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**GROUNDWATER AND**  
**SURFACE WATER**  
**MONITORING PLAN**

**Big Sky County Water  
& Sewer District No. 363  
Big Sky, Montana**

for

**Big Sky County Water  
& Sewer District No. 363  
Big Sky, Montana**

**COPY 2 OF 2**

Big Sky County Water & Sewer District No. 363  
PO Box 160670  
Big Sky, Montana 59716  
Tel 406-995-2660

**Prepared by**

**ENVIRONMENTAL DEVELOPMENT AND MANAGEMENT, INC.**

**September 27, 1999**



Montana Department of  
**ENVIRONMENTAL QUALITY**

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Marc Racicot, Governor

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**PLANNING, PREVENTION AND ASSISTANCE DIVISION**

December 15, 1999

Mr. Ron Edwards, General Manager  
Big Sky County Water & Sewer District No. 363  
PO Box 160670  
Big Sky, Montana 59716

DEC 17 1999

RE: Big Sky Draft Monitoring Plan

Dear Ron:

Upon your request, we have reviewed the Draft Groundwater and Surface Water Monitoring Plan for the Big Sky Water and Sewer District No. 363 prepared by Environmental Development and Management, Inc. (EDM). The draft is dated September 27, 1999. Eric Regensburger, Terry Webster, Chris Levine and I reviewed the plan and have attached an office memo offering some suggestions to the monitoring plan. Please keep in mind that these are suggestions only and prepared at the request of the District.

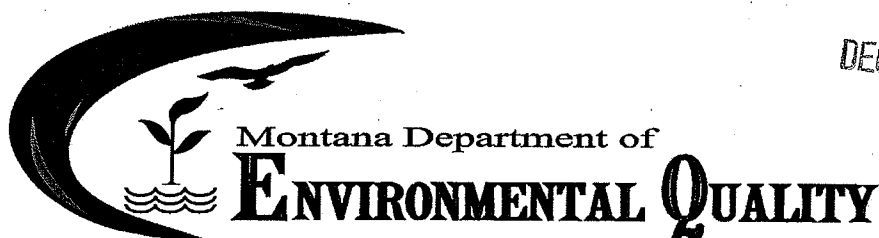
If you have any questions regarding our comments give me a call at 444-5324.

Sincerely,

Todd Teegarden, WPCSRF Program Manager  
Department of Environmental Quality

Cc Eric Regensburger, MDEQ, P&C, Helena  
Terry Webster, MDEQ, P&C, Helena

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DEC 17 1999

**MEMO**

**To:** Todd Teegarden *TT*  
**From:** Eric Regensburger, Terry Webster and Chris Levine *ER TW TL CL*  
**Date:** 12/14/99  
**Subject:** Big Sky Water & Sewer District ground water and surface water monitoring plan

We have reviewed the above referenced document prepared by EDM, Inc. dated September 27, 1999, and have the following recommendations and suggestions.

### Surface Water Sampling Points

#### Locations:

1. Apparently the ground water seeps that existed at grizzly flats (on the South Fork) no longer exist since leakage from the old lagoons ceased. Recommend that these seeps be visually inspected during each round of sampling to determine if flow from the seeps starts again in the future. If the seeps begin to flow again, the seeps or the South Fork immediately adjacent to the seeps should be added to the sampling locations. In addition, the source of the seeps may need to be determined at that time.
2. Strongly suggest that a third sampling location be added on the West Gallatin River. There is currently one sampling point above the confluence with the West Fork which is upgradient of the groundwater seeps. Suggest that a third sampling point be added that lies upstream of both the planned location of the treated effluent discharge and the confluence, but downstream of where the ground water seeps begin. This sampling point will be critical in distinguishing between water quality changes due to the ground water seeps as compared to those due to future discharges.
3. Also recommend maintaining one of the current sampling points above the Mountain Village area. This site could theoretically be used as a "reference" site although there likely aren't any stream segments in Big Sky that are totally isolated from anthropogenic effects. Water quality will likely be an issue at Big Sky for a long time, the more data available to document impacts or lack of impacts, the better prepared we will be to make future decisions.

#### Parameters:

1. Recommend adding orthophosphorus to the parameters. Orthophosphorus is the form of phosphorus that is utilized by organisms and is therefore an indicator of what is available for growth in the stream. Total phosphorus probably isn't necessary if orthophosphorus is collected.
2. Also strongly suggest adding chloride to the parameters. It is a good indicator of anthropogenic impacts because the natural chloride levels are typically near zero, and therefore nearly any detectable levels of chloride can be attributed to anthropogenic sources.

#### Frequency:

1. Recommend adding the months of August and September because this is when the most impacts (at least with regards to visible impacts) are likely to occur (due to the warm conditions and low turbidity levels in the streams). Revise the February and April rounds to January and March for a little more even spacing between sampling rounds in the winter.

## **Ground Water Sampling Points**

### **Location:**

1. Strongly suggest maintaining monitoring well 4 in the sampling plan. In the past, monitoring well 4 had the highest fecal impacts as a result of the old lagoons. Therefore, monitoring well 4 is likely one of the best place to monitor for impacts or lack of impacts.
2. Please note that groundwater monitoring above and downgradient of the snowfluent application site will be required by the Department in the future.

### **Parameters:**

1. Strongly suggest adding orthophosphorus and chloride (and removing total phosphorus) for the same reasons discussed for the surface water parameters.
2. All samples should be filtered before laboratory analyses.
3. Remove TKN, there shouldn't be any significant amount in groundwater.

### **Frequency:**

1. No comments

## **Lysimeter Sampling Points**

### **Location:**

1. No comments

### **Parameters:**

1. Strongly suggest adding orthophosphorus and chloride (and removing total phosphorus) for the same reasons discussed for the surface water parameters.
2. All samples should be filtered before laboratory analyses.
3. Remove TKN, there shouldn't be any significant amount in groundwater.

### **Frequency:**

1. No comments

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## **A. Introduction**

In accordance with an authorization by the Big Sky County Water & Sewer District No. 363 (District) on April 12, 1999, Environmental Development and Management, Inc. (EDM) has prepared an updated groundwater and surface water monitoring plan for the District. This plan is based on our review of the location of the district's historic monitoring sites, water quality parameters included in previous water monitoring events, groundwater and surface water quality monitoring data accumulated during those events, and additional information provided by the District.

The monitoring plan includes a listing of recommended surface water sampling locations along the West Fork of the Gallatin and tributaries, and the main stem of the Gallatin River. The plan also provides a list of recommended groundwater sampling sites at the district's monitoring well locations near the wastewater treatment storage ponds, and drill holes located at the Big Sky golf course. Also, the plan addresses continued sampling of water collected by lysimeters located at the golf course. Recommended sampling frequency and parameters for field and laboratory analyses are provided for each monitoring location.

## **B. Monitoring Locations and Water Quality Parameters**

EDM reviewed existing surface water, groundwater and lysimeter analytical data referenced above. Proposed sampling analytical parameters outlined in this monitoring plan were chosen based on potential areas of concern (such as nutrient loading), baseline information in support of future discharge strategy, and assessment of current and long-term operations.

Parameters of concern appear to be related directly to domestic waste. Those parameters are primarily nutrients which include forms of nitrogen and phosphorus. However, several other parameters will aid in developing baseline water quality data, including specific conductance and pH. Those parameters may be related nutrient loading and, in conjunction with the nutrient levels, will aid in assessing current surface water conditions as well as target future concerns for discharge strategies.

Based on the review of all known analytical data regarding the Big Sky Sewer District, EDM recommends the following sampling strategy.

### **B.1 Surface Water**

#### **B.1.a Location**

Table 1, attached, provides a list of proposed surface water sampling sites. Locations of the sampling sites are illustrated on Figure 1. The proposed sites are the same as follows:

- West Fork Below North Fork Confluence as the upstream sampling location on the West Fork Gallatin River above Meadow Village (including the golf course, wastewater treatment facility and storage ponds)

- West Fork Below Meadow Village as the downstream West Fork Gallatin River sampling location below Meadow Village
- South Fork at Firelight Bridge as the upstream South Fork Gallatin River sampling location above Meadow Village
- South Fork Above West Fork Confluence as the downstream South Fork Gallatin River sampling location below Meadow Village
- Gallatin River Above West Fork upstream of the confluence of West Fork Gallatin River
- Gallatin River Below West Fork downstream of the confluence of West Fork Gallatin River
- Filter effluent as it leaves the treatment plant, before it flows into the irrigation pond (Pond #3)

The list of surface water sampling sites provides monitoring locations upstream and downstream of Meadow Village along the West Fork and South Fork, on the Gallatin River main stem upstream and downstream of West Fork, and the filter effluent that is temporarily stored in Pond #3 for use as irrigation water for the golf course. Except for the Firelight Bridge location, each of the sampling sites has been included in the District's historic surface water monitoring activities. Firelight Bridge is a new monitoring location that will provide water quality data on the South Fork Gallatin River upstream of current development in the Meadow Village area, including the District's facilities. Historically, the District has sampled and tested the filter effluent as it leaves the treatment plant, before it flows into the irrigation pond.

It is the opinion of EDM that monitoring of surface waters beyond sampling locations identified in this monitoring plan would be beyond a reasonable scope of monitoring for evaluation of surface water quality with regard to the District's facilities. Historic and recent developments in the Big Sky area include facilities providing on-site septic systems located beyond the District's wastewater collection. This monitoring plan includes no surface water monitoring beyond locations identified above because of the recent improvements to the District's wastewater collection system for the purpose of reducing inflow and infiltration within the District's network, and the aerial extent of private treatment facilities located at, and beyond, the Mountain Village and Meadow Village portions of the West Fork Gallatin basin. Nonetheless, the District should consider additional upgradient surface water sampling locations if future monitoring results indicate impacts to water quality from sources upgradient of monitoring locations listed herein.

#### **B.1.b Sampling Parameters**

Table 2 includes the list of analytical parameters for surface water samples. The following field parameters are recommended for surface water samples, including stream samples and samples obtained from treated effluent entering the golf course irrigation land application system from the irrigation pond:

- pH
- Temperature
- Specific Conductance

The following laboratory analytical parameters are recommended for surface water :

- Total Suspended Solids
- Phosphorus, Total
- Nitrate/Nitrite as Nitrogen
- Ammonia as Nitrogen
- Total Kjeldahl Nitrogen
- Specific Conductance (only as a verification of field results)
- Fecal Coliform (filter effluent only)

The field parameters provide data on water samples at the time and place of sampling. Specific conductance is included as a field parameter, and may be used as an indication of total dissolved solids in the sample. Laboratory analysis for specific conductance is recommended only as a verification of field results. Laboratory analyses for total phosphorous and forms of nitrogen provide nutrient data for surface waters above and below the treatment plant, as well as local tributaries of the West Fork and Gallatin River main stem. Fecal coliform is included in laboratory testing of filter effluent as documentation of that parameter with regard to filter effluent flowing to Pond #3 for temporary storage prior to use as irrigation water at the golf course.

### **B.1.c Frequency**

EDM recommends that the frequency of sampling of surface water be monthly during high flow, which is anticipated to occur during May, June and July. Also, sampling should occur on a quarterly basis in October, February and April of each year.

## **B.2 Groundwater**

### **B.2.a Location**

Table 3, attached, provides a list of proposed ground water sampling sites. Locations of the sampling sites are illustrated on Figure 2. The proposed groundwater monitoring sites are as follows:

- Monitoring Well 7 located upgradient of the storage ponds, and Monitoring Well 2 located downgradient of the storage ponds.
- Drill Hole 3 located upgradient of the golf course, and Drill Hole 1 located downgradient of the golf course.

The list of groundwater sampling sites provides water quality monitoring of the alluvial aquifer at locations upgradient and downgradient of the alluvial aquifer Meadow Village, including the golf course, wastewater treatment facility and storage ponds. Each of the sampling sites has been included in the District's historic surface water monitoring activities.

Groundwater monitoring beyond the above-referenced monitoring locations does not appear to be warranted given that discharge from the water treatment plant is limited to irrigation water for the golf course, with additional monitoring points located upgradient and downgradient of the treatment ponds. Monitoring of filter effluent as it leaves the treatment plant, before it flows into the irrigation pond, is discussed in *Section B - Surface Water*.

Drill Hole 3, located upgradient of the golf course, has generally yielded no groundwater available for sampling purposes since soon after its installation in July 1996. Nonetheless, its location appears suitable for an upgradient sampling location. The well may yield water only during periods when the local water table is relatively high, particularly during late spring/early summer.

Installation of a new monitoring well in the vicinity of Drill Hole #3, or extending the depth of the current monitoring well, might allow more sustained interception of shallow groundwater and provide a more reliable source of groundwater samples for chemical analysis. Until installation of a new well or extension of the existing well is completed, the District should continue to monitor Drill Hole #3 in accordance with the scope of monitoring described herein, noting, when necessary, sampling periods during which the well is dry and no sample can be taken.

#### **B.2.b Sampling Parameters**

Table 4 includes the list of analytical parameters for groundwater water samples. The following field parameters are recommended for groundwater:

- pH
- Specific Conductance

The following sampling laboratory analytical parameters are recommended for groundwater samples:

- Fecal Coliform (MW-7 and MW-2 only)
- Phosphorus, Total
- Nitrate/Nitrite as Nitrogen
- Ammonia as Nitrogen
- Total Kjeldahl Nitrogen
- Specific Conductance (only as a verification of field results)

#### **B.2.c Frequency**

The frequency of groundwater monitoring at drill holes located at the golf course should occur on a monthly basis during the irrigation season. The frequency of groundwater monitoring at the monitoring wells near the storage ponds should occur on a monthly basis throughout the year.

### B.3 Lysimeters

#### B.3.a Location

Table 3 also provides a list of lysimeter sampling sites. The sites are the same as those for which the district has conducted previous water quality monitoring, including Lysimeters 1 through 6 located in the golf course area.

#### B.3.b Sampling Parameters

Table 5 includes the list of analytical parameters for lysimeter water samples. The lysimeters should be weighed, and rain gauge volumes should be obtained, in accordance with the testing schedule that has been submitted previously to the Montana Department of Environmental Quality in the *Big Sky Golf Course Water Quality Monitoring Plan* during March of 1997. The following field parameters are recommended for lysimeter samples:

- pH
- Specific Conductance

The following laboratory analytical parameters are recommended for lysimeter samples :

- Phosphorus, Total
- Nitrate/Nitrite as Nitrogen
- Ammonia as Nitrogen
- Total Kjeldahl Nitrogen
- Specific Conductance (only as a verification of field results)
- Fecal Coliform\*
- Chlorides\*
- BOD<sub>5</sub>\*
- Total Suspended Solids\*

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\*Potential for deletion of this parameter from the list of analytes upon potential revision and approval of the current golf course water quality monitoring plan.

It is the opinion of EDM that four of the parameters (fecal coliform, chlorides, BOD<sub>5</sub>, and total suspended solids) could be potentially deleted from the list of analytes upon revision and approval of the current golf course water quality monitoring plan. Fecal coliform could be deleted from the list of parameters because it is included in the list of laboratory parameters for analysis of the filter effluent temporarily stored in the irrigation pond (Pond #3), as described above, prior to irrigation. Chloride could be deleted from the list because monitoring the water for specific conductance can serve as an indication of chlorides, as well as other dissolved solids. Specific conductance is included as a field parameter and may be used as an indication of total dissolved solids, while laboratory analysis for specific conductance is recommended only as a verification of field results. If monitoring for specific conductance indicates an increase in total dissolved solids, including but not necessarily limited to chlorides, the District could include laboratory analysis of lysimeter samples for chlorides, as necessary.

BOD<sub>5</sub> could be deleted from the listed parameters because it does not necessarily represent BOD<sub>5</sub> of the irrigation water upon application to the golf course, nor of irrigation water that may infiltrate to shallow groundwater. Rather, BOD<sub>5</sub> may continue to be included in the standard scope of analyses currently associated with influent to the treatment ponds/storage ponds. Similarly, total suspended solids is analyzed in the filter effluent as it leaves the treatment plant before it goes into the irrigation pond, and therefore could be deleted from the parameter listing.

Alteration of the scope of analyses, as described above, would likely require revision and approval of the above-referenced golf course water quality monitoring plan. Upon approval of those changes, however, the scope of analysis may be limited to field parameters including pH and specific conductance, and laboratory parameters including total phosphorus, nitrate/nitrite as nitrogen, ammonia as nitrogen, total Kjeldahl nitrogen. Continued monitoring of those parameters would assist golf course maintenance personnel in evaluating any need for supplemental nutrients (fertilizers) for the turf, while the current scope of monitoring of influent to the ponds provides water quality data with regard to the District's in-plant wastewater treatment processes.

### **B.3.c Frequency**


Lysimeter sampling frequency should continue monthly based on lysimeter water volume during the irrigation season.

## **C. Standard of Care**

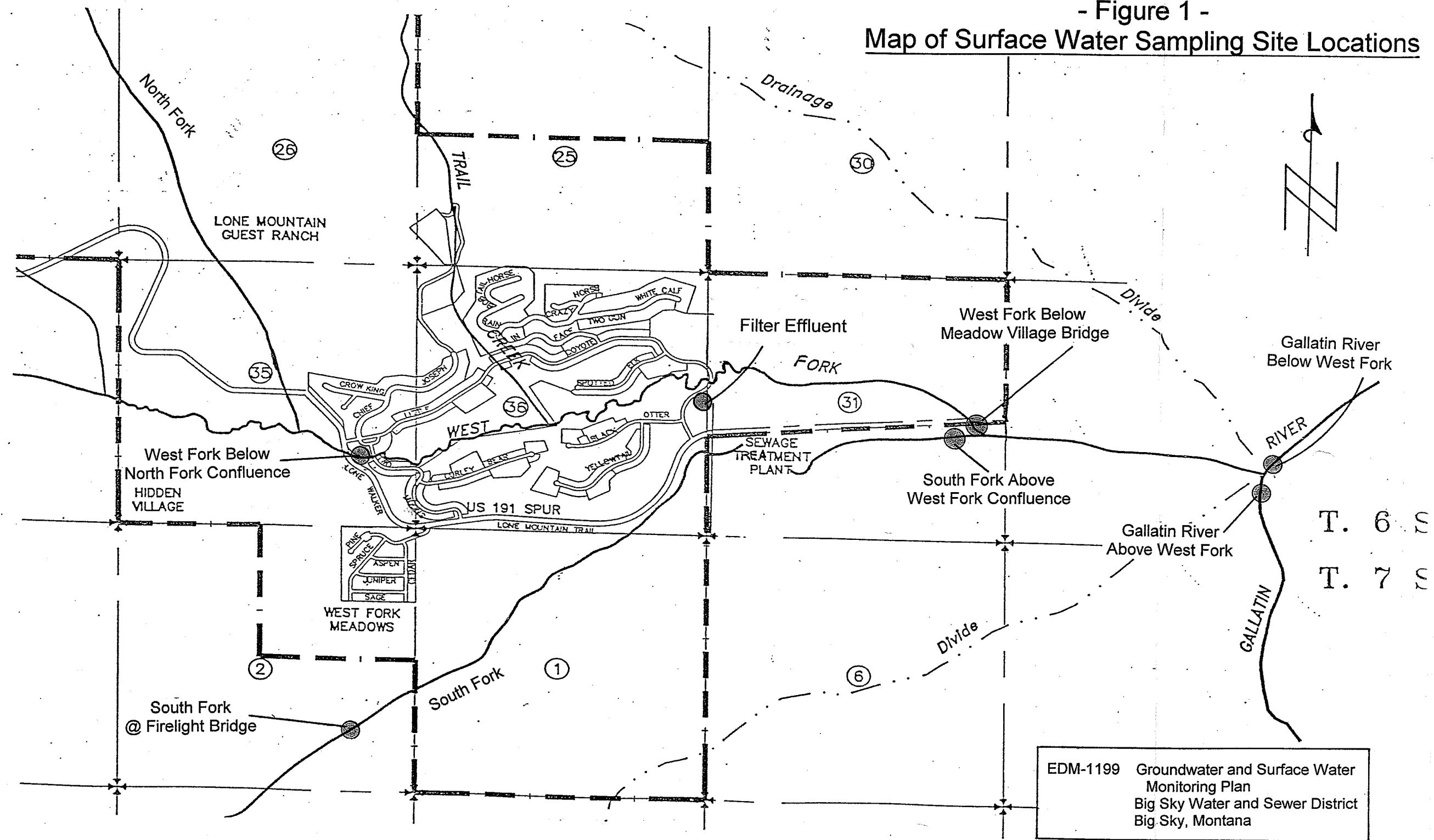
Services performed by EDM environmental specialists for preparation of this groundwater and surface water monitoring plan have been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in this area. This is our professional responsibility. No warranty, expressed or implied, is made.

EDM appreciates the opportunity to provide our professional environmental consulting services on this project. Please contact me at your convenience at (406) 254-8570 if you have any questions regarding this monitoring plan.

Sincerely,

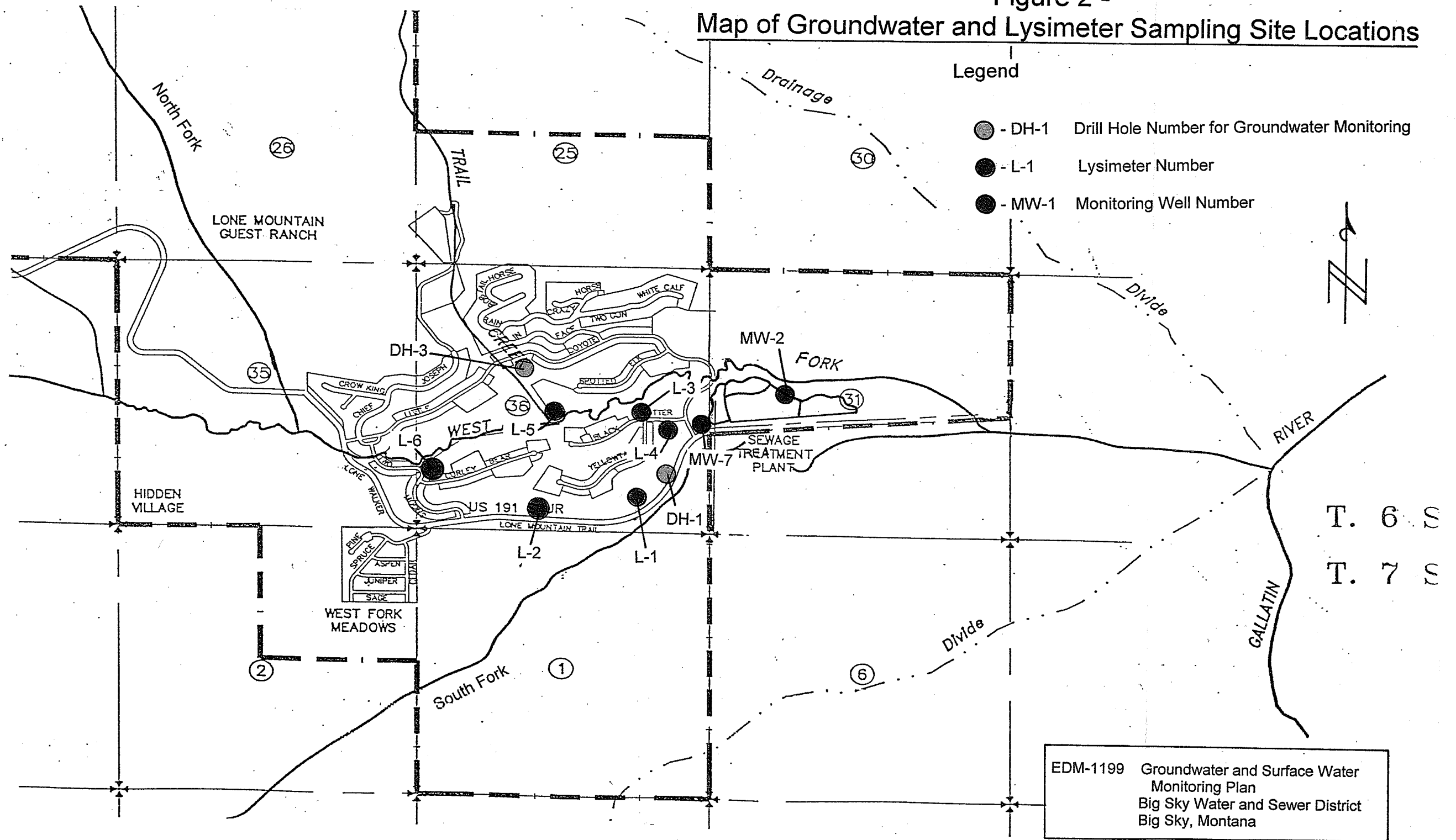
  
Paul D. Burley, P.E.  
General Manager

- Figure 1 -  
**Map of Surface Water Sampling Site Locations**



EDM-1199 Groundwater and Surface Water  
 Monitoring Plan  
 Big Sky Water and Sewer District  
 Big Sky, Montana

- Figure 2 -  
**Map of Groundwater and Lysimeter Sampling Site Locations**



- Legend**
- - DH-1 Drill Hole Number for Groundwater Monitoring
  - - L-1 Lysimeter Number
  - - MW-1 Monitoring Well Number

EDM-1199 Groundwater and Surface Water  
 Monitoring Plan  
 Big Sky Water and Sewer District  
 Big Sky, Montana

**- Table 1 -  
 Surface Water Sampling Site Locations**

<i>Surface Water</i>	<i>Site Name</i>	<i>Site Location</i>
West Fork	West Fork Below North Fork Confluence	Up gradient, west of Meadow Village
	West Fork Below Meadow Village Bridge	Down gradient, east of Meadow Village
South Fork	South Fork @ Firelight bridge	Up gradient of Meadow Village
	South Fork Above West Fork Confluence	Down gradient, east of Meadow Village
Gallatin River (Main Stem)	Gallatin River Above West Fork	Up gradient of confluence with West Fork
	Gallatin River Below West Fork	Down gradient of confluence with West Fork
Filter Effluent	Filter Effluent leaving Treatment Plant	Source of irrigation water for golf course

- Table 2 -  
Analytical Parameters for Surface Water Samples

<i>Parameter</i>	<i>Remarks</i>
Nitrate-Nitrite as N	Laboratory parameter
Ammonia as N	Laboratory parameter
Total Kjeldahl Nitrogen as N	Laboratory parameter
Phosphorus, Total	Laboratory parameter
Total Suspended Solids	Laboratory parameter
Fecal Coliform	Laboratory Parameter (filter effluent only)
Specific Conductance	Field parameter - laboratory analytical parameter only as a verification of field results
pH	Field parameter
Temperature	Field parameter

**Sampling frequency:** Surface water to be sampled monthly during high flow, anticipated to occur during May, June and July. Also, sampling to occur on a quarterly basis in October, February and April of each year.

**- Table 3 -  
 List of Groundwater and Lysimeter Sampling Site Locations**

<i>Aquifer</i>	<i>Sites Name</i>	<i>Site Location</i>
Alluvium (storage pond area)	Monitoring Well #7	Up gradient of storage ponds
	Monitoring Well #2	Down gradient (east) of storage pond #1
Alluvium (golf course area)	Drill Hole 3	Up gradient (northwest) of golf course
	Drill Hole 1	Down gradient (southeast) of golf course
Soil Moisture (golf course area)	Lysimeter #1	Golf course irrigation site
	Lysimeter #2	"
	Lysimeter #3	"
	Lysimeter #4	"
	Lysimeter #5	"
	Lysimeter #6	"

<b>- Table 4 - Analytical Parameters for Groundwater Samples (Monitoring Wells 2 &amp; 7, Drill Holes 1 &amp; 3)</b>	
<i>Parameter</i>	<i>Remarks</i>
Fecal Coliform	Laboratory parameter (MW-2 and MW-7 only)
Nitrate-Nitrite as N	Laboratory parameter
Ammonia as N	Laboratory parameter
Total Kjeldahl Nitrogen as N	Laboratory parameter
Phosphorus, Total	Laboratory parameter
pH	Field parameter
Specific Conductance	Field parameter - laboratory analytical parameter only as a verification of field results

**Sampling frequency:** Groundwater monitoring at Drill Holes 1 and 3 to be conducted on a monthly basis during irrigation season. Groundwater monitoring at Monitoring Wells 2 & 7 to be conducted on a monthly basis throughout the year.

**- Table 5 -  
Analytical Parameters for Lysimeter Water Samples**

<i>Parameter</i>	<i>Remarks</i>
Phosphorus, Total	Laboratory parameter
Nitrate-Nitrite as N	Laboratory parameter
Ammonia as N	Laboratory parameter
Total Kjeldahl Nitrogen as N	Laboratory parameter
pH	Field parameter
Specific Conductance	Field parameter
Fecal Coliform*	Laboratory parameter
Chlorides*	Laboratory parameter
BOD <sub>5</sub> *	Laboratory parameter
Total Suspended Solids*	Laboratory parameter

\* Potential for deletion of this parameter from the list of analytes upon potential revision and approval of the current golf course water quality monitoring plan.

**Sampling frequency:** Lysimeters to be sampled monthly during irrigation season.

