RECOMMENDATIONS FOR WATER QUALITY MONITORING NEAR WASTE WATER DISPOSAL SITES IN GLACIER NATIONAL PARK

WATER
RESOURCES
FIELD
SUPPORT
LABORATORY

WRFSL PROJECT REPORT NO. 83 - 2P

NATIONAL PARK SERVICE
Department of the Interior

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RECOMMENDATIONS FOR WATER QUALITY MONITORING NEAR WASTE WATER DISPOSAL SITES IN GLACIER NATIONAL PARK

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Submitted to:

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August 1983

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INTRODUCTION

Marshall Flug and Gary Smillie met with members of the maintenance division of Glacier National Park on the 20th and 21st of June, 1983. Our discussions centered around the adequacy of past monitoring efforts at three waste water disposal locations: (1) Park Headquarters near the lower end of Lake McDonald, (2) St. Mary near the town of St. Mary, and (3) Many Glacier between Swiftcurrent Lake and Lake Sherburne. The park personnel feel that previous monitoring studies were inadequate and that an effective, on-going monitoring scheme needs to be developed to evaluate possible future impacts caused by waste water disposal. The following questions regarding the design of a monitoring network came up at the meetings and are addressed in this report.

1) What water quality variables should be measured?
2) Where should sampling take place?
3) What sampling frequency is appropriate?
4) Who should do the laboratory analysis and by what methods?
5) What level of detection is necessary?
6) What is the expected useful lifetime of each system?
7) Are existing observation wells sampling from the correct aquifers?
8) In the U.S.G.S. monitoring study, nitrate concentrations are expressed as nitrate-nitrogen; what does this unit mean and why is it used?

The recommendations made in this report are general in nature and apply to each of the three disposal sites. Since all three locations present similar situations and potential problems, the same monitoring strategy may be utilized for each. Site specific modifications to the

category of measurements that should be made less frequently such as the heavy metals to see if they are starting to buildup in the environment. The third category are those measurements that are required by state or federal laws. We do not address the third category in our table and believe that park personnel are meeting these requirements.

Question 2: Where should sampling take place?

Water quality sampling should be reinitiated at the existing observation wells located in and around the disposal sites. In addition, water quality samples should be drawn from adjacent streams, above and below the treatment areas. The downstream sampling location should be established far enough downstream to allow mixing of treated effluent with river water. In turbulent streams such as those found in Glacier this distance should not be more than 1/2 or 1 mile.

Analysis of the well water should show that many of the constituents present in the effluent are present in the ground water, at least at modest concentrations. This situation is to be expected and is not necessarily a problem unless the aquifer is also a drinking water source. The bottom line is the impact to the surface water resource. As long as adjacent stream water quality is acceptable, i.e. meets stream standards or other such quality criteria, the sewage disposal system is working in an adequate fashion. The variables that should be measured at the stream sites are essentially the same as at the well sites, as listed in Table 1.

Question 3: What sampling frequency is appropriate?

Water quality samples should be taken at least every two weeks (biweekly) during the sewage disposal season and at least every two months (bimonthly) during the off-season if weather and icing conditions

permit. Some variables, as noted in Table 1, need not be sampled as frequently as others. To save time, work, and money, certain easy-to-do tests can be made most frequently and serve as indicators for variables that are more difficult to measure. For example, turbidity (easy to do) can be a substitute for some TSS tests (more involved to do). Likewise, conductivity can substitute for some TDS tests. Table 1 indicates these examples. This sampling frequency will provide enough information to perform statistical analysis to ascertain changes in water quality and provide timely information should a problem arise and an operational modification be necessary.

Question 4: Who should do the lab analyses and how?

a) Four split samples per year from each sampling station should be analyzed by a certified laboratory.

b) The remaining samples may be analyzed on the Park's Spec 21 and other lab facilities.

This scheme of chemical analysis will provide the park with sufficient certified lab results to corroborate the results of the in-park analysis. The end result will be a relatively inexpensive monitoring program yielding data of reliable quality for use in routine evaluation of water quality impacts/changes.

Question 5: What level of detection is necessary?

In general, the detection levels for chemical analyses need to be below the water quality criteria for each variable. Water quality criteria for each suggested variable in Table 1 is presented in Table 2. Also the detection limits for the Park's Spec 21 and typical certified laboratory procedures are shown in the table. It can be seen that all

detection limits on the table are below the recommended criteria and therefore meet the above requirement.

The assessment of water quality changes often requires detection limits considerably below criteria. The lab believes that given cost constraints, the detection limits on the Park's Spec 21 are acceptable to detect major changes in water quality.

Question 6: What is the expected useful lifetime of each site?

Experience with waste water disposal sites similar to those in Glacier has shown that with proper operation (i.e. not overloading) such facilities may perform well for 15 or more years. With land treatment such as aeration or lime application the useful lifetime of these systems can be extended even longer. The lab is unable to provide a more precise lifetime expectancy based on the information presently available to us. If a more specific time estimate is needed lab staff may be able to acquire enough information to make a better assessment with one site visit.

Question 7: Are existing observation wells sampling from the correct aquifers?

In general, the observation wells should be sampling from the uppermost aquifer (free aquifer) since the disposal systems are all of the surface application variety. From the descriptions given in the U.S.G.S report, apparently some of the wells are sealed and penetrate through confining strata and sample from deeper water originating from areas other than the disposal sites (see Figure 1 for a schematic sketch of this siruration). These wells provide some useful information regarding deep mixing of effluent but cannot necessarily be used to indicate ground water quality impacts due to the waste water disposal. The park, however, may use conservative constituents found in effluent,

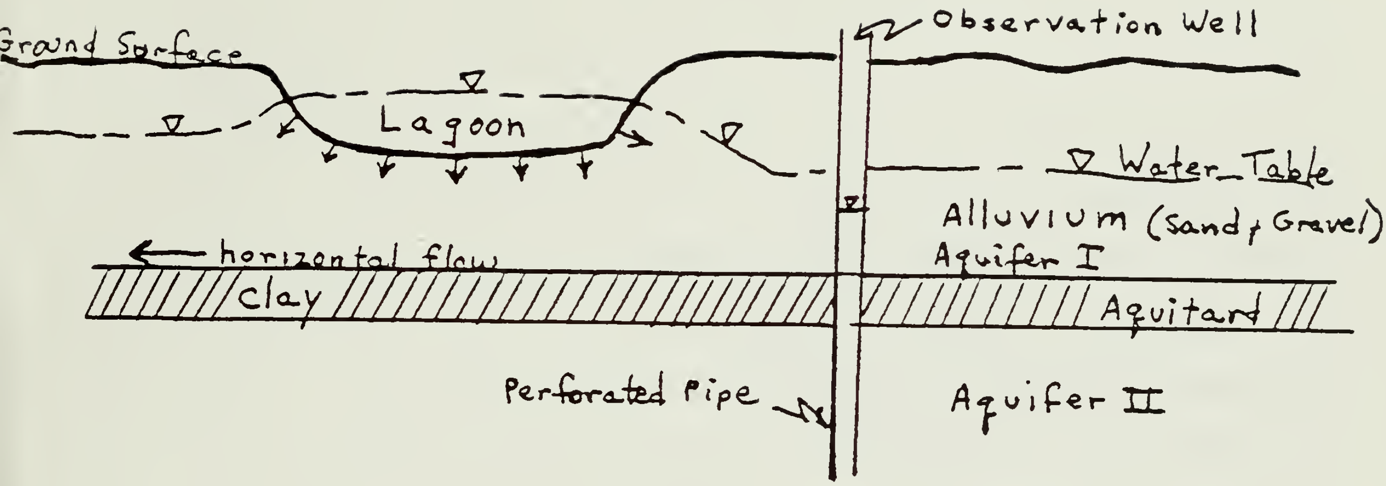

Figure 1. Typical Groundwater and Observation Well in a Multiple Layered System

such as chloride ion, as an indicator of the presence of waste water in samples drawn from the observation wells. Chloride should be found in higher concentrations in the aquifers that are indeed influenced by the surface application of waste water.

Question 8: Why is nitrate concentration expressed NO_3-N?

Nitrate concentration expressed as nitrogen may be interpreted as follows. The atomic weight of nitrate is 62, of which 14 or approximately 23% is made up of nitrogen. When nitrate is expressed as nitrogen, only 23% of the total concentration is expressed. For example, a nitrate concentration of 100 mg/ℓ nitrate can be expressed as 23 mg/ℓ nitrate-nitrogen. This unit is used so that total nitrogen may be calculated as the sum of nitrate-nitrogen plus all the other types of nitrogen found in a water.

SUMMARY

The Water Resources Field Support Lab recommends that Glacier National Park continue to monitor ground and surface water quality in the vicinity of the Headquarters, St. Mary, and Many Glacier waste water disposal sites. The variables which should be sampled are listed in Table 1. The recommended sampling frequency varies for different variables but most should be sampled at least biweekly during the sewage disposal season and at least bimonthly (if possible) during the off-season. The analysis of water quality samples can largely be performed in-park, thereby, keeping costs down. Approximately four samples per year from each sampling site, however, should be analyzed by a certified lab as well as by the park to provide quality control and a statistically reliable data set. The facilities subject to operational changes should perform well for an extended period, perhaps 15-25 years.

Table 1. Suggested list of index measurements needed for monitoring potential impacts on the water resource.

		Minimum Frequency of Measurements During Disposal Season				
		Well Monitoring Sites		Stream Above-Below Monitoring Sites		
	Variable	Every 2 weeks	Every 2 months	Every 2 weeks	Every 2 months	
Key Indices for Monitoring Potential Impacts	NO_3-N	x		x		NO_3 easily moves through ground; a colorimetric test[3] and important indicator of nitrogen overloading; over 10 mg/L undesirable. NO_3 most significant N usually found in ground water.
	PO_4-P	x		x		Should be trapped by a soils clay, if system working; also colorimetric[3] test.
	Conductance	x		x		Specific electrical conductivity, uses meter, easily measured, indicates total chemical content of inorganics and many of the pollutants. Can regress conductance with TDS.
	Total Coliform	x		x		Total coliform bacteria shows contamination--suggest run these tests locally.
	Fecal Coliform	[1]		[1]		<u>If</u> TOT COL starts to show up high, will want to run FEC COL.
	Cℓ	x		x		Good indicator, easily filtrated, shows water changes due to pollutants since Cℓ moves with ground water.
	BOD	x		x		Indicates level of organic material in water and is standard test of "loading levels" of pollutants. Organic matter not so mobile and, if system works, should be trapped in soil. BOD should help confirm functioning system.
	Total Dissolved Solids		x		x	Should show total chemicals, both organic and inorganic, in solution as a check-on other analyses; also can related to conductivity vis a vis inorganics.
	Total Suspended Solids				x	Total suspended solids will show if particulate matter is a problem.
	Turbidity	x		x		Turbidity is a quick check on particulate matter that can be used in place of TSS most of the time, after relating the two.
	SO_4	x		x		Easy to measure, may indicate presence of effluent.
	Total N		x		x	To evaluate the total amount of N, regardless of oxidation state or whether organic or not.
	Total P		x		x	To evaluate organic and other P, not just PO_4.
	NH_4-N	x		x		Pollution indicator as reduced form of N that can appear in polluted waters, both ground and surface and in sewage.
	pH	x		x		Unlikely to change; possibly will be near neutral; nonetheless if effluent has high pH, some potential is there.
Other Infrequent[2] More Complete Analyses	COD					Helps confirm BOD test; also in case of BOD test malfunction COD valuable.
	Alkaline earths (Ca, Na, Mg)	(twice per year high flow, low flow)				Effects only soils-rocks and cation exchanges in soil may be reflected; also important to help show salt impacts (Na).
	Carbonates, bicarbonates	(twice per year high flow, low flow)				For chemical balance checks; will read these major anions to help check completeness of analyses; indicates buffering in system.
	Metals (occasionally)	(twice per year high flow, low flow)				Observe any toxic levels of metals arising (very unlikely)
	Boron	(twice per year high flow, low flow)				A constituent important because very toxic to plants, but very unlikely to be a problem.

[1]Follow-up measurement only needed should TOT COL ever appear to rise, to see if fecal contamination.

[2]Four times per year do these as well as all other variables normally <u>done</u> at Glacier Lab, using certified laboratory for a quality control.

Table 2. Notes on detection limits for the variables suggested for monitoring.

	Recommended Criteria	Usual U.S.G.S. detection limits[3]	Comments on some commonly attained detection limits on routine lab equipment[7]	Contract Price (U.S.G.S Denver price $)
NO_3-N	10 mg/ℓ[1]	0.05 mg/L	<0.5 mg/L	$4.30
NH_4-N	0.5 mg/L	0.01 mg/L	0.5 mg/L	4.30
Total N	10 mg/ℓ	0.1 mg/L	<5 mg/L	11.30
PO_4	0.1 mg/L	0.01 mg/L	0.01 mg/L	4.30
Total P	50 mg/ℓ	0.01	<0.2 mg/L	12.10
Conductance	-	1 umho/cm	10 umho/cm or better, most meters	1.25
Total Coliforms	-	-	-	(about $12.00 most labs)[5]
Fecal Coliforms	50/100 ml[2]	-	-	(about $12.00 most labs)[5]
Cl	250 mg/ℓ[1]	0.01 mg/L	0.5 mg/L easily titrated	6.75
SO_4	90 mg/ℓ	5 mg/L	1 mg/L, B&L Spec Typical with turbidimetric method	6.40
BOD	4 mg/ℓ	-	-	(about $20)[5]
TDS	500	1 mg/L	1 mg/L if balance goes to 0.1 mg	11.30
TSS	500	1 mg/L	1 mg/L if balance goes to 0.1 mg	11.30
Turbidity	200	0.05 NTUs	1 NTU easily seen	4.30
COD	12 mg/L[8]	-	5 mg/L suffices	(about $15)[5]
Alkaline earths	-	varies but mostly ≤ 1mg/ℓ	varies but mostly ≤ 1mg/ℓ	[6]
Alkalinity (hydroxides, carbonates, barbonats)	more needed	1 mg/L	1 mg/L	4.50
Metals	(individuals)	mostly <0.1 mg/L	<0.1 mg/L	[6]
Boron	750 μg/ℓ[1]	0.01 mg/L	-	9.80
pH	6.5-9[1]	0.1 unit	0.1 unit most meters	1.25

[1]From EPA "Redbook" or McKee and Wolf.
[2]Montana State Stream Standards.
[3]In most cases they also have extra low detection limit methods, but these are more expensive and usually not necessary.
[4]For wastewater monitoring, Reference: U.S.G.S. 1983 Water Quality Services Catalog, APHA "Standard Methods"
[5]No US GS price.
[6]Principal metals and alkalines earths frequently done as package for about $20-30 most.
[7]Assuming B&L Spec 20 or 21 type for colorimetry.
[8]9-16 mg/L COD typical in rain; 25-80 mg/L COD in <u>treated</u> municipal sewage and 250-750 mg/L in <u>un</u>treated.