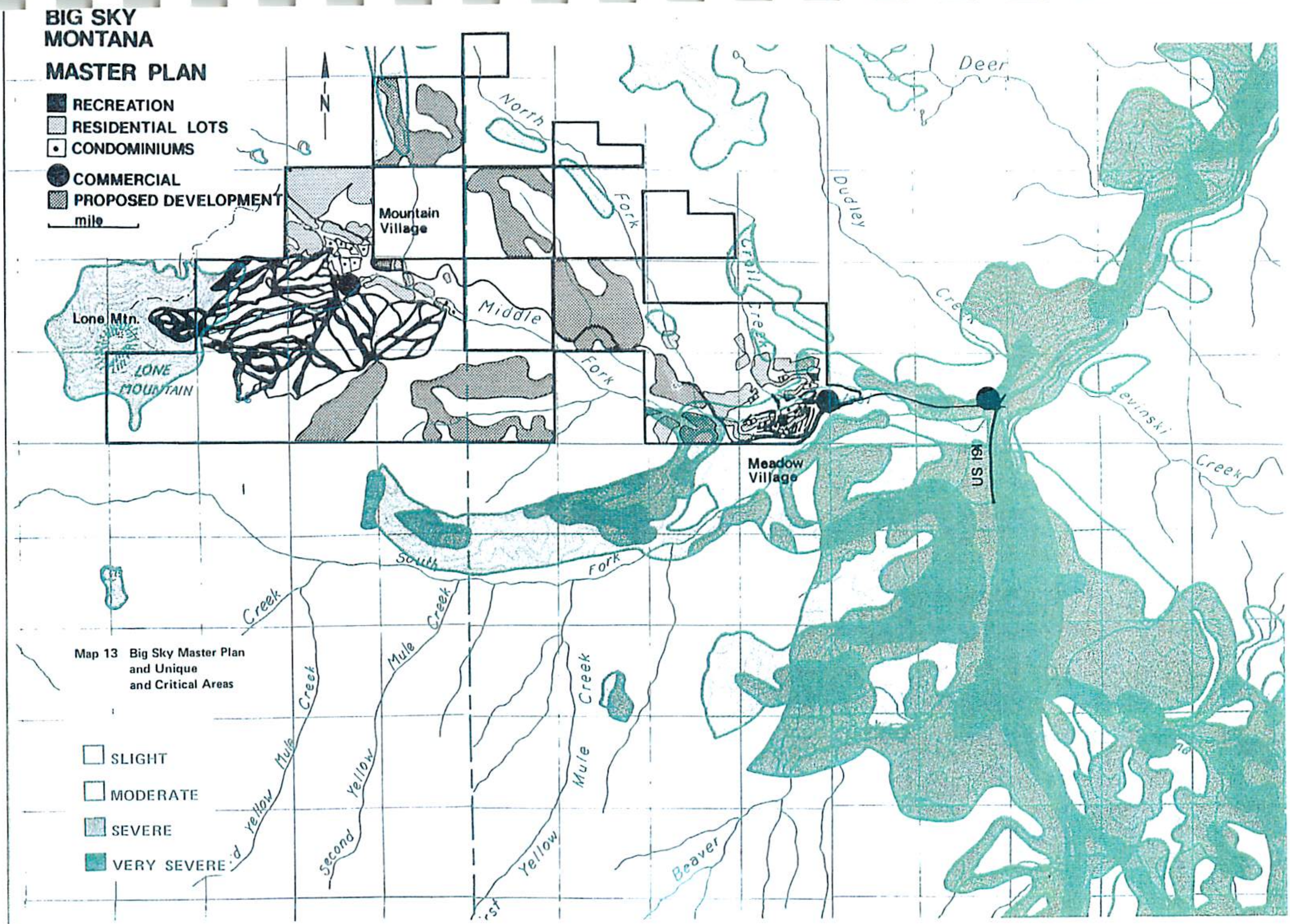


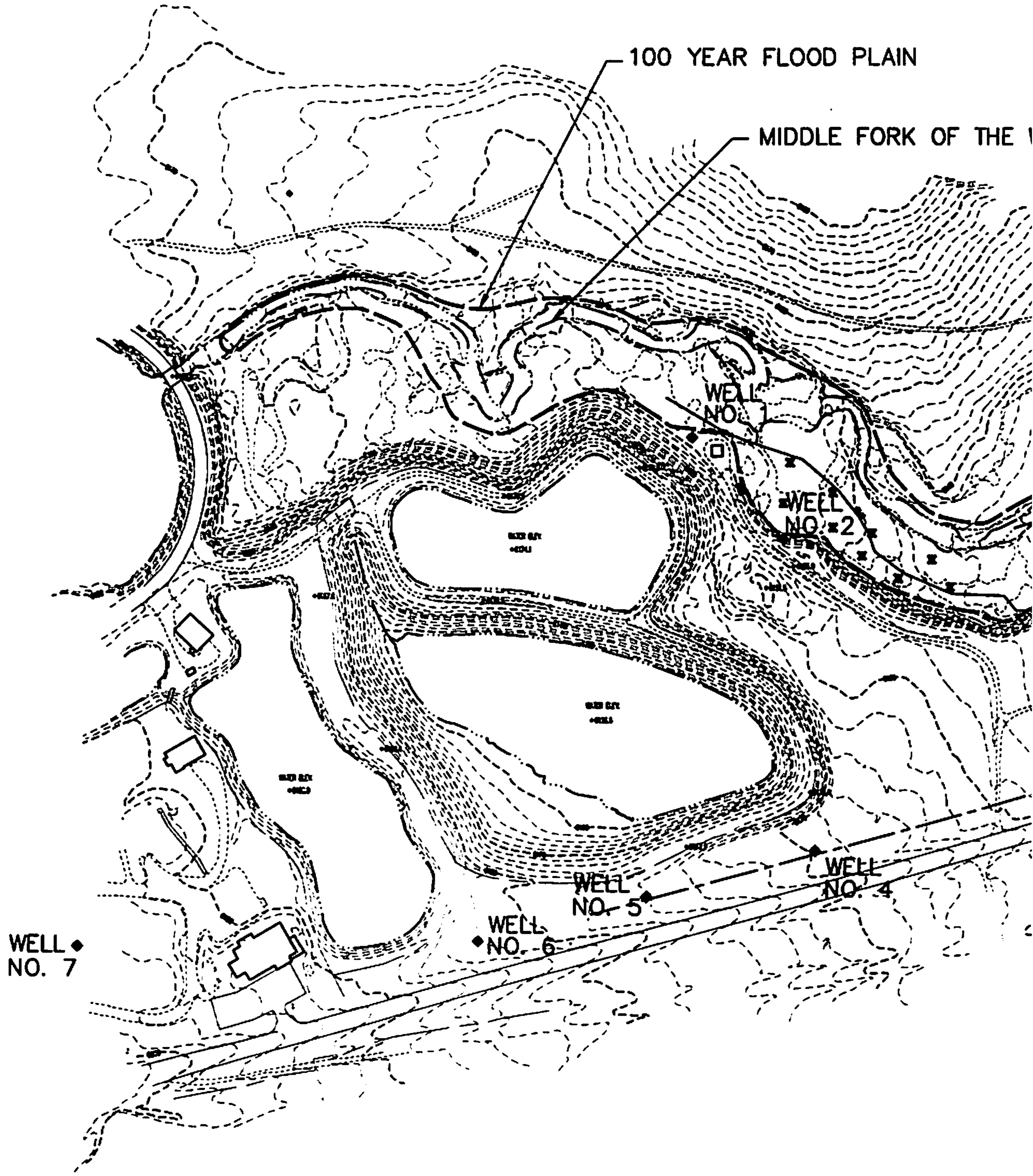
Map 13 Big Sky Master Plan and Unique and Critical Areas

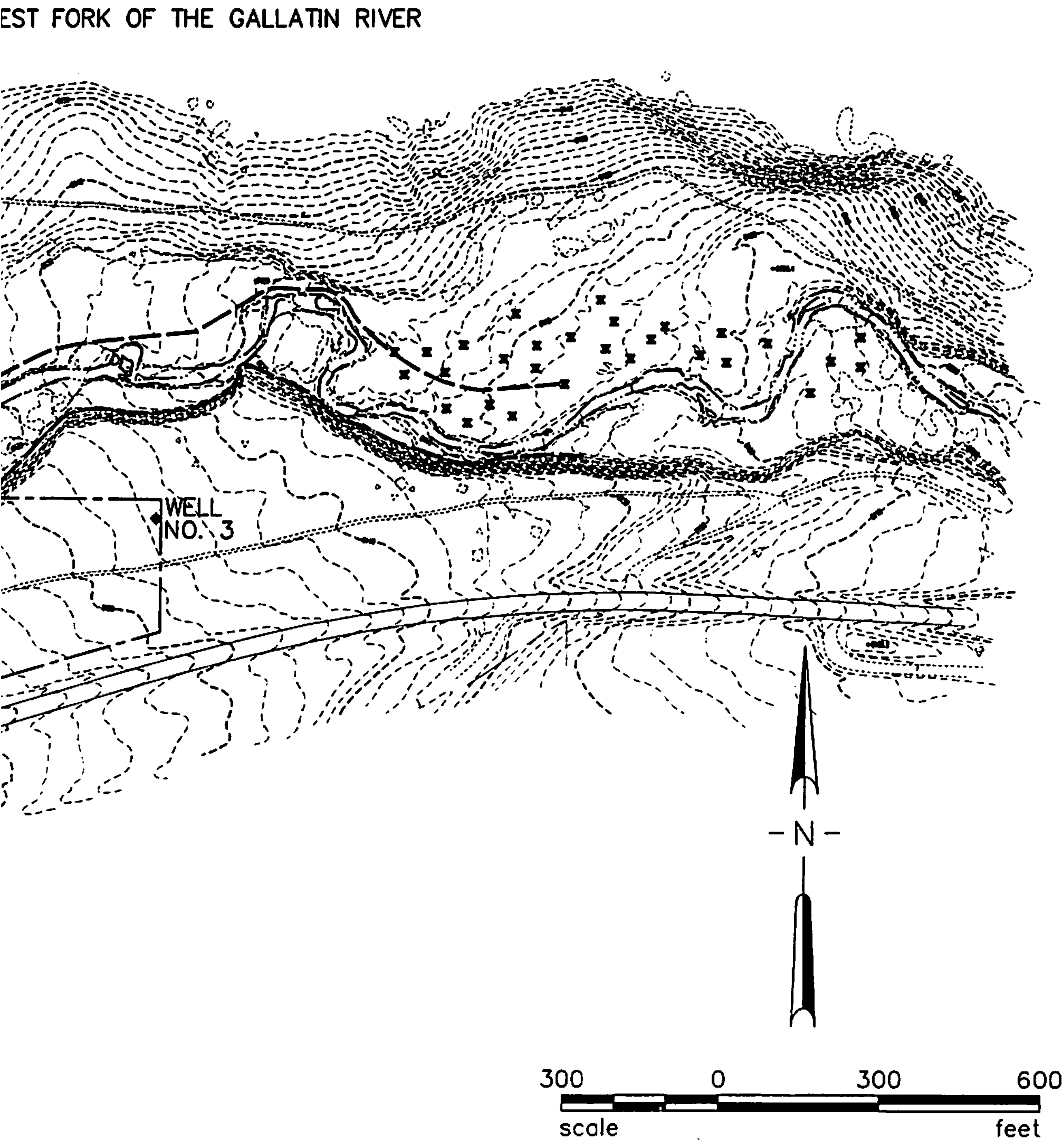
Even though no scientific studies have been done recently, the air quality is considered to be high. As stated in the Gallatin Canyon draft land use plan, one of the goals is to preserve the clean air and water in the area.

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.


100 YEAR FLOOD PLAIN
MIDDLE FORK OF THE
WELL NO.
WELL NO. 2
WELL NO. 4
WELL NO. 5
WELL NO. 6
WELL NO. 7



BIG SKY WASTEWATER FACILITY PLAN

100 YEAR FLOOD PLAIN

FIGURE 4.1.7-1

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TABLE 4.2-1 POPULATION CHARACTERISTICS FOR BIG SKY, MONTANA (FROM DRAFT LAND USE PLAN)	
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 below 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 1993, 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

	1987	1988	1989	1990	1991	1993	1994
January	8.4	5.2	5.3	5.9	5.8	7.2	7.07
February	8.2	8.4	5.9	6.4	6.5	7.3	6.99
March	8.3	10.5	7.0	7.8	7.8	9.2	9.82
April	8.6	18.3	7.4	10.7	5.1	6.9	7.84
May	8.3	14.2	11.8	7.9*	15.9	16.3	5.08
June	9.5	7.4	7.9	11.7	14.0	13.5	
July	8.4	5.9	6.4	8.5	10.1	14.8	
August	6.9	5.4	5.3	6.1	8.6	12.5	
September	5.3	3.0	3.0	3.6	5.6	14.0	
October	N/A	1.9	2.2	2.5	2.8	6.0	
November	1.9	2.2	1.9	1.8	4.4	4.1	
December	4.5	4.1	4.9	5.6	4.9	5.2	
TOTAL ANNUAL		76.6	69.1	78.5	91.5	117.0	
AVG. DAY GALLONS		209,895	189,299	214,975	250,686	320,500	
AVG. MONTH		6.4	5.8	6.5	7.6	9.8	
PEAK MONTH/ AVG. MONTH		2.22	2.05	1.79	2.08	1.66	

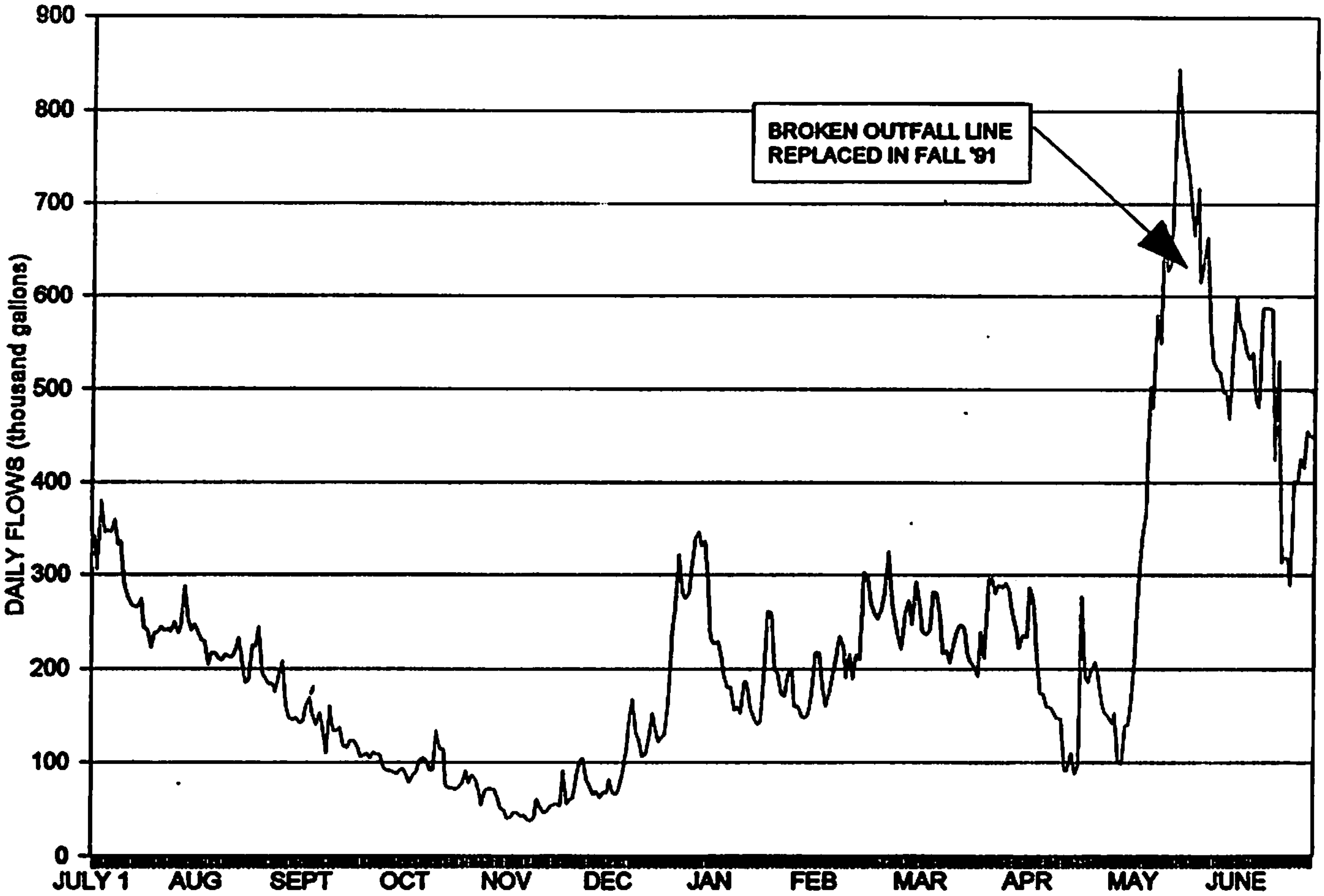
*From TDH Data
N/A Not Available
+Meter appears bad. Use average of 88, 89, 90

Figure 4.4-1 is a plot showing the daily flows from July 1, 1990 to June 30, 1991. 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

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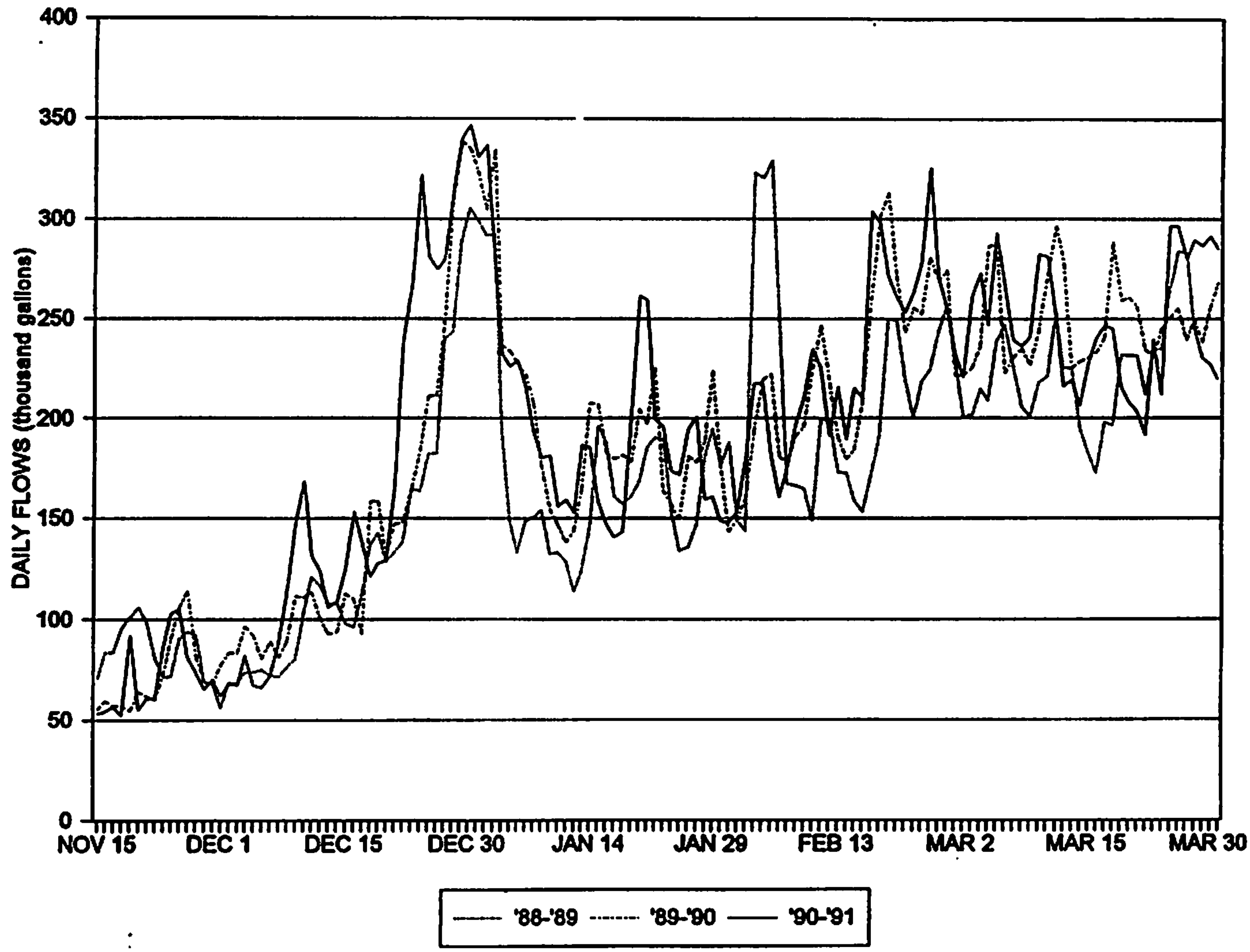

BIG SKY WASTEWATER FACILITY PLAN

DAILY FLOWS
SKI SEASON

FIGURE 4.4–2

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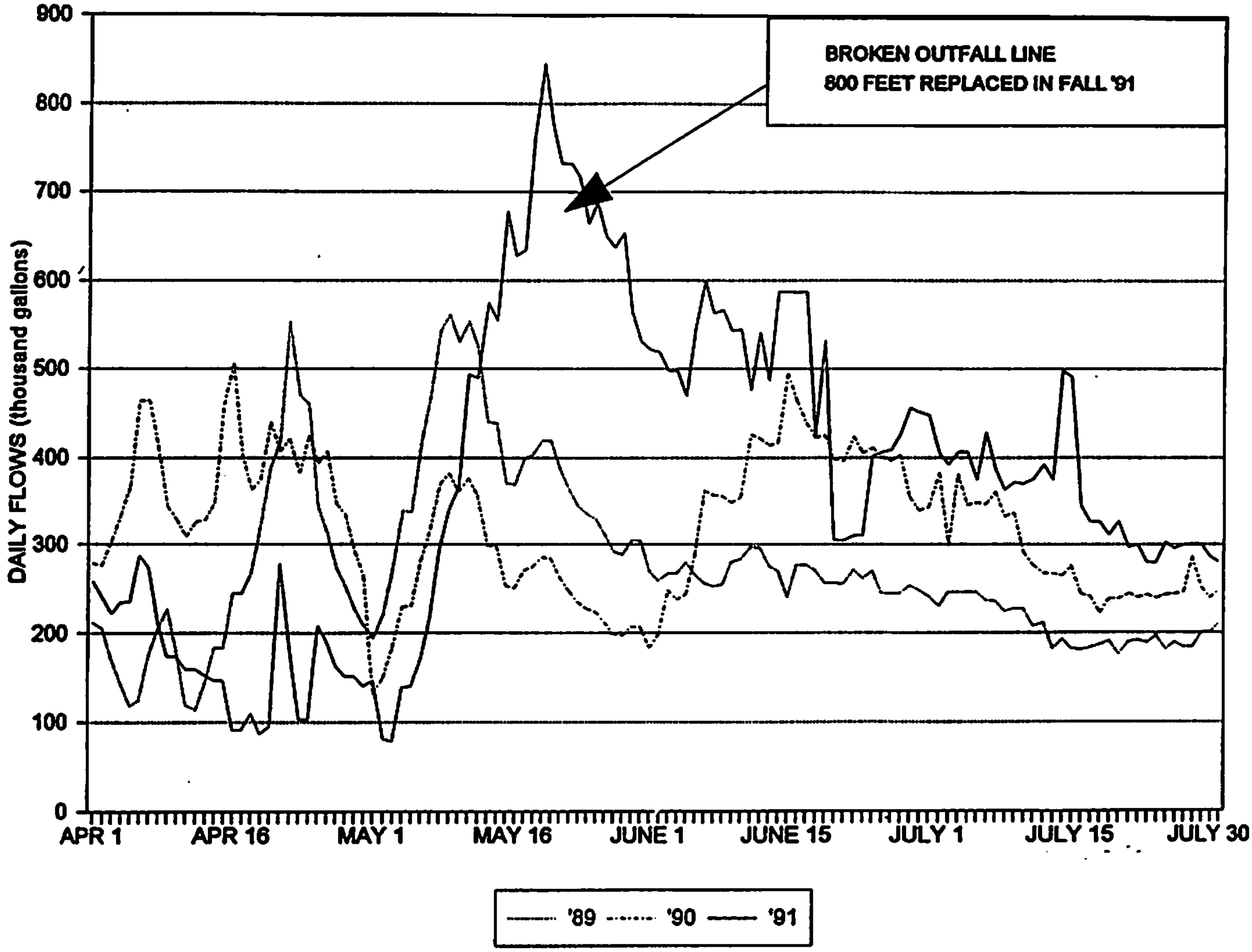

BIG SKY WASTEWATER FACILITY PLAN

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 contribute flow to the system (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.

Data is limited for the existing (Biochemical Oxygen Demand) BOD_5 load on the treatment plant. A total of 6 influent samples were collected between December 10, 1987 to April 22, 1991. Eleven additional samples were collected from December 1993 through March 1994. It should be noted that most of the first 6 samples were collected during the non-ski season. The influent BOD_5 concentrations are low and do not appear to be representative of the influent load during the ski season. The eleven samples collected recently show high BOD_5 values indicative of a strong wastewater. The sample date and results are shown in Table 4.4.3. Table 4.4.3 also shows the BOD_5 values measured in the storage pond on the same dates.

TABLE 4.4-3 EXISTING WASTEWATER BOD_5 CONCENTRATIONS		
Date	**Influent BOD_5 mg/l**	**Storage Pond BOD_5 mg/l**
12/10/87	83	
05/03/88	23	33
05/10/89	29	55
09/17/89	--	127
04/18/89	12	81
10/30/90	57	9
04/22/91	28	49
12/29/93	302	12
01/03/94	311	17
01/11/94	286	24
01/18/94	244	22
01/25/94	269	34
02/02/94	266	21
02/07/94	299	35
02/16/94	316	28
02/23/94	366	30
03/02/94	320	30
03/09/94	194	42

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 two 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 or, (2) a land application system such as spray irrigation or rapid infiltration basin could be used.

State regulations pertaining to the required quality of state waters are contained in the Montana Water Quality Act. This legislation classifies waters based on present and future "most beneficial uses". 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. A complete description of the specific water quality standards for B-1 water is included in the Appendix.

More importantly the Water Quality Act also adopts a non-degradation policy which is intended to protect the water quality of streams that have a higher water quality than the established water quality standards. This 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 alternatives to the proposed project that would result in no degradation;
> >
> > (b) the proposed project 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 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) Every 5 years, the department shall review authorizations to degrade state waters. To enable the department to adequately review authorizations as required under this section, the authorization holder shall revise the initial authorization application no sooner than 3-1/2 years and no later than 4 years after the date of the authorization or the date of the latest department review. The specific revised information required must be determined by the department. If, based on the review, the department determines that the standards and objectives of 75-5-303 or the rules adopted pursuant to 75-5-303 are not being met, it shall revoke or modify the authorization. A decision by the department to revoke or modify an authorization may be appealed to the board.

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

Recently passed legislation (Senate Bill 401) made several amendments to the Water Quality Laws. Specifically, the law requires the Board of Health and Environmental Sciences to adopt administrative rules. The law directs the Board to develop rules specifying the level of protection or treatment required if degradation is allowed. In the law, degradation is defined as "a change in water quality that lowers the quality of high-quality water for a parameter. The term does not include those changes in water quality determined to be non-significant....". In addition, SB 401 allows a mixing zone where water quality standards may be exceeded.

The Water Quality Bureau has recently published proposed rules for implementating the new statutory changes contained in the Non-degradation Policy and for the determination of mixing zones. A copy of the draft 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 rules for implementing the non-degradation policy and the mixing zone policy have been the subject of much debate within the State. At this time, rules have not been adopted by the Board of Health regarding how non-significant discharges will be determined.

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

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TABLE 4.6-1 COLLECTION SYSTEM CHARACTERISTICS			
SUBSYSTEM	LENGTH OF SEWER (L.F.)	PIPE SIZE (Inches Diameter)	INCH-DIAMETER-MILES
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/LoneMountain	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

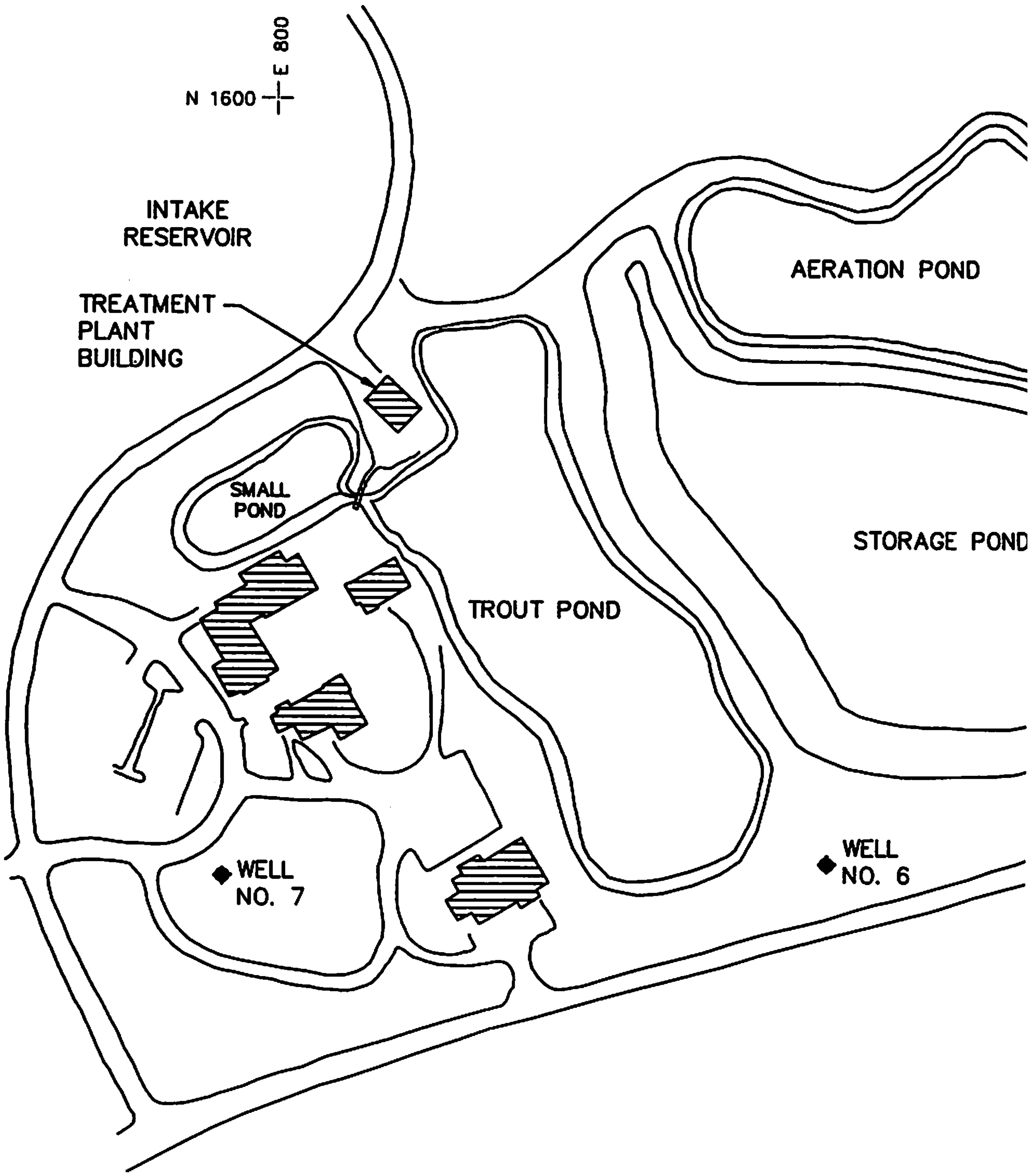
4.7 WASTEWATER TREATMENT SYSTEM

4.7.1 Introduction

The original wastewater facility at Big Sky was constructed in 1972-1973 with modifications being made in 1981-1982. The present facility (Figure 4.7.1-1) consists of an influent metering flume, one 8.2 MG aeration pond, two storage ponds of 13.5 MG and 34.3 MG, a recirculation pump station, a chlorine contact tank, and a golf course irrigation system.

The existing 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



E 800
N 1600
INTAKE
RESERVOIR
TREATMENT
PLANT
BUILDING
SMALL
POND
AERATION POND
STORAGE POND
TROUT POND
WELL
NO. 7
WELL
NO. 6

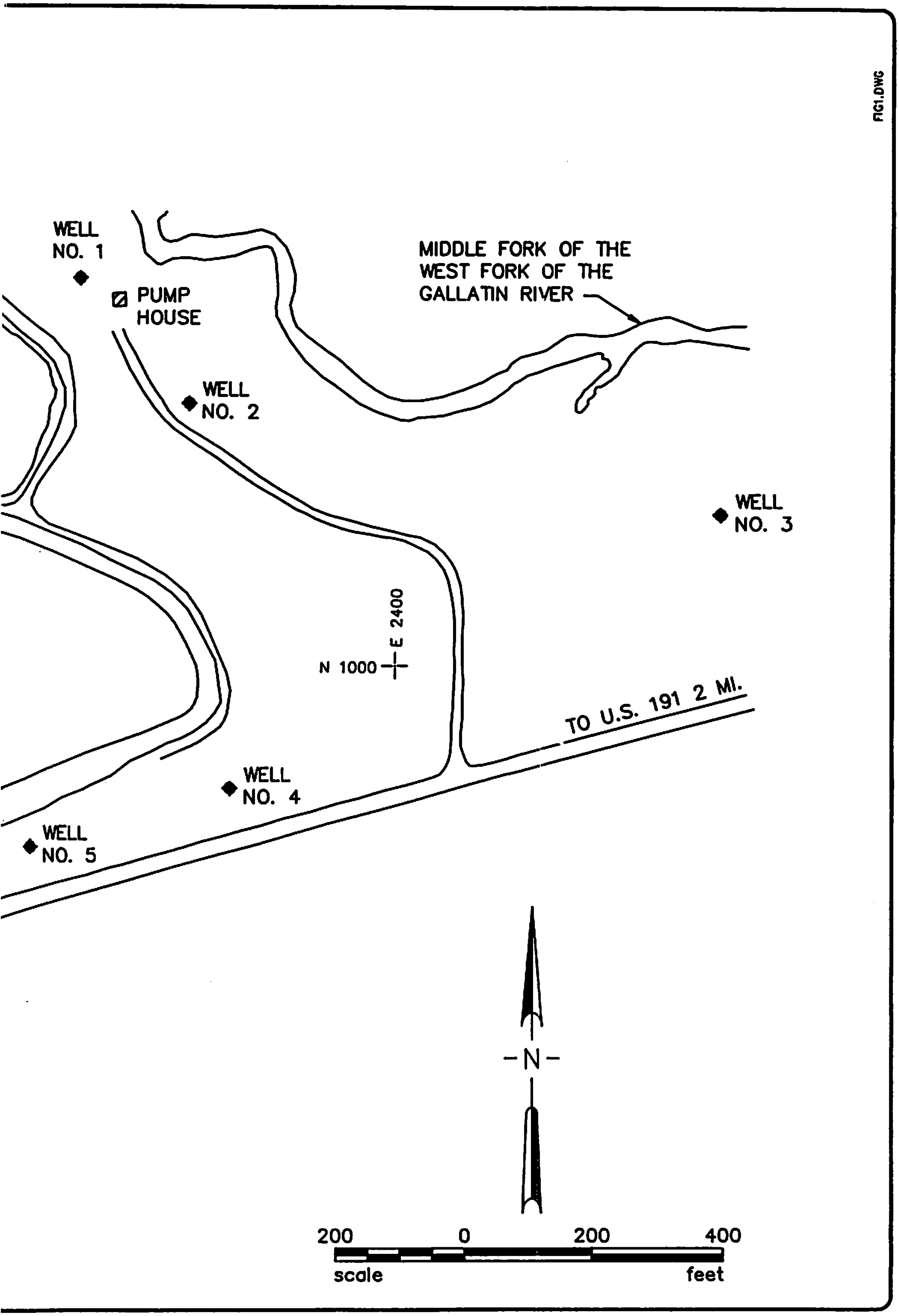


FIGURE 4.7.1-1

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4M357.102
MAY 1993

BIG SKY WASTEWATER FACILITY PLAN
EXISTING TREATMENT SYSTEM

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 current 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 4.4.3, BOD_5 levels in the storage pond are frequently above 30 mg/l.

Air to the aeration pond is supplied by two 50 HP blowers, model H9PDR12 manufactured by Gardiner-Denver. The blowers operate at 10 psig. Based on the blower curve, each blower has an inlet capacity of 800 CFM. Each blower can supply 16,290 pounds/day of oxygen that can be delivered to the aerators; assuming an inlet pressure of 11.69 psia and an inlet temperature of 60°F. With a transfer efficiency of 10 percent, 1629 pounds of oxygen will be transferred to the water. This is adequate to treat a BOD_5 load of 814 pounds per day with one blower.

4.7.3 Storage Ponds

Two unlined storage ponds are used to store water from the aeration pond during the non-irrigation season. The storage ponds have capacities of approximately 13.6 MG and 34.3 MG

(47.9 total). The smaller pond (trout pond) is maintained at full capacity for aesthetic reasons, and as-such is not serving as part of the storage system. Since the pond is never emptied, storage volume is not made available. At the 1993 flow rates, approximately 62 MG of storage is required to store water from October to June (240 days). It appears that approximately 47 to 60 million gallons per year seeps out of the ponds and into the ground. In fact, seepage has been observed on the east side of the aeration cell and storage cell #1.

In past litigation covering the Westland, Inc. property, it was apparently agreed that 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.

Based on the above analysis it is apparent that the storage ponds are inadequate to store the existing flows. Expansion of the treatment system using spray irrigation or a periodic discharging system may require constructing new storage ponds. The treatment system utilized in the plant expansion will dictate the size of the storage ponds if necessary. A treatment system, such as spray irrigation, must provide enough storage capacity to store all winter flows until the irrigation season beings.

4.7.4 Irrigation

The existing treatment system uses treated wastewater to spray irrigate the golf course. A review of the irrigation system indicates that approximately 80 to 90 acres are currently being irrigated. The course manager has indicated there are plans to eventually expand the system to irrigate approximately 165 acres (Kremer, 1994). Leakage from the existing storage ponds significantly reduces the volume of water that must be disposed of by spray irrigation.

Two 20 HP pumps, each rated at 500 GPM at 100 feet total head, are used to pump to the golf course irrigation system. Assuming a 12 hour per day irrigation schedule, the pump station has a firm capacity of 360,000 gallons per day or 43.2 million gallons per year based on 120 days of irrigation.

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 15 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 and crop uptake. Deep percolation past the root zone should be minimized to prevent lateral flow in the underlying gravels which may surface at the stream cuts bordering the golf course. Over irrigation of the golf course may result in ponding in low areas of the golf course.

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.

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. In order to minimize deep percolation, the hydraulic capacity of the golf course was estimated based on the net irrigation requirement. 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 irrigation capacity of the golf course was estimated using the monthly consumptive use estimates for turf grass at Lake Yellowstone, precipitation and soils data from Meadow Village and acreages from the Meadow Village golf course. Based on the golf course soils, the available water capacity in the turf grass root zone is about 1.2 inches.

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.

Climatic factors affecting ET include temperature, humidity, radiation, and wind speed. ET literature explains that high temperature, low humidity, high radiation, high wind areas have higher measured ET rates than cooler, humid, cloudy, calm locations. This fact being generally recognized, it can be assumed that the 10% warm season ET would approximately correspond with the 10% dry precipitation year and vice versa.

The land application of effluent will take place annually during varying climatic conditions (average, wet, and dry years). Three scenarios have been examined herein representing each of the three conditions. Each scenario assumed that the golf course (165 acres) at Meadow Village could be utilized for land application.

Depending on the climatic conditions, the irrigation capacity of the golf course could vary. During a cool wet year the irrigation capacity of the golf course is limited to 47.5 million gallons. During a dry warm year the irrigation capacity of the golf course is 92.8 millon gallons. Tables 4.7.4-1 through 4.7.4-3 show the values used to calculate the irrigation capacity of the golf course.

Nitrogen Loading. The irrigation of the golf course can be limited by either the hydraulic capacity or nitrogen loading. The non-degradation law makes it necessary to limit the nitrogen loading to a level that limits percolation of nitrate into the ground water. Kentucky Bluegrass has a nitrogen uptake rate of approximately 150 to 200 pounds per acre per year. Using the calculation procedure contained in the EPA publication Land Treatment of Municipal Wastewater and assuming a denitrification and volatilization rate of 15 percent, the applied wastewater could have a nitrogen concentration of 38 mg/l at the highest hydraulic loading of 92.85 million gallons per year. This application rate would be equivalent to a nitrogen loading of 178 pounds nitrogen per acre. As the nitrogen concentration in the applied wastewater is below 38 mg/l, it is concluded the irrigation of the golf course is controlled by the hydraulic loading rather than the nitrogen loading if the commercial fertilizer applied to the golf course is not considered.

Data on the actual irrigation volume is extremely limited. A flow meter was installed in the fall of 1992 to record the actual water pumped to the golf course. Therefore only one year of actual irrigation records are available. Also, the summer of 1993 was an extremely wet year so the irrigation was not typical of a normal year.

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. If the application of a commercial fertilizer is continued, the nitrogen concentration in the

TABLE 4.7.4-1

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	165	0	0.00
JUN	2.99	3.96	1.90	1.10	1.57	0.13	165	22	7.03
JUL	4.17	2.30	1.25	2.91	4.16	0.35	165	57	18.64
AUG	3.61	2.20	1.17	2.44	3.49	0.29	165	48	15.62
SEP	1.42	2.47	1.15	0.27	0.39	0.03	165	5	1.75
SEASON	14.37	14.39	6.95	7.42	10.60	0.88	165	146	47.50

* 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 4.7.4-2

GOLF COURSE IRRIGATION CAPACITY (AVERAGE YEAR)

MONTH	MEAN LAWN GRASS ET* (INCHES)	MEADOW VILLAGE MEAN PRECIPITATION (INCHES)	MEAN EFFECTIVE ** PRECIPITATION (INCHES)	MEAN NET IRR. REQ'T (INCHES)	(using 70% irrigation application efficiency) MEAN GROSS IRR. REQ'T (INCHES)	MEAN GROSS IRR. REQ'T (FT)	GOLF COURSE IRRIGATED AREA (ACRES)	TOTAL POTENTIAL WATER USE (AC-FT)	TOTAL POTENTIAL WATER USE (MG)
MAY	0.96	2.48	1.12	0.00	0.00	0.00	165	0	0.00
JUN	3.91	2.84	1.49	2.42	3.46	0.29	165	48	15.49
JUL	4.90	1.65	0.97	3.93	5.62	0.47	165	77	25.19
AUG	4.19	1.58	0.89	3.30	4.71	0.39	165	65	21.12
SEP	2.28	1.77	0.89	1.39	1.99	0.17	165	27	8.90
SEASON	16.24	10.32	5.36	11.04	15.78	1.31	165	217	70.69

* ET VALUES FROM WYOMING IRRIGATION GUIDE @ LAKE YELLOWSTONE, WY

** 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 =1.00 for a (d)= 2.95 inches

Pt = Total monthly precipitation (mm)

ETc = monthly ET (mm)

TABLE 4.7.4-3

GOLF COURSE IRRIGATION CAPACITY (WARM YEAR)

MONTH	10% PROBABILITY WARM YEAR** LAWN GRASS ET* (INCHES)	MEADOW VILLAGE DRYEST YEAR IN 10 TOTAL PRECIPITATION (INCHES)	DRYEST YR IN 1 EFFECTIVE *** PRECIPITATION (INCHES)	DRYEST YR IN 1 NET IRR. REQ'T (INCHES)	(using 70% Irrigation application efficiency) DRYEST YR IN 10 GROSS IRR. REQ'T (INCHES)	DRYEST 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	1.31	1.60	0.77	0.54	0.77	0.06	165	11	3.44
JUN	4.90	1.83	1.06	3.84	5.49	0.46	165	75	24.60
JUL	5.59	1.06	0.66	4.93	7.04	0.59	165	97	31.56
AUG	4.87	1.02	0.61	4.26	6.08	0.51	165	84	27.25
SEP	3.01	1.14	0.61	2.40	3.42	0.29	165	47	15.35
SEASON	18.22	6.65	3.71	14.50	20.72	1.73	165	285	92.85

* 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 1 out of every 10 years (ie. There is a 10% 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 10% values for seasonal ET and Gross Irr. Req'ts apply to seasonal values and do not assume that the 10% monthly values occur in consecutive months of the same year.

applied wastewater should be maintained below 12.5 mg/l in order to match the nitrogen uptake rate of Kentucky Bluegrass.

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 4.7.4-4
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 <u>Montana Irrigation Fertilizer Guide</u>, a 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.

4.7.5 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 regulations 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.

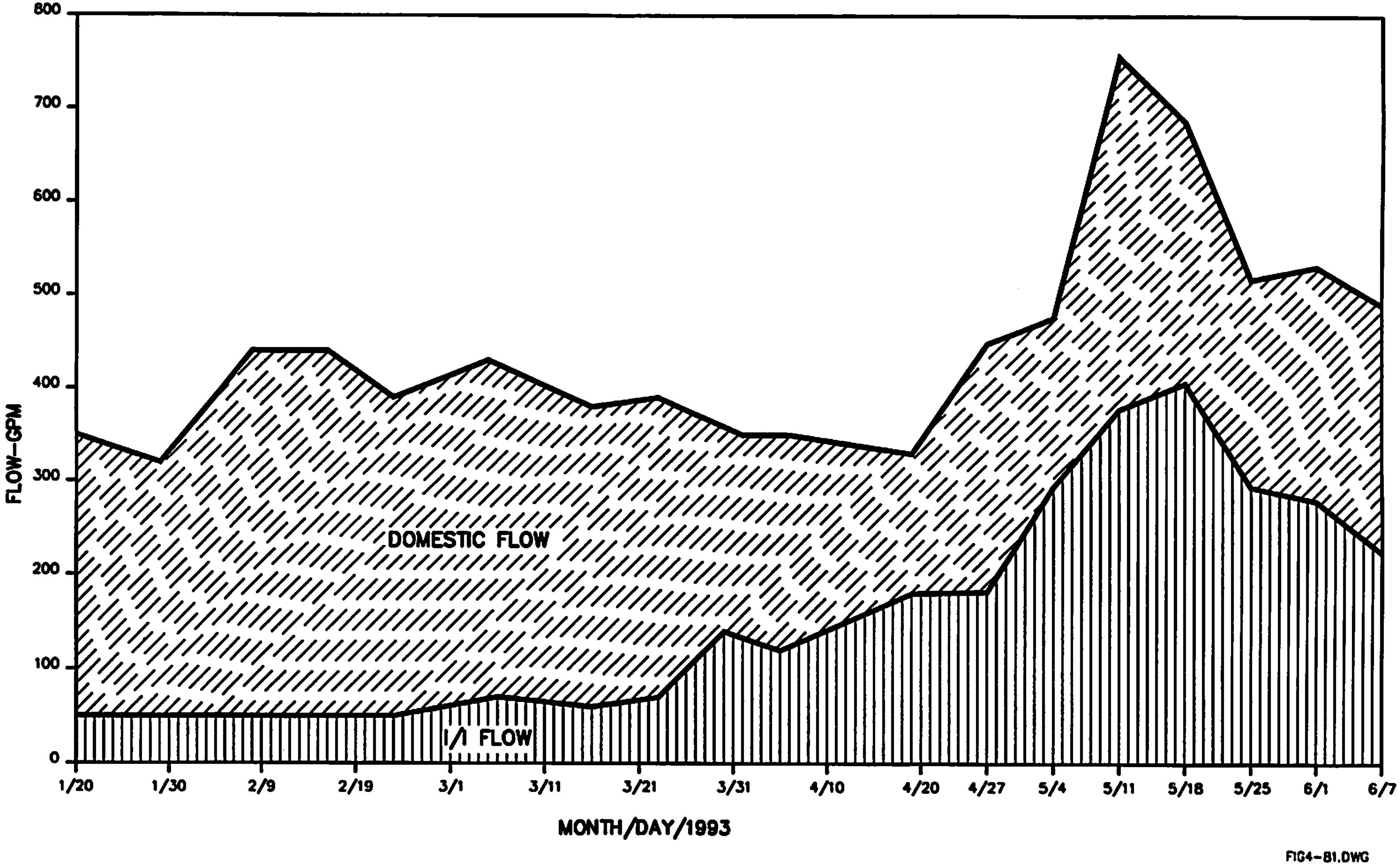
Typically, the EPA considers wastewater flows over 120 gallons per capita per day as excessive (EPA, 1984). Another technical source uses a flow quantity with units of gallons per day per inch diameter per mile of sewer. In one study with 128 cities reporting, 59% had infiltration allowances of 500 gpd/inch-diameter-mile 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 the summer and fall of 1993. 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



BIG SKY WASTEWATER TREATMENT PLANT

INSTANTANEOUS WEEKLY MAXIMUM AND MINIMUM FLOWS

FIGURE 4.8-1

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sources of high I/I. The analysis of the individual drainage areas was limited to instantaneous flow measurements during the early morning hours of November 11, 12, 13, 1993. As groundwater levels are low during the fall, the measured flows do not provide a good representation of where groundwater infiltration is occurring during the spring. It is recommended that additional monitoring be completed on the individual drainage areas during May and June when high groundwater conditions exist and snow melt runoff is occurring.

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 1993 (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

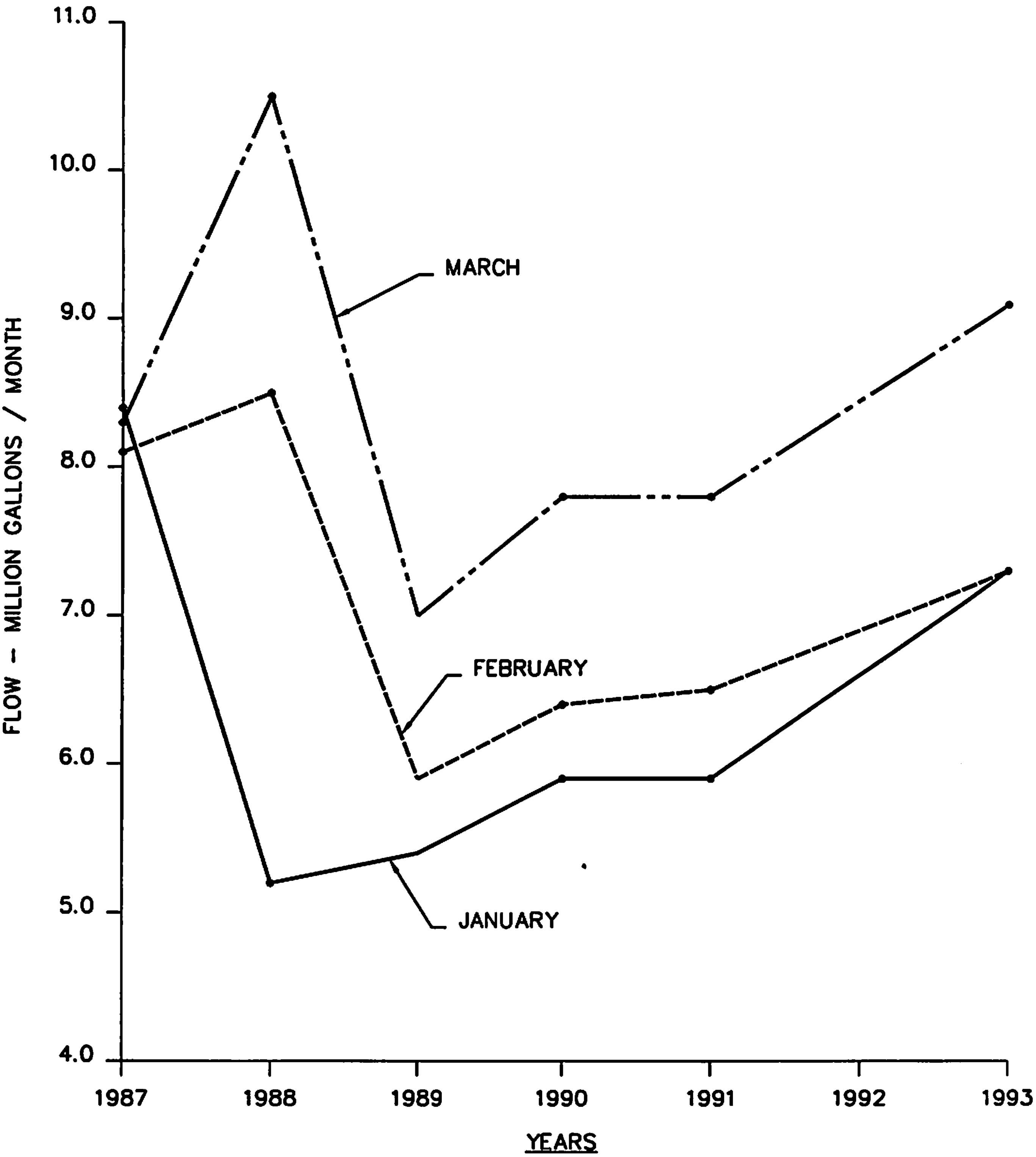

FIG4-821.DWG

BIG SKY WASTEWATER TREATMENT PLANT

INFILTRATION / INFLOW ANALYSIS
JANUARY - MARCH FLOWS

FIGURE 4.8.2-1

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The data indicates that the flow increase during the 1993 ski season was due primarily to the increase in usage. The data also reflects the decrease in gallons per skier day achieved since 1988.

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. 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

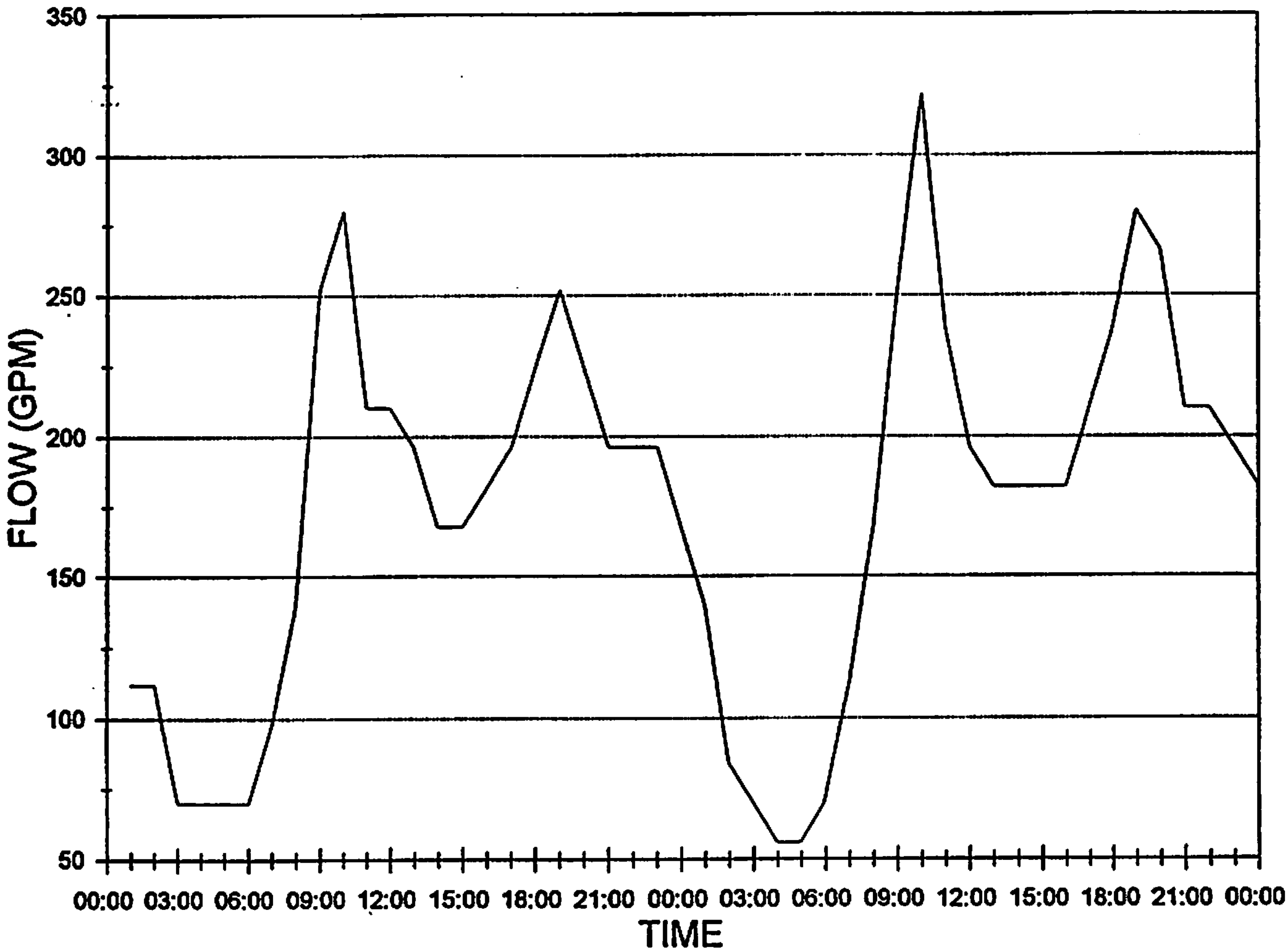

FIG4-822.DWG

BIG SKY WASTEWATER TREATMENT PLANT

TREATMENT PLANT FLOW
JANUARY 22 & 23, 1993

FIGURE 4.8.2-2

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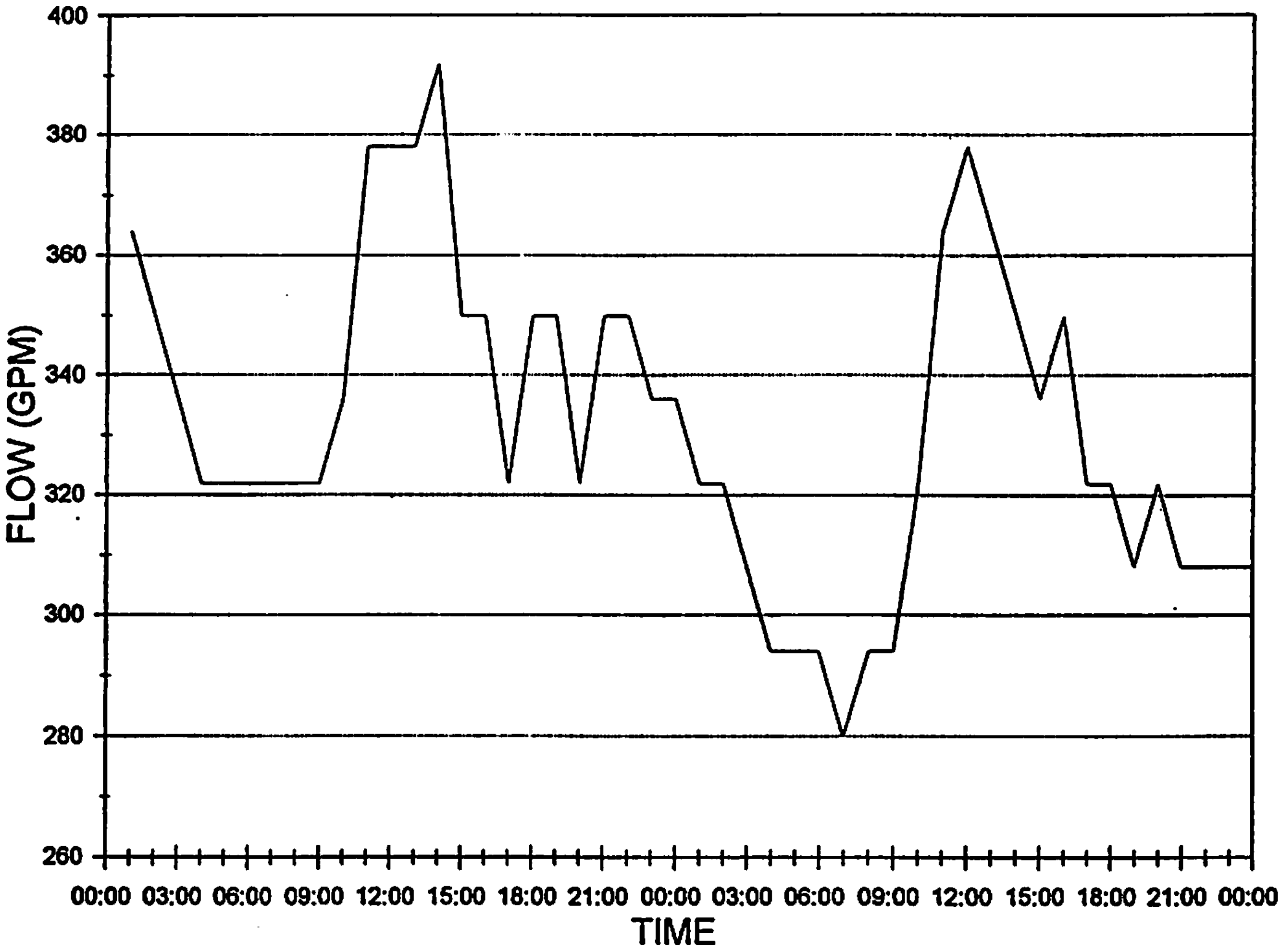

FIG4-823.DWG

BIG SKY WASTEWATER TREATMENT PLANT

TREATMENT PLANT FLOW
JUNE 3 & 4, 1993

FIGURE 4.8.2-3

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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.

Repairs were made to many sections of the collection system during the fall of 1993. The success of the I/I reduction program cannot be determined with much confidence until the spring runoff period is complete. Based on the flows measured in April 1994 to May 17, 1994, it appears the reduction in springtime I/I is in the vicinity of 38 percent. If a 38% reduction in I/I is also obtained during the remaining high groundwater period (June through September), the annual I/I flow would be approximately 42.29 million gallons per year. However, the I/I entering the system in the spring of 1994 may not be a good representation of what will occur during a normal year. The winter of 1993-1994 was a dry year at Big Sky and snowfall and runoff were below average.

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)
<u>MOUNTAIN SYSTEM</u>					
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)
<u>OUTFALL LINE</u>	112	151 (4/86)			31 11/93)
<u>HIDDEN VILLAGE</u>	131	2.5 (12/85)	5.3 (4/86)	4.1 (7/86)	2 (11/93)
<u>MEADOW SYSTEM</u>					
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)
<u>WASTEWATER PLANT</u>		107-116 (12/85)			44 (11/93)

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) 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.

Based on the figures and discussions above an average annual growth rate of 3.0 is assumed.

Table 5.1-2 shows the projected SFE's connected to the sewer system at 5 year increments assuming the average 3% per year growth rate is maintained. As noted in Chapter 3.0, the District has legal commitments to provide treatment capacity to 6440.9 SFE's that have already been approved through the subdivision review process.

TABLE 5.1-2
PROJECTED SINGLE FAMILY EQUIVALENTS

YEAR	SFE	YEAR	SFE
1993	1928.7	2018	4038
1998	2236	2023	4681
2003	2592	2028	5427
2008	3005	2033	6291
2013	3483	2038	7293

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.

The District has already begun a water conservation program. Specifically the District has contacted the Water Quality Bureau to assist in establishing a Water Conservation training class. The District is currently in the process of establishing a water conservation ordinance that will be instituted in 1994. The ordinance will require low flow plumbing fixtures. The District is also in the process of developing a rate structure to encourage conservation.

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.

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 2018 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:

- The current domestic flow is 53.5 MG per year.

- Conservation measures could reduce the current domestic flow per SFE by 5%.

- Conservation measures could reduce future domestic flow rates per SFE by 10%.

- Domestic flow rates will increase in proportion to increased growth at the resort (3% per year).

- The occupancy rate at the resort will increase 20% from current levels during the 20-year design period.

Using these assumptions, domestic flow contribution for the year 2018 can be calculated as shown below:

20-year Domestic Flow $= [(53.5 \text{ MGY})(.95)+(53.5(1.03)^{25}-53.5)(.90)]1.2$
$= 124.18 \text{ MGY}$

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 summer of 1993, approximately 28,300 feet of sewer line was inspected with a television camera and repairs were made at many locations where infiltration was occurring. As discussed in Section 4.8.2, it appears from the flow measurements in April and part of May, 1994 that the repair work completed in 1993 may have achieved some flow reduction. The early results indicate a 38% reduction in I/I flows during the high groundwater period. If these results are maintained through the remaining high groundwater period, the annual I/I flow would be approximately 42.3 million gallons per year. However, the I/I observed during the spring of 1994 may not be a good indicator of the I/I during a normal year at Big Sky. Snowfall at the resort was below normal and the runoff period was short. Because of uncertainty of the actual I/I flow reduction, it is recommended an additional allowance of 5 MG/year be included in the design flow. This would correlate to an I/I allowance of 47.3 million gallons per year in the system. With the current collection system consisting of 213.992 inch●diameter●miles of line, an I/I allowance of 47.3 million gallons per year equals a flow of 605 gpd/inch●diameter●mile. This allowance is still within acceptable limits as reported by several cities (ASCE No. 60). Additional I/I reduction may be achieved by future rehabilitation work but substantial flow reduction is not anticipated. The work completed in 1993 removed the majority of easily identified I/I.

In addition to the current I/I flow of 42.3 MG/YR, an allowance should be added for the installation of new sewer lines installed when currently platted subdivisions are developed. An estimate of the allowance for I/I that may result from future sewer lines installed to serve platted but undeveloped subdivisions was made by measuring the road length in each platted subdivision.

The following lengths of sewer line were assumed for the new sewer lines.

Blue Grouse Hills	3,292 L.F. of 8 inch sewer
South Fork Basin	5,300 L.F. of 8 inch sewer
TOTAL	8,592 L.F. of 8 inch sewer

An allowance of approximately 9,000 L.F. of line was also made for additional development in the Mountain Village area and service lines. With these additions, a total of 27.0 inch● diameter●miles of new sewer lines are allowed for in the facility plan.

Using an allowance of 200 gpd/inch●diameter●mile equates to an annual volume of 1.97 million gallons. The additional 1.97 million gallons of I/I is assumed to be added in equal increments during the 20-year design period. This results in an I/I flow of 49.3 million gallons per year for the 20-year design flow.

Through litigation, the court has required that sufficient wastewater treatment capacity be available to treat 43 million gallons per year from the Westland Inc. property when the property is developed. Currently, the Westland Inc. property is not developed and there are no indications that development will occur in the immediate future. Therefore, for planning purposes, a 3% annual growth rate starting with the construction of 10 homes in 1997 has been assumed. It is assumed that each home will be equivalent to 1.47 SFE's and the domestic flow per SFE is 29,958 gallons per year. The flow per SFE is based on the current flow rate taking into account conservation measures and increased occupancy. An allowance for I/I should also be included with the Westland flows. Since the land is currently undeveloped and no plans are available to estimate the length of the sewer lines, an I/I flow allowance was based on the current I/I flow per SFE of 0.022 MG/YR/SFE. A similar I/I allowance is added to the projected domestic flow for the Westland property.

The projected annual average flows are shown in Table 5.2-1.

TABLE 5.2-1
PROJECTED ANNUAL FLOWS

YEAR	SFE	DOMESTIC FLOW MG/YR	I/I FLOW MG/YR	WESTLAND CAPACITY MG/YR	TOTAL FLOW MG/YR	AVG. DAY MGD
1998	2236	70.2	47.7	0.763	118.26	0.324
2003	2592	80.9	48.1	0.885	129.88	0.356
2008	3005	93.2	48.5	1.027	142.73	0.391
2013	3483	107.5	48.9	1.189	157.59	0.432
2018	4038	124.2	49.3	1.378	174.88	0.479
2023	4681	143.4	49.7	1.597	194.70	0.533

The projected flow distribution throughout the year is assumed to have the same pattern as the existing domestic flow. The projected annual flow of 174.88 MGD in the year 2018 will be distributed as shown in Table 5.2-2.

TABLE 5.2-2 PROJECTED FLOW DISTRIBUTION			
MONTH	MONTHLY FLOW - MG	MONTH	MONTHLY FLOW - MG
January	19.27	July	14.37
February	19.94	August	22.55
March	14.07	September	19.27
April	14.07	October	15.37
May	5.56	November	9.15
June	8.50	December	12.76

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, the peak day flows were due primarily to the amount of infiltration in the system. As growth occurs, the domestic component of the flow will make up a greater percentage of the flow. As shown previously in Figure 4.4-3, the current peak day flows typically occur during spring runoff and are approximately 550,000 gpd (ignoring the unusually high flow in 1991 which resulted from a broken line).

Peak day flows during the ski season are typically around 350,000 gallons per day. Of this flow approximately 43,330 gallons are attributed to I/I (from Table 4.4-2, 1.3 MG ÷ 30 day = 43,330 gal.). Therefore, the current peak flow per SFE is (350,000 - 43,330) ÷ 1928 = 159 gpd.

It was shown previously in Section 4.4, that the existing average domestic flow component per SFE is 76.0 gpd, at the existing occupancy rate. The existing peak day flow is 159 gpd/SFE. This gives a peak day to average day flow ratio of 2.09 for the domestic flow. As the occupancy rate increases, it is expected the domestic flow per SFE will also increase. Typically, the peak day to average day ratio is approximately 2.9. (Metcalf and Eddy, 1979). Therefore, the projected peak day domestic flow is estimated based on a peak day to average day ratio of 2.9.

Based on the above peaking factor and the flows in Table 5.2-1 the projected peak day flow for the year 2018 is calculated as follows:

$$\text{Peak Day Flow} = \frac{[124.2\ \text{MG} + 1.378\ \text{MG}]\ 2.90 + 49.3\ \text{MG}}{365\ \text{day}} = 1.13\ \text{MGD}$$

It is pointed out that since the peaking factor is not applied to the I/I component, the overall peaking factor is 2.35. Based on the above discussion and calculations it is recommended that the new facility be designed for an average day flow of 0.48 MGD and a peak daily flow of 1.13 MGD. It is emphasized that these design flows are based on I/I flow reductions observed through May 17, 1994.

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 4812.7 SFE's. In addition to the 4812.7 SFE commitment, a recent court decision has mandated a capacity of 43 million gallons per year must 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. With the court decision and past agreement with Westfork properties, the district is legally obligated to provide treatment capacity to 6440.9 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 (4812.7 SFE)	=	147.27 MG/year
Westland Capacity	=	43.0 MG/year
Westfork Capacity	=	6.04 MG/year
I/I	=	49.7 MG/year
TOTAL		246.01 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 246.01 MG/year. 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 246.01 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.

The influent BOD_5 samples collected from December 1993 through March 1994 indicate a fairly high strength waste averaging 288 mg/l. With flow conservation measures it is anticipated that influent concentration could increase. Therefore an influent BOD_5 concentration of 315 mg/l has been used for planning. The Recommended Standards for Sewage Works indicates the ratio of suspended solids to BOD_5 is typically 1.176. Based on this ratio, an influent TSS concentration of 370 mg/l has been used for planning.

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.

TABLE 5.4-1 20-YEAR DESIGN CRITERIA	
Design Year	2018
Single Family Equivalents	4038
Occupancy Rate	20% Increase from Existing
Design Flow - Annual	174.88 MG/YR
Average Day	0.48 MGD
Peak Day	1.13 MGD
Minimum Day	0.1 MGD
BOD_5	
Average Day - lbs/day	1,261
Peak Day - lbs/day	3,152
TSS	
Average Day - lbs/day	1,481
Peak Day	3,703
Phosphorus Average day - mg/l	12
Total Nitrogen - mg/l	60
Ammonia - mg/l	40
Organic Nitrogen mg/l	20

5.4.1 Sludge Disposal Requirements

Sludge generated must be disposed of in accordance with the recently adopted 503 regulations 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.

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.

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

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.

- 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

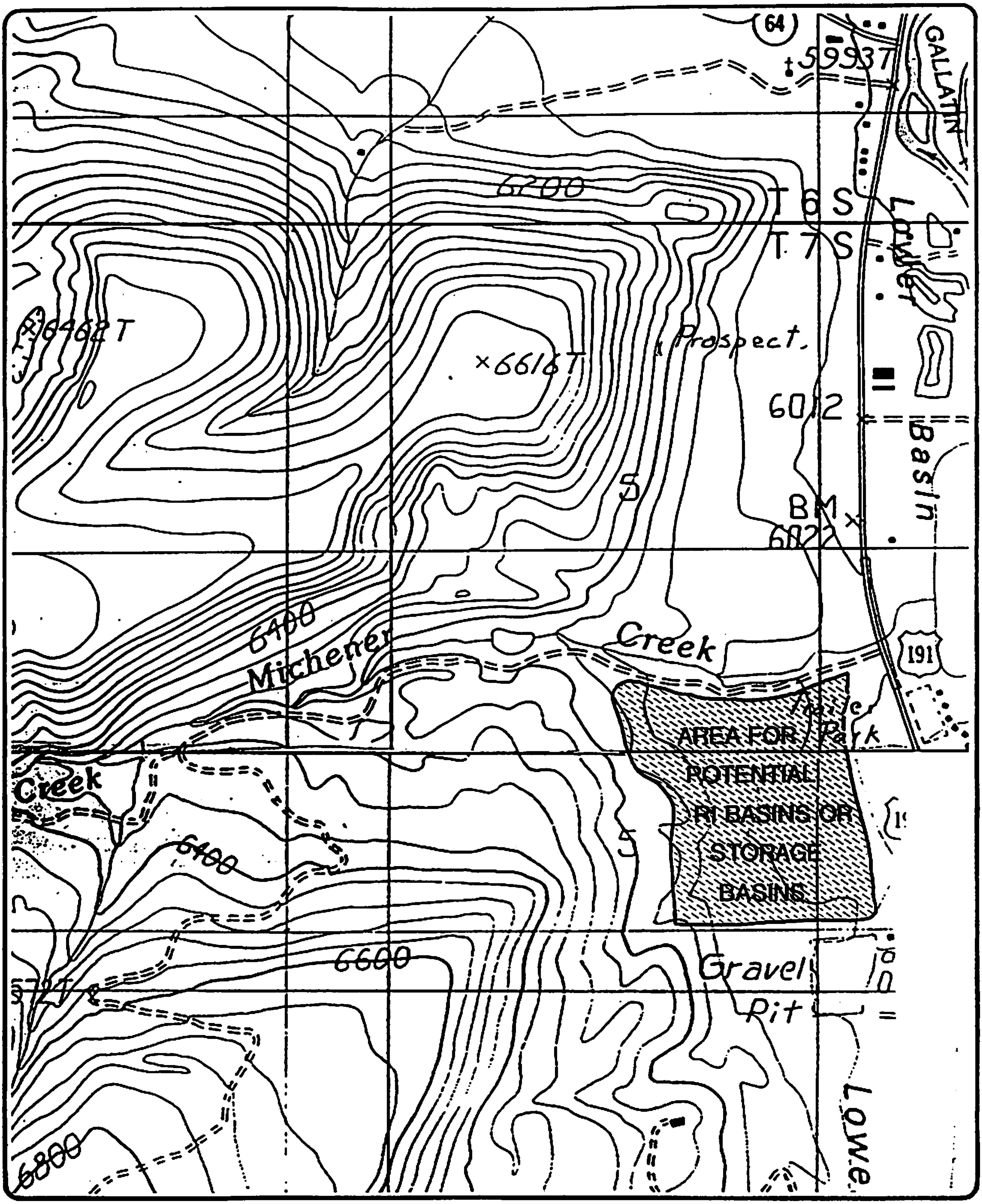
6.1 LAND APPLICATION SYSTEMS

Several potential land application sites have been identified in addition to the existing golf course. The first site consists of approximately 50 acres located south of the Big Sky turn off near Michener Creek. Figure 6.1-1 shows the location of the Michener Creek site. Based on size and slope considerations, the Michener Creek site was considered as a potential location for rapid infiltration basins or storage basins.

As discussed in Section 5.7.4, the golf course currently irrigates approximately 80 to 90 acres. There is a potential irrigation area of 165 acres. In order to maximize the use of the golf course, the pump system will have to be upgraded and the irrigation system expanded.

6.1.1 Rapid Infiltration (RI) Basins

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).
shows a cross section of the geological conditions at the Michener Creek site. As the above discussion and Figure 6.1.1-1 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



BIG SKY WASTEWATER FACILITY PLAN
MICHENER CREEK SITE

FIGURE 6.1-1

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Figure 6.1.1-1 shows, exceeding the infiltration capacity of the site could lead to springs developing along the toe of the slope.

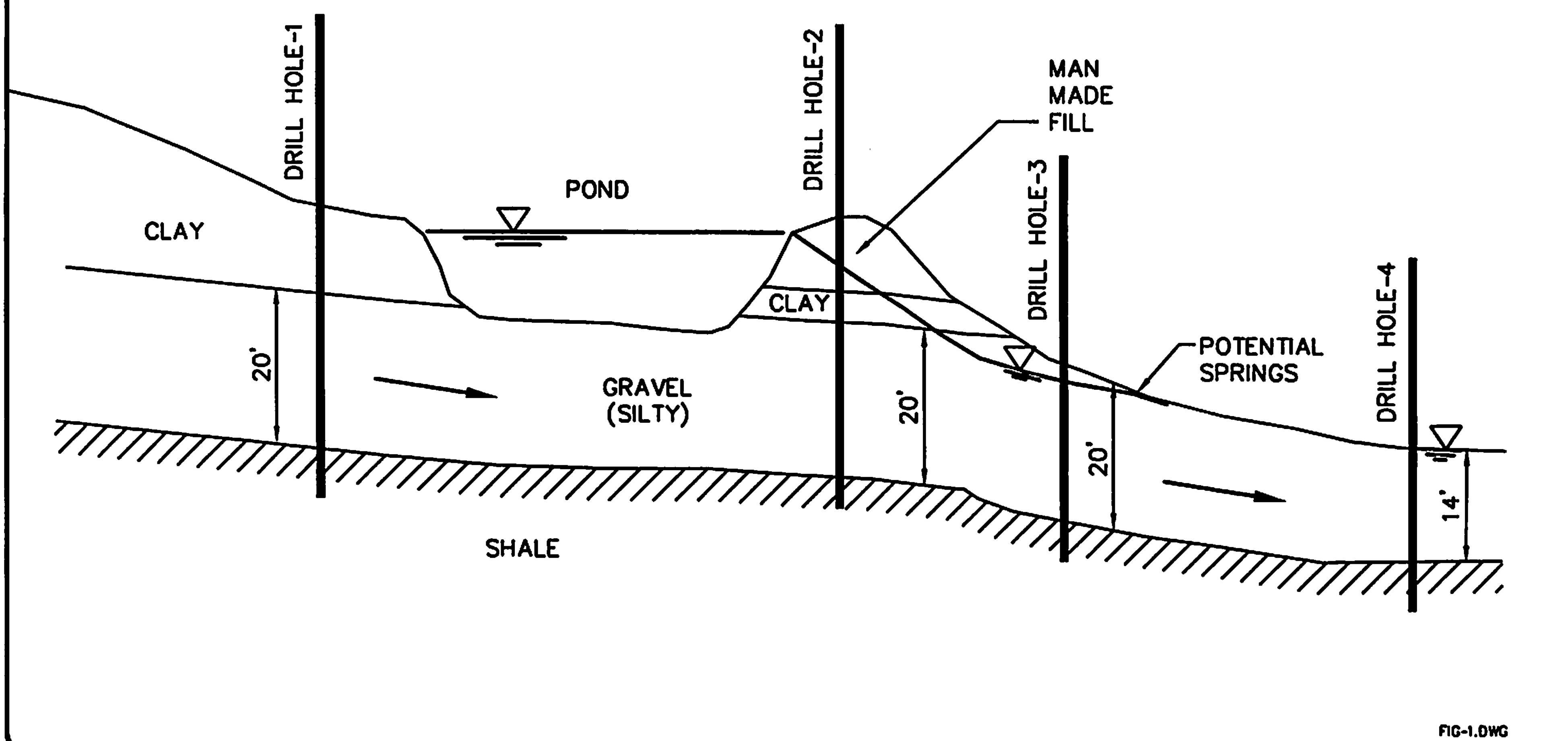
It is possible to mitigate the development of springs and to increase the infiltration capacity of the site by installing a groundwater drain system that would discharge into Michener Creek. The surface discharge would have to meet non-degradation requirements or a waiver would have to be obtained.

Two types of underdrain systems have been investigated. The first system would involve 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 would maximize phosphorus removal as the wastewater passes through the soil. The second type of underdrain system would consist 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 involves 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.

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 non-degradation criteria a waiver would have to be obtained. Obtaining a waiver would be difficult and would likely result in a 1½ to 2 year



BIG SKY WASTEWATER FACILITY PLAN

GEOLOGICAL CONDITIONS
MICHENER CREEK SITE

FIGURE 6.1.1-1

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delay in the project. Therefore, constructing rapid infiltration basins on the Michener Creek site is not considered a viable alternative.

During the public meeting process, there has been some discussion regarding the option of continuing to use the existing storage ponds as infiltration ponds. The option has been proposed in which a mechanical plant would be constructed ahead of the storage ponds to remove the majority of pollutants. Then the existing leaking storage pond would be allowed to continue functioning as a quasi infiltration pond. Additional studies would be necessary before this option could be used as a long term solution. However, it may be possible to continue to use this as a short term solution.

The infiltration capacity of the existing storage pond site is questionable. Currently the ponds are estimated to leak approximately 47 million gallons per year. At the twenty year design flows, assuming continued irrigation of the golf course, the percolation rate would have to be approximately 127 million gallons per year. It is unlikely the infiltration rate could be increased to this level without substantial seepage occurring along the stream banks. The high infiltration rates could also result in a bank failure caused by piping of the fine material out of the bank. The 1978 renovation of the aeration pond was necessitated by a piping failure of the embankment (ECI, 1986).

In summary, it does not appear that the use of rapid infiltration basins is a feasible alternative unless a waiver of the non-degradation 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 could not meet surface water non-degradation 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.

6.1.2 Spray Irrigation System

As indicated previously, the golf course pump system will have to be upgraded in order to irrigate the full 165 acres. During a dry year the golf course has a gross irrigation requirement of 92.85 MG/YR. Assuming a 12 hour pumping schedule for 120 days, the golf course pump station should have a firm capacity of 1,075 gallons per minute.

In order to fully utilize the golf course for irrigation, the existing pump station will be upgraded to a firm capacity of 1,075 gpm and laterals and risers will be installed in the 85 acres that are currently not irrigated.

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 6.1.2-1 shows a portion of the EPA guidelines.

The golf course is currently irrigated with water that has been treated in an aerated lagoon and disinfected. While it may be possible to continue irrigating with this level of treatment by claiming the process should be "grandfathered" under the old regulations, we do not recommend this approach.

TABLE 6.1.2-1

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.

Due to the close proximity of the 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. At Big Sky no buffer zone is proved.

Exposure to bacteria and enteric viruses can occur by several routes including drinking contaminated water, aerosols created 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 for golf course irrigation. As discussed in Section 4.7.4, the golf course has an irrigation capacity of approximately 47.5 million gallons per year during a cool wet year. During a dry year, the irrigation capacity of the golf course is 92.85 million gallons per year. A site is needed that is capable of handling 174.88 million gallons per year in the design year 2018. The additional land required for the spray irrigation alternative must have a capacity to treat 127.38 million gallons per year. At full development of the existing treatment commitments, the wastewater flow is estimated at 246.01 million gallons per year. At a flow of 246.01 MG/YR the spray irrigation site(s) must have a capacity to treat 198.51 million gallons per year in addition to the golf course capacity. While the continued irrigation of the golf course does provide a disposal site for a portion of the wastewater, the need to treat the wastewater to a higher level results in a potential cost increase. Therefore, the spray irrigation options have been evaluated under two options: 1) continue treatment with an aerated lagoon and dispose of all water at a new site or, 2) provide advanced treatment, continue to use the golf course and additional land at a new site.

In order to locate additional spray irrigation sites a factor overlay methodology was used to make a first cut in eliminating areas from consideration for spray irrigation. The technique used for the first cut was to physically overlay a base map of the area with transparent sheets depicting favorable or unfavorable conditions for spray irrigation based on three specific factors: (1) slope stability; (2) elevation; and (3) slope. (HKM, 1993). The factor overlay method eliminated lands from consideration if any of the following conditions occurred: (1) landslide area; (2) elevation greater than 8000 feet; and (3) slopes greater than 40%. Based on the factor overlay the following areas were evaluated further.

- The Beaver Creek Area
- Drainage basins of the upper tributaries to the South Fork
- Upper Buck Creek
- Upper Jack Creek Basin
- Scattered areas on the Hidden Lake Quadrangle
- Gallatin River bottom land
- Porcupine Creek area
- Land surrounding Meadow Village

After further evaluation, the majority of these sites were considered as poor irrigation sites due to a combination of factors which fell just outside the screening criteria.

Two potential spray irrigation sites were identified and are discussed in this report. The Porcupine Creek area and the drainage basins of the upper tributaries to the South Fork (Yellow Mule site).

For the Porcupine Creek site, it is estimated that an area of approximately 566 acres would be required for the 20 year design flow of 174.88 million gallons per year. When all of the legally committed treatment capacity is fulfilled the annual flow is estimated to be 246.01 million gallons per year. At an annual flow of 246.01 million gallons per year approximately 793 acres would be required.

The land in the Porcupine Creek area would have to be acquired or leased. The land is currently included in a land trade being negotiated between the Forest Service and a private lumber company. If the trade is completed, the land at the Porcupine Creek site would be transferred to the Forest Service. Discussion with the Forest Service indicates a special use permit would have to be obtained in order to use the site for spray irrigation. The Forest Service also indicated a special use permit would not even be considered until the land trade is complete. Our contact with the Forest Service has indicated that:

1) The Forest Service policy has been not to 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) The present land swap negotiations will have to be complete before serious consideration can be given to spray irrigation. After that, there would be a substantial public involvement period and environmental assessment. The net result is 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 possible public involvement in a plan which utilizes approximately 800 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.

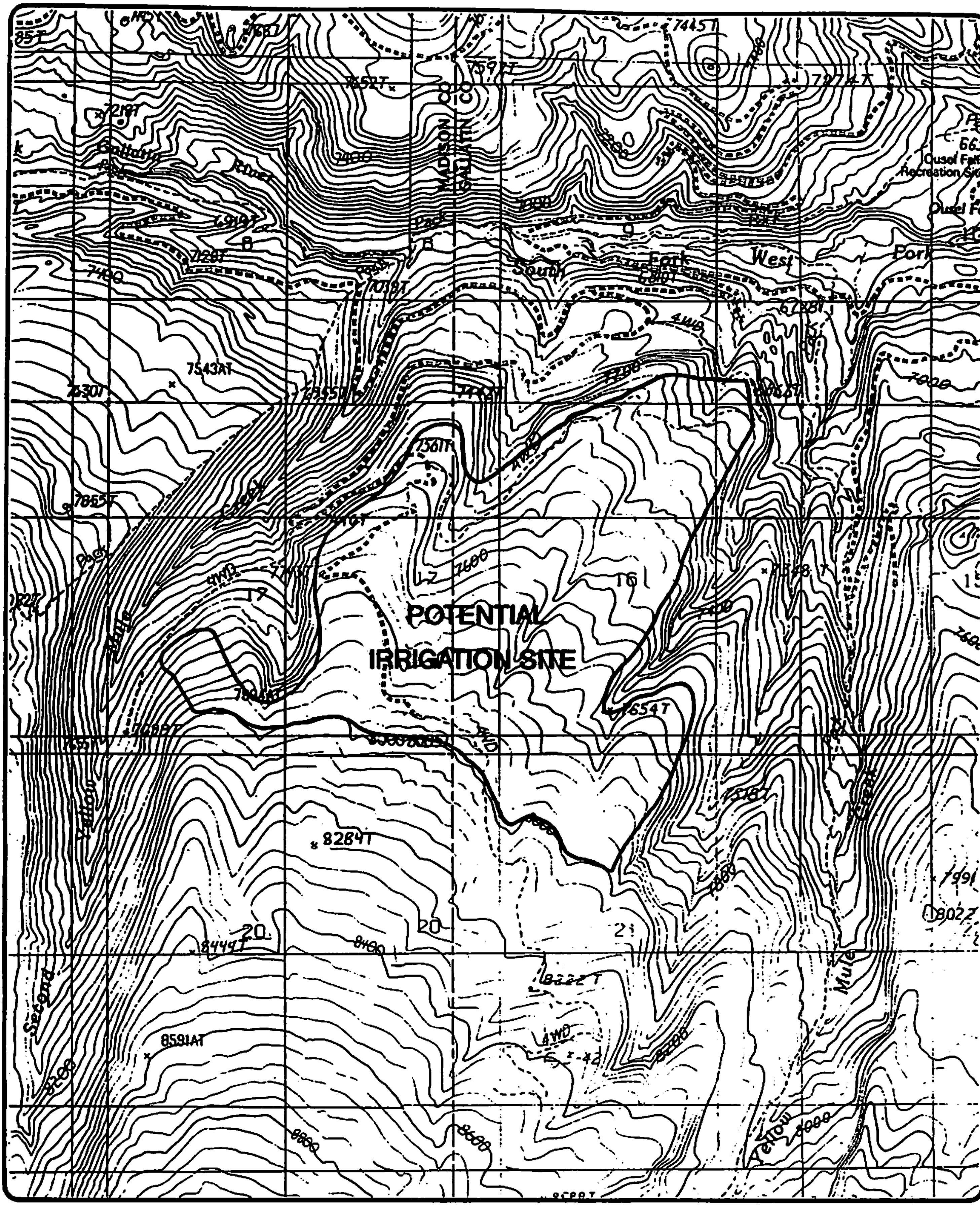
The second site considered for spray irrigation is the Yellow Mule site located in the South Fork drainage. Figure 6.1.2-1 shows the location of the Yellow Mule site.

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 shown later in Table 7.1-13, both options have a high equivalent annual uniform cost and have not been selected as the recommended alternative. As the Yellow Mule site falls just outside a grizzly bear management area, there was also a concern about potential impacts from the project.

In the first option, an irrigation area of 805 acres is required for disposal of the 20-year design flows. A winter storage volume of 138 MG is required. At a flow of 246.01 million gallons per year, an irrigation area of 1134 acres is required and a winter storage volume of 195 MG is required. The area in the vicinity of the Yellow Mule site is relatively steep and is not a good location for a large storage reservoir. For the 195 MG storage at full build out of the legal commitment, approximately 35 acres of relatively flat land would have to be acquired.

A 20-inch steel line would be installed between the existing plant site and the spray irrigation site. Water from the storage reservoirs would be pumped to the Yellow Mule irrigation site with the transfer pumps. A surge tank would be located at the Yellow Mule site to function as a pump suction reservoir for the irrigation pumps.

A transfer pump station consisting of three 600 HP pumps would be required. Each pump would have 50% of the total capacity requirements. In addition to the transfer pumps, large irrigation pumps would also be required. Three 600 HP pumps would be provided with each pump having 50% of the total capacity. One pump would serve as a backup pump.



BIG SKY WASTEWATER FACILITY PLAN

YELLOW MULE SITE

FIGURE 6.1.2-1

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The second option involves constructing an advanced nutrient removal wastewater treatment plant and disposal of the treated water on the golf course and the Yellow Mule site. In this option it is assumed irrigation at the Yellow Mule site would occur for 5 months of the year. An area of 528 acres is required in addition to the 165 acres on the golf course. A storage volume of 138 MG should be provided for the 20 year design flows. A spray disposal area of 896 acres is required, in addition to the golf course area, for the flow of 246.01 MGY projected for the legally committed hookups. A storage volume of 195 million gallons should be provided for the full build out flows.

By increasing the length of the irrigation season and utilizing the golf course, the transfer line to the irrigation site can be reduced to 12-inches, the transfer pumps could be reduced to 300 HP pumps, and the irrigation pumps could be reduced to 250 HP pumps. Two pumps would be installed at each pump station with each pump having 100 percent capacity. One pump in each station would serve as a backup pump.

6.2 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. The SBR is a fill and draw process in which discrete treatment cycles occur in a single basin. The cycles can be either time or volume based. The specific treatment cycles are:

- 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).

Figure 6.2-1 illustrates the treatment cycles in the SBR process.

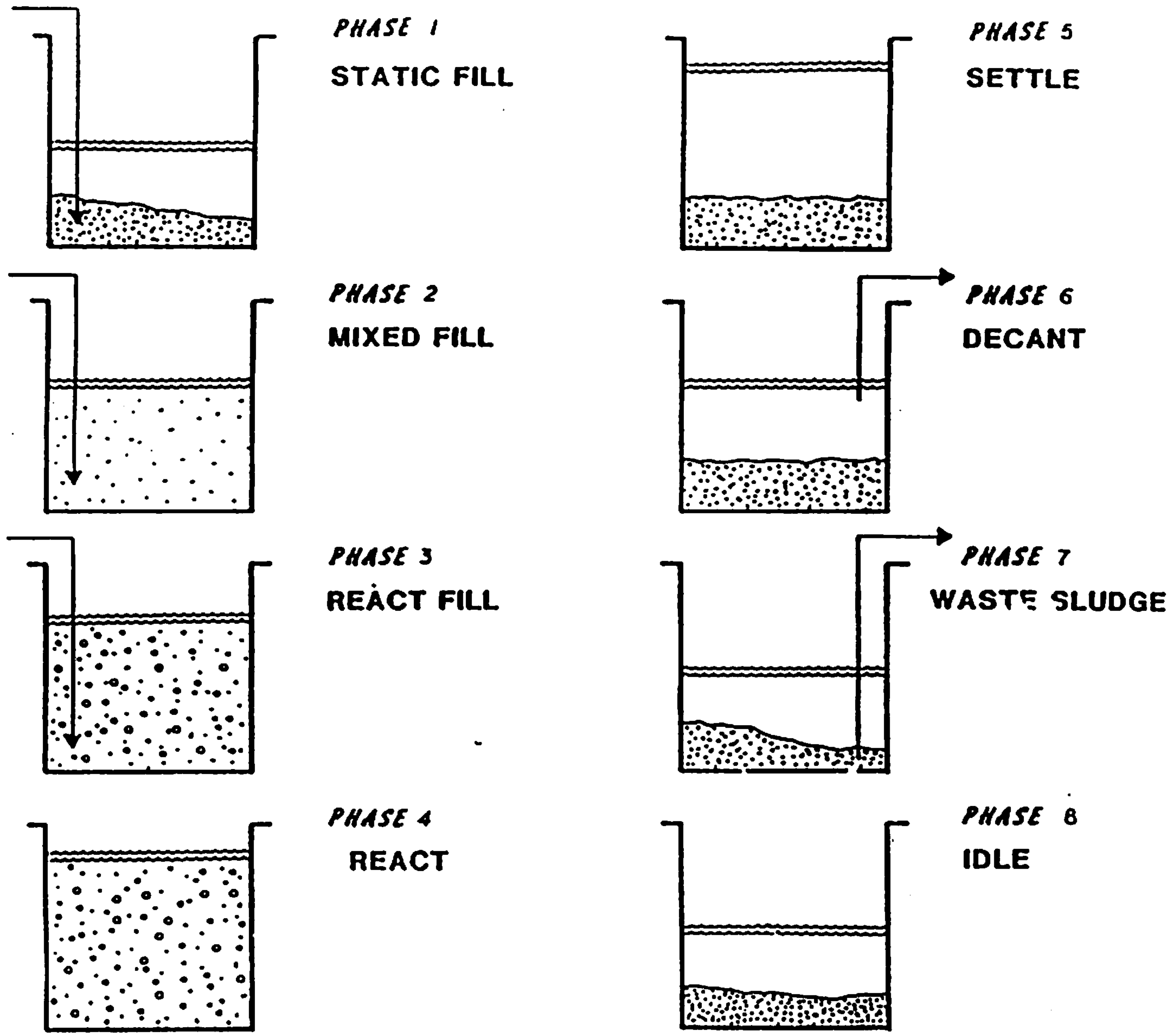
The process allows a substantial amount of operational flexibility as the cycle times and volumes can be varied to accomplish nutrient removal.

The process flow diagram for the SBR system is shown in Figure 6.2-2. The treatment system consist of the following components:

- Pretreatment
  - Bar Screen
  - Grit Removal
- SBR Basin and Equipment
- Filter and Backwash System
- Flotation Thickener and Related Equipment
- Aerobic Digester
- Sludge Holding Basin
- Chemical Addition Equipment
- Sludge Pumps
- Disinfection

The SBR system would consist 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.

Aeration would be required to meet both the carbonaceous and nitrogen oxygen demand. It is estimated that three (3) seventy five (75) horsepower blowers would be required to supply the oxygen demands.



BIG SKY WASTEWATER FACILITY PLAN

CYCLES FOR SBR

FIGURE 6.2-1

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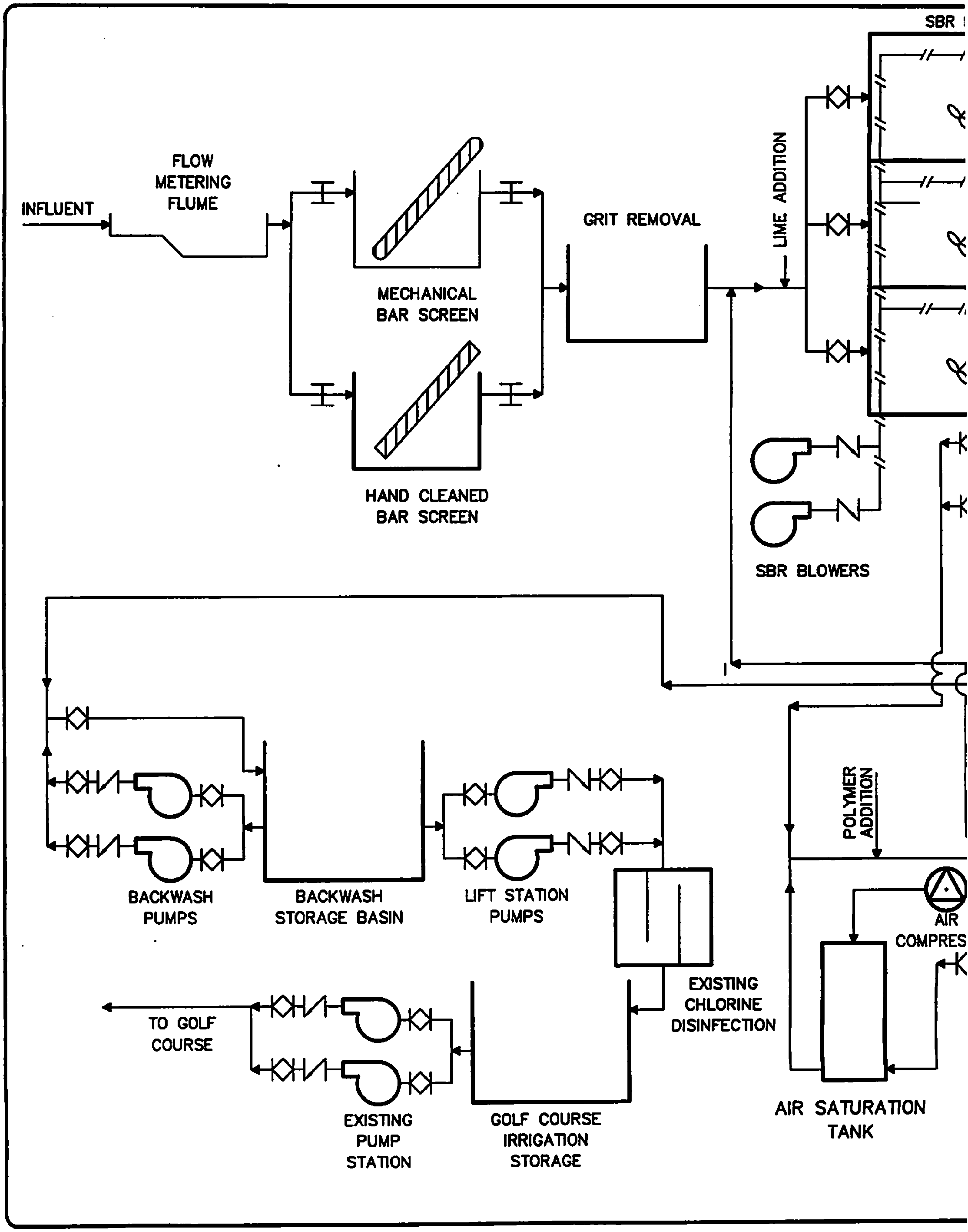
SBR
INFLUENT
FLOW
METERING
FLUME
MECHANICAL
BAR SCREEN
HAND CLEANED
BAR SCREEN
GRIT REMOVAL
LIME ADDITION
SBR BLOWERS
BACKWASH
PUMPS
BACKWASH
STORAGE BASIN
LIFT STATION
PUMPS
EXISTING
CHLORINE
DISINFECTION
POLYMER
ADDITION
AIR
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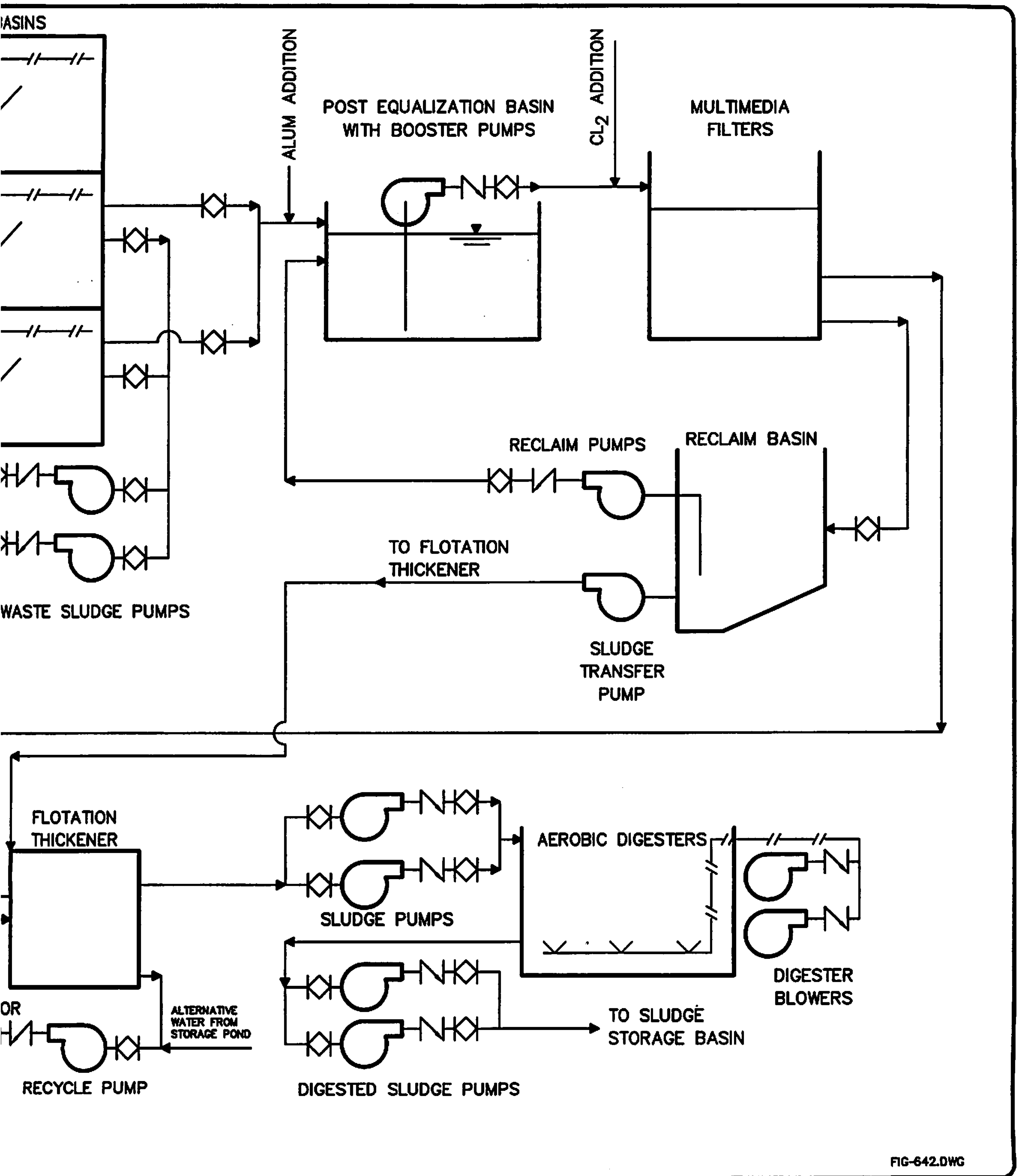
IRRIGATION
STORAGE



BIG SKY WASTEWATER FACILITY PLAN

PROCESS FLOW DIAGRAM
SEQUENCING BATCH REACTOR (SBR)

FIGURE 6.2-2

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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 addition, each basin would contain a decant system to allow the settled and clarified water to be drawn off.

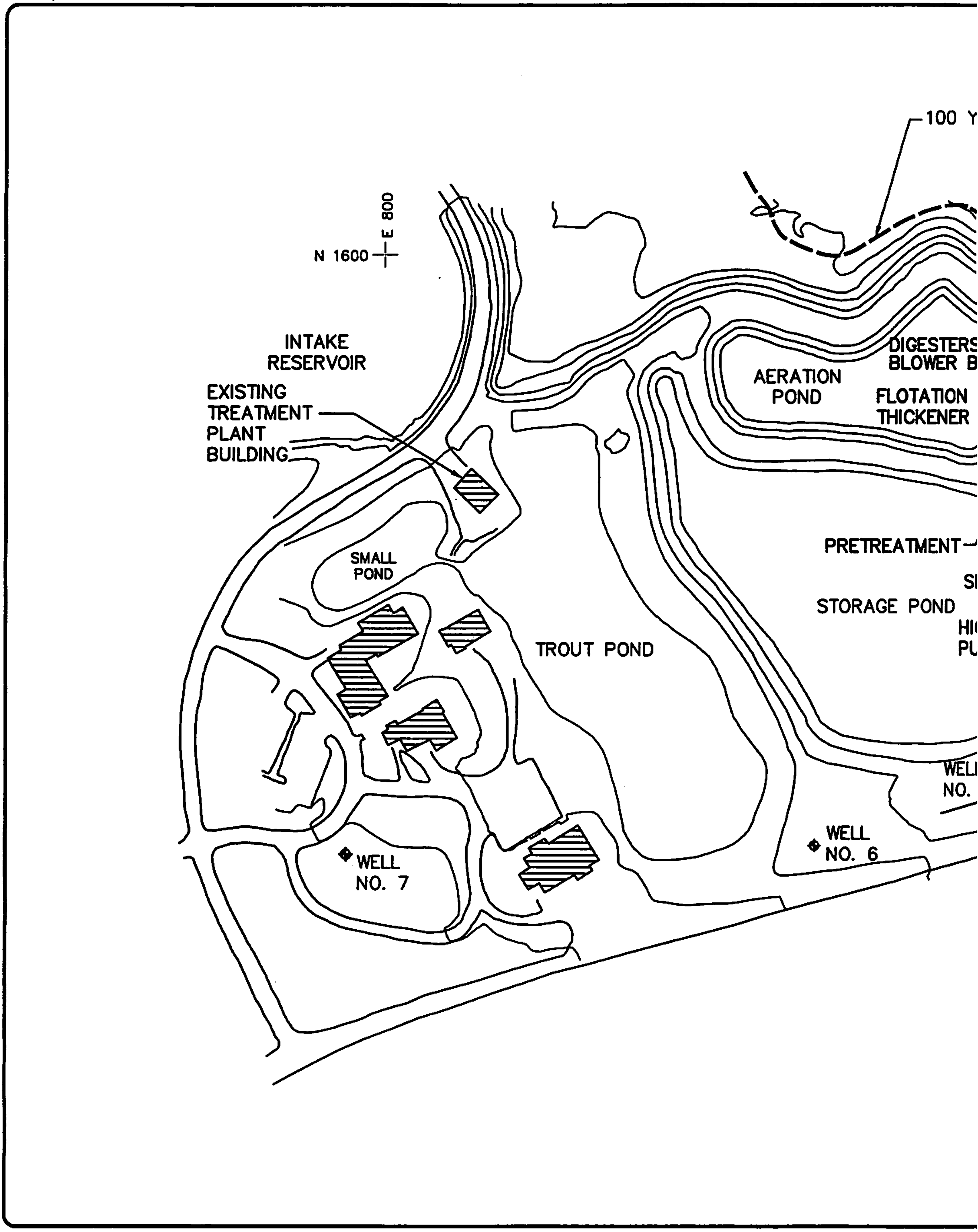
Effluent from the reactor basin would be discharged to a post equalization basin and a mixed media filter.

The post filtration system would consist of two (2) filters providing a filtration area of 157 square feet in each filter. A mixed media filter consisting of a anthracite, silica sand, and garnet sand would be used in the filtration process. In order to clean the filters, a backwash system would be required. The backwash system would consist of:

- a backwash storage basin
- backwash pumps
- surface wash pumps
- reclaim basin
- reclaim pumps
- and sludge transfer pumps.

The site layout for the SBR System is shown in Figure 6.2-3.

As with any biological system, sludge generated during the treatment process must be removed from the reactor basin. This would be accomplished with sludge pumps which would transfer


100 Y
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BUILDING
AERATION
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DIGESTERS
BLOWER B
FLOTATION
THICKENER
PRETREATMENT
SMALL
POND
STORAGE POND
TROUT POND
WELL
NO. 6
WELL
NO. 7
WELL
NO.

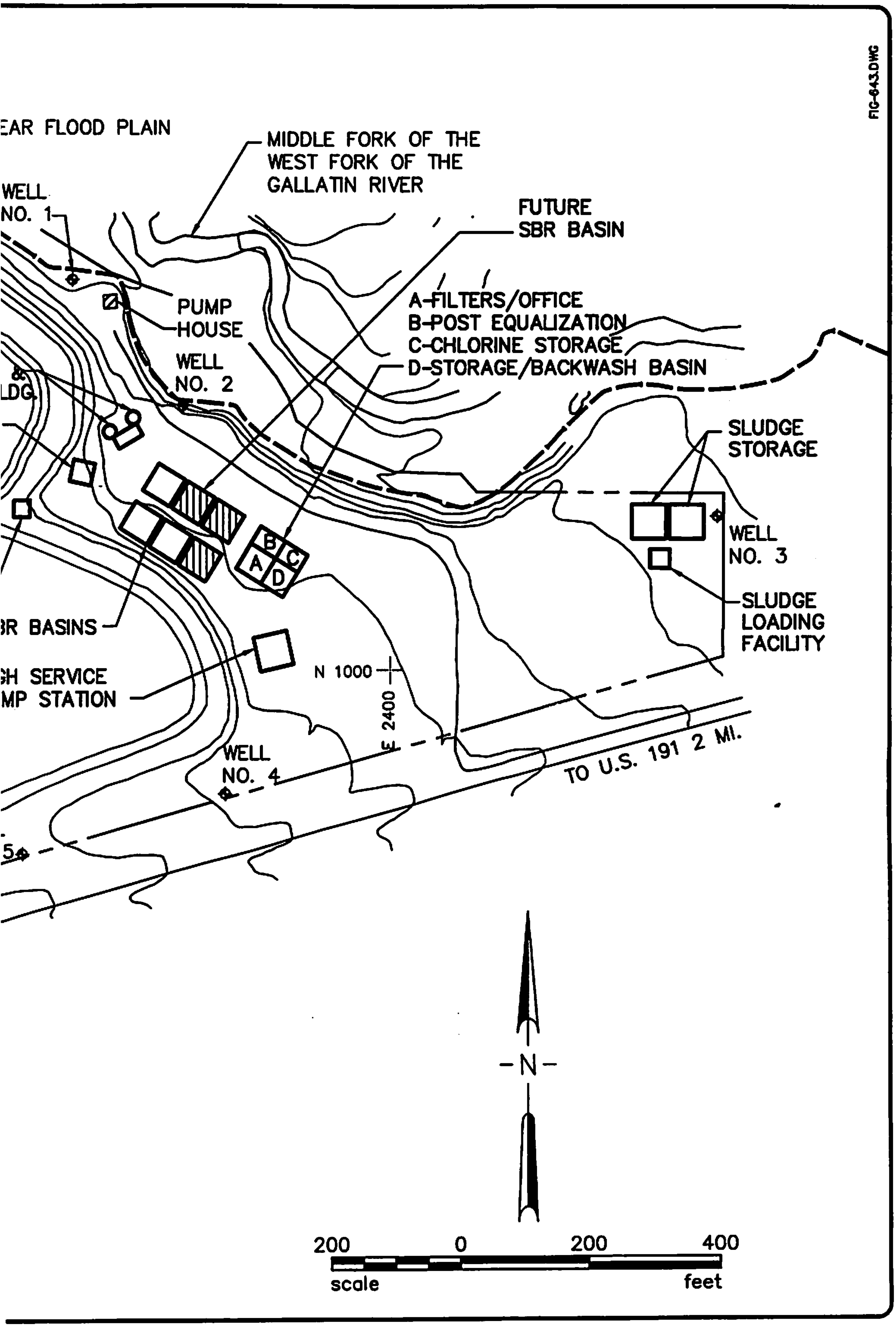

FIGURE 6.2-3

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BIG SKY, MONTANA
SITE LAYOUT FOR SBR SYSTEM

- 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 $0.2845 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
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
Sequencing Batch Reactor with filter	102,400	51,100	33,200	20,000	6,900	8,000	221,600
Aerated Lagoon with Spray irrigation at Yellow Mile (3 month)	54,300	110,200	72,100	5,000	6,400	4,800	252,800
Advanced Treatment with spray irrigation at Yellow Mule (5 months)	88,000	110,100	74,400	20,000	6,900	8,000	307,400
Advanced Treatment with snowmaking	110,000	65,900	54,300	20,000	6,900	8,000	265,100

Tables 7.1-8 through 7.1-12 show the estimated salvage value for each of the alternatives.

TABLE 7.1-8
SALVAGE VALUE FOR SEQUENCING BATCH REACTOR WITH FILTER

ITEM	COST	LIFE	SALVAGE VALUE 20 YR.
Pre-Treatment	$ 128,000	30	$ 42,900.00
SBR Basins	636,000	30	213,200.00
Flotation Thickener	225,000	30	75,400.00
Aerobic Digestion	244,000	30	81,800.00
Sludge Storage	45,000	50	27,000.00
Sludge Transport	320,000	20	0.00
Control/Lab/Maintenance	229,200	50	137,500.00
Chemical Feed Equipment	75,000	20	0.00
Site Work	140,000	---	140,000.00
Excavation/Fill	125,000	---	125,000.00
Electrical	211,600	30	70,900.00
Controls & Instrument	95,000	20	0.00
Yard Piping	125,000	50	75,000.00
HVAC	47,600	30	16,000.00
Filters	300,000	30	100,600.00
Backwash Basin	45,000	50	27,000.00
Reclaim Basin	40,000	50	24;000.00
Reclaim Pumps	6,000	20	0.00
Filter Building	235,000	50	141,000.00
Backwash Pumps	14,000	20	0.00
Sludge Transfer Pumps	6,000	20	0.00
		TOTAL	$1,297,300.00

TABLE 7.1-9 SALVAGE VALUE FOR AERATED LAGOON			
ITEM	COST	LIFE	SALVAGE VALUE 20 YR.
New Cell	$ 200,000	—	$200,000.00
Aeration Tubes	23,000	20	0.00
Surface Preparation	17,000	—	17,000.00
Liner	417,950	30	211,700.00
Air Line	26,400	50	15,840.00
Blower & Motor	20,000	20	0.00
Interior Piping	15,000	50	9,000.00
		TOTAL	$ 453,540.00

TABLE 7.1-10 SALVAGE VALUE FOR SNOWMAKING SYSTEM			
ITEM	COST	LIFE	SALVAGE VALUE 20-YEAR
Advanced Treatment Plant	$3,477,400.00	varies	$1,342,300.00
16-inch PVC	479,500.00	50	287,700.00
Valves	14,000.00	50	8,400.00
Land Purchase	400,000.00	--	400,000.00
Clearing and Grubbing	37,500.00	--	37,500.00
New Storage	810,000.00	--	810,000.00
Liner	729,950.00	30	244,500.00
Access Road	63,000.00	--	63,000.00
Fencing	40,000.00	50	24,000.00
Surface Preparation	20,000.00	--	20,000.00
14-inch Steel	1,800,000.00	50	1,080,000.00
Cathodic Protection	37,500.00	30	12,600.00
14-inch Valves	30,000.00	50	18,000.00
Pump Station (40 HP)	90,000.00	50	54,000.00
Pump Station (1050 HP)	700,000.00	50	420,000.00
Pump Station (700 HP)	550,000.00	50	330,000.00
Telemetry	20,000.00	20	0.00
		TOTAL	5,152,000.00

TABLE 7.1-11 SALVAGE VALVE FOR SPRAY IRRIGATION SYSTEM AT YELLOW MULE SITE (3 MONTH)			
ITEM	COST	LIFE	SALVAGE VALUE 20-YEAR
Aerated Lagoon	868,650		453,500
Liner	471,250	30	157,900
Land Purchase	700,000	--	700,000
Surface Preparation	21,000	--	21,000
Embankment	1,440,000	--	1,440,000
Clearing & Grubbing	50,000	--	50,000
20-inch Line	3,000,000	50	1,800,000
Cathodic Protection	20,000	30	6,700
Pump Station (1800 HP)	750,000	50	450,000
Surge Tank	15,000	50	9,000
Valves	26,00	50	15,600
Pump Station (1500 HP)	700,000	50	420,000
20-inch Steel Irrigation Line	720,000	50	432,000
Laterals & Risers	2,240,000	50	1,344,000
Telemetry	10,000	20	0.00
Electrical Extension	400,000	--	400,000
		TOTAL	7,699,700

TABLE 7-1-12 SALVAGE VALUE FOR SPRAY IRRIGATION SYSTEM AT YELLOW MULE SITE (5 MONTH)			
ITEM	COST	LIFE	SALVAGE VALUE 20-YEAR
Advanced Treatment Plant	$3,4777,400	Varies	$1,342,300.00
Liner	845,500.00	30	283,200.00
Surface Preparation	40,000.00	--	$40,000.00
Land Purchase	800,000.00	--	800,000.00
Excavation and Embankment	922,500.00	--	922,500.00
Clearing and Grubbing	50,000.00	--	50,000.00
12-inch Pipe	1,375,000.00	50	825,000.00
Valves	19,500.00	50	11,700.00
Cathodic Protection	20,000.00	30	6,700.00
Pump Station (600 HP)	450,000.00	50	270,000.00
Surge Tank	15,000.00	50	9,000.00
Surface Restoration	125,000.00	--	125,000.00
Pump Station (450 HP)	375,000.00	50	225,000.00
12-inch Steel Pipe	302,500.00	50	181,500.00
Laterals and Risers	1,848,000.00	50	1,108,800.00
Telemetry	10,000.00	20	0.00
Electrical Extension	400,000.00	--	400,000.00
		TOTAL	6,600,700.00

Table 7.1-13 illustrates the equivalent uniform annual cost (EUAC) for each viable alternative. The EUAC includes the capital cost, estimated operation and maintenance cost, and the salvage value at the 20-year design life. The salvage value has been determined using a straight line depreciation.

TABLE 7.1-13						
Alternative	Capital Cost	Annual Cost of Capital	Annual O&M	Salvage Value	Annual Worth of Salvage	Equivalent Annual Uniform Cost
Aerated Lagoon with Spray Irrigation at Yellow Mule (3 months)	$15,068,000			$7,699,700		
		$1,563,300	$252,800		($163,600)	$1,652,500
Advanced Treatment with Filtration and Spray Irrigation of Yellow Mule (5 months)	$15,172,800			$6,600,700		
		$1,574,200	$307,400		($140,300)	$1,741,300
Advanced Treatment with Filtration and Snowmaking	$13,109,250			$5,152,000		
		$1,360,100	$265,100		($109,300)	$1,515,900

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.

Spray Irrigation

Two sites were being considered for spray irrigation; the Porcupine Creek site and the Yellow Mule site. The Porcupine Creek site was ruled out as a viable option due to the length of time required to acquire the land. The Yellow Mule site was ruled out as other less expensive options were available.

The Yellow Mule site is privately owned. The current owner has indicated approximately 900 acres could be made available for spray irrigation. Depending on the irrigation option selected, the land required for the 20-year design flow is either 528 acres or 805 acres. For the projected flow of 246.01 MG/YR, the land required would be either 896 acres or 1134 acres, depending on the irrigation options selected. An agreement for additional land would be required for any future expansion in the Yellow Mule Area.

Sequencing Batch Reactor

The sequencing batch reactor is a fairly compact plant and could easily be expanded at the present wastewater treatment plant site.

Aerobic Lagoons

Adequate room is available at the existing plant site to construct an additional 18 MG pond. This would provide adequate expansion capability.

Snowmaking

Boyne USA currently has snowmaking on 4 runs on Andesite Mountain covering approximately 200 acres. Ten guns are used for snowmaking. Currently, approximately 32 million gallons per year are used in the snowmaking operation (Tout). Boyne has indicated they are planning to expand the snowmaking operation to 40 guns. Future snowmaking is planned for the Southern Comfort runs on the south facing slopes of Andesite. In addition, snowmaking is planned for the intermediate slopes in the vicinity of the gondolas. With an expansion to a 40 gun system, it is estimated 128 million gallons would be used in a typical season.

Under the design conditions of a cool summer, when only limited irrigation of the golf course would occur, 127.4 million gallons would need to be disposed of by snowmaking. The expansion of the snowmaking operation currently planned by Boyne USA will cover the runs on the southside of Andesite and one run served by the gondola. Additional runs are available to expand the snowmaking operation beyond the currently planned expansion.

The level of treatment provided in the alternative will also allow reuse in urban type irrigation systems. Therefore, it would be possible to expand the irrigation disposal area to include new subdivisions when they are approved for development.

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 SBR or 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.

Land disposal of aerated lagoon effluent has a greater potential to impact the groundwater than water from a nutrient removal plant simply due to the higher total nitrogen concentration in the sprayed water. Total nitrogen concentrations of 15 to 25 mg/l-N could be expected in the effluent of an aerated lagoon. Assuming an 84% removal efficiency in the irrigation process, due to the higher initial concentration, a total nitrogen concentration of 2.4 to 4.0 mg/l-N would be expected in the leachate.

The alternative utilizing snowmaking is expected to have minimal or no impact on groundwater. 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 alternatives considered, two would result in treated water entering a surface water. The two alternatives are 1) advanced treatment plant with land disposal at the Yellow Mule site for 5 months, and 2) advanced treatment plant with snow making.

Both the spray disposal alternative of the Yellow Mule site for 5 month and the snowmaking alternative would be expected to have minimal and nonsignificant impacts to surface waters. Both alternatives involve treating the wastewater with an advanced nutrient removal treatment plant with filtration before disposing of the treated water in a land application system. The expected quality of the water from the treatment plant is shown below.

Ammonia	1 mg/l -NH_3 -N
Nitrate	2 mg/l NO_3 -N
PO_4	1 mg/l PO_4
BOD_5	<10 mg/l
TSS	<5 mg/l

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 alternative would require installing a new line to the Mountain Village area. The line would parallel the existing sewer outfall line and therefore, construction would be in a previously disturbed area.

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 was 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 which tend to trap air pollutants in low lying areas. The primary sources of air pollutants is 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 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.

Sequencing Batch Reactor (SBR)

The SBR technology has only recently been utilized in the United States and therefore the published performance data is limited. Table 7.4-1 shows the published performance data from five operating SBR plants (Water Environment Federation, 1991).

TABLE 7.4-1
SBR PERFORMANCE DATA

PLANT	EFFLUENT			
	BOD mg/l	T-P mg/l	NH_4-N mg/l	NO_4 - N mg/l
Oak Pt., Michigan	5.0	2.0	0.4	3.7
Grundy Center, Iowa	5.0	4.3	0.5	3.5
Culver City, Indiana	9.2	0.6[a]	1.0	1.3
Armada, Michigan	10.3	0.48	3.43	—
Manchester, Michigan	3.0	0.50	0.43	—

[a/] Achieved with chemical addition

As Table 7.4-1 shows the SBR process is capable of producing a high quality effluent. The SBR process relies heavily on automated controls to open and close valves in the process sequence. While the reliability of automated controls has improved in recent years, it is expected that the plant operators will have to be familiar with programmable process controllers so that the process variables can be modified to suit different operating conditions.

The EPA publication Nitrogen Control lists operating data for 13 full scale SBR plants. The data shows the average total nitrogen concentration from the plants was 3.74 mg/l and the average nitrate concentration was 2.16 mg/l.

Reverse Osmosis

The reverse osmosis process is very reliable however it can require extensive maintenance. The primary concern with the reverse osmosis process is biofouling of the membranes. This can be controlled to a limited extent with chemical addition. It is estimated the membranes will have to be replaced on a two to three year interval. In order to ensure the proper operation of a full scale plant it will be necessary to conduct a pilot plant study using the actual water to be treated.

Reverse osmosis plants are normally used to treat brackish sea water or well water for potable drinking water. While they have been used as an advanced treatment for municipal wastewater reclamation in a few locations, there is a lack of operational data over a wide range of influent conditions. Because the use of RO plants for municipal wastewater reclamation is a fairly new technology, a pilot plant study will be needed to ensure adequate pretreatment is provided to reduce biofouling problems.

The reverse osmosis process will produce an extremely high quality effluent.

Snowmaking

The reliability of the snowmaking operation is highly dependent on the quality of water produced in the treatment plant. Snowmaking 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.

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 disposal if required.

8.0 RECOMMENDED ALTERNATIVE

8.1 DESCRIPTION AND PRELIMINARY DESIGN DATA

8.1.1 General

The recommended alternative for Big Sky consists of constructing a sequencing batch reactor (SBR) to provide tertiary levels of treatment. The SBR will be designed as a nutrient removal plant to remove nitrogen and phosphorus. The SBR system will consist of pretreatment, biological treatment, a post equalization basin, chemical feed, effluent filtration, disinfection, aerobic digestion, and sludge storage with land disposal.

Effluent disposal will involve a combination of irrigation of the golf course in the summer and snowmaking in the winter. Storage of the effluent would be required between seasons. In addition to the existing storage ponds, a 62 million gallon lined storage pond would be constructed to provide the required storage volume. The new storage pond would be constructed at the Michener Creek site. A 16-inch PVC line would allow water to be transferred between the existing storage ponds and the new ponds at Michener Creek. A low head pump station would pump water from the Michener Creek site to the existing storage ponds.

Water from the storage basins will be disposed of on the golf course during the summer and on the ski hill during the fall and winter. It is anticipated that irrigation of the golf course will occur from June through September with snowmaking occurring in late October, November and December. The existing golf course irrigation system would be expanded and upgraded by installing new laterals and risers on approximately 85 acres of golf course land. The existing golf course pump station would be upgraded to larger pumps to match the increased irrigation requirements.

For the snowmaking operation, a pump station consisting of three 350 HP pumps will be constructed to pump water from the storage basins to an intermediate surge tank located at an elevation of approximately 6960. A second pump station with two 350 HP pumps would draw water from the surge tank and pump to the snowmaking pumps located at Lake Levinsky. A new 14-inch steel line would be installed from the existing storage ponds to the snowmaking pumps.

8.1.2 Description of SBR Process

The process flow diagram for the recommended alternative is shown in Figure 8.1.2-1. The treatment and disposal system consists of the following components:

- Pretreatment
  - Bar screen
  - Grit removal
- SBR Basin and Equipment
- Two filters and backwash system
- Flotation thickener and related equipment
- Aerobic digesters
- Sludge storage lagoon
- Sludge injector and transport truck
- Chemical feed equipment
- Sludge pumps
- Disinfection
- Effluent pump stations
- 62 MG storage basin at Michener Creek

In the SBR process, the influent flow would continue to be measured at the existing metering station. After being metered, the flow 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.

sludge from the SBR basin to a dissolved air flotation (DAF) thickener. The purpose of the DAF thickener is to reduce the volume of sludge that must be stabilized in downstream processes. Sludge pumped from a SBR basin typically has a solids concentration of 1.0 to 1.5 percent solids. After thickening in a DAF, solids concentrations of 4.0 to 6.0 percent are typically obtained.

After thickening, the sludge would be transferred to a digester for further stabilization. As discussed in Section 5.4.1, the sludge must be treated to meet the requirements of Federal sludge regulations (40 CFR Parts 257, 403, and 503). The four most common stabilization process are:

- Anaerobic digestion,
- Aerobic digestion,
- Composting, and
- Lime stabilization.

An additional process, Autothermal Thermophilic Aerobic Digestion (ATAD), has been used in Europe but no 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.

The composting process and lime stabilization process were not considered as good options for Big Sky. The composting process can require a large land area, has a high operational cost, and has a potential for odors. The lime stabilization process was ruled out due to similar concerns. The two stabilization processes considered for Big Sky are:

- Anaerobic digestion
- Aerobic digestion

Both processes are used extensively throughout the U.S. Anaerobic digestion is more common in larger facilities while aerobic digestion is commonly used in plants under 5 MGD.

As phosphorous is released from the biological sludge under anaerobic conditions, it is important to maintain the sludge in an aerobic condition. This requirement favors the use of DAF thickening and aerobic digestion.

An aerobic digester is being proposed for the Big Sky project primarily due to ease of operation, lower odor potential, and the lower phosphorous concentration in the digester supernatant. The high concentration of ammonia and phosphorous in the supernatant of an anaerobic digester could severely impact the SBR process. It is generally recommended that anaerobic digesters not be supernated in a nutrient removal plant, but that the entire digested flow be sent directly to final disposal. This would result in a much larger volume of sludge for disposal.

Two aerobic digesters would be constructed. This would 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. The final disposal of the sludge would be to agricultural land. A sludge injector truck and a sludge tanker truck would be required for sludge disposal.

6.3 SNOWMAKING

The use of treated wastewater for snowmaking at ski areas is a relatively recent occurrence with only 1 or 2 resorts reusing treated wastewater for snowmaking. The EPA guidelines for water reuse presented previously in Table 6.1.2-1 do not deal explicitly with reuse for snowmaking. However, the guidelines do provide recommendations for recreational impoundments where incidental contact or full body contact with reclaimed water may occur. Following the EPA guidelines would require secondary treatment, filtration, and disinfection.

Table 6.2-1 provides a comparison of the advantages and disadvantages of each process.

TABLE 6.2-1 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 Flame associated with burning waste gas may be objectionable in the reset setting
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

When snowmaking is combined with a summer spray irrigation system, winter storage requirements, pump sizes and line sizes can be reduced. In addition, the runoff from the snowmaking operation would occur during high stream flow periods when any impact to surface waters would be minimal.

The existing snowmaking system at Big Sky consists of 10 guns that utilize approximately 40 to 50 gpm each. Approximately 200 to 300 acres are used in the snowmaking system. The distribution lines extend to the top of Andesite Mountain. One 250 HP pump with a capacity of 500 gpm is used to pump to the snowmaking guns. With the existing operation, approximately 32.5 MG of water is used to make snow. Currently, Boyne makes snow in October and November.

Boyne has indicated they are planning on expanding the snowmaking operation to operate 40 guns (Tout, 1994). Five 400 HP pumps are planned. Two of the five pumps are scheduled to be installed in the summer of 1994. With the expanded snowmaking system, approximately 130 MG of water will be required for snowmaking.

The snowmaking alternative would consist of constructing an advance nutrient removal plant, such as a SBR, continuing to use the existing storage ponds after they are lined, pumping to a small intermediate storage pond located in Section 29 east of the Mountain Village, and pumping from the intermediate storage pond to the snowmaking pumps near Lake Levinsky. During the summer, the golf course would continue to be used for irrigation. Expansion and upgrading of the golf course system would involve changing out the existing pumps to provide a pump station with a firm capacity of 1,075 gpm. Laterals and risers would be installed to cover the 85 acres that are currently not irrigated.

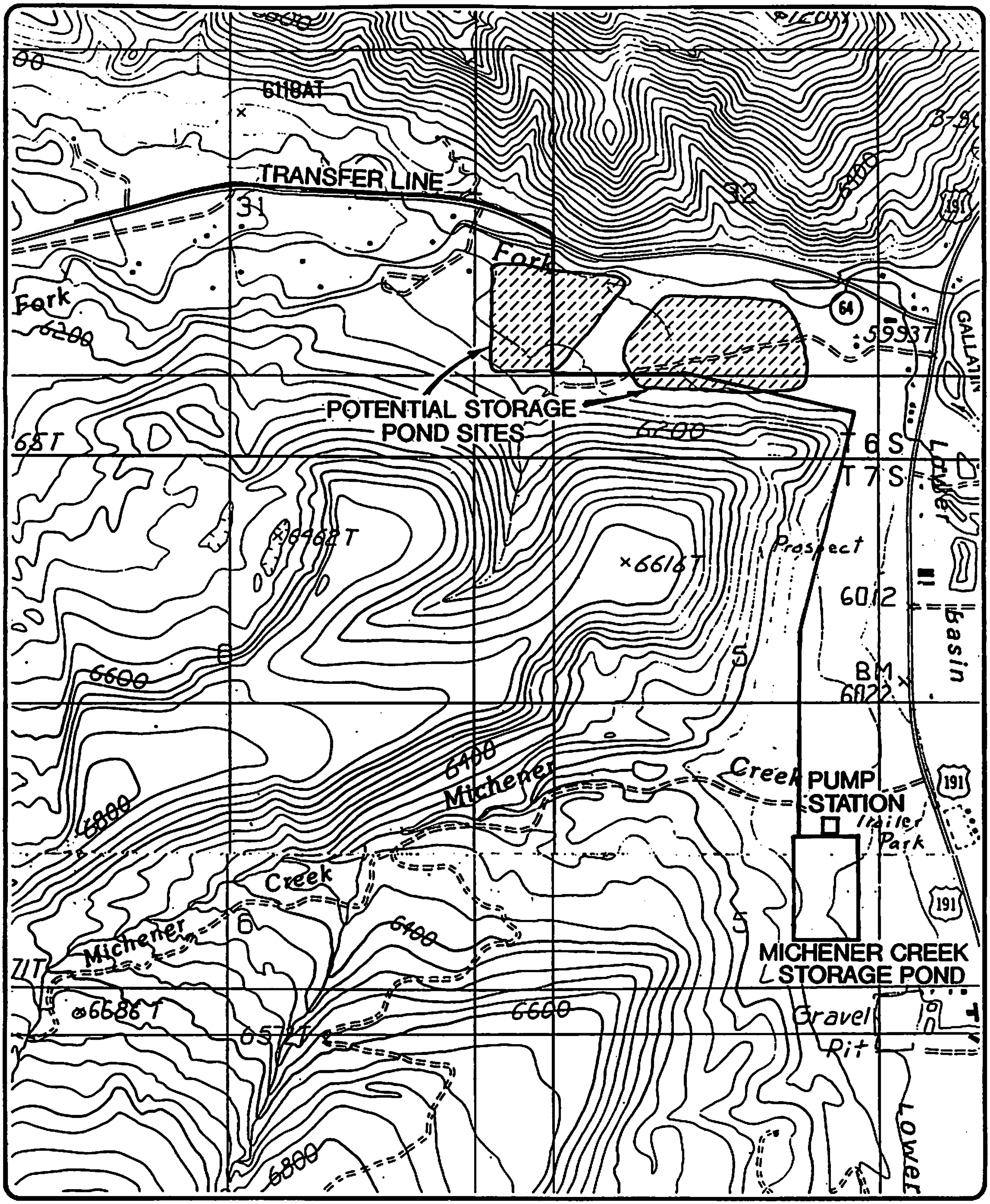
A storage volume of 118 MG is required for this alternative. The existing ponds have a total storage volume of 56 MG which includes the aeration pond and the smaller "trout pond". New pond(s) with a storage volume of approximately 62 million gallons will be required for the 20-year design flows.

The existing treatment plant site does not have enough land area to place an additional 62 million gallon pond at the site. Therefore, an offsite storage pond would be required. Approximately 15 to 20 acres would be required to construct the new pond. The Michener Creek site has previously been identified as a potential site for storage. While additional sites may be able to be obtained nearer to the current site, the Michener Creek site has been used for cost estimation purposes. Figure 6.3-1 shows the proposed storage pond site at Michener Creek along with the proposed pipeline route to the Michener Creek site. A potential pond site in Section 32 is also identified.

Approximately 13,700 feet of 16-inch PVC pipe would be installed from the existing plant site to the Michener Creek storage pond. The line would allow water to be transferred between the existing storage ponds and the new ponds at Michener Creek. A low head pump station would be located at the Michener Creek site to pump water back to the existing storage pond site. The low head pump station would consist of two 20 HP pumps. Each pump would have 100% of the required capacity.

A high head pump station would be located at the existing treatment plant site to pump water to the intermediate surge tank. Three 350 HP pumps would be used to pump to the intermediate surge tank. Each pump would have 50 percent of the required pumping capacity. One pump would function as a backup pump. Approximately 25,000 feet of 14-inch steel line would be installed from the existing storage pond to the intermediate tank. Another 5,000 feet of 14-inch steel line would be installed from the intermediate pump station to the snowmaking pumps. It is estimated two 350 HP pumps would be used to pump from the intermediate tank to the snowmaking pumps. The final sizing of the intermediate pumps would have to be coordinated with the snowmaking pumps.

While the primary means of disposal in this option are irrigation of the golf course and snowmaking, irrigation of future subdivisions and green spaces can also be utilized in future phases of development. This would require that when future subdivisions are planned, provisions be incorporated to provide a separate irrigation line into the subdivision.



BIG SKY WASTEWATER FACILITY
STORAGE PONDS AT MICHENER CREEK

FIGURE 6.3-1

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6.4 DEEP WELL INJECTION

The possibility of discharging the effluent by deep well injection is discussed in this section. In general, the method is to pump the effluent into a deep formation via an injection well. Deep well injection is used in the petroleum industry to dispose of undesirable brines that are extracted from oil wells. Brines are generally injected into formations after the crude oil has been pumped out, or to displace the crude oil toward other production wells.

In the oil industry, the environmental consequences of injecting an undesirable liquid into a deep formation is generally considered inconsequential because the original source of the brine is the same formation. This would not be the case for disposing of the wastewater treatment plant effluent. In general, in order for the process to be environmentally sound, it is expected that the effluent would have to be discharged into a formation that did not produce acceptable drinking water (i.e. non-degradation of the groundwater would not apply). In addition, the accepting formation would also have to be pervious enough to accept the injected flow.

For this site, the near surface geologic formations are dominated by fine-grained shales, siltstones, and claystones. The Kootenai Sandstone and the Madison Limestone are probably the nearest formations that could accept the relatively high discharge rates required. However, since these are both aquifers of regional significance, that produce high quality drinking water, the environmental consequences of discharging the effluent into these formations would be unacceptable. On this basis, any discharge by deep well injection would require a well at least 2,000 feet deep to get below these aquifers. The actual depth to a suitable accepting formation with poor water quality could easily be significantly deeper than 2,000 feet.

Other problems with deep well injection include clogging from particulates and biofouling of the well screen and surrounding formation. Wastewater treatment plant effluent is especially vulnerable to biofouling. A fairly high risk of clogging exists for long-term, deep well injection of wastewater treatment plant effluent. These risks are substantial when the high cost of drilling new deep wells is considered.

Based on the above listed problems, deep well injection is not considered a viable method of disposing of the wastewater plant effluent. On this basis, we do not recommend further consideration of this method as an alternative disposal method.

6.5 ADVANCED TREATMENT ALTERNATIVES

In order to meet the stringent effluent limits that may be required for a surface water discharge, an advanced treatment system would be required following the secondary treatment plant. The alternatives discussed below are treatment methods that would follow the SBR. The advanced treatment alternative would treat only the water that could not be disposed of by spray irrigation.

6.5.1 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. This quantity of brine solution could not be disposed of in any economical manner and therefore the ion exchange process is ruled out as a viable treatment alternative.

6.5.2 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 which 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. 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.

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

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.

The reverse osmosis option would involve constructing an RO plant that would treat water that is in excess of the irrigation capacity. In addition to constructing the RO plant, the existing storage ponds would be cleaned and lined with a synthetic liner to prevent leakage.

While the reverse osmosis option may meet the non-degradation criteria when the rules are finalized, it would result in a point source discharge to the Gallatin River. Even though a point source discharge is a legally authorized option if non-degradation criteria are met, the District has indicated they do not wish to pursue a point source discharge to the Gallatin at this time. Therefore, the reverse osmosis option is not evaluated further.

6.6 ADDITIONAL CONSIDERATIONS

6.6.1 Two Treatment Plants

During meetings with the planning committee and at the public meeting, a suggestion was made regarding the possibility of maintaining separate treatment plants for the Mountain Village and the Meadow Village. In order to evaluate this option, it is necessary to estimate the volume of wastewater flow generated at each location.

The domestic wastewater flow was estimated by allocating the flow based on the number of Single Family Equivalents in the Meadow Village area and the Mountain Village Area. The allocation of the I/I flow was based on the ratio of inch●diameter●miles of pipe in each area.

The domestic wastewater flow from each village was estimated by multiplying the projected design year domestic flow by the ratio of SFE's in each village to the total SFE's. The allocation of I/I flow was based on the ratio of inch●diameter●mile of pipe in each area. Using this approach, the flow allocation is shown below in Table 6.6.1.

TABLE 6.6-1 FLOW ALLOCATION BETWEEN THE MOUNTAIN VILLAGE MG/YEAR AND THE MEADOW VILLAGE				
	YEAR 2018		FULL BUILD OUT	
	MEADOW	MOUNTAIN	MEADOW	MOUNTAIN
Estimated Domestic Flow	63.17	56.5	59.42	87.85
Estimated I/I Flow	29.0	20.31	18.40	13.0
Westland Flow	1.378	0.0	43.0	0.0
Westfork Flow	4.49	0.0	6.04	0.0
Estimated Total Flow	98.0	76.8	126.86	100.89

As Table 6.6-1 indicates, even at the 20-year flows the anticipated flow from the Meadow Village would exceed the irrigation capacity of the golf course. Therefore, a new disposal site for the Meadow Village site would still be needed.

In addition, at full build out flows of the legal commitments, a storage volume of approximately 88 MG would be required for the Mountain Village. This would require a relatively flat site of approximately 18 acres. A review of the quad maps indicates a suitable site is not available in the Mountain Village area. Based on these considerations, the two plant option does not appear to be a viable option.

6.6.2 Waiver Request of Non-Degradation Requirement

The RID 305 has previously filed an application for a permit to discharge with the Water Quality Bureau. The application was filed in order to determine what treatment levels would be required in order to discharge to a surface stream. The Water Quality Bureau has not yet processed this MPDES application. Action on the application was delayed pending the findings and recommendation of this facility plan. RID 305 has also filed an application for determination of significance under the draft implementation rules. A ruling on the application for significance cannot be resolved until rules are passed by the Board of Health and implementation procedures have been developed. Depending on the final rules, it may be possible for a surface discharge to be classified as nonsignificant in which case a waiver would not be required. In issuing a discharge permit, the WQB must comply with the Montana Water Quality Act dealing with non-degradation. The Water Quality Act also provides a mechanism to appeal the Department's decision to the Board of Health and Environmental Sciences.

6.7 REGIONALIZATION

The only possible regional system in the Big Sky area would be to include the lower basin area into the service area. Septic tanks and drainfields are currently used in the lower basin. As discussed previously, the lower basin chose not to be included in the sewer district.

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.

Currently, the plant is located in a highly visible area adjacent to a commercial mall area. A plant located on the Michener Creek site would be fairly well hidden from view even from housing and commercial areas in the lower basin area.

Wastewater treatment plants are a potential source of odors. Process upsets can occur that can cause offensive odors. A treatment plant located at the Michener Creek site would be less likely to result in odor complaints due to the greater distance from the plant to the nearest development.

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 as it would not correct the leakage problems with the existing lagoons. Further, failure to correct the leakage would violate the Compliance Order.

7.0 EVALUATION OF VIABLE ALTERNATIVES

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, the annual O&M cost, and the salvage value of each alternative is included in the computation of the EUAC.

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 options 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 has been included on the assumption that the land would have to be purchased.

The EUAC analysis includes the salvage value of each alternative. The salvage value is based on a straight-line depreciation from the initial cost to the end of the 20-year planning period. Capital costs are presented for the following alternatives:

1. Sequencing Batch Reactor
2. SBR with Post Filtration
3. Aerated Lagoon Upgrade for Spray Irrigation
4. Snowmaking
5. Spray Irrigation at Yellow Mule Site
    a. 3 months using aerated lagoon for treatment
    b. 5 months using advanced treatment plant for treatment

Tables 7.1-1 through 7.1-6 present the capital cost for the various alternatives.

Table 7.1-7 shows the estimated annual operation and maintenance costs for the various options. Tables 7.1-8 through 7.1-12 show the estimated salvage value for each option.

Table 7.1-13 presents the equivalent uniform annual costs for the alternatives presented in Section 6.0. Table 7.1-13 is based on capital costs, annual operating costs, and salvage values developed in this section. The annual cost has been computed with an interest rate of 8.25% and a planning period of 20 years. For planning purposes, the engineering administration and legal costs are based on a percent of construction. The actual fees will typically be negotiated based on a defined scope of work and may vary from the estimated percent of construction.

Table 7.1-1 shows the cost estimate for a sequencing batch reactor (SBR). It is assumed that the SBR would be located at the existing lagoon site. As it may be necessary to add an effluent filter to the SBR, in some options, the cost associated with the filter is shown separately in Table 7.1-2.

TABLE 7.1-1
SEQUENCING BATCH REACTOR COST ESTIMATE

Description	Unit	Quantity	Unit Price	Total
Pretreatment	L.S.	1	$128,000.00	$ 128,000.00
SBR Basins (one standby basin)	Each	3	$212,000.00	$ 636,000.00
Flotation Thickener	L.S.	1	$225,000.00	$ 225,000.00
Aerobic Digestion	L.S.	1	$244,000.00	$ 244,000.00
Sludge Storage	L.S.	1	$ 45,000.00	$ 45,000.00
Sludge Transport and Application	L.S.	1	$320,000.00	$ 320,000.00
Control/Lab/Maintenance Building	L.S.	1	$229,200.00	$ 229,200.00
Chemical Feed Equipment	L.S.	1	$75,000.00	$ 75,000.00
Process Piping	L.S.	1	$135,000.00	$ 135,000.00
SUBTOTAL UNIT PROCESS				$2,037,200.00
Mobilization	L.S.	1	$50,000.00	$ 50,000.00
Site Work	L.S.	1	$140,000.00	$ 140,000.00
Excavation/Fill	L.S.	1	$125,000.00	$ 125,000.00
Electrical	L.S.	1	$211,600.00	$ 211,600.00
Controls and Instrumentation	L.S.	1	$95,000.00	$ 95,000.00
Yard Piping	L.S.	1	$125,000.00	$ 125,000.00
HVAC	L.S.	1	$47,600.00	$ 47,600.00
SUBTOTAL CONSTRUCTION COMPONENTS				$ 794,200.00
SUBTOTAL				$2,831,400.00
CONTINGENCY 15%				$ 424,700.00
SUBTOTAL				$3,256,100.00
ENGINEERING AND LEGAL 15%				$ 488,400.00
TOTAL				$3,744,500.00

TABLE 7.1-2 SBR POST FILTRATION COST ESTIMATE				
Description	Unit	Quantity	Unit Price	Total
Mixed Media Filters With Surface Wash	Each	2	$150,000.00	$300,000.00
Backwash Basin	Each	1	$45,000.00	$45,000.00
Reclaim Basin	Each	1	$40,000.00	$40,000.00
Reclaim Pumps	Each	2	$3,000.00	$6,000.00
Filter Building	L.S.	1	$235,000.00	$235,000.00
Backwash Pumps	Each	2	$7,000.00	$14,000.00
Sludge Transfer Pumps	Each	2	$3,000.00	$6,000.00
			SUBTOTAL	$646,000.00
			CONTINGENCY 15%	$96,900.00
			SUBTOTAL	$742,900.00
			ENGINEERING AND LEGAL 15%	$111,435.00
			TOTAL	$854,335.00

Table 7.1-3 shows the estimated capital cost for the option consisting of constructing an advanced nutrient removal plant, continuing to irrigate the golf course, and pumping to the snowmaking system at the Mountain Village.

TABLE 7.1-3
SNOWMAKING COST ESTIMATE

DESCRIPTION	UNITS	QUANTITY	UNIT COST	TOTAL COST	
1. SBR PLANT WITH FILTRATION (Tables 7.1-1 and 7.1-2)	L.S.	1	$3,477,400.00	$3,477,400.00	
2. TRANSFER LINE TO MICHENER CREEK					
16-inch PVC Line	Ft.	13,700	$35.00	$479,500.00	
Creek Crossing	Ea.	4	$15,000.00	$60,000.00	
Road Crossing (Bored)	Ea.	1	$25,000.00	$25,000.00	
Surface Restoration	Ft.	13,700	$3.00	$41,100.00	
Valves	Ea.	7	2,000.00	$14,000.00	619,600.
3. STORAGE					
Land Purchase	Acre	20	$20,000.00	$400,000.00	
Clearing & Grubbing	Acre	15	$2,500.00	$37,500.00	
New Storage (62 MG)	C.Y.	180,000	$4.50	$810,000.00	
Line new Pond	S.F.	553,000	$0.65	$359,450.00	
Sludge Removal	L.S.	1	$25,000.00	$25,000.00	
Surface Preparation	L.S.	1	$20,000.00	$20,000.00	
Line Existing Pond	L.F.	570,000	$0.65	$370,500.00	
Access Road	L.F.	1,800	$35.00	$63,000.00	1,729,950.
Fencing		4,000	$10.00	$40,000.00	
4. TRANSFER LINE TO MOUNTAIN					
14-inch Steel Line	L.F.	30,000	$60.000	$1,800,000.00	
Cathodic Protection	L.S.	1	$37,500.00	$37,500.00	
Surface Restoration	L.F.	30,000	$3.00	$90,000.00	
Valves	Each	15	$2,000.00	$30,000.00	1,957,500.
5. PUMPING					
Michener Creek (40 HP)	L.S.	1	$90,000.00	$90,000.00	
Plant Site (1050 HP)	L.S.	1	$700,000.00	$700,000.00	
Intermediate Station (700 HP)	L.S.	1	$550,000.00	$550,000.00	
Telemetry	L.S.	1	$20,000.00	$20,000.00	
6. GOLF COURSE UPGRADE					
Lift Station Upgrade	L.S.	1	$75,000.00	$75,000.00	
Laterals & Risers	Acres	85	$3,500.00	$297,500.00	
			SUBTOTAL	9,912,450.00	
			CONTINGENCY 15%	$1,486,900.00	
			SUBTOTAL	$11,399,350.00	
			ENGINEERING & LEGAL	$1,709,900.00	
			TOTAL	$13,109,250.00	

Table 7.1-4 shows the cost estimate to upgrade and expand the existing aerated lagoon system to the 20-year design flow. The aerated lagoon system would be used in conjunction with spray irrigation. The cost shown in table 7.1-4 include only costs to expand the existing lagoon system.

TABLE 7.1-4
AERATED LAGOON COST ESTIMATE

Description	Unit	Quantity	Unit Price	Total
New Aeration Cell	L.S.	1	$200,000.00	$200,000.00
Aeration Tubes	Each	23	$1,000.00	$23,000.00
New Blower & Motor	Ea.	1	$20,000.00	$20,000.00
Interior Piping Modifications	L.S.	1	$15,000.00	$15,000.00
Surface Preparation - Aeration	L.S.	1	$8,000.00	$8,000.00
New Aeration Pond Liner	S.F.	73,000	$0.65	$47,450.00
Surface Preparation - Existing Storage	L.S.	1	$20,000.00	$20,000.00
Pond Liner-Existing Storage Cells #1 & 2	S.F.	570,000	$0.65	$370,500.00
New Air Line	L.F.	800	$33.00	$26,400.00
Sludge Removal From Existing Pond	L.S.	1	$25,000.00	$25,000.00
			SUBTOTAL UNIT PROCESS	$755,350.00
			CONTINGENCY 15%	$113,300.00
			SUBTOTAL	$868,650.00
			ENGINEERING AND LEGAL 15%	$130,300.00
			TOTAL	$998,950.00

Table 7.1-5 shows the estimated capital cost for irrigation of the Yellow Mule site when an aerated lagoon is used for treatment and irrigation is limited to 3 months of the year. In this alternative, irrigation of the golf course is discontinued.

TABLE 7.1-5
ESTIMATED CONSTRUCTION COST FOR IRRIGATION AT YELLOW MULE SITE
(AERATED LAGOON WITH 3 MONTH IRRIGATION)

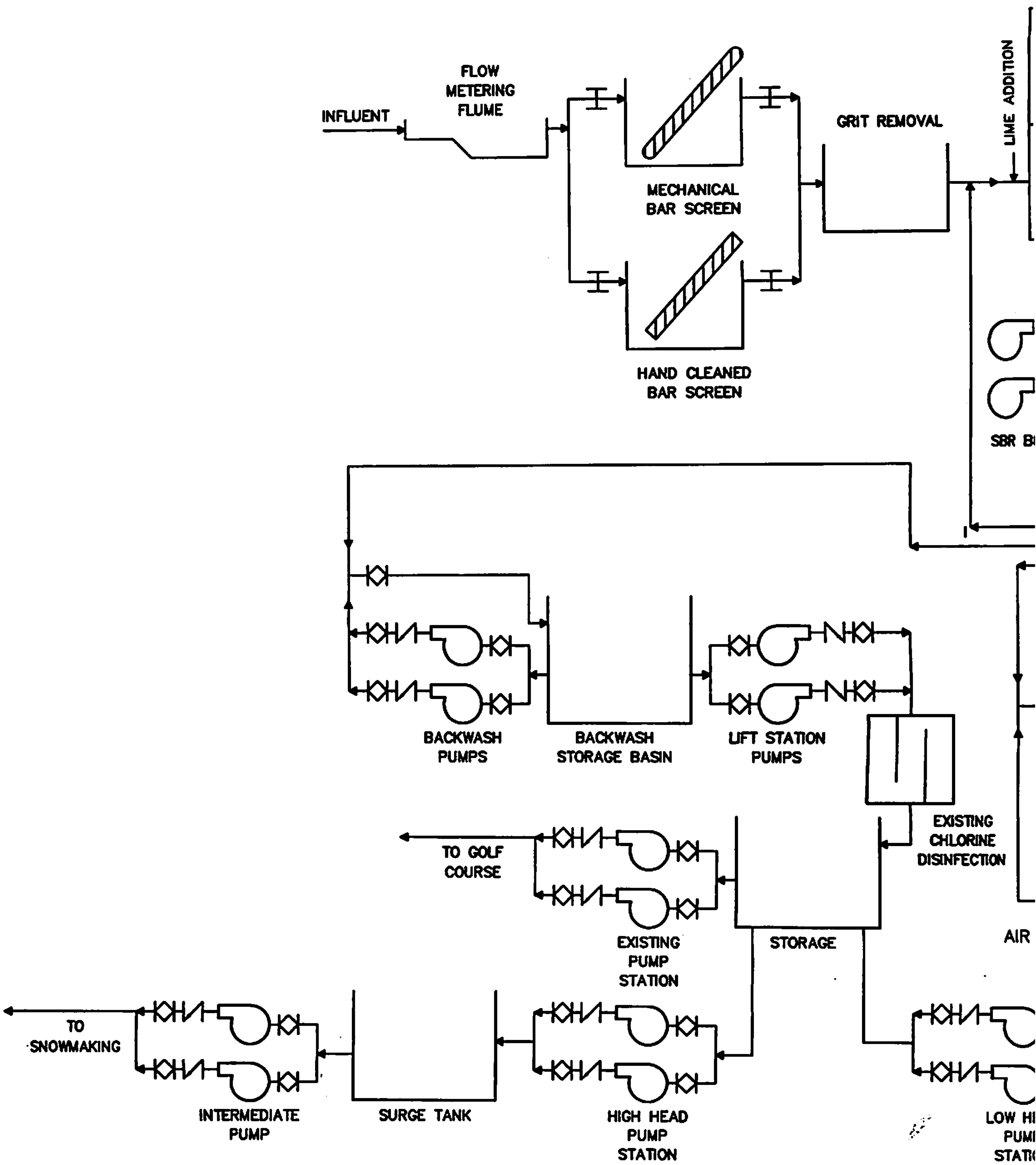
Description	Unit	Quantity	Unit Price	Total Price
1. UPGRADE EXISTING AERATED LAGOON AND STORAGE (TABLE 7.1-4)	L.S.	1	$	$755,350.00
2. NEW STORAGE (81 mg)				
Land Purchase	Acres	35	$20,000.00	$700,000.00
liner	S.F.	725,000	$0.65	$471,250.00
surface preparation	L.S.	1	$21,000.00	$21,000.00
excavation & embankment	C.Y.	320,000	$4.50	$1,440,000.00
clearing & grubbing	Acre	20	$2,500.00	$50,000.00
3. PUMPING & TRANSFER LINE				
20-inch pipe	L.F.	25,000	$120.00	$3,000,000.00
valves	Ea.	10	$2,600.00	$26,000.00
cathodic protection	L.S.	1	$20,000.00	$20,000.00
pump station (1,800 HP)	L.S.	1	$750,000.00	$750,000.00
surge tank	L.S.	1	$15,000.00	$15,000.00
surface restoration	L.F.	25,000	$3.00	$75,000.00
4. IRRIGATION SYSTEM				
Pump Station (1500 HP)	L.S.	1	$700,000.00	$700,000.00
20 inch steel line	L.F.	6,000	$120.00	$720,000.00
laterals and risers	Acre	640	$3,500.00	$2,240,000.00
Telemetry	L.S.	1	$10,000.00	$10,000.00
Electrical extension	L.S.	1	$400,000.00	$400,000.00
			SUBTOTAL	$11,393,600.00
			CONTINGENCY 15%	$1,709,000.00
			SUBTOTAL	$13,102,600.00
			ENGINEERING & LEGAL 15%	$1,965,400.00
			TOTAL	$15,068,000.00

Table 7.1-6 shows the estimated capital cost for irrigation at the Yellow Mule site when an advanced treatment plant is constructed and irrigation occurs for 5 months. In this alternative, the golf course irrigation continues to be used.

TABLE 7.1-6 ESTIMATED CONSTRUCTION COST FOR IRRIGATION AT YELLOW MULE SITE (ADVANCED TREATMENT WITH 5 MONTH IRRIGATION)				
Description	**Unit**	**Quantity**	**Unit Price**	**Total Price**
1. ADVANCED TREATMENT PLANT SBR with filter (Tables 7.1-1 and 7.1-2)		1	$3,477,400.00	$3,477,400.00
2. EXISTING STORAGE				
sludge removal	L.S.	1	$25,000.00	$25,000.00
liner	S.F.	570,000	$0.65	$370,500.00
surface preparation	L.S.	1	$20,000.00	$20,000.00
3. NEW STORAGE (82 MG)				
land purchase	Acre	40	$20,000.00	$800,000.00
liner	S.F.	731,000	$0.65	$475,000.00
surface preparation	L.S.	1	$20,000.00	$20,000.00
excavation & embankment	C.Y.	205,000	$4.50	$922,500.00
clearing & grubbing	Acre	20	$2,500.00	$50,000.00
4. PUMPING AND TRANSFER LINE				
12-inch pipe	L.F.	25,000	$55.00	$1,375,000.00
cathodic protection	L.S.	1	$20,000.00	$20,000.00
pump station (600 HP)	L.S.	1	$450,000.00	$450,000.00
surge tank	L.S.	1	$15,000.00	$15,000.00
surface restoration	L.F.	25,000	$5.00	$125,000.00
valves	EA.	13	$1,500.00	19,500.00
5. IRRIGATION SYSTEM				
pump station (500 HP)	L.S.	1	$375,000.00	$375,000.00
12-inch steel line	L.F.	6,050	$50.00	$302,500.00
laterals & risers	Acre	528	$3,500.00	$1,848,000.00
telemetry	L.S.	1	$10,000.00	$10,000.00
electrical extension	L.S.	1	$400,000.00	$400,000.00
6. GOLF COURSE UPGRADE				
Lift Station Upgrade	L.S.	1	$75,000.00	$75,000.00
Laterals & Risers	Acres	85	$3,500.00	$297,500.00
			SUBTOTAL	**$11,472,900.00**
			CONTINGENCY 15%	**$ 1,720,900.00**
			SUBTOTAL	**$13,193,800.00**
			ENGINEERING AND LEGAL	**$ 1,979,000.00**
			TOTAL	**$15,172,800.00**

Table 7.1-7 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:



FLOW
METERING
FLUME
INFLUENT
MECHANICAL
BAR SCREEN
HAND CLEANED
BAR SCREEN
GRIT REMOVAL
LIME ADDITION
BACKWASH
PUMPS
BACKWASH
STORAGE BASIN
LIFT STATION
PUMPS
EXISTING
CHLORINE
DISINFECTION
TO GOLF
COURSE
EXISTING
PUMP
STATION
STORAGE
AIR
TO
SNOWMAKING
INTERMEDIATE
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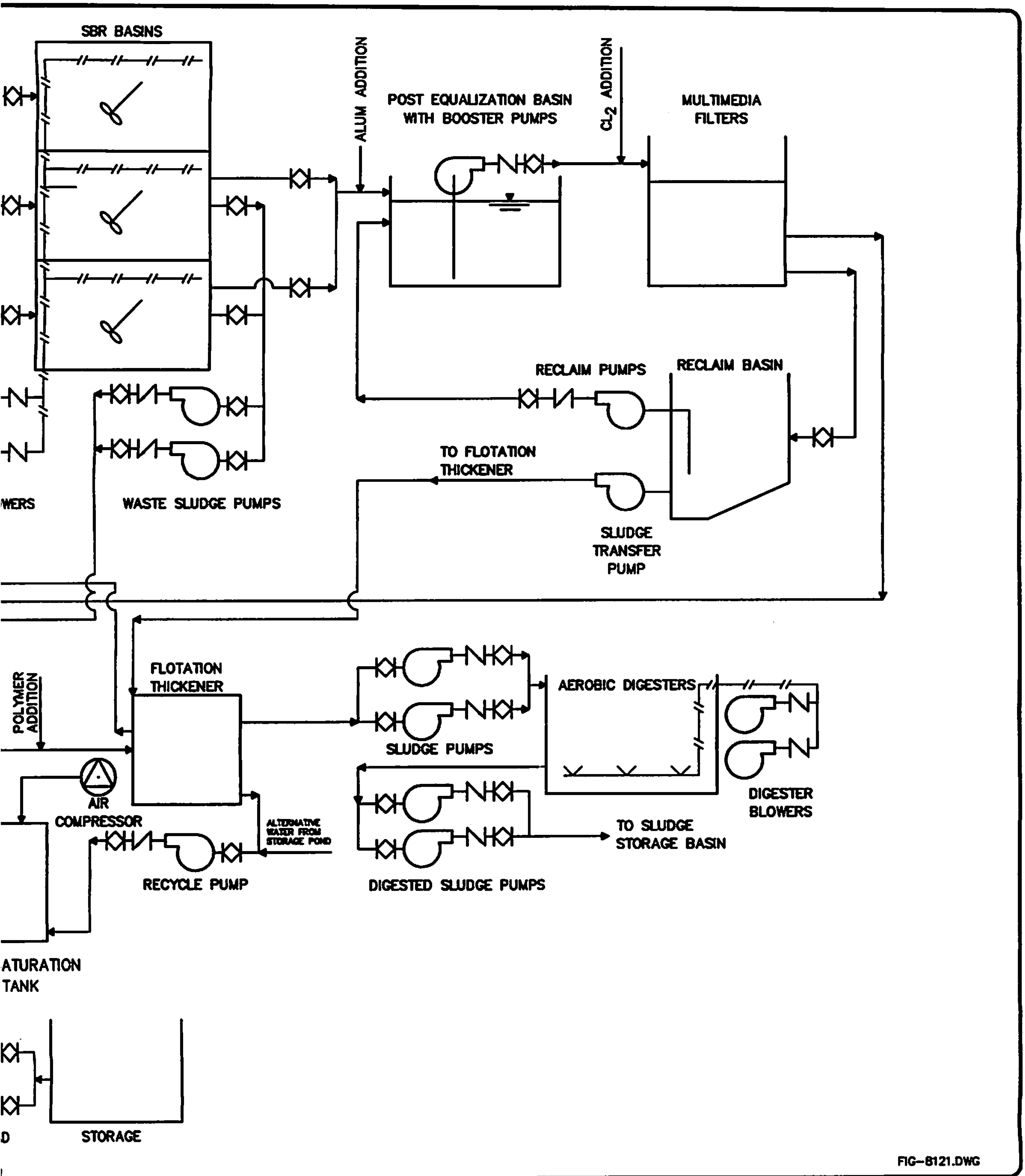
HIGH HEAD
PUMP
STATION



BIG SKY WASTEWATER FACILITY PLAN

PROCESS FLOW DIAGRAM
SBR WITH SNOWMAKING

FIGURE 8.12-1

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Grit removal will follow the bar screens. A vortex type grit removal system is proposed. A vortex type system is proposed for two reasons: (1) it has less odor potential than an aerated grit chamber and (2) the nutrient removal process in the SBR requires an anoxic phase as the first step to maximize phosphorous removal. A vortex type system will minimize turbulence and the addition of oxygen in the pre-treatment stage.

The SBR basins are the main treatment component in the system. Three basins would be provided. Each basin would be approximately 50 feet square with a water depth of 19 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.

Aeration in the basins would be provided by three 75 HP blowers and coarse bubble diffusers. Each of the blowers would have 1/2 the required capacity. The additional blower acts as a back-up so that 100 percent aeration capacity is provided even with one blower out of service. Each basin will also contain a mixer and decant equipment.

During the decant cycle, water will flow to a post equalization basin before being pumped to filters.

Granular media filters will be used to reduce the effluent suspended solids and phosphorus levels. A multimedia filter consisting of anthracite, sand, and garnet sand will be used as the filter media. A surface wash and backwash system will be used to clean the filters. Backwash water will flow to a reclaim basin where the solids will settle out. The clarified backwash water will be pumped back to the post equalization basin. Solids that settle in the reclaim basin will be pumped to the flotation thickener.

Effluent from the filters will be pumped to the existing storage basins for irrigation of the golf course. The existing golf course pump station will be upgraded to pump from the storage basins to the golf course spray irrigation system.

A pump station located at the existing treatment plant site would pump to a surge tank located approximately 25,000 feet from the ponds. The pump station would contain three 350 HP pumps. Each pump would have 50 percent of the required capacity.

A second pump station, containing two-350 HP pumps located at the surge tank, would pump from the surge tank to the snowmaking pumps located near Lake Levinsky.

Sludge generated from the SBR and filtration process would be transferred to a flotation thickener and then pumped to an aerobic digester for sludge stabilization. Two digesters would be constructed to provide a total mean cell residence time of 60 days. Sludge from the digester would be transferred to a lined holding pond. A pump station would be used to load sludge into a tanker truck to haul to a disposal site. A sludge injector truck would be used to inject sludge into the ground.

Landowners of potential sludge injection sites have been contacted. 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.

Sludge injection 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.

The preliminary design criteria for the SBR, filtration process is shown in Table 8.1.1-1.

TABLE 8.1.1-1 PRELIMINARY DESIGN CRITERIA - SBR	
FLOW, MGD	
Average Day	0.48 MGD
Peak Day	1.13 MGD
Peak Hour	1.92 MGD
Minimum Day	0.1 MGD
LOADING	
BOD_5 - Average Day	1,261 lbs/day
BOD_5 - Peak Day	3,152 lbs/day
TSS - Average Day	1,481 lbs/day
TSS - Peak Day	3,703 lbs/day
Total Nitrogen - N	240 mg/l
Total Phosphorus - P	48 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

<u>SBR BASINS</u>	
Number of basins	3 (1 standby)
Volume per basin	421,000 gallons
Cycles/day/basin	4
F/M ratio	0.06
MLSS at Minimum Depth	4500 mg/l
Decant Volume at Peak Flow	141,250 gallons
Sludge Yield	0.93 lbs. solids/lb. BOD_5 removed
<u>POST EQUALIZATION BASIN</u>	
Number	1
Volume	95,000 gallons
<u>FILTERS</u>	
Number	2
Loading Rate @ Avg. Day	1.0 gpm/ft^2
Loading Rate @ Peak Day With One Filter	5 gpm/ft^2
Backwash Rate	15 gpm/ft^2
Backwash Volume	35,700 gallons
<u>RECLAIM BASIN</u>	
Number	1
Volume	71,500 gallons
<u>BACKWASH PUMPS</u>	
Number	2
Capacity	2,355 gpm
<u>FLOTATION THICKENER</u>	
Number	1
Solids Loading Rate	1.5 lbs/hr/ft^2
Inlet Concentration	0.4 to 0.5%
Outlet Concentration	4.0%

DIGESTER	
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
SLUDGE STORAGE	
Type	Lined Pond
Volume	800,00 gallons

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 SBR plant 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

	SBR WITH SNOWMAKING
Operation Cost	110,000
Maintenance Cost	65,900
Power Cost	54,300
Chemical Costs	20,000
Administrative Cost	6,900
Lab Cost	8,000
SUBTOTAL PLANT BUDGET	**$265,100**
EXISTING COLLECTION SYSTEM BUDGET	**$126,850**
TOTAL SYSTEM BUDGET	**$391,950**

The budget shown in Table 8.2-1 represents the estimated cost to operate the new facility. The existing budget for operating the sewer collection and treatment system is approximately $166,850. Of the existing budget, approximately $126,850 are expenses related to operating the collection system, providing office space, miscellaneous engineering and legal expenses, and personnel costs that will continue after the new system is constructed.

Staffing

It is estimated that three full time employees will be required to operate and maintain the SBR plant in addition to the system manager. A part time employee will also be required to cover vacations, sick days, and during sludge injection 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 SBR 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.

In the recommended alternative, it is proposed that sludge from the aerobic digesters will be stored in a lined storage lagoon during the winter. Sludge from the storage lagoon will be hauled out during the summer and injected onto agricultural land. It is estimated approximately 0.7 million gallons of sludge per year would have to be transported and disposed of at the twenty year design flow. Approximately 25 acres will be needed to dispose of the sludge. Agreements for sludge disposal on 100 to 150 acres should be secured in order to allow a rotation of application sites.

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 need to be made in coordination with the landowners.

8.3 FINANCING

Financing of the improvements is expected to be through the State Revolving Loan (SRF) program. 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. Use of the resort tax to fund a portion of the capital cost or to pay part of the annual debt service cost could be used to lower the annual user charge.

Average annual user charges per Single Family Equivalent (SFE) for constructing the recommended alternative are established in Table 8.3-1. Costs shown in Table 8.3-1 are based on financing 100% of the project through the State Revolving Loan Program. If the RID prevails in their litigation with Boyne USA, Inc., the user charges shown would be substantially reduced. If the RID prevails, the users would pay only the operation and maintenance costs and Boyne USA would pay all of the capital costs. With annual O&M costs of $391,950, the average user charge would be $16.93/month/SFE which equates to $21.78 per month per account.

It is anticipated revenue bonds would be sold by the District or other entity. If revenue bonds are used, it will be necessary for the District to adopt, prior to the bond sale, a system of rates and charges that will produce revenues sufficient to pay the costs of operating and maintaining the system and providing net revenues equal to 125% of the annual principal and interest on the bonds.

TABLE 8.3-1
AVERAGE ANNUAL USER CHARGE FOR SBR PLANT
WITH FILTRATION AND SNOWMAKING

CAPITAL COSTS	
Total Capital Cost (Table 7.1-3)	$13,109,250
O&M MANUAL, OPERATOR TRAINING, PLANT START-UP	$ 60,000
LOAN COSTS	
Bond Counsel	$ 15,000
Debt Service Reserve	1,065,250
Administration Fee	83,250
Origination Fee	144,775
TOTAL LOAN AMOUNT	$14,477,525
ANNUAL COST	
Net Revenues (125% annual P&I)	$1,331,550
Annual O&M	391,950
TOTAL ANNUAL COST	$1,723,500
Average User Charge for 1928.7 SFE's	$893.61/yr
	$ 74.47/mo
Average User Charge Per Account (1500 accounts)	$1,149.00/yr
	$ 95.75/mo

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9.0 IMPLEMENTATION

On July 26, 1993, the voters approved the creation of Water and Sewer District 363. The formation of the District provided the legal structure to allow financing of the project.

This section of the report discusses the major tasks that are necessary to implement the project. Figure 9.0-1 identifies the tasks and the approximate time frame for each task.

Review Draft Facilities Plan

The Water and Sewer Board and staff will need to review the Draft Facilities Plan in detail to ensure that the recommended plan satisfactorily addresses their social, political, and economic interests. The Water Quality Bureau will need to review the Draft Facilities Plan to ensure that the proposed project will meet water quality objectives, will meet the prerequisites for loan assistance, and will satisfy state and federal statutory requirements.

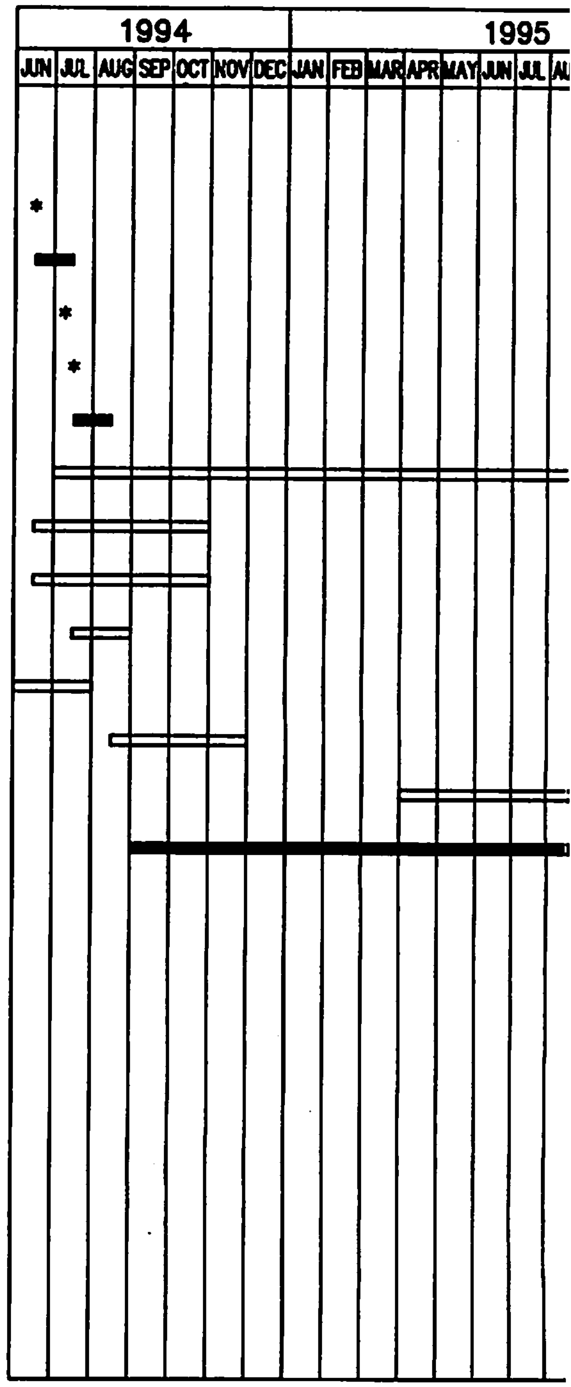
Adopt Facility Plan by Resolution

The Water and Sewer District will need to formally accept the Facilities Plan by resolution. The resolution will be included as an Appendix to the Facilities Plan.

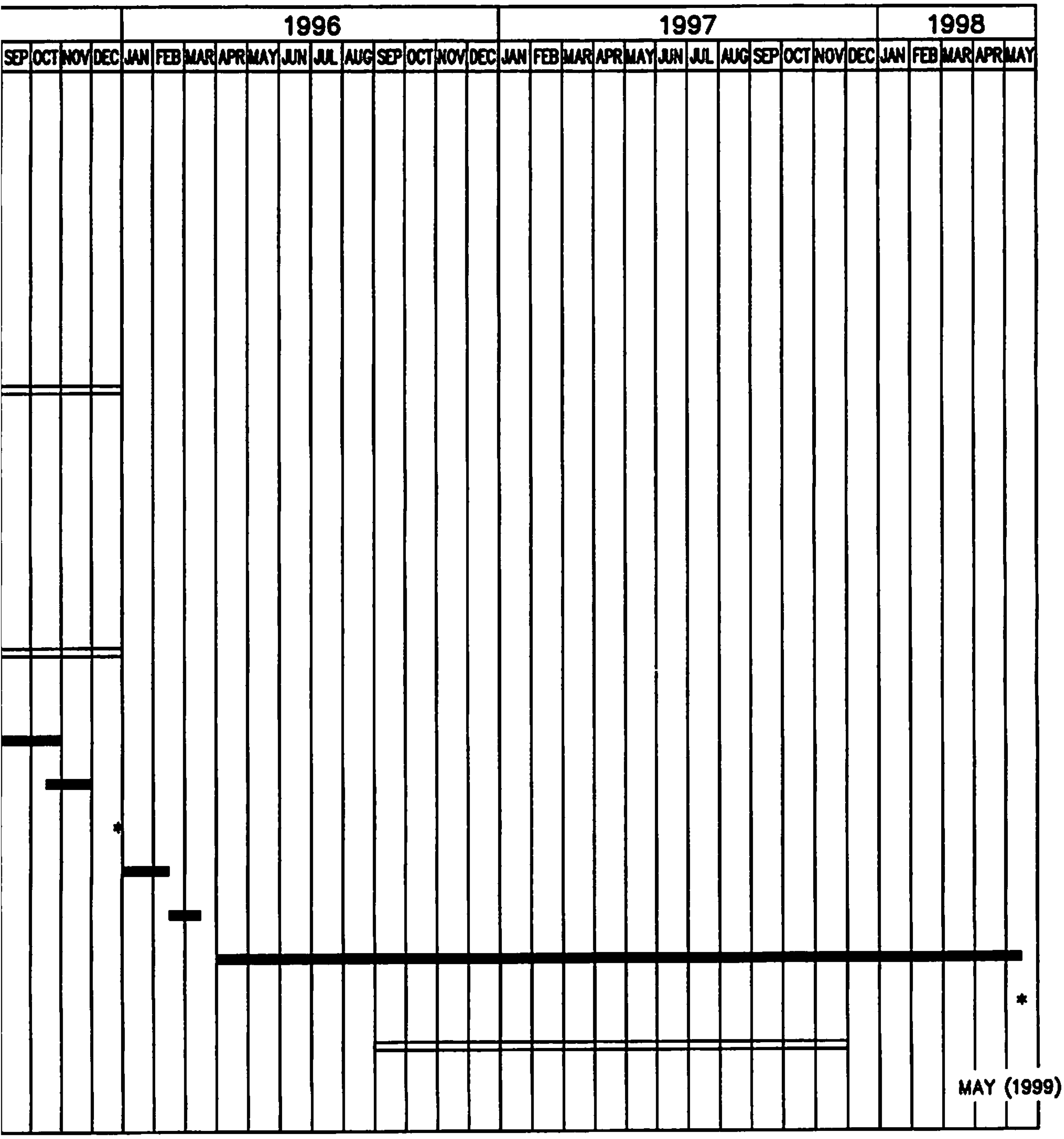
Prepare Final Facilities Plan

The final Facilities Plan will address the District's and WQB's comments resulting from their reviews, the public's comments offered during the Public Hearing, and interested governmental agencies' comments resulting from the Clearing House review.

ACTIVITY	RESPONSIBILITY
SUBMIT FINAL DRAFT FACILITY PLAN	ENGINEER (OWNER)
REVIEW DRAFT PLAN	WQB, OWNER
ADOPT PLAN BY RESOLUTION	OWNER
SUBMIT FINAL PLAN	ENGINEER (OWNER)
REVIEW FINAL PLAN	WQB, OWNER
ARRANGE FINANCING	OWNER (ENGINEER)
OBTAIN AGREEMENTS FOR GOLF COURSE IRRIGATION	OWNER
OBTAIN AGREEMENTS FOR SNOWMAKING	OWNER
PROCURE DESIGN & CONSTRUCTION ENGINEER	OWNER
PROCURE BOND COUNSEL	OWNER
SUBMIT SRF LOAN APPLICATION	OWNER (ENGINEER)
DEVELOP USER CHARGE SYSTEM	OWNER, ENGINEER
PREPARE PRELIM. PLANS & SPECIFICATIONS	ENGINEER (OWNER)
REVIEW PRELIM. PLANS & SPECIFICATIONS	WQB, OWNER
PREPARE FINAL PLANS & SPECIFICATIONS	ENGINEER (OWNER)
OBTAIN APPROVAL TO BID	WQB, OWNER
ADVERTISE FOR BIDS	OWNER (ENGINEER)
REVIEW BIDS, AWARD CONTRACT	OWNER (ENGINEER) (WQB)
CONSTRUCT FACILITY	CONTRACTOR (ENGINEER) (OWNER)
INITIATE OPERATION OF FACILITY	OWNER (ENGINEER)
PREPARE O & M MANUAL	ENGINEER (OWNER)
ONE-YEAR PERFORMANCE EVALUATION	ENGINEER (OWNER)



CONTINUOUS ACTION



TERMITTENT ACTION ═══ SUPPORT ROLE ( )

PS.DWG

FIGURE 9.0-1

HKAN ASSOCIATES
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4M357.102 | JUNE 1994

BIG SKY WASTEWATER FACILITY PLAN
WASTEWATER TREATMENT IMPROVEMENTS
IMPLEMENTATION SCHEDULE

Arrange Financing

It is anticipated that the project will be funded through the SRF Loan program. This program requires a bond sale by the District. Bond counsel should be contacted to obtain a reliable estimate of costs related to a bond sale and to ensure that all legal requirements are satisfied.

Obtain Agreements for Irrigation, Snowmaking, and Sludge Disposal

The District will need to obtain long term agreements to utilize the golf course and the ski area for effluent disposal.

Agreements with landowners for sludge disposal sites also need to be obtained.

Procure Bond Counsel

In order to receive a loan from the SRF loan program the District will have to sell bonds to secure the loan. It is important that the District retain bond counsel to ensure that proper procedures are followed in preparing for the bond sale.

Bond counsel will review the resolution calling for the bond election, advise the District with respect to statutory requirements, and prepare the final bond resolutions.

Submit Loan Application

An application for loan assistance can be submitted to the Water Quality Bureau after the Facility Plan has been approved by the WQB. With the loan application, the District will need to submit an Wastewater Facilities Financial Information Sheet to demonstrate that they have the legal, institutional, managerial, and financial capability to ensure adequate construction and O&M of the proposed project.

Develop User Charge System

Loan regulations require the recipient to establish a user charge system which distributes the costs of operation, maintenance and replacement of the system to the users in proportion to the total loading of each user. The existing User Charge System (UCS) and Sewer Use Ordinance (SUO) will need to be reviewed to ensure that they comply with loan requirements. The UCS and SUO need to be approved by the WQB before the plans and specifications will be approved by the WQB.

Prepare Preliminary Plans and Specifications

No discussion necessary.

Review Preliminary Plans and Specifications

No discussion necessary.

Prepare Final Plans and Specifications

No discussion necessary.

Advertise for Bids

A 30-day advertisement period is required.

Review Bids, Award Contract

Bids will need to be reviewed to ensure that the contract is awarded to the lowest responsible bidder. The low bidder will need to provide documentation that he has taken affirmative steps to assure that small, minority and women's businesses and labor surplus areas are used when possible in accordance with State's procurement regulations.

Construct Facility

The District will need to provide and maintain competent and adequate engineering supervision and full-time inspection.

Prepare O&M Manual

An O&M Manual will need to be prepared to provide essential information and guidance for the treatment facility for day-to-day operations.

Initiate Operation of Facility

Start-up services in an amount commensurate with the project's size and complexity will need to be obtained from the design and construction engineer.

One Year Performance Evaluation

In accordance with loan regulations, one year following initiation of operation of the facility, the District must certify to the WQB whether or not the project is meeting its performance standards. The performance standards will have been established during design by the WQB in cooperation with the design engineer. The engineer will need to prepare a basis of certification report to the District for review by the WQB.

10.0 PUBLIC PARTICIPATION

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 the draft facility plan. A total of 36 persons were in attendance. The attendance list for the Public Hearing is also attached.

Relevant questions that were raised during the April 1993 meeting are listed below. A response is also included.

1. What are the chances for getting a waiver for a discharge permit? If it is possible to use the SBR with filtration plus ion exchange in order to meet non-degradation, why not do it?

   Response: It is difficult to assess the possibility of obtaining a waiver from non-degradation criteria. At the time of this writing, the rules are not finalized so it is not possible to determine criteria for requesting a waiver. In all probability, a waiver request would be strongly opposed by environmental groups. It is our belief that the opposition and reviews required for a waiver would delay the project by one to two years.

2. How would a separate plant on the Mountain effect the project?

   Response: The option of constructing two treatment plants was evaluated and is discussed in the Facility Plan. With two plants, a large storage basin is required at the Mountain Village. In reviewing USGS quad maps in the vicinity of the Mountain Village, no sites suitable for a reservoir were located. Therefore this alternative was eliminated from further consideration.

3. Can we pump our effluent to another Town that has a discharge permit?

Response: The remoteness of the site makes this alternative unfeasible.

4. Has a discharge into Jack Creek been investigated?

Response: Pumping water to agricultural land near Ennis was investigated. The cost was estimated to range from 18 to 20 million dollars.

During the Public Hearing on August 31, 1993, questions were again raised on the possible benefit of constructing separate plants for the Mountain Village and the Meadow Village. The two plant option is discussed in the Facility Plan.

In the Public Hearing, the impacts of the I/I flow on the treatment process was discussed. The design flow has been revised to reflect the results of the sewer system repairs completed during the summer and fall of 1993.

In the Public Hearing, a letter was received which proposed the use of an electrocoagulation process for treatment. The electrocoagulation process is an add on process that would be used after a conventional treatment process. The manufacturer was proposing the use of a trickling filter as the pretreatment process. With the selected alternative, an add on process after advanced treatment and filtration is not required.

When all of the public input, environmental impacts, and costs were considered, the alternative of constructing a Sequencing Batch Reactor for treatment and utilizing spray irrigation of the golf course in the summer and snowmaking in the winter was selected as the recommended alternative.

PUBLIC HEARING - BIG SKY
AUGUST 31, 1993
MAMMOTH ROOM - MT VILLAGE
7:00 p.m.

NAME	ADDRESS/AFFILIATION
Robert Juel	Big Sky / New Dist.
EK-McBride	" -" " "
Shirley McBride	
Ladora McBride	Box 160146 Big Sky
Bob McBride	Big Sky / NEW DIST
DONN/BERYL PARSCH	" "
Steve Sveningson	Big Sky Stillwater
O. ARDIS BURT	BIG SKY BIG HORN
Paul LaVigne	MDHES/WQB
Bob Thompson	" "
Dan Fraser	" "
Scott Anderson	
Deborah McAtee	TM Land Partners
Terry Threlkeld	RID 305
WILLIAM NEECE	BigSky PO BOX 160175
BILL OGGE	PO Box 1387 BOZEMAN –
Dee Rothschiller	Box 160028 Big Sky –
Wayne Hill	Box 160277 B.S.
Suzanne Squires	49890 Gallatin Rd Gallatin Gtwy 59730
John-Skip Radick	PO Box 160011 Big Sky, MT.
KEVIN KELLEHER	54725 GALLATIN ROAD GALLATIN GWY MT. 59730 LONE PEAK LOOKOUT (BIG SKY'S NEWSPAPER)

PUBLIC HEARING (CONT) AUG 31, 1993

NAME	ADDRESS / AFFILIATION
TIM CYR	P.O. BOX 160056 BIG SKY MT
John Hansen	~~[illegible]~~ Silver Bow - Meadow Village
Beenny Hansen	" " " "
Pete Hansen	" " " "
Debbie Stoner	Meadow Village
Paul A Cronin	Meadow "
John R Fontana	Meadow Village
Paul & Janet Cronin	Blue Grouse
[illegible]	
Bill Erwin	138 Elmwood Helena
GEORGE METCALFE	175 HOLLISTER WAY NORTH, GLASTONBURY, CT 06033
Melissa Cronin	Blue Grouse
Craig Swick	Meadow Village -
Larry Cole	1200 Lakeview Mpls MN 55416
Jenny Swick	Meadow

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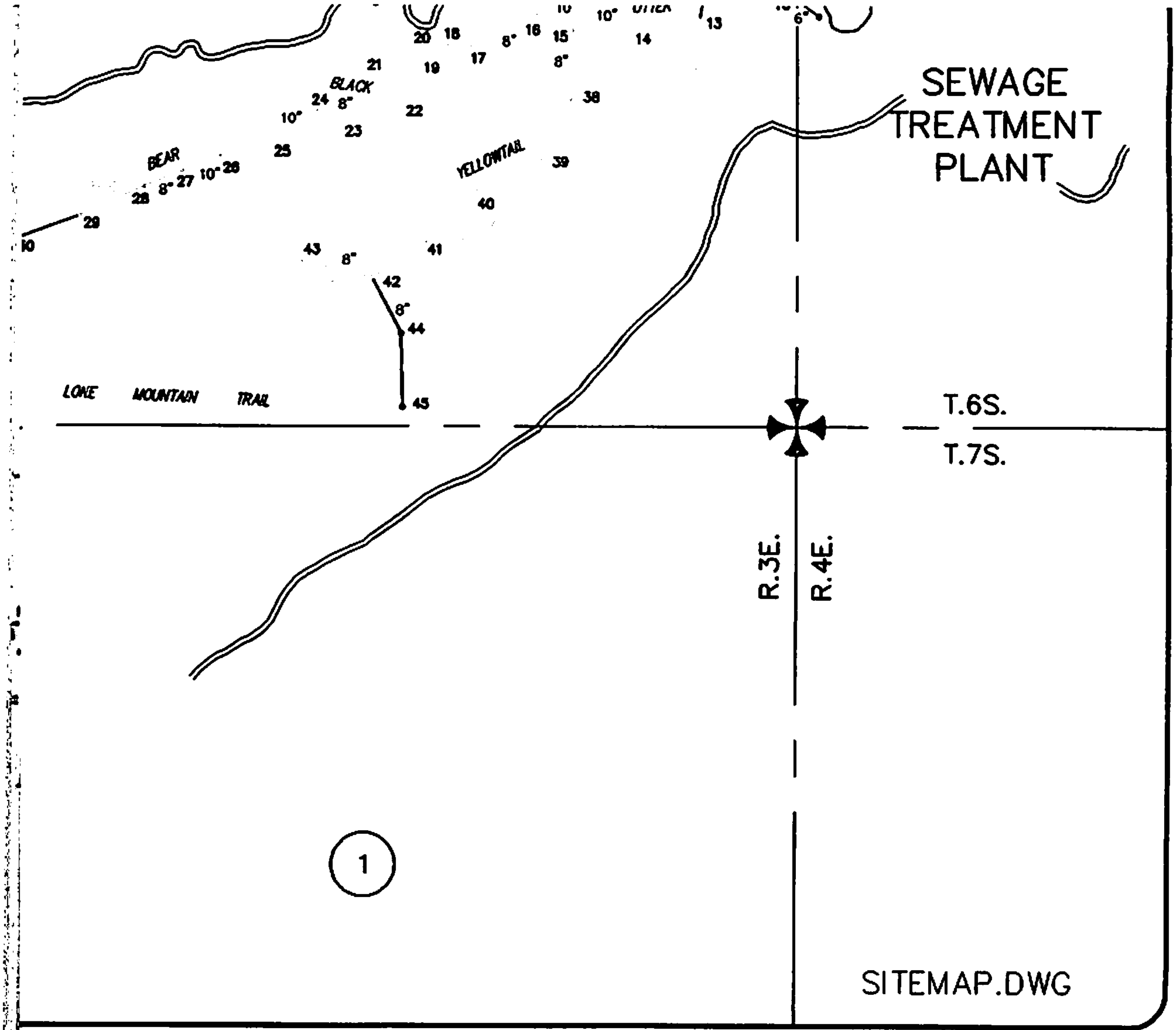
APPENDIX A

BIG SKY WASTEWATER COLLECTION SYSTEM



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APPENDIX A

HKM ASSOCIATES

ENGINEERS · PLANNERS

4M357.102	MAY 1993

APPENDIX B

SOILS DATA

SOIL SURVEY OF THE GALLATIN FOREST AREA
SOUTHWESTERN MONTANA

INTERIM DRAFT REPORT- APRIL 1984

by Carl E. Davis and Henry F. Shovic

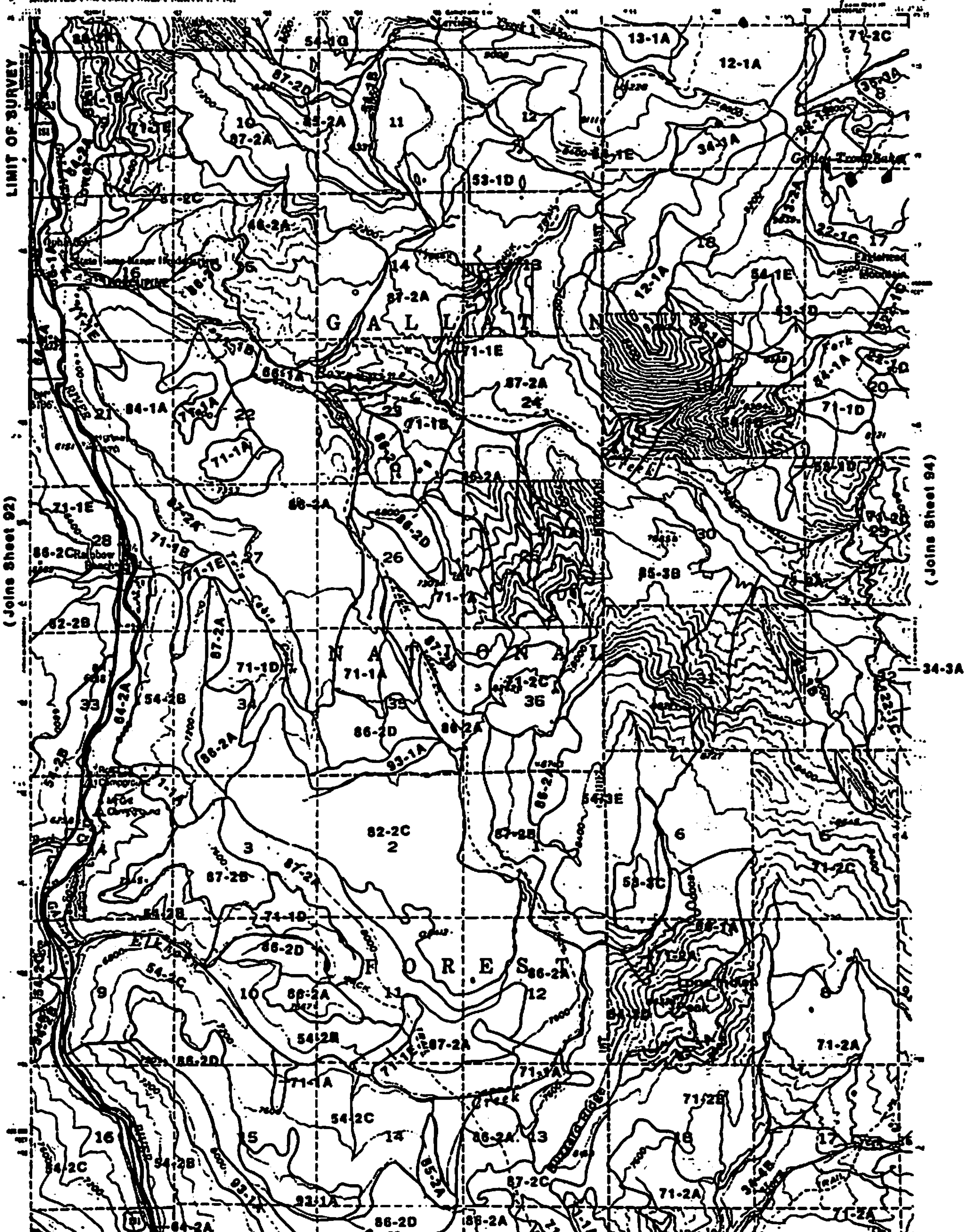
United States Department of Agriculture
Forest Service
in cooperation with the Soil Conservation Service
and the Montana Agricultural Experiment Station

Gallatin National Forest, Box 130, Federal Building, Bozeman, MT 59771

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
MODIFIED FOR USDA FOREST SERVICE USE

SHEET NUMBER 93
GALLATIN FOREST AREA
SOIL SURVEY, MONTANA

CROWN BUTTE N.W. QUADRANGLE
MONTANA
7.5 MINUTE SERIES



GALLATIN FOREST AREA
SOIL SURVEY

Draft

MAP UNIT DESCRIPTION

M.U. 64-2A

MAP UNIT SUMMARY

M.U. SETTING The landform consists of nearly level terraces, floodplains, and alluvial fans (center and lower left of the block diagram). Delineations occur throughout the survey area.

M.U. COMPONENTS Soils are moderately coarse to moderately fine textured with dark colored surface layers. They are formed in floodplain or glacial outwash deposits derived from a mixture of rock types. Native vegetation is mountain shrubland, mountain grassland, and open grown Douglas-fir or subalpine forest.

ADJOINING M.U. Adjacent units have steep slopes with dense forest vegetation.

TOPOGRAPHY

SLOPE (%)	ASPECT	ELEVATION (FT.)	ROCK OUTCROP (%)
0-10	Southern	6,500-8,000	0

The unit consists of nearly level glacial outwash terraces and stream floodplains in valley bottoms. Included are some alluvial fans and stream terraces. These deposits are dissected by well defined perennial streams. There are occasional dry stream channels. The drainage system has a dendritic pattern with low channel gradients. These landforms often contain one major stream, and are subject to flooding after prolonged, high intensity storms. They have high subsurface water storage capacity and surface runoff occurs rarely.

VEGETATION

HABITAT TYPE (HT) OCCURRENCE The unit consists of big sagebrush/Idaho fescue (ARTR/FEID) or Idaho fescue/bluebunch wheatgrass (FEID/AGSP) - 55 percent; Douglas-fir HTs with shrub or bunchgrass understories - 30 percent. Included HTs with dissimilar management implications are subalpine fir HTs - 10 percent or riparian community types - 5 percent.

HABITAT TYPE DISTRIBUTION ARTR/FEID and FEID/AGSP occur in a mosaic throughout the unit. Douglas-fir HTs are included as similar. Warm, somewhat dry climates and moderately productive range sites are associated with these HTs in this unit.

Included are up to 15 percent dissimilar HTs. Subalpine fir HTs occur at higher elevations and are more productive as timber sites. Riparian communities occur along perennial streams and are more productive range sites.

EXISTING VEGETATION consists of mountain grasslands and shrublands with open grown Douglas-fir or subalpine fir forest. The grasslands are dominated by Idaho fescue, bluebunch wheatgrass, junegrass, western needlegrass and common forbs. The shrublands have a canopy of big sagebrush with an understory dominated by Idaho fescue and common forbs. On more moist sites, sticky geranium, bearded wheatgrass, mountain brome, and timber oatgrass are included. The forest has an understory dominated by low shrubs or grasses. Douglas-fir seedlings frequently invade mountain grasslands and shrublands.

GEOLOGY

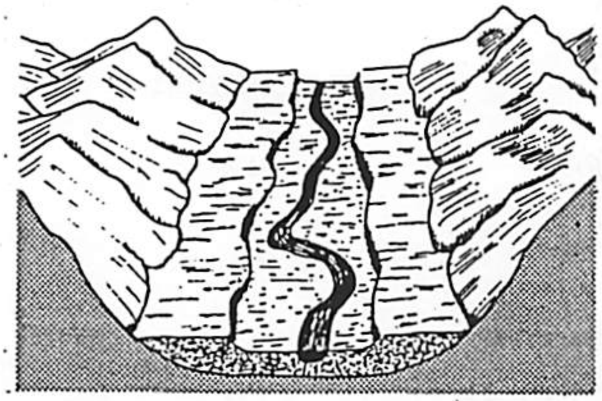
OCCURRENCE The unit contains glacial outwash and alluvial deposits - 100 percent.

The deposits are derived from a variety of rocks. They are Pleistocene or Holocene in age. These deposits are medium to moderately fine textured and contain numerous rounded cobbles and pebbles.

Included are some deposits with dissimilar properties. Deposits which contain few rock fragments are near low gradient streams or seeps. Soils formed in these deposits are more productive and have lower bearing strength.

SOILS

GENERAL NATURE OF SOILS Soils are well to moderately well drained, with moderately coarse to moderately fine textures. Subsoils contain 10-50 percent rock fragments.



GALLATIN FOREST AREA
SOIL SURVEY

Draft

MAP UNIT DESCRIPTION

M.U. 66-1A

MAP UNIT SUMMARY

M.U. SETTING The landform consists of nearly level stream floodplains and terraces (central portion of the block diagram). Delineations occur throughout the area.

M.U. COMPONENTS This unit contains an undifferentiated group of soils. Soils have variable textures and are seasonally or permanently wet. They are formed in recent alluvial deposits. Native vegetation is wet meadow and riparian communities.

ADJOINING M.U. Adjacent units have steep slopes with forested vegetation.

TOPOGRAPHY

SLOPE (%)	ASPECT	ELEVATION (FT.)	ROCK OUTCROP (%)
0-10	Variable	6,600-8,600	0

The unit consists of nearly level terraces and floodplains. They contain stream channels, ponds, and bogs, and are dissected by well defined, large, perennial streams. The drainage system has a dendritic pattern with low channel gradients. These landforms are subject to frequent flooding. They have high subsurface water storage capacity and surface runoff occurs rarely.

VEGETATION

HABITAT TYPE (HT) OCCURRENCE The unit consists of tufted hairgrass/sedge (DECA/CAREX) and willow communities - 90 percent. Included HTs with dissimilar management implications are forest and moist meadow HTs associated with better drained soils - 10 percent.

EXISTING VEGETATION consists of wet mountain meadows and willow with occassional forest or moist meadows. The wet meadows contain tufted hairgrass, timber oatgrass, timothy, rushes, and bentgrass.

HABITAT TYPE DISTRIBUTION DACA/CAREX and willow communities dominate the unit. Cool, very wet sites and highly productive range sites are associated with the HTs in this unit.

Included are up to 10 percent dissimilar HTs associated with better drained sites on benches and terraces. The moist meadows are less productive range sites and the forest HTs are most productive as timber sites.

GEOLOGY

OCCURRENCE The unit consists of recent alluvial deposits - 100 percent.

These deposits are derived from a variety of rock types. They are Holocene in age. Typically these deposits have variable textures and are seasonally or permanently wet.

Included are deposits having better drainage. They occur on benches and small knolls. They are less productive range sites but more productive timber sites.

SOILS

GENERAL NATURE OF SOILS Soils are somewhat poorly to poorly drained, with variable textures. Subsoils contain 0 - 50 percent rock fragments.

OCCURRENCE AND DISTRIBUTION The unit contains an undifferentiated group of somewhat poorly or poorly drained soils. Soils in this group have dark to light colored surface layers and variable textures. They occupy 90 percent of the unit.

Included are up to 10 percent dissimilar soils. Slightly better drained soils are on benches and knolls. They are either less productive range sites or more productive timber sites and have higher bearing strengths.

GENERAL DESCRIPTION The surface layer is light gray to very dark grayish brown silt loam about 15 inches thick. The subsoil is grayish brown, mottled with yellowish brown, sandy clay loam about 17 inches thick. The substratum, a gray, sandy clay loam, loam, or silt loam, overlies bedrock at depths greater than 5 feet. The water table fluctuates between depths of 0 and 20 inches. Soil descriptions 1 and 2 are representative of some soils in this unit. Soils vary from one area to another.

CLASSIFICATION REMARKS The soils with dark colored surface layers are Cryoquolls. The soils with light colored surface layers are Cryaquents.

The included dissimilar better drained soils are Argic Cryoborolls and Aquic Cryoboralfs.

MANAGEMENT IMPLICATIONS

TIMBER The unit contains only scattered trees and is poorly suited to timber management.

ROADS The unit is poorly suited to road construction. The high water table severely limits excavation. The base material has low bearing strength. Suitable subgrade material and drainage design are required when crossing wet areas. Care is required when constructing roads in and near stream channels to keep sediment from entering the channel system.

RANGE The unit is moderately suited to range mangement. Soils too wet to support grazing animals severely limit access to forage. Livestock trampling damages soils and vegetation when soils are wet. Livestock prefer these sites and tend to overutilize the vegetation before grazing adjacent uplands. The potential native plant community produces about 3,190 pounds per acre of air dry herbage in normal years. Timothy may have invaded these wet meadows. This may affect grazing season and utilization.

WILDLIFE-FISHERIES This unit is potentially good summer, fall, and winter moose habitat. It also is potentially good summer grizzly bear and elk habitat. Only major streams within the unit normally contain trout habitat.

INTERPRETATIONS

Landslide Hazards	low
Soil Erodibility	low
Sediment Delivery Efficiency	moderate
Timber Productivity	---
Forest Regeneration Limitations	---
Forest Understory Forage Productivity	---
Grassland and Shrubland Productivity	high to very high

See Use and Management Section for more detail.

CLIMATIC FEATURES

Mean Annual Precipitation (inches)	20-50
Precipitation Distribution	variable
Average Winter Snow Depth (inches)	10-60+
Spring Runoff	April-June
Length of Frost Free Season (days)	50-120
Potential Evapotranspiration	moderate
Hydrologic Soil Groups	B, C, D

MAP UNIT DESCRIPTION

M.U. 71-18

MAP UNIT SUMMARY

M.U. SETTING The landform consists of a hummocky land surface (block diagram). Delineations are mainly in the southern Gallatin Range, southern Madison Range and west of Hebgen Lake.

M.U. COMPONENTS This unit contains a complex of moderately fine textured soils. They are formed in landslide deposits derived primarily from sandstone and shale. Native vegetation is mountain grassland and mountain shrubland with some Douglas-fir or lower subalpine forest.

ADJOINING M.U. Adjacent units have steeper slopes or forest vegetation.

TOPOGRAPHY

SLOPE (%)	ASPECT	ELEVATION (FT.)	ROCK OUTCROP (%)
1-20	Variable	6,800-7,800	0

The unit consists of hummocky land surfaces characterized by a regular pattern of mounds and depressions. Indicators of movement such as large cracks, slip scars, and lobate shaped deposits are present. These slopes are dissected by poorly defined streams. The drainage system has a deranged or irregular pattern with numerous seeps and ponds in depressions. Where streams have well defined channels, the banks are nearly vertical. These landforms have moderate landslide hazards on 20-40 percent of the unit. They have high subsurface water storage capacity and the deranged drainage system diverts surface runoff into ponds and bogs.

Included are some structurally controlled sandstone ridges which are stable.

VEGETATION

HABITAT TYPE (HT) OCCURRENCE The unit consists of Idaho fescue/bluebunch wheatgrass (FEID/AGSP) - 30 percent and big sagebrush/Idaho fescue (ARTR/FEID) - 30 percent; and subalpine fir (ABLA) HTs with grassy and shrubby understories - 20 percent. Included HTs with dissimilar management implications are Douglas-fir/snowberry (PSME/SYAL) - 15 percent; tufted hairgrass/sedges (DECA/CAREX) - 5 percent.

HABITAT TYPE DISTRIBUTION FEID/AGSP and ARTR/FEID occur in a mosaic throughout the map unit. A similar HT, Idaho fescue/bearded wheatgrass (FEID/AGCA) is in depressional areas. The ABLA HTs occur in lodgepole pine forests at upper elevations. Warm moist climates and moderate range productivity are associated with the mountain grassland and shrubland HTs in this unit. Moderate timber productivity is associated with the ABLA HTs.

Included are up to 20 percent dissimilar HTs. PSME/SYAL is at lower elevations and has low timber productivity. This HT requires different silvicultural treatment than the ABLA HTs because of regeneration limitations. DECA/CAREX is in wet landscape positions and range productivity is high.

EXISTING VEGETATION consists of mountain grassland and shrubland with scattered stands of dense lodgepole pine forest. The grassland is dominated by Idaho fescue, bluebunch wheatgrass, junegrass, western needlegrass and common forbes. The shrubland has a canopy of big sagebrush with an understory dominated by Idaho fescue and common forbes. On moist sites, sticky geranium, bearded wheatgrass, mountain brome, and timber oatgrass are common. Douglas-fir seedlings are invading these mountain grasslands and shrublands in some areas.

GEOLOGY

OCCURRENCE The unit consists of landslide deposits and structural features associated with landslides - 100 percent.

The landslides have developed in weathered bedrock and/or glacial till deposits. These deposits are composed of material derived from shale, mudstone, siltstone, and some sandstone. These bedrocks are included in formations from the Cretaceous and Jurassic time periods. Typically these landslide deposits are fine textured and contain few rock fragments. Some have a few hard crystalline boulders scattered on the surface.

GALLATIN FOREST AREA
SOIL SURVEY

Draft

MAP UNIT DESCRIPTION

M.U. 71-1E

MAP UNIT SUMMARY

M.U. SETTING The landform consists of a hummocky land surface (block diagram). Delineations are mainly in the northern Gallatin Range, eastern Bridger Range, southern Madison Range, and north of Hebgen Lake.

M.U. COMPONENTS This unit contains a complex of soils with dark colored and somewhat dark colored surface layers. They are formed in landslide deposits derived primarily from sandstone and shale. Native vegetation is Douglas-fir and subalpine fir forest intermixed with mountain meadows.

ADJOINING M.U. Adjacent units have steeper slopes or have grassland or subalpine forest vegetation.

TOPOGRAPHY

SLOPE (%)	ASPECT	ELEVATION (FT.)	ROCK OUTCROP (%)
0-20	Southern	6,700-7,500	0

The unit consists of an irregular series of benches intermixed with some hummocky land surfaces. Bedrock outcrops are lacking but rock rubble is common on prominent ridges. These slopes are dissected by poorly defined streams. The drainage system has a deranged or irregular pattern with occasional seeps in depressions. Where streams have well defined channels, the banks are nearly vertical. These landforms have moderate landslide hazards in less than 20 percent of the unit. They have high subsurface water storage capacity and the deranged drainage system diverts surface runoff into seeps and swales.

Included are some structurally controlled sandstone ridges which are stable.

VEGETATION

HABITAT TYPE (HT) OCCURRENCE The unit consists of Douglas-fir/blue huckleberry (PSME/VAGL) and Douglas-fir/snowberry (PSME/SYAL) - 45 percent; subalpine fir/blue huckleberry (ABLA/VAGL) - 30 percent. Included HTs with dissimilar management implications are Idaho fescue/bluebunch wheatgrass (FEIO/AGSP) - 15 percent; Douglas-fir and limber pine with grassy understory unions - 10 percent.

HABITAT TYPE DISTRIBUTION PSME/VAGL and PSME/SYAL are at lower elevations or on southern exposures. Included similar HTs are Douglas-fir/ninebark (PSME/PHMA), Douglas-fir/white spirea (PSME/SPBE), Engelmann spruce (PIEN) with forb and shrub understory unions and subalpine fir/pinegrass (ABLA/CARU). Warm, moist climates and moderate timber productivity are associated with these HTs. ABLA/VAGL is at upper elevations and includes the similar subalpine fir/grouse whortleberry (ABLA/VASC) HT. Cool climates and moderate timber productivity are associated with these HTs.

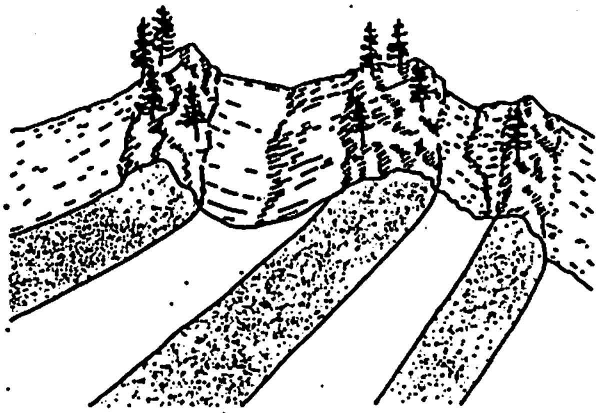
Included are small areas of dissimilar HTs. FEIO/AGSP is at lower elevations or on southern exposures, and may include some big sagebrush (ARTR) HTs. Douglas-fir and limber pine HTs with grassy understories are often adjacent to these mountain grasslands. Warm, dry climates are associated with these non-timbered or sparsely timbered HTs.

EXISTING VEGETATION consists of open grown to dense Douglas-fir and lodgepole pine forest with scattered mountain grasslands. The forest understory is composed of a moderately thick stand of shrubs dominated by snowberry and blue huckleberry. Bunchgrass and pinegrass are common. The mountain grasslands are dominated by Idaho fescue, bluebunch wheatgrass and common forbs. Some are being invaded by Douglas-fir seedlings.

GEOLOGY

OCCURRENCE The unit consists of landslide deposits and structural features associated with landslides - 100 percent.

The landslides have developed in weathered bedrock and/or glacial till deposits. These deposits are composed of material derived from shale, mudstone, siltstone, and some sandstone. These bedrocks are typically included in formations from the Cretaceous and Jurassic time periods. Typically these landslide deposits are fine textured and contain few rock fragments. Some have a few hard crystalline boulders scattered on the surface.



GALLATIN FOREST AREA
SOIL SURVEY

Draft

MAP UNIT DESCRIPTION

M.U. 86-2A

MAP UNIT SUMMARY

M.U. SETTING The landform consists of gently sloping to moderately steep, structurally controlled slopes (block diagram). Delineations are mainly in the Gallatin Range, southern Madison Range, Hebgen Lake area, and Absaroka-Beartooth Range.

M.U. COMPONENTS This unit contains an association of soils. Soils are moderately fine textured. They have formed in material weathered from thickly bedded sandstone and shale. Native vegetation is dense lower subalpine forest and mountain meadows.

ADJOINING M.U. Adjacent units have steep structurally controlled slopes, mountain grassland or dense upper subalpine fore-

TOPOGRAPHY

SLOPE (%)	ASPECT	ELEVATION (FT.)	ROCK OUTCROP (%)
10-45	Variable	6,800-8,000	5

The unit consists of ridges with gently sloping to moderately steep concave slopes and occassional small valleys or swales. The shape of these landforms is strongly controlled by the underlying interbedded bedrock. Ridges are generally underlain by sandstone which is often exposed on ridgetops. Small valleys and swales are underlain by "soft" shale, siltstone, or mudstone. Landscapes can be complex depending upon the bedding characteristics of the underlying rock. Slope of the land surface seldom conforms to underlying bedrock dip. These slopes are dissected by poorly defined, intermittent streams. The drainage system has a dendritic or rectangular pattern with low channel gradients. These landforms have moderate landslide hazards in 20-40 percent of the unit. They have high subsurface water storage capacity and surface runoff occurs rarely.

VEGETATION

HABITAT TYPE (HT) OCCURRENCE The unit consists of subalpine fir/blue huckleberry (ABLA/VAGL) and subalpine fir/twin flower (ABLA/LIBO) - 45 percent; and Idaho fescue/bearded wheatgrass (FEID/AGCA) - 30 percent. Included HTs with dissimilar management implications are subalpine fir-whitebark pine/grouse whortleberry (ABLA-PIAL/VASC) - 10 percent; and Douglas-fir HTs with shrubby understory unions - 10 percent.

HABITAT TYPE DISTRIBUTION ABLA/VAGL and ABLA/LIBO are in forested areas. Similar included HTs are subalpine fir/heartleaf arnica (ABLA/ARCO), subalpine fir/grouse whortleberry (ABLA/VASC) and Engelmann spruce (PIEN) HTs. Cool, moist climates and moderate timber productivity are associated with these HTs. FEID/AGCA is in mountain meadows. Similar included HTs are big sagebrush/Idaho fescue (ARTR/FEID) and Idaho fescue/ bluebunch wheatgrass (FEID/AGSP). Cool moist climates and high range productivity are associated with these HTs in this unit.

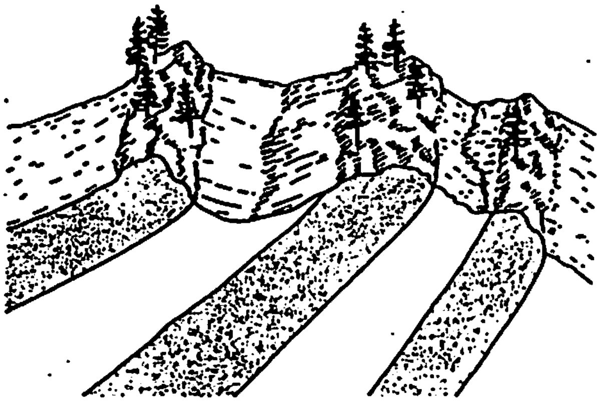
Included are up to 20 percent dissimilar HTs. ABLA-PIAL/VASC is at upper elevations on less productive timber sites. Doulgas-fir HTs are at lower elevations on sites where forest regeneration is more difficult.

EXISTING VEGETATION consists of dense lodgepole pine and subalpine fir forest with large mountain meadows. The forest understory is composed of a thick mat of shrubs dominated by blue huckleberry, twin flower, and grouse whortleberry. Heartleaf arnica, virgins bower and pinegrass also occur. The mountain meadows consist primarily of bearded wheatgrass, mountain brome, timber oatgrass, sticky geranium and abundant forbs. Occasionally, big sagebrush forms a dense overstory.

GEOLOGY

OCCURRENCE The unit is underlain by interbedded shale, siltstone, and sandstone - 100 percent.

The bedrock consists of thick beds of light colored sandstone shale, mudstone, or siltstone. Slope of the land surface seldom conforms underlying bedrock dip. The bedrock is upper Cretaceous to Triassic in age. The most common geologic formations are Telegraph Creek, Cody, Mowry-Thermopolis, Kootenai, Morrison, and formations of the Ellis group. The Albino formation occurs locally in the Madison and southern Gallatin Range.



GALLATIN FOREST AREA
SOIL SURVEY

Draft

MAP UNIT DESCRIPTION

M.U. 86-2C

MAP UNIT SUMMARY

M.U. SETTING The landform consists of rolling to moderately steep structurally controlled slopes (block diagram). Delineations are mainly in the northern Bridger Range, the northern Absaroka-Beartooth Range, the northern Gallatin Range, with most in the southern Madison Range.

M.U. COMPONENTS Soils are moderately fine textured with dark colored surface layers. They have formed in materials weathered from thickly bedded sandstone and shale. Native vegetation is mountain grassland with some subalpine forest.

ADJOINING M.U. Adjacent units have steep, structurally controlled slopes with subalpine forest vegetation.

TOPOGRAPHY

SLOPE (%)	ASPECT	ELEVATION (FT.)	ROCK OUTCROP (%)
10-45	Variable	7,000-8,000	5

The unit consists of ridges with gently sloping to moderately steep concave slopes and occasional small valleys or swales. The shape of these landforms is strongly controlled by the underlying interbedded bedrock. Ridges are generally underlain by sandstone which is often exposed on ridgetops or steep sideslopes. Small valleys and swales are underlain by shale, siltstone, or mudstone. Landscapes can be complex depending upon the bedding characteristics of the underlying rock, but slope of the land surface seldom conforms to underlying bedrock dip. These slopes are dissected by well defined, intermittent streams. The drainage system has a dendritic pattern with moderate channel gradients. These landforms have moderate landslide hazards in 20-40 percent of the unit. They have high subsurface water storage capacity and surface runoff occurs rarely.

VEGETATION

HABITAT TYPE (HT) OCCURRENCE The unit consists of Idaho fescue/bluebunch wheatgrass (FEID/AGSP) and big sagebrush/Idaho fescue (ARTR/FEID) - 85 percent. An included HT with dissimilar management implications is subalpine fir/grouse whortleberry (ABLA/VASC) - 10 percent.

HABITAT TYPE DISTRIBUTION FEID/AGSP and ARTR/FEID occur in a mosaic throughout the unit. The similar HT, Idaho fescue/bearded wheatgrass (FEID/AGCA) is in depressions. Warm, dry climates and moderately productive range sites are associated with these HTs.

Included are small areas of the dissimilar HT ABLA/VASC. This HT is found in scattered forest stands with low timber productivity. It occupies up to 10 percent of the unit.

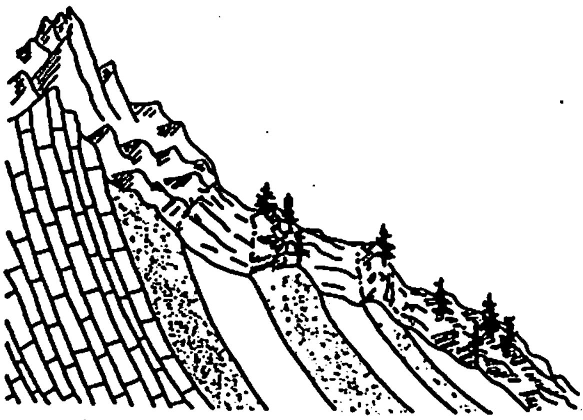
EXISTING VEGETATION consists of mountain grassland and shrubland with a few scattered stands of dense lodgepole pine forest. The mountain grassland contains abundant Idaho fescue, bluebunch, wheatgrass, junegrass, western needlegrass and common forbs. The mountain shrubland contains big sagebrush with Idaho fescue dominating the understory. Bluebunch wheatgrass, junegrass and and forbs are common. On moist sites, sticky geranium, bearded wheatgrass, mountain brome and timber oatgrass are common. Forest understories are dominated by shrubs. Douglas-fir seedlings frequently invade mountain grasslands and shrublands.

GEOLOGY

OCCURRENCE The unit is underlain by interbedded shale, siltstone, and sandstone - 100 percent.

The bedrock consists of thick beds of light colored sandstone shale, mudstone, or siltstone. The bedrock is upper Cretaceous to Triassic in age. The most common geologic formations are Telegraph Creek, Cody, Mowry-Thermopolis, Kootenai, Morrison, and formations of the Ellis group. The Albino formation occurs locally in the Madison and southern Gallatin Range.

Included bedrock with dissimilar properties is light colored quartzitic sandstone of the Quadrant formation. Weathering products from this bedrock are more erodible. Some thin beds of limestone are also present. Weathering products from these bedrocks are high in carbonates.



GALLATIN FOREST AREA
SOIL SURVEY

Draft

MAP UNIT DESCRIPTION

M.U. 87-2A

MAP UNIT SUMMARY

M.U. SETTING The landform consists of steep, structurally controlled slopes (block diagram). Delineations are mainly in the Gallatin and Bridger ranges with some in the southern Madison Range.

M.U. COMPONENTS This unit contains an association of soils. Soils are moderately fine textured. They have formed in material weathered from thickly bedded sandstone and shale. Native vegetation is open grown Douglas-fir forest and mountain grassland.

ADJOINING M.U. Adjacent units are entirely mountain grassland or dense subalpine forest.

TOPOGRAPHY

SLOPE (%)	ASPECT	ELEVATION (FT.)	ROCK OUTCROP (%)
45+	Southern	5,800-7,800	10

The unit consists of ridges with steep slopes and occasional small valleys or swales. The shape of these landforms is strongly controlled by the underlying interbedded bedrock. Ridges are generally underlain by sandstone which is often exposed on ridgetops. Small valleys and swales are underlain by shale, siltstone, or mudstone. Landscapes can be complex depending upon the bedding characteristics of the underlying rock, but the land surface seldom conforms to bedrock dip. These slopes are dissected by well defined, intermittent streams. The drainage system has a dendritic to rectangular pattern with steep channel gradients. These landforms have moderate landslide hazards in 20-40 percent of the unit. They have moderate subsurface water storage capacity and surface runoff occurs occasionally.

VEGETATION

HABITAT TYPE (HT) OCCURRENCE The unit consists of Douglas-fir/Idaho fescue (PSME/FEID) - 50 percent; and Idaho fescue/bluebunch wheatgrass (FEID/AGSP) - 25 percent. An included HT with dissimilar management implications is Douglas-fir/snowberry (PSME/SYAL) - 15 percent.

HABITAT TYPE DISTRIBUTION PSME/FEID and FEID/AGSP form a mosaic throughout the unit. Limber pine (PIFL) HTs with grassy understories and big sagebrush/Idaho fescue (ARTR/FEID) are similar included HTs. Warm dry climates and low timber productivity are associated with these HTs.

Included are small areas of the dissimilar HT PSME/SYAL on northern exposures. THis HT is on more productive timber sites. This HT occupies up to 15 percent of the unit.

EXISTING VEGETATION is a mosaic of open grown Douglas-fir forest and mountain grassland. Forest trees are stunted and the understory is composed of Idaho fescue and bluebunch wheatgrass. Mountain grasslands consist of Idaho fescue, bluebunch wheatgrass, junegrass, western needlegrass and common forbs. Occasionally, big sagebrush forms a dense overstory in these grasslands. Douglas-fir seedlings are often found invading the grasslands.

GEOLOGY

OCCURRENCE The unit is underlain by interbedded shale, siltstone, and sandstone - 100 percent.

The bedrock consists of thick beds of light colored sandstone shale, mudstone, or siltstone. This bedrock is upper Cretaceous through Triassic in age. The most common geologic formations are Telegraph Creek, Cody, Mowry-Thermopolis, Kootenai, Morrison, and formations of the Ellis group. The Albino formation occurs locally in the Madison and southern Gallatin Range.

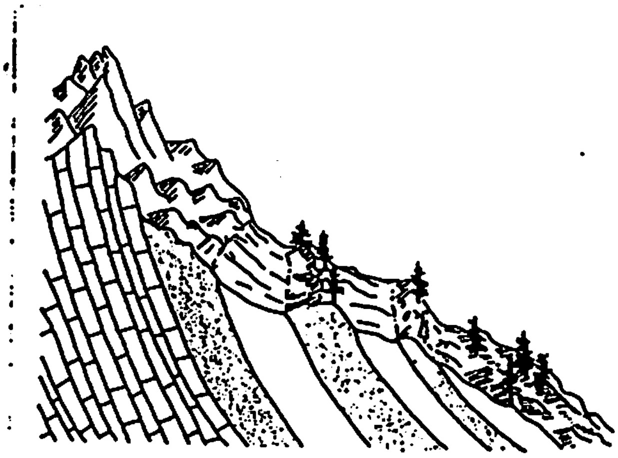
Included bedrock with dissimilar properties is light colored quartzitic sandstone of the Quadrant formation. Weathering products from this bedrock are more erodible.

SOILS

GENERAL NATURE OF SOILS Soils are well drained, with moderately fine textures and subsoil clay accumulation. Subsoils contain 3-20 percent rock fragments.

GALLATIN FOREST AREA
SOIL SURVEY

Draft



MAP UNIT DESCRIPTION

M.U. 87-2C

MAP UNIT SUMMARY

M.U. SETTING The landform consists of steep, structurally controlled slopes (block diagram). Delineations are mainly in the northwestern Bridger Range, the northwestern Crazy Mountains, the northern Absaroka-Beartooth Range, the Gallatin Range, and the southeast Madison Range.

M.U. COMPONENTS The unit contains a complex of medium to moderately fine textured soils with dark colored surface layers. They have formed in material weathered from thickly bedded sandstone and shale. Native vegetation is mountain grassland and shrubland and Douglas-fir forest.

ADJOINING M.U. Adjacent units are entirely dense Douglas-fir or subalpine forest vegetation.

TOPOGRAPHY

SLOPE (%)	ASPECT	ELEVATION (FT.)	ROCK OUTCROP (%)
45 +	Southern	6,500-7,500	10

The unit consists of ridges with steep slopes and occasional small valleys or swales. The shape of these landforms is strongly controlled by the underlying interbedded bedrock. Ridges are generally underlain by sandstone or limestone which is often exposed on ridgetops or steep slopes. Small valleys and swales are underlain by shale, siltstone, or mudstone. Landscapes can be complex depending upon the bedding characteristics of the underlying rock. The land surface often conforms to bedrock dip. These slopes are dissected by well defined, intermittent streams. The drainage system has a parallel pattern with steep channel gradients. These landforms have moderate landslide hazards on dip slopes. They have moderate subsurface water storage capacity and surface runoff occurs occasionally.

VEGETATION

HABITAT TYPE (HT) OCCURRENCE The unit consists of Idaho fescue/bluebunch wheatgrass (FEID/AGSP) and big sagebrush/Idaho fescue (ARTR/FEID) - 60 percent; and Douglas-fir/snowberry (PSME/SYAL) - 25 percent. Included HTs with dissimilar management implications are subalpine fir (ABLA) HTs with shrubby understory unions - 5 percent.

HABITAT TYPE DISTRIBUTION FEID/AGSP and ARTR/FEID occur in a mosaic throughout the unit. An included similar HT, Idaho fescue/bearded wheatgrass (FEID/AGCA) is in depressions. Warm dry climates and moderately productive range sites are associated with these HTs. PSME/SYAL occurs in scattered forest stands throughout the unit. Warm moist climates and low timber productivity are associated with this HT.

Included are small areas of dissimilar HTs. ABLA HTs occupy scattered forest stands at upper elevations. Cool moist climates and moderate timber productivity are associated with these HTs.

EXISTING VEGETATION is a mosaic of mountain grassland and shrubland with scattered stands of dense Douglas-fir forest. The mountain grassland contains Idaho fescue, bluebunch wheatgrass, junegrass, western needlegrass and common forbs. The shrubland has a canopy of big sagebrush with an understory of Idaho fescue and common forbs. Sticky geranium, bearded wheatgrass, mountain brome and timber oatgrass are common on moist sites.

GEOLOGY

OCCURRENCE The unit is underlain by interbedded shale, siltstone, and sandstone - 100 percent.

The bedrock consists of thick beds of light colored sandstone shale, mudstone, siltstone and occasionally limestone. This bedrock is upper Cretaceous through Triassic in age. The most common geologic formations associated with this group are Telegraph Creek, Cody, Mowry-Thermopolis, Kootenai, Morrison, and formations of the Ellis group. The Albino formation occurs locally in the Madison and southern Gallatin Range.

Included bedrock with dissimilar properties is light colored quartzitic sandstone of the Quadrant formation. Weathering products from this bedrock are more erodible.

280B

MAP UNIT DESIGN NOTE

NAME JD
AREA Big Sky
DATE FY 91

MAP UNIT NAME L IBEG, 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

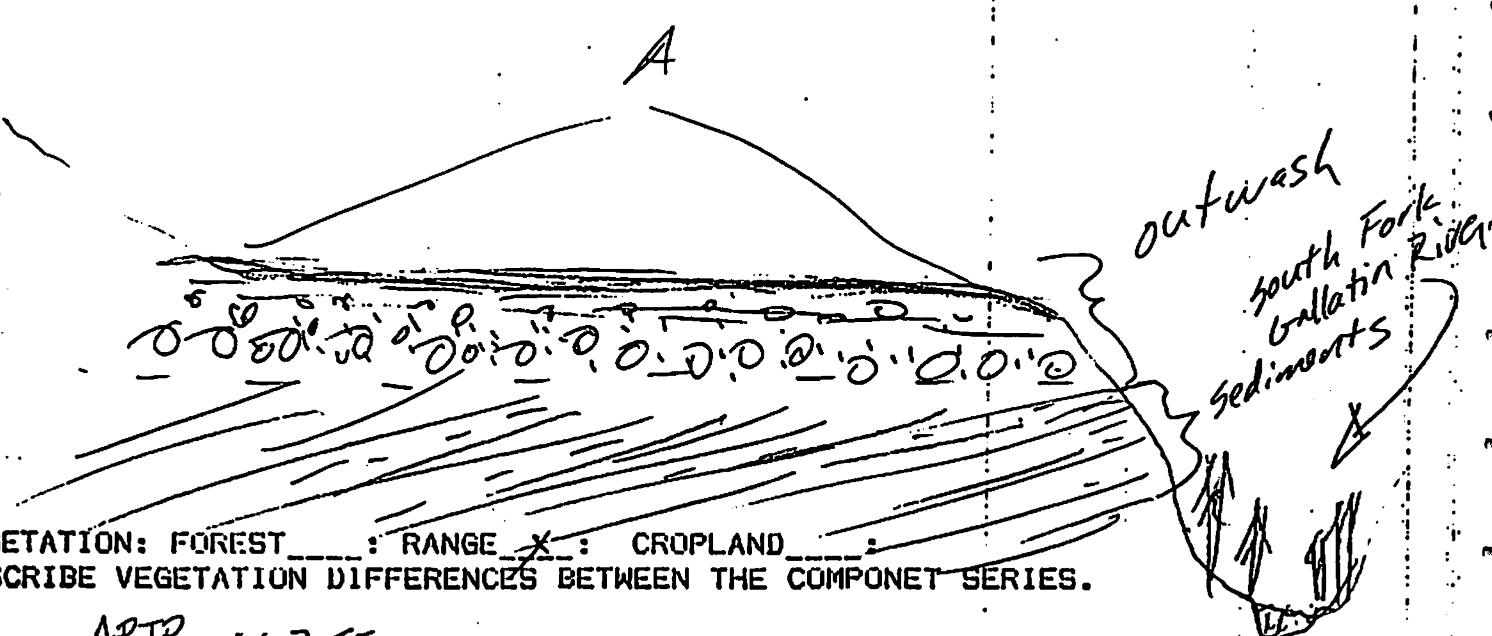
E ~~soils on~~

F.

INCLUSIONS (NONCONTRASTING)

B 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

ADVANCE COPY - SUBJECT TO CHANGE

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:
CONASSOCIATION:____: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 SURFACES~~

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

ADVANCE COPY - SUBJECT TO CHANGE

Mapunits 280B and 779E

Series Libeg

<u>Depth class:</u> deep
<u>Drainage class:</u> well drained
<u>Permeability:</u> moderate
<u>Landform:</u> mountain slopes, stream terraces and alluvial fans
<u>Parent material:</u> alluvium and colluvium
<u>Slope range:</u> 0 to 60 percent
<u>Elevation range:</u> 5500 to 8500 feet
<u>Annual precipitation:</u> 20 to 24 inches
<u>Annual air temperature:</u> 34 to 38 degrees F
<u>Frost free period:</u> 50 to 75 days

<u>Taxonomic Class:</u> 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

<u>Control section:</u> 6 to 31 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 15 inches
<u>Content of clay in the control section:</u> 18 to 35 percent
<u>Rock fragments in the control section:</u> 35 to 80 percent
<u>Depth to the Bk horizon:</u> greater than 40 inches
<u>Soil phases:</u> 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 coobly 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

MAP UNIT DESIGN NOTE 608B

NAME JB
AREA Big Sky
DATE FY 91

MAP UNIT NAME Turson Var - Fubar - Cryaquolls, 0-4% slopes Rare Flooding

LOCATION SHT 110

TYPE OF UNIT:
CONSOCIATION:____:COMPLEX X :ASSOCIATION____:UNDIFFERENTIATED GROUP____

PARENT MATERIAL AND LANDFORM alluvium from high-gradient streams in narrow valleys

SLOPE GROUP 0-4% ELEVATION RANGE__________

COMPONET 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				

INCLUSIONS: (CONTRASTING)

D

E

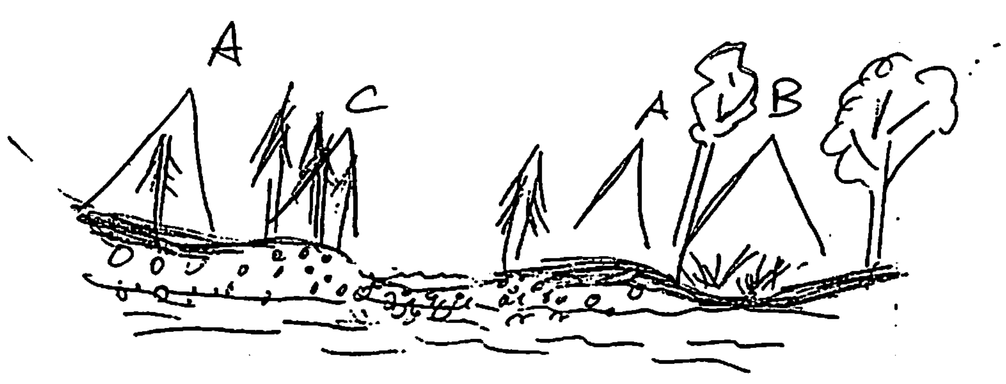
F

INCLUSIONS (NONCONTRASTING)

soils that are >40" to sand and gravel

GEOMORPHIC LANDSCAPE DESCRIPTION: LANDSCAPE DIAGRAM AND POSITIONS OCCUPIED BY COMPONET SOILS AND INCLUSIONS.

V Varies by having a sand & gravel subsoil.



VEGETATION: FOREST X : RANGE X : CROPLAND____:
DESCRIBE VEGETATION DIFFERENCES BETWEEN THE COMPONET SERIES.

A: grasses, forbs
B: willow, sedges, Aspen

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.

EOGRAPHIC 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
REV. 12-70
FILE 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 & 2700' N of SE corner **Sheet No.** 110

N. 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** 0-16" **Stoniness**

Slope 10% **Moisture** throughout

Aspect NE **Root distrib.** **% Clay** *

Erosion wind: **water:** **% Coarse fragments** * **% Coarser than V.F.S.** *

Permeability

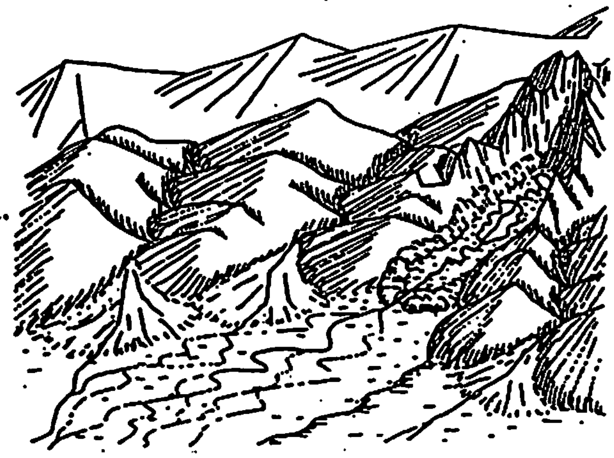
Additional notes

% 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		Texture	Structure	Consistence			pH Reaction BtB	Boundary	% Clay	Roots	Effervesc.
		Dry	Moist			Dry	Moist	Wet					
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	↓
Cg1	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	↓
Cg2	31-60	2.5Y 6/2	2.5Y 4/2 w/ mottles: 2.5Y 4/4	(>15% f.s.) SiCL	1msbk	vh	fi	vs/vp	6.8		36-38	1vf, f	↓



GALLATIN FOREST AREA
SOIL SURVEY

Draft

MAP UNIT DESCRIPTION

M.U. 46-2A

MAP UNIT SUMMARY

M.U. SETTING The landform consists of nearly level plains dnd benches (lower part of block diagram). Delineations are adjacent to major streams and rivers in the survey area.

M.U. COMPONENTS The unit contains medium to moderately fine textured soils. They are formed in glacial outwash deposits derived primarily from sedimentary or volcanic rocks. Native vegetation is mountain grasslands and shrublands with some Douglas-fir forest.

ADJOINING M.U. Adjacent units have steeper slopes or forest vegetation.

TOPOGRAPHY

SLOPE (%)	ASPECT	ELEVATION (FT.)	ROCK OUTCROP (%)
0-10	Variable	6,500-7,500	0

The unit consists of nearly level terraces in large valley bottoms. These terraces are frequently adjacent to major streams and rivers. Larger terraces may contain old, braided stream courses. These terraces are dissected by poorly defined intermittent streams. The drainage system has an irregular pattern with low channel gradients. These landforms are stable except on terrace escarpments where soils tend to unravel. These landforms have high subsurface water storage capacity and surface runoff occurs rarely.

VEGETATION

HABITAT TYPE (HT) OCCURRENCE The unit consists of Idaho fescue/bluebunch wheatgrass (FEID/AGSP) - 40 percent and big sagebrush/Idaho fescue (ARTR/FEID) - 35 percent. Included HTs with dissimilar management implications are Idaho fescue/bearded wheatgrass (FEID/AGCA) and Douglas-fir (PSME) and subalpine fir (ABLA) HTs with low shrub understories - 25 percent.

HABITAT TYPE DISTRIBUTION FEID/AGSP and ARTR/FEID form a mosaic throughout the unit. Douglas-fir and limber pine HTs with bunchgrass understory unions are included similar HTs. Warm, dry climates and moderate range site productivity are associated with these HTs in this unit.

Included are up to 25 percent dissimilar HTs. Douglas-fir and subalpine fir HTs with shrub understory unions occur in densely forested areas. They are timber sites. FEID/AGCA occurs on moist sites near seeps or in swales and is a more productive range site.

EXISTING VEGETATION consists of a mosaic of mountain shrubland and mountain grassland with scattered Douglas-fir or limber pine forest. The mountain grasslands contain Idaho fescue, bluebunch wheatgrass, junegrass, and western needlegrass. The mountain shrublands have a canopy of big sagebrush with an understory dominated by Idaho fescue. In forested areas, the understory is dominated by bunchgrasses where the forest is open grown and shrubs where the canopy is dense. Douglas-fir seedlings frequently invade mountain grasslands and shrublands.

GEOLOGY

OCCURRENCE The unit contains glacial outwash and alluvial deposits - 100 percent.

The glacial outwash and alluvial deposits are derived primarily from sandstone, limestone, and shale. They are Pleistocene or Holocene in age. Soils formed in these deposits are medium to moderately fine textured and contain rounded cobbles and pebbles.

Included are dissimilar deposits containing fewer rock fragments. They have lower bearing strength.

SOILS

GENERAL NATURE OF SOILS Soils are well drained and moderately fine textured. Subsoils contain more than 35 percent rounded and subrounded rock fragments.

OCCURRENCE AND DISTRIBUTION The unit consists of an undifferentiated group of soils. Soil properties vary with average annual precipitation and the quantity of subsoil rock fragments. Soils with dark colored surface layers occur where average annual precipitation exceeds 20 inches. Soils with lighter colored surface layers occur where average annual precipitation is less than 20 inches or where soils overlie limestone rubble. Included are similar soils with fewer subsoil rock fragments. These soils occupy 75 percent of the unit.

Included are up to 25 percent dissimilar soils. Somewhat poorly drained soils,or soils with thick dark surface layers occur in swales or near seeps and occupy. They are more productive range sites. Soils with light colored surface layers occur under dense forests. They are timber sites.

GENERAL DESCRIPTION The surface layer is dark grayish brown, silt loam about 8 inches thick. The upper subsoil is light yellowish brown, very gravelly silt loam about 6 inches thick. The lower subsoil is light yellowish brown, very cobbly silty clay loam about 8 inches thick. The substratum, a yellowish brown, very cobbly loam, overlies bedrock at depths greater than 5 feet. See soil description 10 for more detail.

CLASSIFICATION REMARKS The major soils are Typic Argiborolls, loamy skeletal, mixed. The included similar soils with lighter colored surface layers are Aridic Argiborolls, loamy skeletal, mixed. The soils with subsoils containing less than 35 percent rock fragments are Typic Argiborolls, fine loamy mixed.

Included are up to 25 percent dissimilar soils. The somewhat poorly drained soils are Aquic Argiborolls, fine loamy, mixed. Soils under dense forests are Mollic Eutroboralfs, loamy skeletal, mixed, or Typic Ustochrepts, loamy skeletal, mixed frigid.

MANAGEMENT IMPLICATIONS

TIMBER The unit contains only scattered trees and is poorly suited to timber management.

ROADS The unit is well suited to road construction. Unsurfaced roads become rutted when wet and dusty when dry. Surfacing or seasonal closures help overcome these limitations.

RANGE The unit is well suited to range management. The potential native plant community produces about 1,408 pounds per acre of air dry herbage in normal years. Timothy has invaded some grasslands. This may alter grazing seasons and affect utilization. In places, sagebrush control improves production of desirable forage plants and forage accessibility. Lack of stock water may limit the distribution of livestock.

WILDLIFE-FISHERIES This unit is potentially good fall elk, summer mule deer and spring grizzly bear habitat. At lower elevations, it is potential elk winter range. Good spring blue grouse habitat is also available. Only major streams within the unit normally contain trout habitat. If erosion occurs within the unit, it is a potential source of sediment which can damage fish habitat.

INTERPRETATIONS

Landslide Hazards	low
Soil Erodibility	moderate
Sediment Delivery Efficiency	low
Timber Productivity	---
Forest Regeneration Limitations	---
Forest Understory Forage Productivity	---
Grassland and Shrubland Productivity	low to moderate

See Use and Management Section for more detail.

CLIMATIC FEATURES

Mean Annual Precipitation (inches)	15-30
Precipitation Distribution	40% snow; 60% rain
Average Winter Snow Depth (inches)	26-40
Spring Runoff	March-April
Length of Frost Free Season (days)	90-120
Potential Evapotranspiration	moderate
Hydrologic Soil Groups	B

APPENDIX C

ADMINISTRATIVE RULES OF MONTANA

MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCES
Environmental Sciences Division
Water Quality Bureau
Helena, Montana 59620

Administrative Rules of Montana

Title 16, Chapter 20 - Water Quality

Sub-Chapter 6 - SURFACE WATER QUALITY STANDARDS

HEALTH AND ENVIRONMENTAL SCIENCES

Sub-Chapter 6

Surface Water Quality Standards

<u>16.20.601 POLICY</u> 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. 75-5-301 MCA; <u>IMP</u>, Sec. 75-5-301 MCA; Eff. 12/31/72; <u>AMD</u>, Eff. 11/4/73; <u>AMD</u>, Eff. 9/5/74; <u>AMD</u>, 1980 MAR p. 2252, Eff. 8/1/80.)

<u>16.20.602 APPLICATION AND COMPOSITION OF SURFACE WATER QUALITY STANDARDS</u> (1) The standards in this sub-chapter 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 sub-chapter.

(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. (History: Sec. 75-5-301 MCA; <u>IMP</u>, Sec. 75-5-301 MCA; Eff. 12/31/72; <u>AMD</u>, Eff. 11/4/73; <u>AMD</u>, Eff. 9/5/74; <u>AMD</u>, 1980 MAR p. 2252, Eff. 8/1/80.)

<u>16.20.603 DEFINITIONS</u> In this sub-chapter the following terms shall have the meanings indicated below and shall be supplemental to the definitions given in section 75-5-103, MCA:

(1) "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.

(2) "Conduit" means any artificial or natural duct, either open or closed, capable of conveying liquids or pollutants.

(3) "Dewatered stream" means a perennial or intermittent stream from which water has been removed for one or more beneficial uses.

(4) "EPA" means the U.S. Environmental Protection Agency.

(5) "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.

(6) "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.

(7) "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.

(8) "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. Water quality standards do not apply in the mixing zone for those parameters regulated by a MPDES or NPDES permit.

(9) "MPDES" means the Montana Pollutant Discharge Elimination System.

(10) "NPDES" means the National Pollutant Discharge Elimination System.

(11) "Naturally occurring" means conditions or material present from runoff or percolation over which man has no control 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.

(12) "Nonpoint source" means the source of pollutants which originates from diffuse runoff, seepage, drainage, or infiltration.

(13) "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.

(14) "Pollutants" means sewage, industrial wastes and other wastes as defined in sections 75-5-103(1),(2),(3), MCA.

(15) "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.

(16) "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.

(17) "Sewer" means a pipe or conduit that carries wastewater or drainage water.

(18) "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, transporting or impounding pollutants shall not be considered surface water.

(19) "Storm sewer" or "storm drain" means a pipe or conduit that carries storm water and surface water and street washings.

(20) "True color" means the color of water from which the turbidity has been removed.

(21) "Turbidity" means a condition in water or wastewater caused by the presence of suspended matter resulting in the scattering and absorption of light rays. (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, 1980 MAR p. 2252, Eff. 8/1/80.)

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 subsections (1)(a) through (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 . . . . E
(The Anaconda Company tailings pond and Silver Bow Creek drainage from this pond 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. 75-5-301 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.)

16.20.605 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 . . . . E

(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. 75-5-301 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.)

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. 75-5-301 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 . . . . E

(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 drainage (tributary to Sun River) . . . . E

(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)(f) 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 below Highway 223 . . . . B-3

(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)(e) 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 except for the waters listed in subsections (5)(e)(i) through (5)(e)(vi) B-1

(i) Musselshell River (mainstem) from Hopley Creek to Deadman's Basin Diversion Canal near Shawmut B-2

(ii) Musselshell River drainage below Deadman's Basin diversion canal above Shawmut except portions of Careless, Swimming Woman, Flatwillow, South Willow Creek and Deadmans Basin Reservoir listed below C-3

(iii) Careless and Swimming Woman Creek drainage above their confluence north of Ryegate . . B-1

(iv) Flatwillow Creek drainage above U.S. Highway 87 crossing south of Grassrange B-2

(v) South Willow Creek drainage above county road bridge in T10N, R24E, Section 7 . . . . . B-1

(vi) Deadmans Basin Reservoir 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) People's Creek drainage to and including the South Fork of People's 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. 75-5-301 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.)

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) and (2)(b) 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) Tributaries to the Clarks Fork Yellowstone River from Jack Creek (mainstem is B-2) to the Yellowstone River except the portion of West Fork of Rock Creek listed in subsection (2)(b)(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-2

(d) Fox Creek drainage near Sidney B-2

(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, 1980 MAR p. 2252, Eff. 8/1/80.)

16.20.609 WATER-USE CLASSIFICATIONS -- LITTLE MISSOURI RIVER DRAINAGE -- BELLE FOURCHE DRAINAGE The water-use classifications adopted for all waters in the Little Missouri and Belle Fourche drainages are C-3

(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, 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. 75-5-301 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.)

16.20.611 WATER-USE CLASSIFICATIONS -- NATIONAL PARK, WILDERNESS AND PRIMITIVE AREA WATERS 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. 75-5-301 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 16.20.612 through 16.20.614 reserved

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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. 75-5-301 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.

(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) For waters classified A-Closed the following specific water quality standards shall not be violated by any person:

(a) The geometric mean number of organisms in the coliform group must not exceed 50 per 100 milliliters.

(b) Dissolved oxygen criteria are not applicable for the classification.

(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 toxic or other deleterious substances, 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. 75-5-301 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.)

16.20.617 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) For waters classified A-1 the following specific water quality standards shall not be violated by any person:

(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 7.0 milligrams per liter.

(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) Concentrations of toxic or other deleterious substances which would remain in the water after conventional water treatment must not exceed the maximum contaminant levels set forth in the 1975 National Interim Primary Drinking Water Standards (40 CFR Part 141) or subsequent revisions or the 1979 National Secondary Drinking Water Standards (40 CFR Part 143) or subsequent revisions. The maximum allowable concentrations of toxic or deleterious substances also must not exceed acute or chronic problem levels as revealed by bioassay or other methods. The values listed in EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379) shall be used as a guide to determine problem levels unless local conditions make these values inappropriate. In accordance with section 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.

(4) The board hereby adopts and incorporates by reference "EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379)", which set forth water quality criteria for toxic or other deleterious substances. Copies of this document may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana, 59620. (History: Sec. 75-5-301 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.)

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) For waters classified B-1 the following specific water quality standards shall not be violated by any person:

(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 7.0 milligrams per liter.

(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) Concentrations of toxic or other deleterious substances which would remain in the water after conventional water treatment must not exceed the maximum contaminant levels set forth in the 1975 National Interim Primary Drinking Water Standards (40 CFR Part 141) or subsequent revisions or the 1979 National Secondary Drinking Water Standards (40 CFR Part 143) or subsequent revisions. The maximum allowable concentrations of toxic or deleterious substances also must not exceed acute or chronic problem levels as revealed by bioassay or other methods. The values listed in EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379) shall be used as a guide to determine problem levels unless local conditions make these values inappropriate. In accordance with section 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.

(3) The board hereby adopts and incorporates by reference "EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379)", which set forth water quality criteria for toxic or other deleterious substances. Copies of this document may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana, 59620. (History: Sec. 75-5-301 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.)

16.20.619 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) For waters classified B-2 the following specific water quality standards shall not be violated by any person:

(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 7.0 milligrams per liter from October 1 through June 1 nor below 6.0 milligrams per liter 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) Concentrations of toxic or other deleterious substances which would remain in the water after conventional water treatment must not exceed the maximum contaminant levels set forth in the 1975 National Interim Primary Drinking Water Standards (40 CFR Part 141) or subsequent revisions or the 1979 National Secondary Drinking Water Standards (40 CFR Part

143) or subsequent revisions. The maximum allowable concentrations of toxic or deleterious substances also must not exceed acute or chronic problem levels as revealed by bio-assay or other methods. The values listed in EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379) shall be used as a guide to determine problem levels unless local conditions make these values inappropriate. In accordance with section 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.

(3) The board hereby adopts and incorporates by reference "EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379)", which set forth water quality criteria for toxic or other deleterious substances. Copies of this document may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana, 59620. (History: Sec. 75-5-301 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.)

16.20.620 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) For waters classified B-3 the following specific water quality standards shall not be violated by any person:

(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 5.0 milligrams per liter.

(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) Concentrations of toxic or other deleterious substances which would remain in the water after conventional water treatment must not exceed the maximum contaminant levels set forth in the 1975 National Interim Primary Drinking Water Standards (40 CFR Part 141) or subsequent revisions or the 1979 National Secondary Drinking Water Standards (40 CFR Part 143). The maximum allowable concentrations of toxic or deleterious substances also must not exceed acute or chronic problem levels as revealed by bio-assay or other methods. The values listed in EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379) shall be used as a guide to determine problem levels unless local conditions make these values inappropriate. In accordance with section 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.

(3) The board hereby adopts and incorporates by reference 40 CFR Part 141, which sets forth the 1975 National Interim Primary Drinking Water Standards, and 40 CFR Part 143, which sets forth the 1979 National Secondary Drinking Water Standards. Copies of 40 CFR Part 141 and 40 CFR Part 143 may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana, 59620.

(4) The board hereby adopts and incorporates by reference "EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379)", which set forth water quality criteria for toxic or other deleterious substances. Copies of this document may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana, 59620. (History: Sec. 75-5-301 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.)

16.20.621 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) For waters classified C-1 the following specific water quality standards shall not be violated by any person:

(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 7.0 milligrams per liter.

(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) Concentrations of toxic or deleterious substances must not exceed levels which render the waters harmful, detrimental or injurious to public health. The maximum allowable concentrations of toxic or deleterious substances also must not exceed acute or chronic problem levels as revealed by bioassay or other methods. The values listed in EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379) shall be used as a guide to determine problem levels unless local conditions make these values inappropriate. In accordance with section 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.

(i) In the segment of the Clark Fork River classified C-1, the parameter limits set forth below apply rather than the limits listed for these parameters in EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379):

Parameter	Maximum Instantaneous Concentration ug/l
Total copper	90
Total zinc	300
Total iron	1300
Total lead	100
Total cadmium	10
Total arsenic	50
Total mercury	1

(3) The board hereby adopts and incorporates by reference "EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379)", which set forth water quality criteria for toxic or other deleterious substances. Copies of this document may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana, 59620. (History: Sec. 75-5-301 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.)

16.20.622 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) For waters classified C-2 the following specific water quality standards shall not be violated by any person:

(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 7.0 milligrams per liter from October 1 through June 1 nor below 6.0 milligrams per liter 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) Concentrations of toxic or deleterious substances must not exceed levels which render the waters harmful, detrimental or injurious to public health. The maximum allowable concentrations of toxic or deleterious substances also must not exceed acute or chronic problem levels as revealed by bio-assay or other methods. The values listed in EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379) shall be used as a guide to determine problem levels unless local conditions make these values inappropriate. In accordance with section 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.

(i) In the segment of the Clark Fork River classified C-2, the parameter limits set forth below apply rather than the limits listed for these parameters in EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379):

Parameter	Maximum Instantaneous Concentration ug/l
Total copper	90
Total zinc	300
Total iron	2200
Total lead	100
Total cadmium	10
Total arsenic	50
Total mercury	1

(3) The board hereby adopts and incorporates by reference "EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379)", which set forth water quality criteria for toxic or other deleterious substances. Copies of this document may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana, 59620. (History: Sec. 75-5-301 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.)

16.20.623 E CLASSIFICATION (1) Waters classified E are suitable for agricultural and industrial water uses other than food processing.

(2) For waters classified E the following specific water quality standards shall not be violated by any person:

(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 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 above 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) Concentrations of toxic or deleterious substances, pathogens, pesticides and organic and inorganic materials including heavy metals must be less than those demonstrated to be deleterious to livestock or plants or to humans who may consume such livestock or plants or to adversely affect other indicated uses. (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, 1980 MAR p. 2252, Eff. 8/1/80; AMD, 1982 MAR p. 1746, Eff. 10/1/82.)

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) For waters classified C-3 the following specific water quality standards shall not be violated by any person:

(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 5.0 milligrams per liter.

(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) Concentrations of toxic or other deleterious substances which would remain in the water after conventional water treatment must not exceed the maximum contaminant levels set forth in the 1975 National Interim Primary Drinking Water Standards (40 CFR Part 141). The maximum allowable concentrations of toxic or deleterious substances also must not exceed acute or chronic problem levels as revealed by bio-assay or other methods. The values listed in EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379) shall be used as a guide to determine problem levels unless local conditions make these values inappropriate. In accordance with section 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.

(3) The board hereby adopts and incorporates by reference "EPA Water Quality Criteria documents (Federal Register Vol. 45, No. 231, Friday, November 28, 1980, pages 79318 - 79379)", which set forth water quality criteria for toxic or other deleterious substances. Copies of this document may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana, 59620.

(4) The board hereby adopts and incorporates by reference 40 CFR Part 141, which sets forth the 1975 National Interim Primary Drinking Water Standards, and 40 CFR Part 143, which sets forth the 1979 National Secondary Drinking ater Standards. Copies of 40 CFR Part 141 and 40 CFR Part 143 may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana, 59620. (History: Sec. 75-5-301 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.)

Rules 16.20.625 through 16.20.630 reserved

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<u>16.20.631 TREATMENT STANDARDS</u> (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. <u>et seq.</u> (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. 75-5-301 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 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. 75-5-301 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 76-5-501 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 holding facilities utilized in the processing of ore 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 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 holding facilities operating as of the effective date of this rule utilized in the processing of ore 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. 75-5-301 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.)

16.20.634 MIXING ZONE Discharges to surface waters may be entitled a mixing zone which will have a minimum impact on surface water quality, as determined by the department. (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, 1980 MAR p. 2252, Eff. 8/1/80.)

16.20.635 SAMPLING METHODS 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. 75-5-301 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.)

16.20.641 RADIOLOGICAL CRITERIA (1) No person shall cause radioactive materials in surface waters to:

(a) Be present in any amount which reflects failure in any case to apply all controls which are physically feasible;

(b) Exceed a concentration of 5 pCi/L of total Radium 226 plus Radium 228;

(c) Exceed a concentration of 8 pCi/L of total Strontium 90;

(d) Be present in the water or in sediments in amounts which could cause harmful accumulations of radioactivity in plants, wildlife, stock or aquatic life;

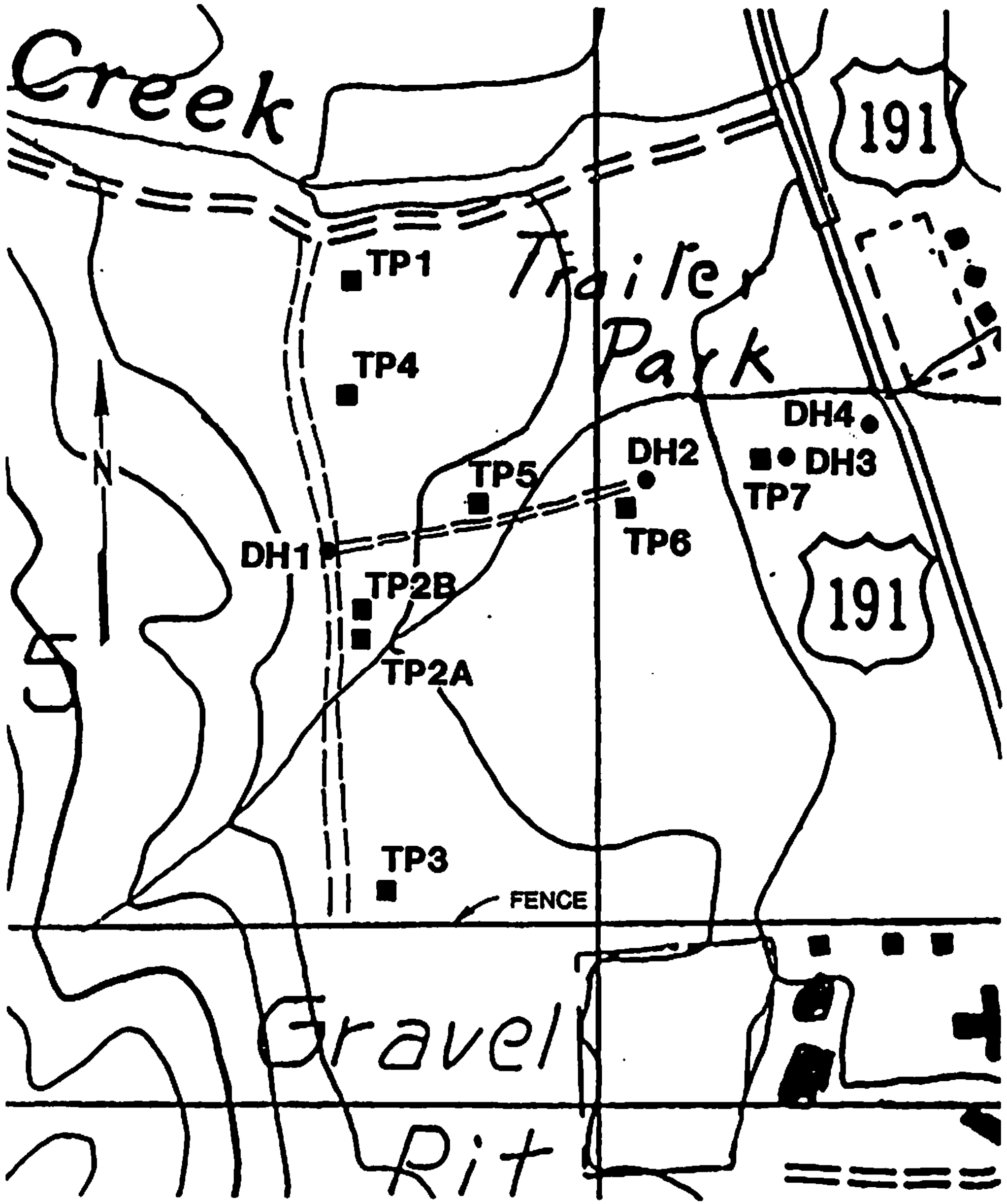
(e) Exceed the radiological limits established in the National Interim Drinking Water Standards (40 CFR Part 141) and subsequent amendments. Copies of the National Interim Drinking Water Standards and subsequent amendments may be obtained from the department. (History: Sec. 75-5-301 MCA; IMP, Sec. 75-5-301 MCA; Eff. 12/31/72; AMD, Eff. 11/4/73; AMD, Eff. 9/5/74; AMD, 1980 MAR p. 2252, Eff. 8/1/80.)

16.20.642 BIOASSAY MEDIAN TOLERANCE CONCENTRATIONS 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. 75-5-301 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.)

16.20.643 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.)

NEXT PAGE IS 16-973

APPENDIX D
DRILL HOLES AT MICHENER CREEK



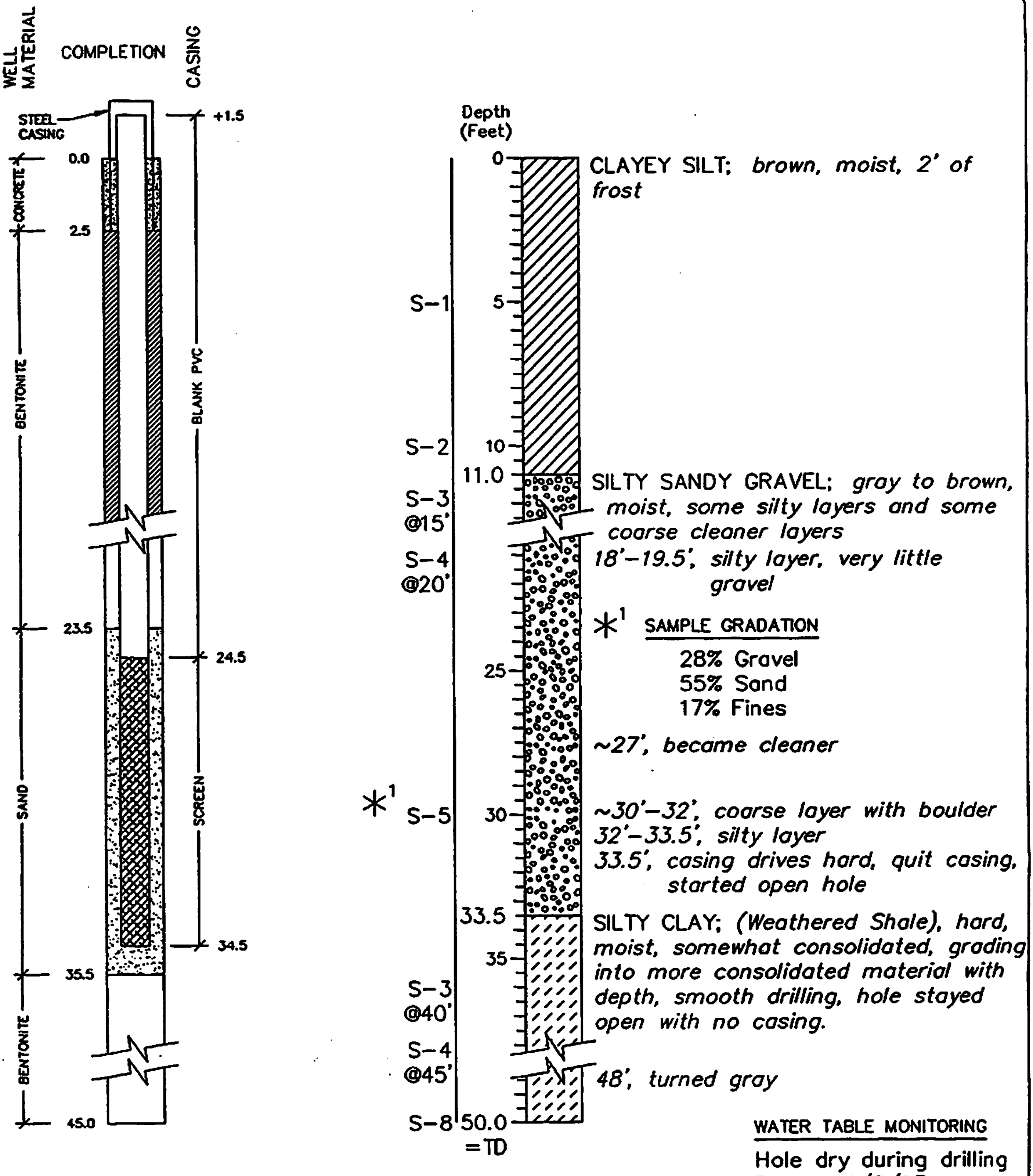
Point	Northing	Easting	Elevation
DH1	10830.8	9681.85	1028.21
DH2	10028.5	9988.41	1003.22
DH3	9835.63	9995.45	971.44
DH4	9595.04	10104.4	960.88
TP1	10915.2	10505.3	1027.03
TP2A	10732.8	9454	1021.54
TP2B	10745.7	9504.2	1021.28
TP3	10527.5	8852.97	1017.15
TP4	10785	10563.6	1018.27
TP5	10479.8	9840.32	1006.68
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



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

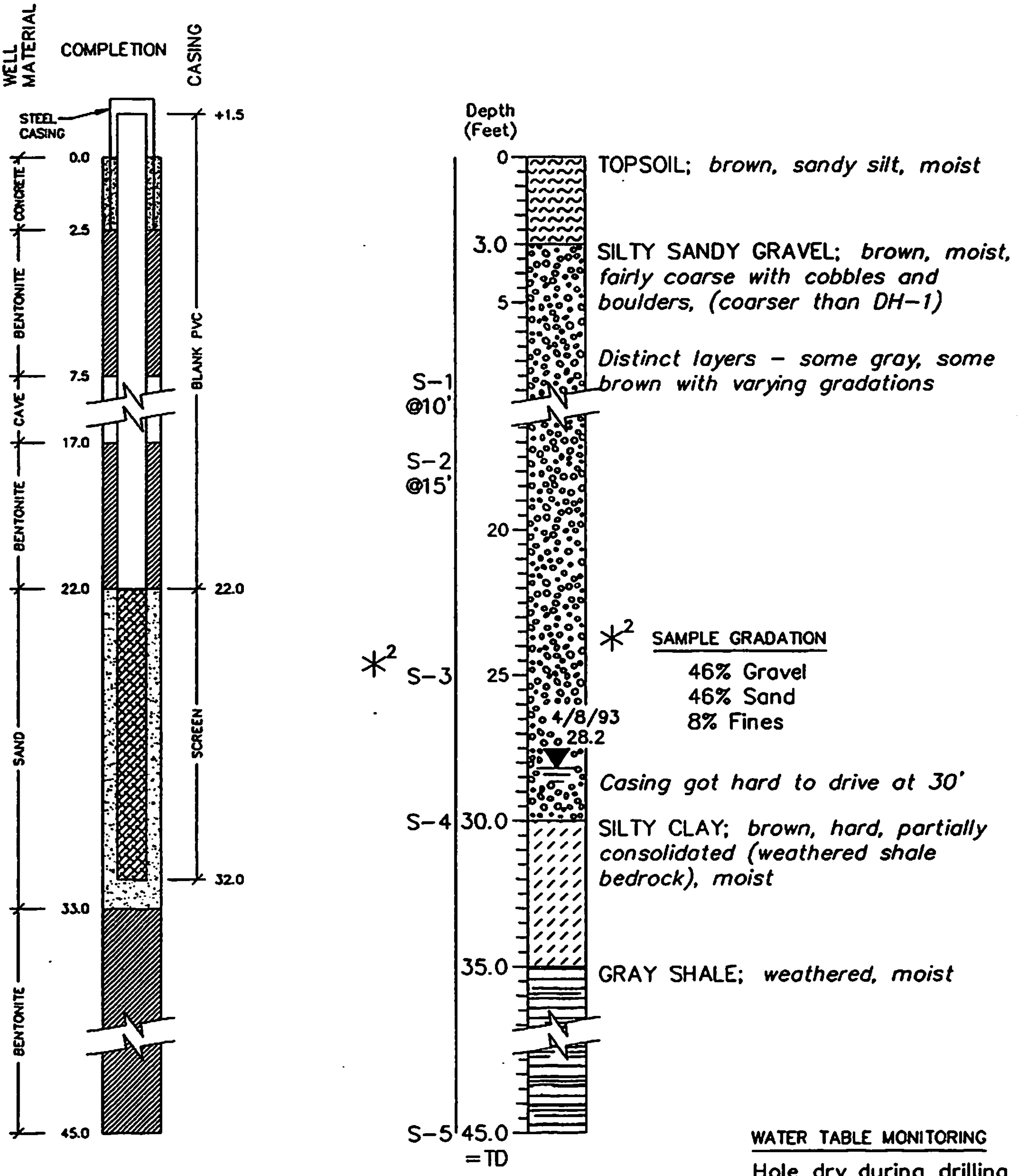
DRILL HOLE 1 (DH-1)

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

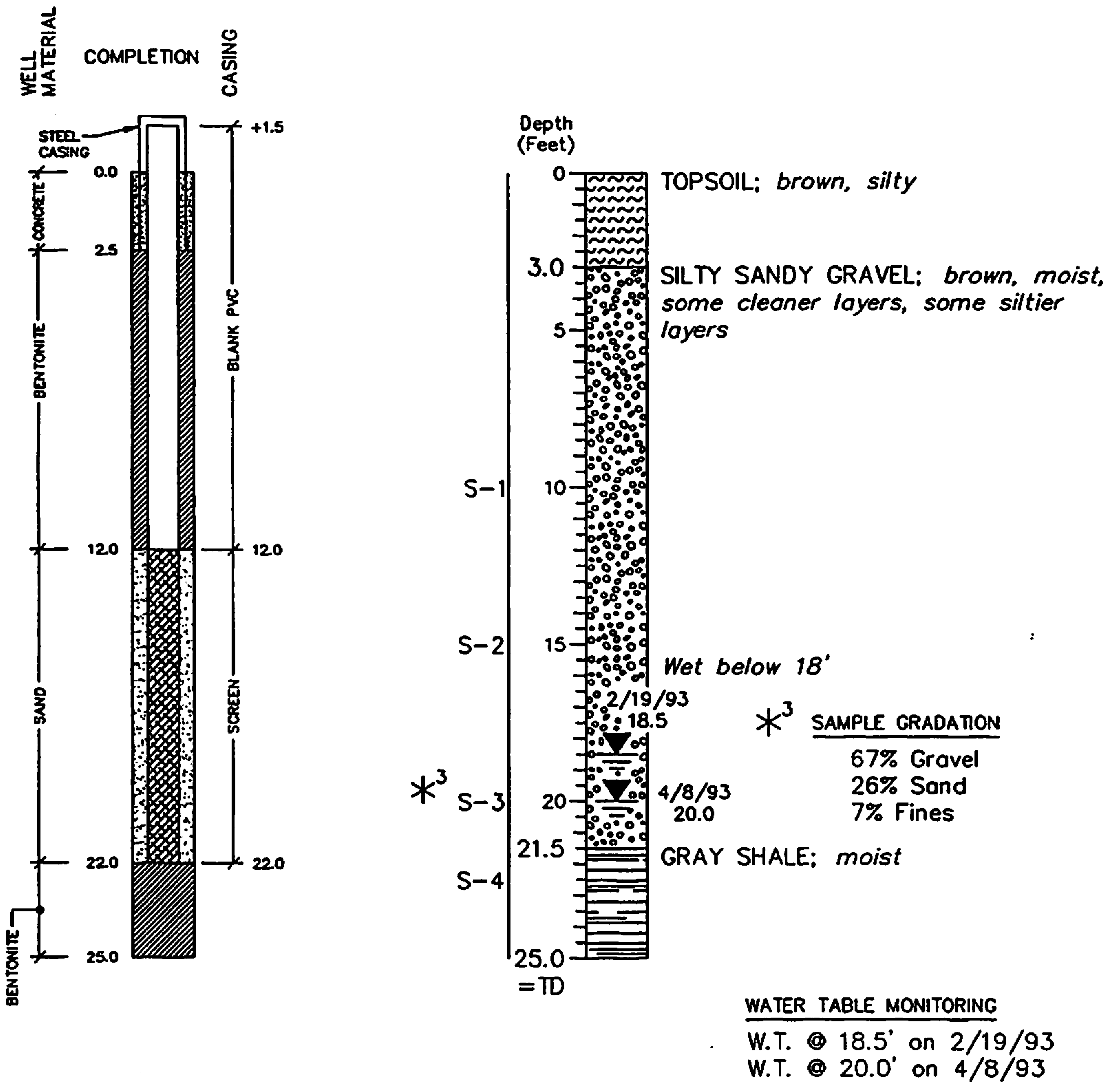
DRILL HOLE 2 (DH-2)

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

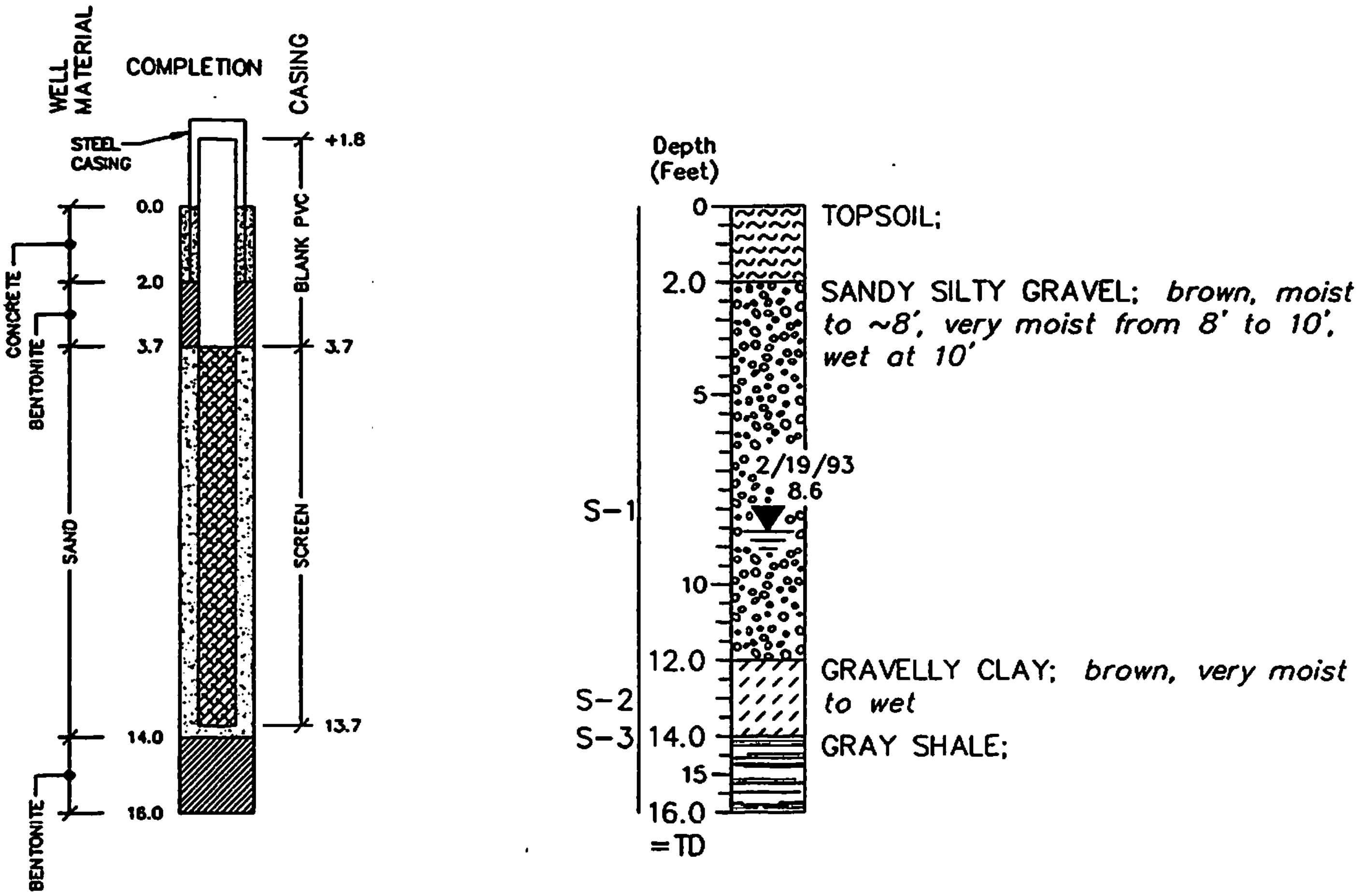
DRILL HOLE 3 (DH-3)

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

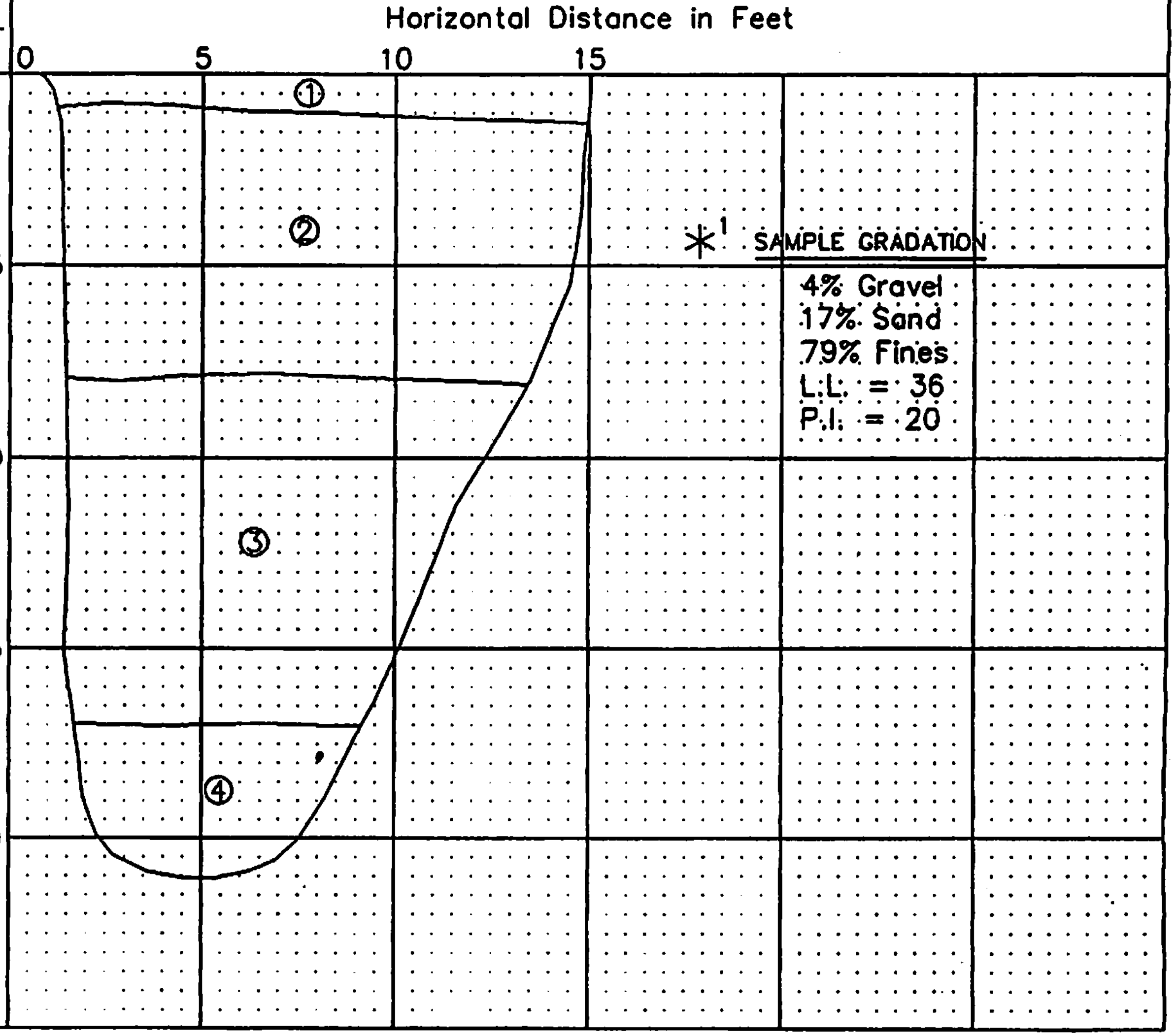
DH-4.DWG

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
④ Dense, brown (mottled FeOx), silty gravel with cobbles, very dirty (~40% fines), rocks are very light, soft (Huckleberry Ridge Tuff?)		17.9	S-3 @11'	
				15
		9.5	S-4 @17'	
		12.8	S-5 @19'	20

Sketch of East Pit Side   Surface Elevation: Approx.



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.DWG

LOG OF BACKHOE TEST PIT

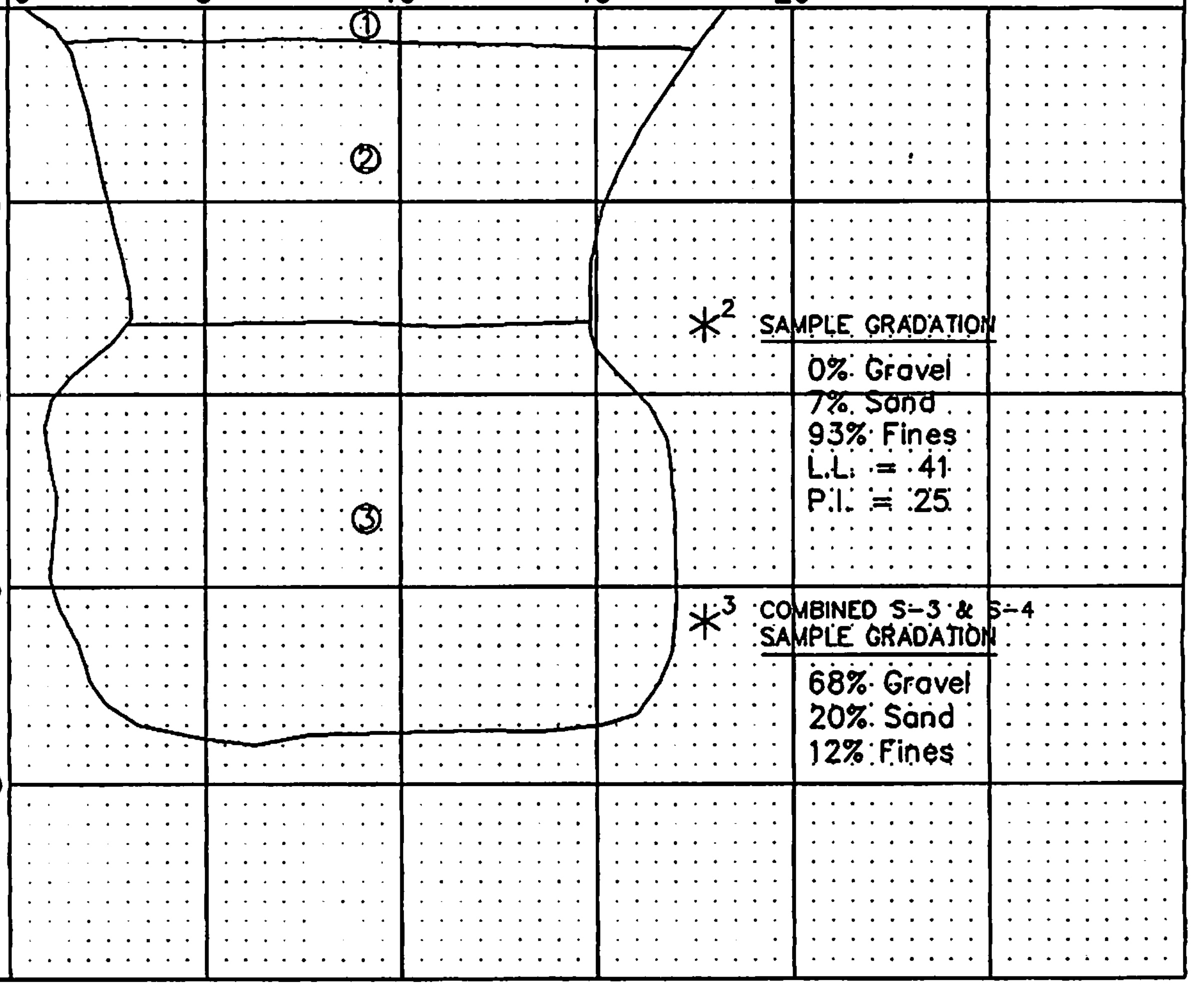
Project Big Sky WWTP   Job No. 4M357.102   Test Pit No. TP-2A

DESCRIPTION OF MATERIALS (Description at Horiz. Sta. ____)	Ground Water	% Water Content	Samples	Depth Ft.
① Brown silt with rocks and organics, frozen (Topsoil)				
② Medium dense, lean clay, moist, with occasional pebbles (very few), varigated				5
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'.		24.2	S-1 @6'	
			*2	
				10
		7.1	S-2 @14'	
				15
		7.2	S-3 @16'	
			*3	
		6.3	S-4 @19'	
				20

Sketch of East Pit Side   Surface Elevation: Approx.

Horizontal Distance in Feet

0 5 10 15 20



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

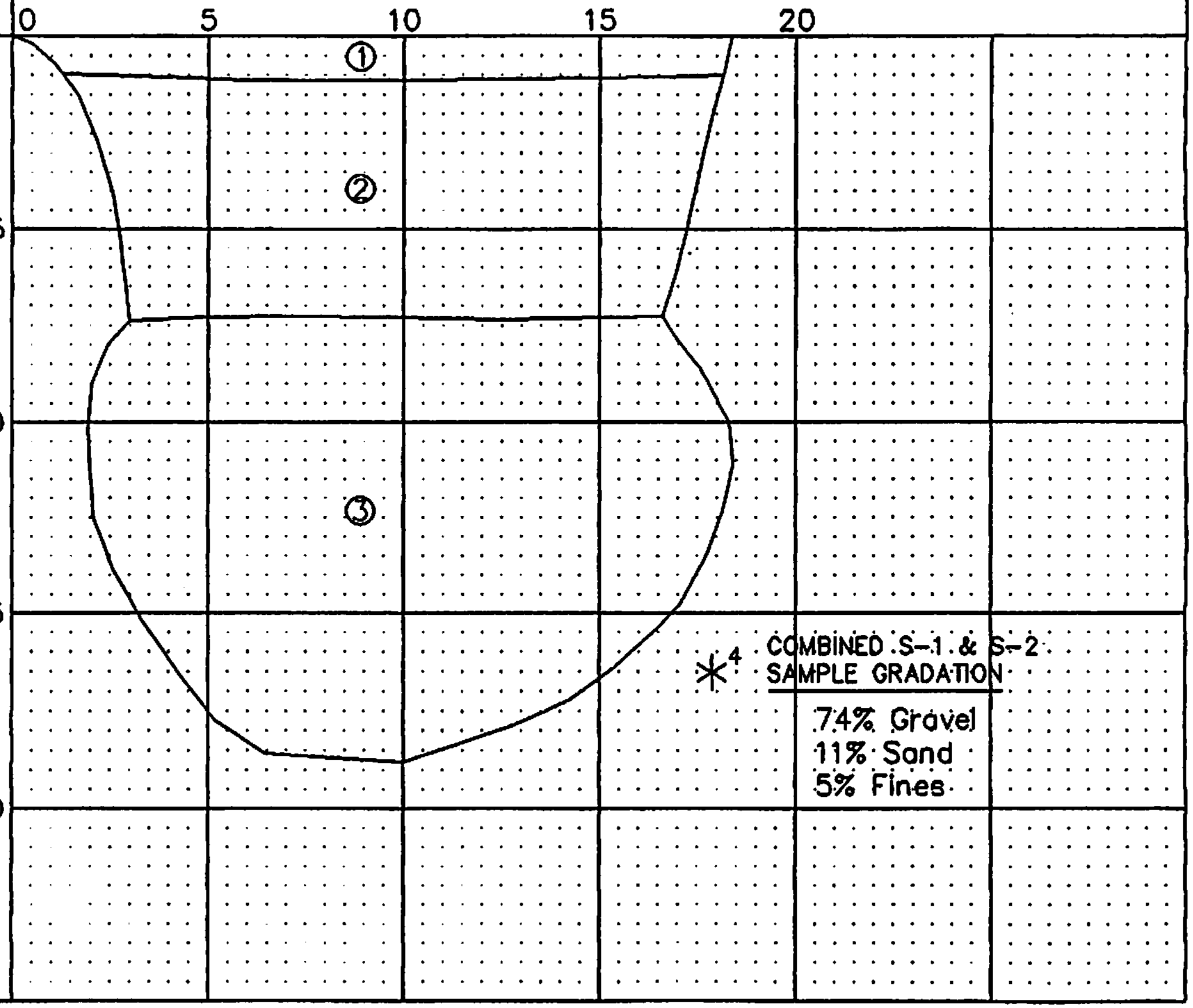
LOG OF BACKHOE TEST PIT

Project Big Sky WWTP   Job No. 4M357.102   Test Pit No. TP-3

DESCRIPTION OF MATERIALS (Description at Horiz. Sta. ____)	Ground Water	% Water Content	Samples	Depth Ft.
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			S-1 @12' $*^4$ S-2 @19'	5 10 15 20

Sketch of North Pit Side   Surface Elevation: Approx.

Horizontal Distance in Feet



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

4M357.102 | MAR. 1993

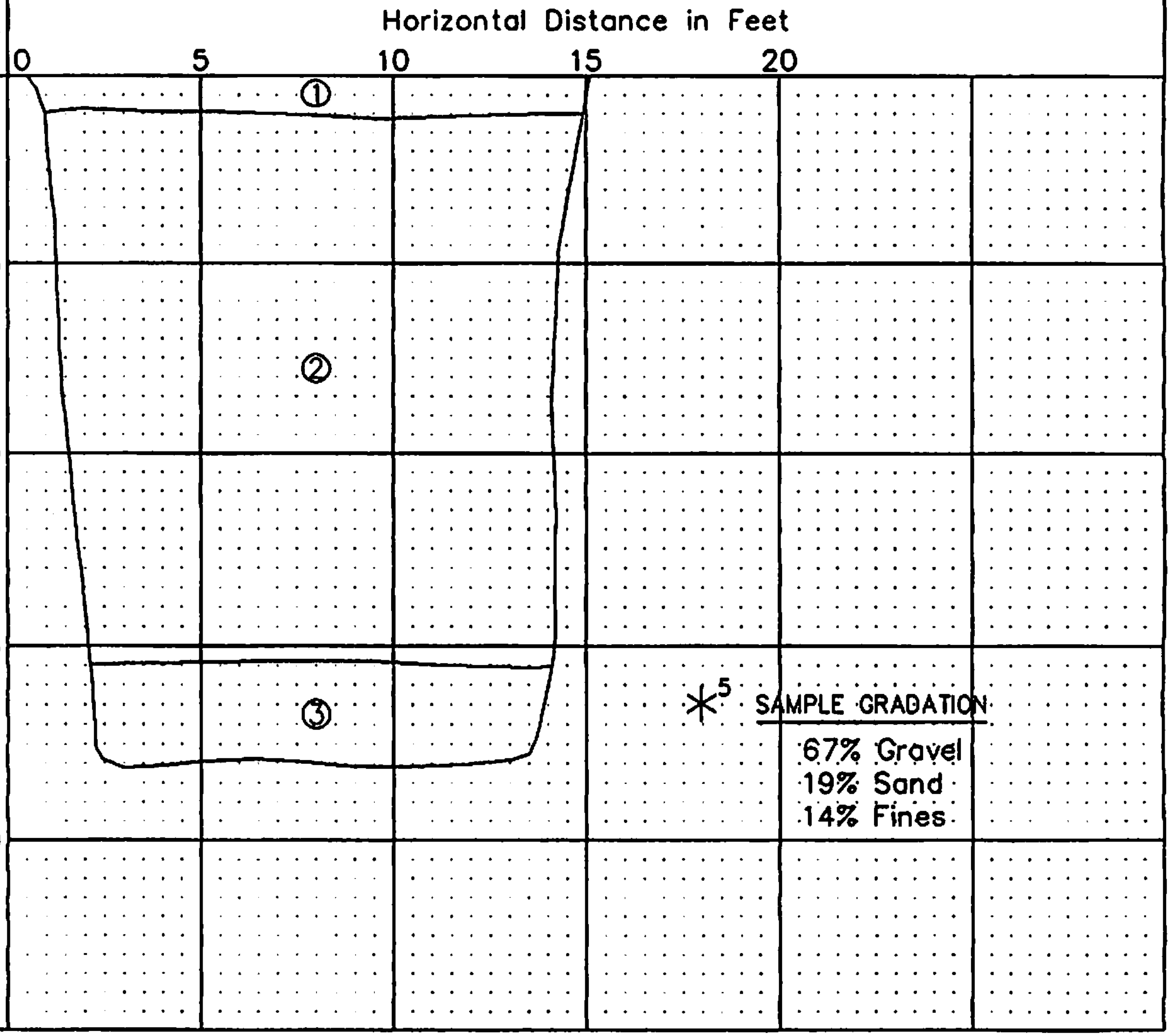
TP-3.DWG

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' ✳5	

Sketch of East Pit Side   Surface Elevation: Approx.



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

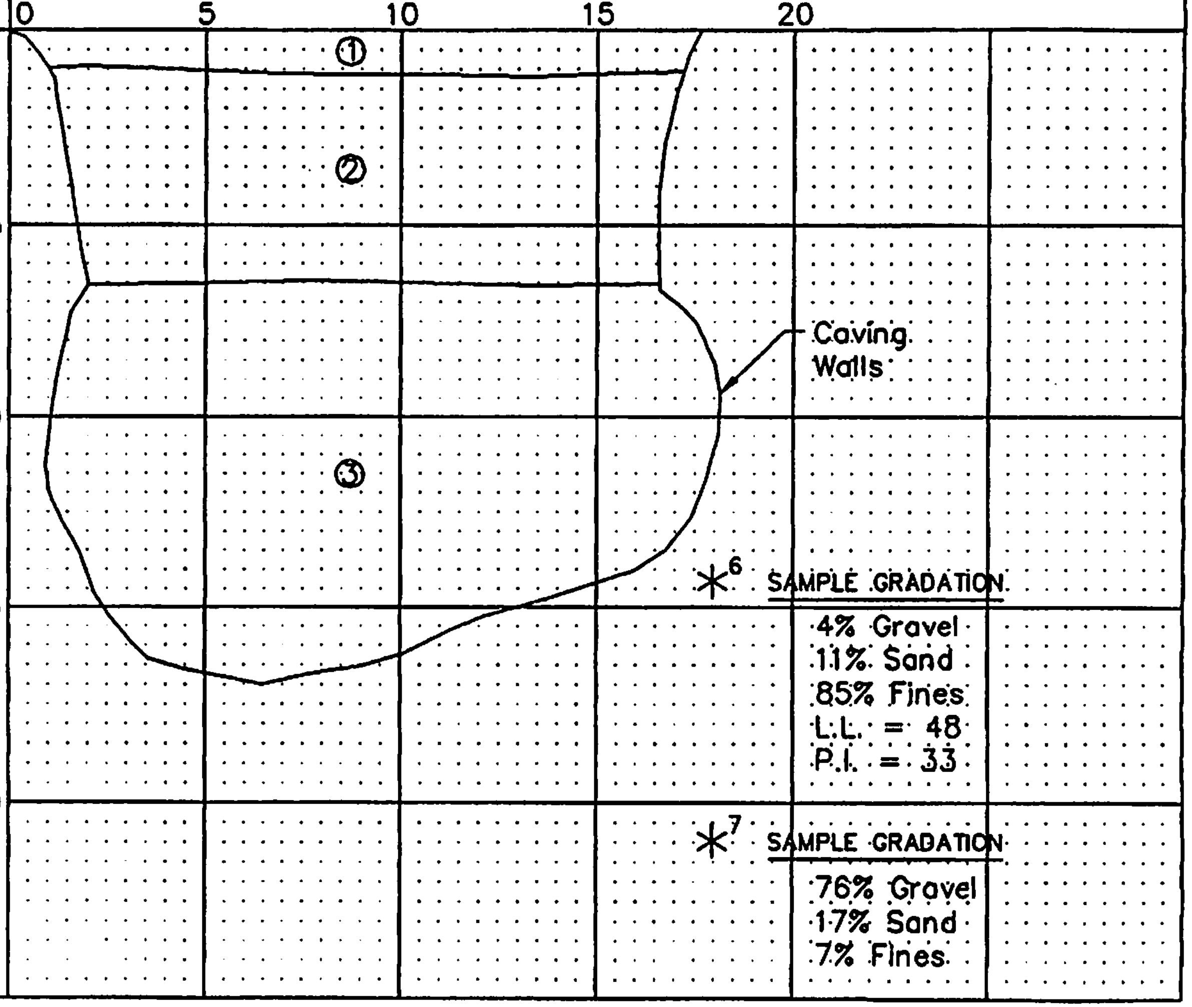
LOG OF BACKHOE TEST PIT

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	
		4.7	S-1 @11' *7	10
				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

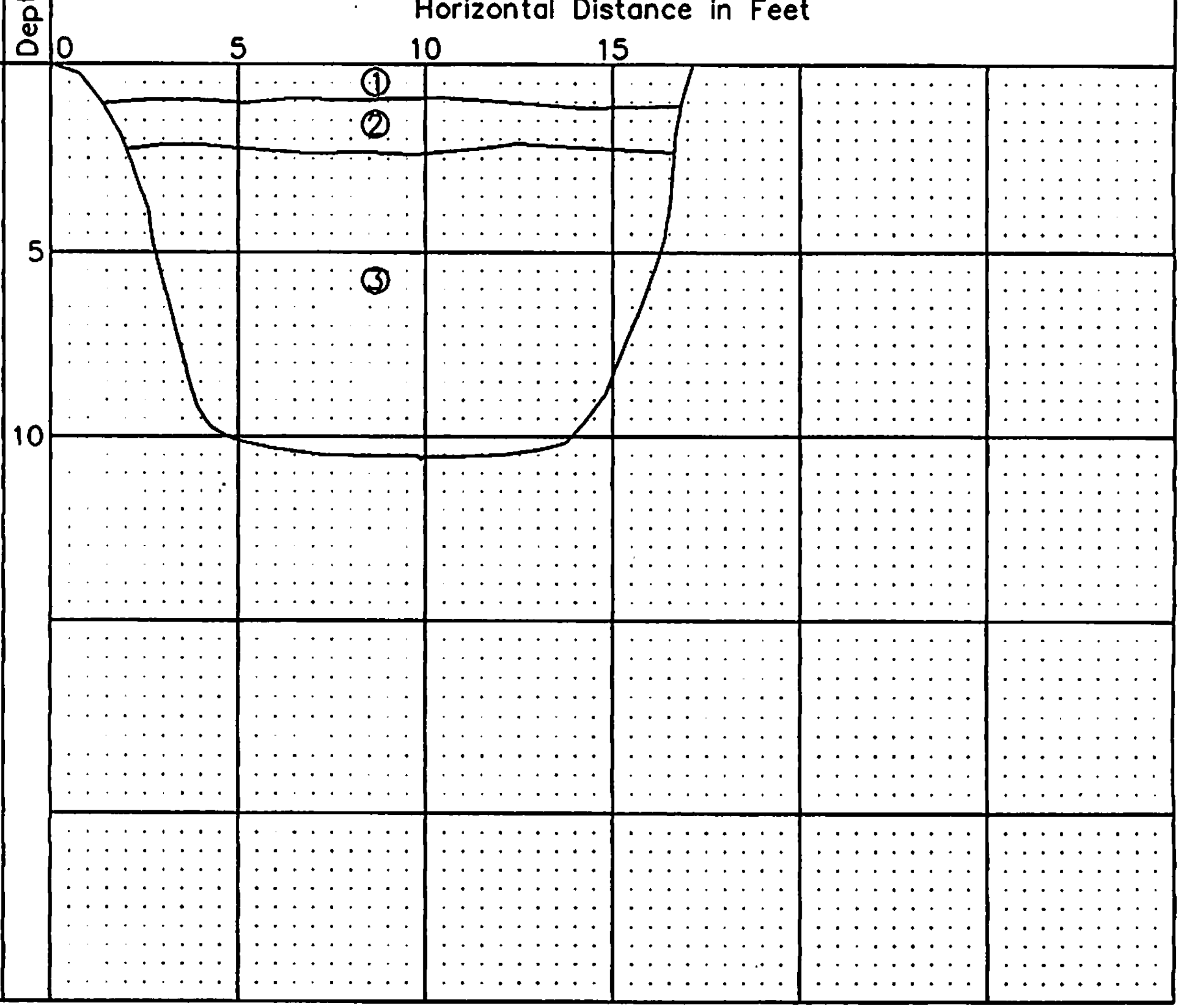
TP-5.DWG

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.				

Sketch of East Pit Side   Surface Elevation: Approx.



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

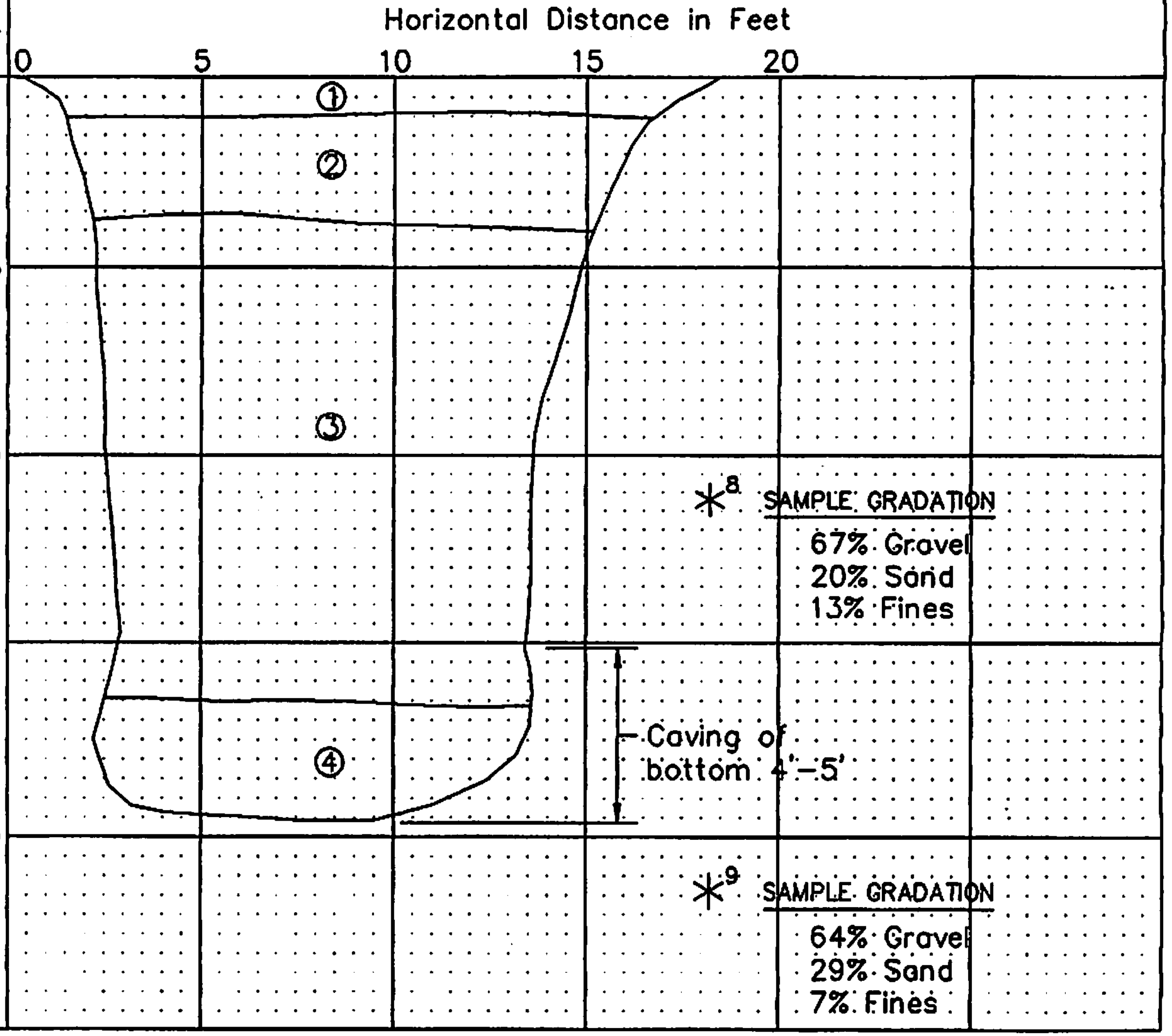
TP-6.DWG

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				5
④ Very dense, sandy gravel with cobbles and boulders, fairly clean, moist				10
			S-1 @16' *8	15
			S-1 @19' *9	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. 1993

TP-7.DWG

APPENDIX E
IMPLEMENTATION PROCEDURES FOR THE NONDEGRADATION POLICY

BEFORE THE BOARD OF HEALTH AND ENVIRONMENTAL SCIENCES
OF THE STATE OF MONTANA

In the matter of the adoption of new rules I through IX and the repeal of rules 16.20.701 through 16.20.705 regarding implementation of the Water Quality Act's nondegradation policy)	SUPPLEMENTAL NOTICE OF ADDITIONAL PUBLIC HEARING AND EXTENDED COMMENT PERIOD ON PROPOSED ADOPTION OF NEW RULES AND REPEAL OF EXISTING RULES (Water Quality Nondegradation)

TO: All Interested Persons

1. On November 24, 1993, the board of health and environmental sciences ("board") published notice at page 2723 of the Montana Administrative Register, Issue No. 22, of the proposed adoption of new rules and repeal of the above-captioned existing rules implementing SB 401, passed by the 1993 legislature.

2. Commenters expressed concern that they could not adequately comment on the references to mixing zones in the proposed nondegradation rules because the rules defining mixing zones had not been published simultaneously with the nondegradation rules. The mixing zone rules have since been developed and are being filed concurrently with this supplemental notice to provide the public the opportunity to review and comment on both the nondegradation rules and the mixing zone rules together.

3. Commentors expressed a desire to be able to comment on the proposed changes to the initially published nondegradation rules. In order to provide the public with the opportunity to review and comment on the board's proposed changes to the originally noticed nondegradation rules, the proposed changes are included in this supplemental notice.

4. Public commentors have requested to review the board's response to comments prepared following the comment period after the initial publication of proposed nondegradation rules published on November 24, 1993. Copies of the board's statement of reasons for and against changes to the November 24th rules are available upon request at the Department of Health and Environmental Sciences, Water Quality Bureau, Cogswell Building, Helena, Montana; those reasons and the comments to which they respond will be included in the final notice of adoption.

5. The rules as proposed to be amended from the version published on November 24, 1993, appear as follows (new material is underlined; material to be deleted is interlined):

<u>RULE I PURPOSE</u> (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.

AUTH: 75-5-301, 75-5-303, MCA; IMP: 75-5-301, MCA

RULE II 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) "Detectable" means the ability to detect a change in the value of a parameter in the receiving water with a 99% level of confidence that the change is greater than zero, based on the procedures which will yield the lowest detection level, either those established in 40 CFR Part 136, as it existed on July 1, 1992, or procedures approved by the department.~~

(3) "Existence value" means the value of the benefit that people may derive from the existence of a resource, without regard to their use or consumption of it.

(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) and does not include class I surface waters (ARM 16.20.623) or class IV ground waters (ARM 16.20.1002(d)).

(9) "Level 2 treatment" means treatment which will remove at least 60% of the nitrogen from the raw state.

~~(9)~~(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.

~~(10)~~ (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 16, chapter 20, subchapter 13.

~~(11)~~ (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 16, chapter 20, subchapter 10.

~~(12)~~ (15) "Nutrients" means total inorganic phosphorus and total inorganic nitrogen.

~~(13)~~ (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~~, where reasonable land, soil, and water conservation practices have been implemented and the discharge does not impact existing or anticipated uses~~;

(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 [Rule VII], [Rule VIII], or 75-5-301(5)(c), MCA.

~~(14)~~ (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) "Opportunity cost" means the value of a resource when used in its highest valued alternate use, regardless of its price or value in its current use.

~~(15)~~ (19) "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, recreational or domestic water supply significance and subsequently have been classified as an ORW by the board.

~~(16)~~ (20) "Permit" means either an MPDES permit or an MGWPCS permit.

(21) "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 or compliance monitoring results to the department unless otherwise specified in a permit, approval or authorization issued by the department.

~~(17)~~ (22) "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.

~~(18)~~ (23) "Toxic parameters" means the parameters listed as toxins in department circular WQB-7 ~~and those parameters for which there are specific numerical limits in the surface water quality standards (ARM 16.20.601 et seq) and the ground water quality standards (ARM 16.20.1001 et seq)~~.

(24) "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.

~~(19)~~ (25) (a) The board hereby adopts and incorporates by reference:

(i) Department circular WQB-7, entitled "Montana Numeri~~cal~~ Water Quality Standards" (19~~93~~ 94 edition), which establishes limits for toxic, carcinogenic, bioconcentrating, and ~~other~~ 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 Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620.

AUTH: 75-5-301, 75-5-303, MCA; IMP: 75-5-303, MCA .

RULE III NONDEGRADATION POLICY--APPLICABILITY AND LIMITATION (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 [RULE VI]. 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 [Rules VII or VIII]. 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 ~~have been~~ shall be achieved the highest statutory and regulatory requirements for all point and nonpoint sources.

(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.

AUTH: 75-5-301, 75-5-303, MCA; IMP: 75-5-303, MCA

RULE IV INFORMATIONAL REQUIREMENTS FOR NONDEGRADATION SIGNIFICANCE/AUTHORIZATION REVIEW (1) Any person proposing an activity which may cause degradation is responsible for compliance with 75-5-303, MCA~~, and may either determine for themselves that the proposed activity will not cause significant changes in water quality, after measuring the activity against the standards contained in [Rules VII or VIII], or submit an application to the department, pursuant to (2) below, for the department to make the determination~~. A person may either:

(a) determine for themselves, using the standards contained in [Rules VII and VIII], that the proposed activity will not cause significant changes in water quality as defined in [Rule III]; or

(b) submit an application to the department pursuant to (2) below, for the department to make the determination."

(2) Any person proposing an activity or class of activities which may cause degradation 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.

(3) The department will review the application and make a determination whether the proposed change in water quality is nonsignificant according to [RULES VII or VIII] within 60 days of receipt of the completed application.

(4) 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.

(5) 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.

(6) 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.

(7)(a) ~~To~~ In order for the department to determine whether or not 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~~ application shall ~~require~~ include an analysis of the benefits and costs, including external environmental costs of the proposed activity, and including the net present value to society of the proposed activity as measured by the following:

~~(i) an analysis demonstrating the extent to which the proposed activity producing lower water quality would result in important economic or social development; and~~

~~(ii) an analysis demonstrating the present and future costs to society caused by the proposed lowered water quality.~~

(i) the present value of the benefits provided to society by the output of the proposed activity over its useful life; minus

(ii) the present value of the direct resource costs of construction and operation of the proposed activity over its useful life; and minus

(iii) the present value of the external environmental resource costs of the proposed activity over its useful life, including costs persisting after the proposed activity has ceased; and

(iv) an analysis of the loss or costs to society resulting from the lower water quality.

~~(b) Factors which may be considered in the above analyses include, but are not limited to, changes, during and after the activity, in any of the categories listed below:~~

~~(i) employment;~~
~~(ii) production;~~
~~(iii) fiscal balance of the state or local government;~~
~~(iv) effects on public health or environment;~~
~~(v) housing;~~
~~(vi) resource utilization and depletion;~~
~~(vii) intrinsic values;~~
~~(viii) opportunity values; or~~
~~(ix) social or cultural values.~~

(b) Factors which should be considered in the analyses in (a) above include, but are not limited to, changes in any of the categories listed below:

(i) the value society places on the output to be produced by the proposed activity;

(ii) uncertainty in each of the factors that make up (a)(i) through (iv);

(c) Factors which also may be considered in the analyses in (a)(iii) and (iv) above include, but are not limited to, changes in any of the categories listed below:

(i) employment dependent on existing water quality;
(ii) effects on public health and the environment;
(iii) resource utilization and depletion;
(iv) existence values; or
(v) opportunity costs;

(8) 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.

(9) 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.

(10) Any application submitted pursuant to this subchapter must comply with the signature and certification requirements of ARM 16.20.1311.

(11) 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.

(12) The board hereby adopts and incorporates by reference ARM 16.20.1311, which sets forth signature and certification requirements for MPDES permit applications. A copy of ARM 16.20.1311 may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, MT 59620.

AUTH: 75-5-301, 75-5-303, MCA; IMP: 75-5-303, MCA

<u>RULE V DEPARTMENT PROCEDURES FOR NONDEGRADATION REVIEW</u>

(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 [Rule VI].

(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) below. 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) In determining economic feasibility:

(i) any non-degrading or less-degrading alternative water quality protection practices which are less than ~~110~~ <u>125</u>% of the present worth of capital and operating costs of the water quality protection practices proposed by the applicant will be rebuttably considered economically feasible without further assessment by the department;

(ii) for any non-degrading or less-degrading alternative water quality protection practices which are equal to or exceed ~~110~~ 125% of the present worth of capital and operating costs of the water quality protection practices proposed by the applicant, the department will determine the economic feasibility of the alternative water quality protection practices by ~~considering any relevant factors~~ evaluating the benefits of the additional resulting water quality and the amount of the private net benefits with and without the alternative water quality protection practices.

(b) In order to determine the environmental feasibility of an alternative, the department will consider whether such alternative practices are available ~~and consistent with the protection of the environment and public health~~ 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 ~~shall consider the following~~ must find, based on an analysis of the benefits and costs, including external environmental costs of the proposed activity and of the benefits of the existing water quality:

~~(i) an analysis of the extent to which the proposed activity would result in important economic or social development, including an analysis of the costs and benefits to society.~~

~~(ii) an analysis of the loss or costs to society resulting from the lower water quality.~~

(i) that the benefits of the proposed activity are reasonably likely to significantly exceed the sum of all its costs, including the costs of lowered water quality;

(ii) that the risk inherent in finding (i) above is reasonable, given the uncertainty in benefits and costs.

~~(b) Factors which may be considered in the analyses in (a) above include, but are not limited to changes in any of the categories listed below:~~

~~(i) employment;~~
~~(ii) production;~~
~~(iii) fiscal balance of the state or local government;~~
~~(iv) effects on public health or environment;~~
~~(v) housing;~~
~~(vi) resource utilization and depletion;~~
~~(vii) intrinsic values;~~

~~(viii) opportunity values; or~~
~~(ix) social and cultural values.~~

(b) In making these findings the department shall consider the net present value to society of the proposed activity as measured by:

(i) the present value of the benefits provided to society by the output of the proposed activity over its useful life; minus

(ii) the present value of the direct resource costs of construction and operation of the proposed activity over its useful life; and minus

(iii) the present value of the external environmental resource costs of the proposed activity over its useful life, including costs persisting after the proposed activity has ceased; and

(iv) an analysis of the loss or costs to society resulting from the lower water quality.

(c) Factors which should be considered in the analyses in (a) and (b) above include, but are not limited to, changes in any of the categories listed below:

(i) the value society places on the output to be produced by the proposed activity;

(ii) uncertainty in each of the factors that make up (b)(i) through (iv);

(d) Factors which also may be considered in the analyses in (b)(iii) and (iv) above include, but are not limited to, changes in any of the categories listed below:

(i) employment dependent on existing water quality;

(ii) effects on public health and the environment;

(iii) resource utilization and depletion;

(iv) existence values; or

(v) opportunity costs;

(e) In making the finding in (4)(a), the department shall weigh those factors that are reasonably quantifiable, and must find that the magnitudes of the unquantifiable factors are not likely to reverse the finding.

(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.
AUTH: 75-5-301, 75-5-303, MCA; IMP: 75-5-303, MCA

<u>RULE VI DEPARTMENT PROCEDURES FOR ISSUING PRELIMINARY AND FINAL DECISIONS REGARDING AUTHORIZATIONS TO DEGRADE</u> (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 description 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 16.20.1334; and

(b) Procedures for the distribution of information set forth in ARM 16.20.1021.

(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 16.20.1334, which sets forth procedures for issuing public notices of MPDES permit applications and hearings, and ARM 16.20.1021 which sets forth requirements for distribution and copying of public notices and permit applications. Copies of ARM 16.20.1334 and 16.20.1021 may be obtained from the Water Quality Bureau, Department of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana 59620.
AUTH: 75-5-301, 75-5-303, MCA; IMP: 75-5-303, MCA

<u>RULE VII 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) below, 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 ~~annual~~ monthly flow of a surface water by less than 15% or the 10 year 7-day low flow by 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 ~~total inorganic phosphorus~~ nutrients, except as specified in (d) and (e) below, which will not cause ~~detectable increases from the existing water quality~~ changes that equal or exceed the trigger values in department circular WQB-7 outside of a mixing zone designated by the department;

(d) Changes in the concentration of nitrogen in ground water which will not impair existing or anticipated beneficial uses, where water quality protection practices approved by the department, referenced as level 2 treatment in Table I below, have been fully implemented, and where the sum of the resulting concentrations of nitrate, nitrite, and ammonia, all measured as nitrogen, outside of any applicable mixing zone designated by the department, will not exceed ~~2.50 milligrams per liter~~ the values given in the table below, as long as such changes will not result in ~~a detectable change~~ increases greater than 0.01 milligrams per liter in the nitrogen concentration in any perennial surface water;

See next page for Table I

[Note: Table I is new material.]

Table I

EXISTING NITROGEN CONCENTRATION IN GROUND WATER	PRIMARY SOURCE OF EXISTING NITROGEN	NITROGEN CONCENTRATION AFTER THE PROPOSED ACTIVITY	REQUIREMENTS FOR NONSIGNIFICANCE
< 2.5 MG/L	HUMAN WASTE	<2.5 MG/L	NONE
		>2.5 <5.0 MG/L	LEVEL 2 TREATMENT
	OTHER	<5.0 MG/L	NONE
		>5<10 MG/L	SIGNIFICANT
2.5-5.0 MG/L	HUMAN WASTE	<5 MG/L	LEVEL 2 TREATMENT
		>5<10	SIGNIFICANT
	OTHER	<5	NONE
		>5<7.5	LEVEL 2 TREATMENT
		>7.5>10	SIGNIFICANT
5.0-7.5	HUMAN WASTE	ANY INCREASE	SIGNIFICANT
	OTHER	<7.5	NONE
		>7.5<10	SIGNIFICANT
>7.5	ANY	ANY INCREASE	SIGNIFICANT
		>10	NOT ALLOWED, VIOLATES STANDARDS
ANY LEVEL	ANY	NO CHANGE	NOT SIGNIFICANT

(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 fifty 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) 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 ~~not~~ 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 16.20.1334.

AUTH: 75-5-301, 75-5-303, MCA; IMP: 75-5-303, MCA

RULE VIII CATEGORIES OF ACTIVITIES THAT CAUSE NONSIGNIFICANT CHANGES IN WATER QUALITY (1) The following categories or classes of activities have been determined by the department to cause changes in water quality that are nonsignificant 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 on land 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~~ response 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 ~~16.21.601, et seq. and ARM 16.21.801, et seq~~ Title 36, chapter 21);

(e) Short-term changes in existing water quality ~~which last less than 60 days~~ resulting from activities authorized by the department pursuant to 75-5-308, MCA;

(f) ~~Domestic sewage treatment systems which discharge to ground water and which are designed, constructed, and operated in accordance with applicable department standards (ARM 16.16.302, 16.16.304, and/or 16.20.401); and where the resulting concentration, outside of any applicable mixing zones designated by the department, will not exceed 2.50 mg/l (nitrogen compounds measured as nitrogen) as long as the changes caused by such systems will not result in a detectable change in the nitrogen concentration in any perennial surface water;~~ Activities which cause increases in the concentration of nitrogen in ground water which do not exceed those listed as nonsignificant in the table in Rule VII(1)(d) and the changes caused by such activities will not result in a change in the nitrogen concentration in any perennial surface water which exceeds the trigger values listed in department circular WQB-7;

~~(g) Domestic sewage treatment systems in areas in which the existing nitrogen concentration in ground water is over 2.50 mg/l; which discharge to ground water an effluent with nitrogen concentrations no greater than 30 mg/l or at least 50% nitrogen removal from the raw state; and where the resulting concentration, outside of any applicable mixing zone designated by the department, will not exceed 5.00 mg/l (nitrogen compounds measured as nitrogen), as long as the changes caused by such systems will not result in a detectable change in the nitrogen concentration in any perennial surface water;~~

~~(h)~~(g) Land application of animal waste, domestic septage, or waste from public sewage treatment systems or other wastes containing nutrients where wastes are land applied in a beneficial manner, application rates are based on ~~a complete~~ agronomic uptake of applied nutrients and other parameters will not cause degradation;

~~(i)~~(h) Incidental leakage of water from a public water supply system as defined in 75-6-102(12), MCA, or ~~wastewater from sources~~ 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 16.20.401-405.

~~(j)~~(i) 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;

~~(k)~~(j) Oil and gas drilling, production, abandonment, plugging, and restoration activities performed in accordance with ARM ~~36.22.101, et seq.~~ Title 36, chapter 22;

~~(l)~~ (k) 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;

~~(m)~~ (l) Coal and uranium prospecting performed in accordance with ARM 26.4.1001, et seq.

(m) Solid waste management systems, motor vehicle wrecking facilities, and county motor vehicle graveyards licensed and operating in accordance with ARM Title 16, chapter 14;

(n) Hazardous waste management facilities permitted and operated in accordance with ARM Title 16, chapter 44.

(o) Discharges of storm water in conformance with a permit issued by the department under the storm water permit program (ARM 16.20.1301 et seq.)

(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) above.

AUTH: 75-5-301, 75-5-303, MCA; IMP: 75-5-303, MCA

RULE IX 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.

AUTH: 75-5-301, 75-5-303, MCA; IMP: 75-5-303, MCA

6. Rules 16.20.701 through 16.20.705, which can be found on pages 16-973 through 16-979 of the Administrative Rules of Montana, are proposed to be repealed because they are being completely replaced by the proposed new rules contained in this notice.

AUTH: 75-5-201, MCA; IMP: 75-5-303, 75-5-401

7. The board is extending until May 27, 1994, the time for public comment on the proposed new rules and repeal of existing rules contained in this notice in order for the public to comment on the agency's proposed changes to the rules in conjunction with the mixing zone rule. A public hearing will be held on the proposed rules and repeal of rules contained in this notice on May 20, 1994, at 9:00 a.m., in Room C209 of the Cogswell Building. Interested persons may present their data, views or arguments, either orally or in writing, at the hearing. Written data, views or arguments may also be submitted to Yolanda Fitzsimmons, Board of Health and Environmental Sciences, Cogswell Building, Capitol Station, Helena, Montana, no later than May 27, 1994.

8. W.D. Hutchison has been designated to preside over and

conduct the hearing.

RAYMOND W. GUSTAFSON, Chairman
BOARD OF HEALTH AND
ENVIRONMENTAL SCIENCES

By William J Gertz
for ROBERT J. ROBINSON, Director

Certified to the Secretary of State April 4, 1994.

Reviewed by:

Eleanor A. Parker
Eleanor Parker, DHES Attorney

APPENDIX F

SURFACE WATER QUALITY DATA

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

	1970		1971		1972		1973		1974	
Sites	#	mean	#	mean	#	mean	#	mean	#	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^{++})

	1970		1971		1972		1973		1974	
Site	#	mean	#	mean	#	mean	#	mean	#	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/l Mg^{++})

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 #	1970 mean	1971 #	1971 mean	1972 #	1972 mean	1973 #	1973 mean	1974 #	1974 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/l 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		1971		1972		1973		1974	
	#	mean	#	mean	#	mean	#	mean	#	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	WG16
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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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

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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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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	LAB NO.:	94-12646
ADDRESS:	Water & Sewer Dist. #363	DATE:	04/11/94 lm
	P.O. Box 160057		
	Big Sky, MT 59716		

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

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 Dist. #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-12647
DATE: 04/11/94lm

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".

ENERGY LABORATORIES

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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 Analyzed
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	03/30/94
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	04/01/94
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	04/06/94
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	04/04/94
Chloride	29	29	112	<1	52	45-55	03/31/94
Total Dissolved Solids @ 180° C	324	326	98	N/A	N/A	N/A	04/04/94

ENERGY LABORATORIES

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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

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 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

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 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

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 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

ENERGY LABORATORIES

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FAX (406) 252-6069 • 1-800-735-4489

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

ENERGY LABORATORIES

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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

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.: 94-23265
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

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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.: 94-23267
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

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23268
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

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LABORATORY REPORT

TO: Terry Threlkeld
ADDRESS: Water & Sewer District #363
P.O. Box 160057
Big Sky, MT 59716

LAB NO.: 94-23269
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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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.: 94-23270
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 Analyzed
Chloride	36	36	102	3	76	69-85	06/02/94
Total Dissolved Solids @ 180°C	459	460	100	<1	N/A	N/A	05/31/94
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	06/02/94
Ammonia as N	<0.1	<0.1	99	<0.1	2.2	1.87-2.60	06/03/94
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	05/27/94
5-Day Biochemical Oxygen Demand	13	12	N/A	<1	202	168-228	05/26/94

LAB. NO. C. 78?

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 1:30

Owner of Water Source ____

Location of Water Source BIG SKY (Nearest City)

County Gallatin

Type of Supply *(Circle One)* Cistern Well Spring (River) Gallatin River Other *(Please Specify)*

Collector of Sample: Thrilkill Phone No. 995-2660

Person to Receive Report *(Please Print)*:

NAME: Tim Thrilkill / 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) (+) 1/100 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: SLIGHT TURBIDITY

(DK)

Acct

LAB. NO. ...782

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 1:20

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: T. Threlkeld Phone No. 995-2600

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. ..378..

..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) ______ 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 (+)

42/100 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. ...1378...

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 / RID 305

Street or RFD: P.O. BOX 160 66

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

(dz)

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 LABORATORY 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

Collected by: Terry Threlkeld Date: 2/23/94 Hour: 12:01 AM Received: 2-23-94

Operator: Operator Certification No. Reported: 2-26-94

Sample Type*	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	<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 was

( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

✓

DATE NOTIFIED ____

Certified Analyst: [signature]

ONTANA DEPART NT OF HEALTH AND ENVIRONMENTAL SCIENCES
BLIC HEALTH LAB... TORY 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

lected by: Terry Threlkeld Date: 3-16-94 Hour: 9:26 Received: 3-16-94 3pm

ified 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	

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 was

( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately*** ✓

DATE NOTIFIED

*SEE BACK OF FORM FOR EXPLANATION

Certified Analyst: [signature]

ONTANA DEPART ENT OF HEALTH AND ENVIRONMENTAL SCIENCES
UBLIC HEALTH LAB ATORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
06) 444-2642 FAX #(406) 444-1802

lease Press Firmly

REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

WSID: B0000090 CITY/SYSTEM BIG SKY RID 305 FECAL COUNTY: GALLATIN

llected by: Terry Threlkeld Date: 4/25/94 Hour: 9:00 Received: 4-25-94

rtified 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		C18935	X	5 fc/100 ml	
	② N. FORK ABOVE PLANT		C18976		12 fc/100 ml	
	③ N. FORK BELOW PLANT		C18977		12 fc/100	
	④ GALLATIN ABOVE		C18978		12 fc/100	
	⑤ GALLATIN BELOW		C18979		4 fc/100 ml	
	⑥ SOUTH FORK		C18980		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 was

( ) Satisfactory at this time ✓
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED

Certified Analyst: DP

*SEE BACK OF FORM FOR EXPLANATION

MONTANA 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

Please Press Firmly

REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

300000 90

WSID: BIG SKY CITY/SYSTEM: WSD 363 FECAL GALLATIN COUNTY: 995-4166

Collected by: TERRY THRELKELD Date: 5/25/94 Hour: ——

Received: 5-25-94
Reported: 5/28/94

Certified 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) N. FORK ABOVE MEADOW		021176	turbid	6/100	
	(8) N. FORK BELOW MEADOW		021177	turbid	3/100	
	(9) N. FORK BELOW PLANT		021178	turbid	6/100	
	(10) S. FORK		021179	Slightly turbid	<1/100mls	
	(11) GALLATIN BELOW		021180	Slighty turbid	1/100	
	(12) GALLATIN ABOVE		02118[illegible]	turbid	12/100	

System Contract No. 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 wa

( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED

Certified Analyst: JT

*SEE BACK OF FORM FOR EXPLANATION

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

(M) C MB PC

RECEIVED AT LAB: 2-17-94 ...

ANALYZED: ... 7:30

ANALYZED BY: ...

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

GROUND WATER QUALITY DATA
FROM 1972 AND 1994

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	.03	.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)

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 District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4873
DATE: 02/14/94 jmw

WATER ANALYSIS

Well No. 7 1
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

ENERGY LABORATORIES

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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.: 94-4872
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

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 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

ENERGY LABORATORIES

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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.: 94-4871
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

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 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. 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

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 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 ~~A~~ 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

ENERGY LABORATORIES

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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.: 94-4869
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

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 District 305
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-4868
DATE: 02/14/94 jmw

WATER ANALYSIS

Well No. ~~1~~ 1
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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FAX (406) 252-6069 • 1-800-735-4489

√

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
ADDRESS: Water & Sewer Dist. #363
P.O. Box 57
Big Sky, MT 59716

LAB NO.: 94-7390
DATE: 03/16/94 lm

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 Nitrite 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	LAB NO.:	94-7389
ADDRESS:	Water & Sewer Dist. #363	DATE:	03/16/94 lm
	P.O. Box 57		
	Big Sky, MT 59716		

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	LAB NO.:	94-7391 spi
ADDRESS:	Water & Sewer Dist. #363	DATE:	03/16/94 lm
	P.O. Box 57		
	Big Sky, MT 59716		

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	LAB NO.:	94-7392
ADDRESS:	Water & Sewer Dist. #363	DATE:	03/16/94 lm
	P.O. Box 57		
	Big Sky, MT 59716		

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	LAB NO.:	94-7395
ADDRESS:	Water & Sewer Dist. #363 P.O. Box 57 Big Sky, MT 59716	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	LAB NO.:	94-12644
ADDRESS:	Water & Sewer Dist. #363	DATE:	04/11/94 lm
	P.O. Box 160057		
	Big Sky, MT 59716		

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

ENERGY LABORATORIES

ENERGY LABORATORIES, INC.

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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

ENERGY LABORATORIES

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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

ENERGY LABORATORIES, INC.
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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

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 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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FAX (406) 252-6069 • 1-800-735-4489

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

ENERGY LABORATORIES
ENERGY LABORATORIES, INC.
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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.: 94-23258
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

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.: 94-23260
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

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.: 94-23261
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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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.: 94-23262
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

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.: 94-23263
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

B0000090

LAB. NO. 3776

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 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 1 Other *(Please Specify)*

Collector of Sample: Threlkeld Phone No. 995-2600

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]

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 12:22

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 PO 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

REMARKS:

HEAVY TURBIDITY

☐ 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.

Acct ✓

LAB. NO. 3779

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:X

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. [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 12:48

Owner of Water Source

Location of Water Source BIG SKY
Nearest City

County GALLATIN

Type of Supply *(Circle One)* Cistern (Well) Spring River No 35
Other *(Please Specify)*

Collector of Sample: Threlkeld Phone No. 995-2660

Person to Receive Report *(Please Print)*:

NAME: Tom Threlkeld R.D 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

[illegible]

Acct

LAB. NO. 3760

˙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 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 /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. 010781

"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 1:10

Owner of Water Source

Location of Water Source BIG SKY (Nearest City)

County GALLATIN

Type of Supply *(Circle One)* Cistern (Well) Spring River No. X7 Other *(Please Specify)*

Collector of Sample: Threlkeld Phone No. 995 2660

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 TURBIDITY

~~Multiple Tube~~ | Membrane Filter

☐ Satisfactory At This Time

REMARKS:

☐ 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.

(initials)

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 6 - 1994

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REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

SID: B0000090 CITY/SYSTEM: BIG SKY RID 305 FECAL COUNTY: GALLATIN

ected by: Terry Threlkeld Date: 3-2-94 Hour: NOON Received: 3-2-94 3:30 P

fied Operator: Operator Certification No. Reported: 3-5-94

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. 5		015862	Turbid	<1/100 mls	
	(8) MINER GUEST		015863		<1/100 mls	
	(9) WELL No. 6		015864	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 was

( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED ______

*SEE BACK OF FORM FOR EXPLANATION

Certified Analyst: dL ✓

'ONTANA DEPART IT OF HEALTH AND ENVIRONMENTAL SCIENCES
UBLIC HEALTH LABC...TORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
·06) 444-2642 FAX #(406) 444-1802

.AR 8 - 1994

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REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

WSID: B0000090 CITY/SYSTEM: BIG SKY RID 305 FECAL COUNTY: GALLATIN

...ed by: Terry Threlkeld Date: 3/2/94 Hour: NOON Received: 3-2-94 330p

...Operator: Operator Certification No. Reported: 3-5-94

Sample Type*	Sample Site No. or Repeat Location**	Cl RES P.P.M.	Lab. No.	RESULTS — LAB USE ONLY: Total Coliform	Fecal	HPC
	(1) 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

RESULTS of the examination of samples at the time received indicated that the water wa...
( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED ____________

Certified Analyst: [signature]

*SEE BACK OF FORM FOR EXPLANATION

ONTANA DEPART IT OF HEALTH AND ENVIRONMENTAL SCIENCES
BLIC HEALTH LABORATORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
6) 444-2642 FAX #(406) 444-1802

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REPORT OF BACTERIOLOGICAL EXAMINATION OF WATER SAMPLES

SID: B0000090 CITY/SYSTEM: BIG SKY RID 305 FECAL COUNTY: GALLATIN

by: Terry Threlkeld Date: 3-16-94 Hour: 11:28 Received: 3-16-94 3p

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
	(13) WELL No. 1		016797	turbid	<1/100	
	(14) LEROY WELL		016798	turbid	<1/100	

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 was
( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED

*SEE BACK OF FORM FOR EXPLANATION

Certified Analyst:

.ONTANA DEPART   NT OF HEALTH AND ENVIRONMENTAL SCIENCES
UBLIC 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

llected by: Terry Threlkeld Date: 3/16/94 Hour: 10:40 Received: 3-16-94 3p

rtified 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
	(7) WELL No. 7		016791	heavy turbidity	<1/100	
	(8) WELL No. 6		016792	Excessive Turbidity	<1/100	
	(9) WELL No. 5		016793	heavy turbidity	<1/100	
	(10) WELL No. 4		016794		2100/100	
	(11) WELL No. 3		016795	turbid	<1/100	
	(12) WELL No. 2		016796	turbid	<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 wa

( ) Satisfactory at this time
( ) Unsatisfactory ✓
( ) Send repeat samples immediately***

DATE NOTIFIED ______

Certified Analyst: [signature]

ONTANA DEPAR' ENT OF HEALTH AND ENVIRONMENTAL SCIENCES
BLIC HEALTH LAB. ATORY W.F. COGSWELL BUILDING HELENA, MONTANA 59620
5) 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 was:

( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED

*SEE BACK OF FORM FOR EXPLANATION

Certified Analyst: DP

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: B0000090 CITY/SYSTEM: BIG SKY WSD 363 FECAL COUNTY: GALLATIN

llected by: TERRY THRELKELD Date: 5/25/94 Hour: Received: 5-25-94

rtified 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		021170	Excessive turbidity	<1/100mls	
	② WELL No 2		021172	Excessive turbidity	<1	
	③ WELL No 3		021172	Excessive turbidity	<1	
	④ WELL No 4		021173	Excessive turbidity	5/100	
	⑤ WELL No 5		021174	Ex turbidity	<1	
	⑥ WELL No 7		021175	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 was

( ) Satisfactory at this time
( ) Unsatisfactory
( ) Send repeat samples immediately***

DATE NOTIFIED ______

Certified Analyst: JP

*SEE BACK OF FORM FOR EXPLANATION