Guidance Document for Compliance with Part I.A.4 of the Lagoon General Permit

The lagoon general permit (MIG580000), Part I.A.4, has been revised to include a "Groundwater Monitoring for Lagoon Exfiltration/Leakage" provision to replace the "Testing for Lagoon Exfiltration/Leakage" provision. While various exfiltration tests previously recommended can adequately detect gross leakage from lagoons, it has been determined that adequate groundwater monitoring best determines any impact to groundwater in accordance with the Part 22 Rules, Groundwater Quality.

The purpose of this document is to provide guidance for compliance with Part I, Sections 3a, 3b, and 3c of the general permit. If it has been determined that you are required to install groundwater monitoring wells and conduct groundwater monitoring, you are then required to submit the following:

Part I, Section 3a: Monitoring Well Installation Plan – This document is only required if there are no existing monitoring wells at the lagoon site or if the existing monitoring wells are not located in appropriate locations or screen depths to adequately determine the direction of groundwater flow and evaluate downgradient groundwater quality.

The information required in this document is very technical and can be extremely complex. It is therefore strongly recommended that the permittee hire professionals with a background in the field of hydrogeology. At a minimum you will be required to advance at least three soil borings for the purpose of collecting continuous core samples to evaluate any deposits receiving discharge from the lagoon(s), install at least three monitoring wells to determine groundwater flow direction, and conduct groundwater sampling for the evaluation of any potential impacts to groundwater and/or surface water.

Part I, Section 3b: Groundwater Monitoring Plan – This document will be required for all lagoon sites where groundwater monitoring has been requested.

Part I, Section 3c: Groundwater sampling results are required to be submitted quarterly to the District Office identified in your Certificate of Coverage.

MONITORING WELL INSTALLATION PLAN

An approvable monitoring well installation plan must include the following information:

- Proposed monitoring well location map
- Proposed drilling method and soil sample collection method
- Proposed monitoring well construction method and construction materials
- Proposed boring depth
- Proposed monitoring well screen depth
- Proposed method of monitoring well development
- Proposed survey of ground surface and top of casing

What drilling methods are acceptable?

The drilling method used should be capable of clearly identifying the horizon from which samples are collected, and allow collection of undisturbed samples. Examples of acceptable drilling methods include Hollow Stem Augers (ASTM D1452) and the use of a Geoprobe. **Mud rotary and solid core augers are not acceptable drilling methods.**

At what depth should the well screen be placed?

Typical shallow wells are screened approximately 10-15 feet below the water table; however, alternative screen placement may be acceptable depending on the site-specific geology.

What are acceptable well casing materials and well screen size and length?

Typical monitoring wells are constructed using 2-inch PVC piping. Monitoring well screens are generally comprised of 10-slot PVC and 5-feet in length.

How is a monitoring well constructed?

Once a well is placed inside the borehole, the annulus around the screen should be backfilled with a filter pack to a depth of 2-feet above the top of the screen. Filter pack material should be coarser and have a higher permeability than the natural formation. The remaining annulus should be backfilled with an annular seal comprised of several different types of permanent, stable, low-permeability materials including pelletized, granular or powered bentonite, neat cement grout, and combinations of both (ASTM D5092-90). Once the annular seal is in place, the well must be completed either above-ground or flush-to-ground. Whichever type of completion is selected, there should always be a surface seal of neat cement or concrete surrounding the well casing and filling the annular space between the casing and the borehole at the surface. A

protective casing is generally installed around the well to discourage unauthorized entry into the well and to prevent damage by contact with vehicles. This protective casing should be kept locked between sampling events.

How is a well developed?

Well development has two broad objectives: 1) repair damage done to the formation by the drilling operation so that the natural hydraulic properties are restored, and 2) alter the basic physical characteristics of the aquifer near the borehole so that water will flow more freely to the well. All new wells should be developed before being put into use. In addition, older wells often require periodic redevelopment.

Effective development procedures should cause reversals of flow through the screen openings that will agitate the sediment, remove the finer fraction, and then rearrange the remaining formation particles. Examples of methods that apply this principal are backwashing and mechanical surging. Using a bailer or one directional pumping to develop a well is not acceptable.

What is required in a survey?

Ground surface and top of well casing must be surveyed and referenced to United States Geological Survey data accurate to 0.01 foot by a land surveyor at each monitoring location

GROUNDWATER MONITORING PLAN

An approvable groundwater monitoring plan must include the following information:

- A list of parameters to be collected and the frequency of sample collection
- A description of the method used to collect static water levels (precision must be to 0.01 foot)
- Method of sample collection including the method and volume of water removed from each well during sampling, steps taken to prevent cross-contamination between wells, sample handling and preservation methods, and laboratory analysis method
- If an appropriate monitoring well network already exists at the lagoon site, soil boring logs, well construction diagrams, and survey data must be submitted, if they are available. **It is also recommended that all existing monitoring wells be re-developed prior to sample collection.**

What is the sampling frequency?

Groundwater samples must be collected on a quarterly basis, unless otherwise approved by the Department. Quarterly sampling should be conducted in January, April, July, and October.

How many rounds of quarterly sampling will I be required to collect?

A minimum of four rounds of quarterly sampling must be completed. Upon the completion of four rounds of sample collection, the permittee may contact EGLE to request a review of the sampling data to determine whether groundwater sampling may be discontinued or whether the frequency may be reduced. Monitoring shall continue to be conducted quarterly until the permittee is notified by the Department that the monitoring can end or be reduced.

What parameters do I need to sample for?

The following parameters are required in the permit: static water elevation, total phosphorus, dissolved phosphorus, total inorganic nitrogen (ammonia nitrogen, nitrate nitrogen, and nitrite nitrogen), sodium, chloride, pH, and specific conductance.

Only EPA approved test methods for wastewater with sufficiently sensitive detection levels will be accepted for the analytical monitoring.

What if there is an existing monitoring well network in place, but there are no soil boring logs or well construction diagrams available?

Depth to water and total well depth measurements may be provided in place of boring logs. Field observations of well size and construction material should also be provided, as well as survey data for the ground surface and top of casing. If survey data does not exist, a new survey must be completed.

How do I collect static water elevation data?

Typically, static water levels are measured with either an electric water level indicator or a chalked steel tape. Both devices are accurate to 0.01 feet. All measurements should be related to a known USGS datum, which should be measured from a clearly identified location (reference point) on each casing.

Electric Water Level Indicator: lower the device into the well until it reaches the water surface as indicated by a tone. Record the distance from the water surface to the reference point on the top of casing.

Chalked Tape: Lower the tape below the water level and hold a convenient foot marker at the reference point. Record both the water level as indicated on the chalked tape section and the depth mark held at the reference point. The depth to water is the difference between the two readings.

Following measurement, the equipment should be decontaminated as necessary.

To determine the groundwater elevation above mean sea level, use the following equation:

$$E_w = E - D$$

Where:

E_w = Elevation of water (feet above mean seal level)

E = Elevation above mean seal level of reference point on top of casing (feet)

D = Depth to water (feet)

What are acceptable methods of groundwater sample collection?

In order to collect a representative groundwater sample, the stagnant water in the well casing and the water immediately adjacent to the well must be removed prior to sample collection. Several groundwater sampling devices are available to meet this requirement including: bailers, submersible pumps, bladder pumps, and peristaltic pumps. Typically, a minimum of 3-5 well volumes should be removed before sample collection.

The low-flow or minimal drawdown sampling method is also acceptable; however, this method is typically more expensive and labor intensive.

To calculate the volume of water to be removed from a well casing, use the following equation*:

$$V = nr^2h \ (cf)$$

Where:

V = Well volume (gallons)

n = pi = (3.14)

r* = radius of monitoring well (feet)

h = height of the water column (feet) (calculated by subtracting the depth to water from the total depth of the well as measured from the same reference point)

cf = conversion factor (gal/ft^3) = 7.48 gal/ft^3

***It is important to remember that most well diameters are in inches and the diameter must be converted to feet before using this equation**

What are the filtration and preservation requirements?

For filtering dissolved inorganic samples, a 0.45 micron filter pore size should be used. Flush or rinse filter membranes and sample containers with laboratory grade water before use unless the equipment is already pre-washed and rinsed. In addition, discard the first 150 milliliters of sample that passes through the filter before filling sample containers. Use positive pressure filtration rather than vacuum filtration, which causes excessive aeration and agitation of the samples.

Preserving samples retards biodegradation reactions, hydrolysis reaction, precipitation and coprecipitation reactions and sorption reactions. Sample preservation usually involves reducing or increasing pH by adding an acid or base preservative. Samples are also preserved by cooling them to 4°C. Add preservative to the container before or immediately after collecting the sample*. If a sample requires filtration, add preservative after filtration, not before.

***Some laboratories may provide pre-preserved bottles**

Example of Filtration and Preservation Summary Table

Parameter	Preservative	Filtered ?
Total Phosphorus	H_2SO_4, Cool to 4°C	No
Dissolved Phosphorus	H_2SO_4, Cool to 4°C	Yes (0.45 micron)
Total Inorganic Nitrogen:		
Ammonia Nitrogen	H_2SO_4, Cool to 4°C	No
Nitrite Nitrogen	Cool to 4°C	No
Nitrate Nitrogen	Cool to 4°C	No
Sodium	HNO_3, Cool to 4°C	No
Chloride	Cool to 4°C	No
pH	NA - Field Measured	NA - Field Measured
Specific Conductance	NA - Field Measured	NA - Field Measured
Static Water Elevation	NA - Field Measured	NA - Field Measured

REPORTING REQUIREMENTS

Part I.A.4.c requires the submittal of groundwater sampling results on a quarterly basis to the District Office identified in your Certificate of Coverage. If the installation of new monitoring wells was required, the following information must be submitted with the first quarter results:

- Final monitoring well location map
- Boring logs and well construction diagrams
- Survey data
- The depth and screened interval for each well with reference to USGS survey data
- Static water elevation data