APPENDIX F

STANDARD OPERATING PROCEDURE FOR SAMPLING

CARLSBAD HYDROLOGIC UNIT LAGOON MONITORING

FOR TMDL DEVELOPMENT

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

SAN DIEGO REGION

INVESTIGATION ORDER NO. R9-2006-076.

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FIELD FLOW MONITORING AND SAMPLING TECHNIQUES

The following text describes clean sampling techniques that should be used when low-level analytical detection limits are to be employed for sampling.

The following topics are discussed below:

- Clean Sample and Equipment Handling
- Composite Bottle changing
- Bottle and Equipment Cleaning

CLEAN SAMPLE AND EQUIPMENT HANDLING

During all sampling operations, extreme care must be taken to minimize exposure of the sample and sample collection equipment to human, atmospheric, and other sources of contamination. This section provides clean sample and equipment handling procedures to be used when samples are collected for-level analysis.

Clean sampling techniques typically require a two person sampling team. Upon arrival at the sampling site, one member of the sampling team is designated as “dirty hands”; the second member is designated as “clean hands”. All operations involving contact with the sample bottle, sample bottle lid, sample suction tubing, and the transfer of the sample from the sample collection device (if the sample is not directly collected in the bottle) to the sample bottle are handled by “clean hands” wearing clean powder-free nitrile gloves. “Dirty hands” (also wearing clean powder-free nitrile gloves) is responsible for preparation of the sampler (except the sample container itself), operation of any machinery, and for all other activities that do not involve handling items that have direct contact with the sample. “Clean hands” will change into clean gloves as frequently as required to ensure that the gloved hands contacting the sample container, container lid, and laboratory cleaned sampling equipment have not contacted any source of potential contamination.

Although the duties of “clean hands” and “dirty hands” would appear to be a logical separation of responsibilities, in fact, the completion of the entire protocol may require a good deal of coordination and practice. For example, “dirty hands” must open the box or ice chest containing the sample bottle and unzip the outer bag; “clean hands” must reach into the outer bag, open the inner bag, remove the bottle, collect the sample, replace the bottle lid, put the bottle back into the inner bag, and zip the inner bag. “Dirty hands” must close the outer bag and place the double-bagged sample in an ice-filled ice chest.

COMPOSITE BOTTLE CHANGING

If an automated monitoring station is used for the collection of composite water samples and a composite bottle change is required, composite bottle changing is conducted using the following steps:

1. The automated sampling equipment is placed in pause mode prior to the initiation of a composite bottle change. This action is accomplished in the field or by remote monitoring personnel if the monitoring station is equipped with telemetry.
2. Composite bottle changing requires two field crew members- “clean hands” and “dirty hands”. Both team members wear clean, powder-free nitrile gloves. “Clean hands” only touches suction tubing and Teflon composite bottle lids. Keep extra gloves within easy reach.
3. Prior to putting on clean gloves, the clean empty sample bottle is placed near the automated sampling unit, and the sampler is opened.
4. Wearing clean powder-free nitrile gloves, “dirty hands” removes the lid clamps from both the full sample bottle and the clean sample bottle.
5. “Clean hands” removes the end of the pump tubing from the composite bottle and “dirty hands” places a clean ziplock bag over the end of the tubing securing it with a rubber band. The inside of the bag should never be touched by sampling personnel.
6. “Clean hands” switches the bottle lids, putting the solid lid on the full bottle and the perforated id on the clean empty bottle.

7. “Dirty hands” installs the lid clamps on both bottles, removes the full bottle from the sampler, replacing it with the clean empty bottle.
8. “Clean hands” holds the tubing while “dirty hands” removes the ziplock bag from the end of the pump tubing, being careful not to touch the tubing.
9. “Clean hands” inserts the tubing through the lid of the clean bottle.
10. The sampler is closed and sampling equipment is placed in sample mode. Remote operation personnel are notified as soon as the bottle change is complete.
11. The sampling tam fills out the appropriate information on the label of the full sample bottle.
12. The full bottle is surrounded with fresh ice or frozen refreezable ice packets, and secured inside the vehicle for transport.

BOTTLE AND EQUIPMENT CLEANING

When use of the preceding clean techniques is called for, additional effort should also be made in the area of bottle and equipment cleaning. Consult also EPA Method 1669, *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels*, and relevant individual 1600 series methods for further information.

Automated Sampling Equipment

Key components required for successful automated sample collection include an automatic sampler, tubing with strainer, and sample bottle(s).

Automatic Sampler

Automatic samplers are comprised of a peristaltic pump, pump control electronics, a sample distribution system, a power supply, and a housing that contains the composite bottle(s). A peristaltic pump creates suction by compressing a flexible tube with a rotating roller, drawing a sample that is then pushed out of the pump. The pump operates best when placed close to the source; this reduces the suction head or lift (experience has shown that the reliability of peristaltic pumps drawing a consistent sample volume is greatly reduced as the static suction head increases). According to manufacturer's specifications, vertical lift must be no greater than 26 feet. When

sampling with an automated sampler, static head height refers to the vertical distance from the surface of the flow stream to the automatic sampler pump inlet. Automatic samplers may be configured for single or multiple bottle composite collection. Samplers configured to fill multiple sample bottles have a sample distribution mechanism. Tubing from the discharge port of the intake pump is connected to a rotating distributor arm that dispenses the samples into several sample bottles. If flow-weighted sampling is planned, the automatic sampler must be capable of accepting a signal from a flow meter that is used to trigger collection of a sample aliquot. Cables can be purchased that connect each type of flow meter to an automated sampler. Automatic samplers are equipped with internal memory circuits, and typically a small LCD data screen. The memory holds the user-programmed values for the sample aliquot volume, sample bottle configuration, and number of samples per bottle. The memory also retains information describing the status of the sampling program and the time at which each triggering signal was received from the flow meter. Messages can be displayed on the data screen for the user regarding any sample collection failures.

Samplers are powered by 12 volt DC batteries, AC power, or solar-powered batteries. Two types of 12V DC batteries are available: nickel-cadmium and lead-acid. Most automated sampler manufacturers offer AC power packs for use where line power is available. Use of AC power decreases routine maintenance requirements, as battery changes are not necessary. The preferred configuration includes AC power with an in-line battery backup. However, back-up batteries typically will not provide adequate power for refrigerated units.

Sampler Intake Strainer, Intake Tubing and Flexible Pump Tubing

The intake strainer is attached to the intake tubing and mounted to the bottom of a pipe or channel. Intake strainers prevent rocks and debris from clogging or damaging the intake tubing or pump. Sizes vary, but smaller intake strainers are generally better for use under low flow conditions. Sample intake strainers are typically made of stainless steel, or a combination of stainless steel and Teflon. For trace metals analyses, all intake strainer parts must be Teflon, or coated with Teflon or Teflon-like material. Specific intake and pump tubing requirements are listed below: Intake tubing: Teflon Maximum vertical lift = 26 feet Maximum length = 99 feet

Pump tubing:
Silicon or other medical grade flexible tubing

Limit to length needed to feed through peristaltic pump, connect to Teflon intake tubing and sample bottle Teflon tubing is used for the sample intake tubing because of its inert properties. This tubing is connected from the intake strainer to the pump tubing, and may range from 3 to 99 feet in length. EPA protocols permit the use of the minimum amount of flexible pump tubing needed to carry the sample water through a peristaltic pump. Silicone tubing is normally used for this purpose.

Sample Bottle(s)

Automatic samplers may be configured to have a variety of sample bottles, from one to a dozen or more sample bottles. If a sampler holds a single bottle, all of the sample aliquots are pumped into this bottle, resulting in one large composite sample. Use of a single composite bottle has the advantage of providing for the estimation of the event mean concentrations (EMCs) directly from analysis of the constituents in the one bottle. However, it does not allow for isolation of specific samples or groups of samples from specific periods of the runoff hydrograph, and provides less visual indication of sampler malfunction (if this should occur). A multiple bottle configuration, however, provides these latter capabilities.

It is important to keep extra bottles (for either the single or multiple bottle configuration) available in case bottles are contaminated or damaged, or in the event that bottles need to be changed to accommodate a larger-than-expected storm. If a storm delivers more precipitation than expected, sample bottles will fill prior to the end of the storm, prompting sample bottle replacement.

AUTOMATED SAMPLER INSTALLATION

The automated sample collection equipment should be installed and maintained according to manufacturer specifications. See Section 5 regarding selection of automated equipment. Installation The automated sampler should be installed inside the

protective enclosure in such a way that all controls, display windows and cable connections are easily accessed. All wiring should be secured, in a well organized fashion to the inside of the enclosure to prevent accidental disconnection or damage. The sampler must be oriented in a way that will allow the sample intake tubing to enter the sampler without sharp bends or kinking, and to allow easy access for tubing replacement. At the sampler peristaltic pump, where the sample intake tubing is connected to the pump tubing, no metallic fittings or clamps should be used. Using “clean techniques”, the Teflon intake tubing should be inserted (at least a half inch) into the flexible pump tubing and fastened using a non-metallic clamp or cable tie. At no time during this procedure should the ends of the tubing be allowed to touch any object that is not known to be clean. The flexible pump tubing should then be fed through the peristaltic pump and into the area of the sampler where the sample bottle(s) re housed. Adequate space must be available in the equipment enclosure to easily remove and replace sample bottles from the automatic sampler. Proper placement of the sampler intake assures the collection of representative samples. The intake strainer should be placed in the main flow. The vertical position of the intake strainer in the flow is important. Placement at the bottom may result in excess heavy solids and no floating material, while placement at the top may result in excess floating material and no heavy solids. The constituents of interest must be considered when positioning the intake strainer. Placement of the intake strainer is usually at the channel invert, but may be mounted slightly above the invert on one side of the channel wall if high solids loadings are expected. This will reduce the amount of solids that may enter the intake strainer, and help prevent blockages. However, with the intake strainer offset above the channel invert, low flows may not adequately submerge the strainer, thus preventing sample collection. Maintenance using laboratory provided blank water, the automated sampler should be calibrated according to manufacturer specifications to collect the desired sample aliquot. At a minimum, the calibration should be checked prior to each stormwater monitoring season.

After each stormwater monitoring event, the sample bottle(s) should be checked to verify that the programmed sample volume was delivered to the sample bottle(s). If the programmed sample volume was not delivered accurately to the sample bottle(s), the automatic sampler should be recalibrated prior to the next monitoring event.

Carlsbad Hydrologic Unit Lagoon TMDL Monitoring Program

Equipment Inspection
Pre-Storm Checklist

GENERAL INFORMATION:			
Date (mm/dd/yy):	Time (24 hr):		
Team Members' Initials:		Stormwater Consultant:	
Site Name:		Site No.:	

SAMPLING AND FLOW MEASUREMENT EQUIPMENT:	Maintenance Required?
Is the monitoring station enclosure locked and structurally sound? ☐ yes ☐ no Comments:	☐ yes ☐ no
Is the rain gauge clean and free of obstructions? ☐ yes ☐ no Comments:	☐ yes ☐ no
Is the gel battery and connect cables present and connected? ☐ yes ☐ no Comments:	☐ yes ☐ no
Are the solar panel, charge controller and cables present and properly connected? ☐ yes ☐ no Comments:	☐ yes ☐ no
Is voltage of gel battery greater than 12.2 volts? ☐ yes ☐ no ☐ not applicable Comments:	☐ yes ☐ no
Is the solar panel charging the battery? ☐ yes ☐ no ☐ not applicable Comments:	☐ yes ☐ no
Is sampler strainer clean and free of obstruction? ☐ yes ☐ no Comments:	☐ yes ☐ no
Does the intake tubing and/or connections need replacement or have kinks or low places? ☐ yes ☐ no Comments:	☐ yes ☐ no
Does the peristaltic pump tubing need replacement? ☐ yes ☐ no Comments:	☐ yes ☐ no
Is the bottle installed, ice added, and stopper removed and placed in a ziplock on site? ☐ yes ☐ no Comments:	☐ yes ☐ no
Has the flow meter been reset to zero? ☐ yes ☐ no Comments:	☐ yes ☐ no
Is the automatic sampler properly programmed and calibrated? ☐ yes ☐ no Aliquot volume _____(ml) (250ml should be the aliquot volume) Comments:	☐ yes ☐ no

Monitoring Equipment Inspection
Pre-Storm Checklist (continued)

Is the flow meter tubing free of kinks, free of obstructions, and properly connected? ☐ yes ☐ no Comments:	☐ yes	☐ no
Does the desiccant cartridge in the flow meter need replacement (i.e. is it pink)? ☐ yes ☐ no Comments:	☐ yes	☐ no
Is the flow meter properly installed? ☐ yes ☐ no Comments:	☐ yes	☐ no
Has the flow volume per sample (or pacing) been set based on the expected amount of rainfall and runoff? See the volume to sample (or pacing) table for this site. ☐ yes ☐ no Comments:	☐ yes	☐ no
Indicate settings below: QPF_____ (cm) Pacing _____ (liters)		
Are both the flow meter and sampler "running"? Verify that flow meter is set to log flow once every 1 minute. ☐ yes ☐ no Comments:	☐ yes	☐ no
Is the wireless modem voltage good and connected to the flow meter? ☐ yes ☐ no Comments:	☐ yes	☐ no
General Comments:		
Dates for maintenance to be completed by: _____		
_____ (Team Leader's Signature)		

Carlsbad Hydrologic Unit Lagoon TMDL Monitoring Program

During Storm Field Data Log Sheet

GENERAL INFORMATION:	
Date (mm/dd/yy):	Time:
Team Member's Initial:	Stormwater Consultant:
Site Name:	Site No.:

METEOROLOGICAL CHARACTERISTICS:

Time since end of previous storm event: ☐ > 72 hours ☐ 48-72 hours ☐ 24-48 hours ☐ < 24 hours

Present rainfall: ☐ None ☐ Intermittent ☐ Light (averaging <0.05 cm/hour)
☐ Moderate (averaging ~ 0.05-0.18 cm/hour) ☐ Heavy (averaging > 0.18 cm/hour)

Meteorological characteristics comments:

FLOW AND FIELD MEASUREMENTS (take at least once per monitoring event) :

QPF set at _____ cm Pacing = _____ liters

Water Temperature (to the nearest 0.1 °C):

Presence of oil (extent):

Floating Material:

Other observations (water color or odor etc):

Flow Level Calibration: ***(at least one hand reading per storm – QA/QC on Level Calibration)***

Flow Level Measurement (from Flow Meter) (cm)	**Hand Level Measurement (with ruler) (cm)**	**Comments**

SAMPLING EQUIPMENT REPAIR NEEDS:

During Storm Field Data Log Sheet (continued)

End of Storm Information: Total flow volume: _____ Total rainfall: _____

Total aliquots attempted: _____ Total aliquots missed: _____ Total aliquots collected: _____

Time first sample collected: _____ Time last sample was collected: _____

Duration of rain: Start (date/time): _____ Stop (Date/Time): _____ Total (hh:mm): _____

Duration of FLOW: Start (date/time): _____ Stop (Date/Time): _____ Total (hh:mm): _____

Approximate sample volume collected (liters): _____ Approximate volume overflowed (liters): _____

No. and size of bottles sent to Laboratory _____

_____

(Team Leader's Signature)

Post-Storm Checklist

GENERAL INFORMATION:	
Date (mm/dd/yy):	Time (24 hr.):
Team Member's Initials:	Stormwater Consultant:
Site Name:	Site No.:

SAMPLING AND FLOW MEASUREMENT EQUIPMENT:	Maintenance Required?
Has the data been downloaded from the flow meter and the meter reset? ☐ yes ☐ no Comments:	☐ yes ☐ no
Has the auto sampler bottle been replaced and the sampler reset? ☐ yes ☐ no Comments:	☐ yes ☐ no
Has the battery voltage been checked? Record voltage: Gel battery: _____V Comments: _____ _____	☐ yes ☐ no
Is the monitoring station enclosure structurally sound and locked? ☐ yes ☐ no Comments:	☐ yes ☐ no
Are the flow intakes and bubbler tubing free of clogging or obstructions? ☐ yes ☐ no Comments:	☐ yes ☐ no

ACTION TAKEN:

_____

(Team Leader's Signature)

Lagoon Transect Sampling Field Data Sheet

Lagoon		**Field Leader**
Sampling Date		**Field Assistant**
Time Start	**Time End**	**Field Assistant**
Index Period		**Field Assistant**

Site Location: Record the transect sampling site number, the nearest segment site number, the GPS latitude and longitude.

Site #	Segment #	Latitude	Longitude

Field Measurements: Record the transect sampling site number and temperature, dissolved oxygen, pH, conductivity, turbidity and TDS in triplicate.

Site #	Temp (°C)			DO (mg/L)			pH			Conductivity (mS)			Turbid (NTU)			TDS		
	-1	-2	-3	-1	-2	-3	-1	-2	-3	-1	-2	-3	-1	-2	-3	-1	-2	-3

Lagoon	Sampling Date

Sample Collection: Check sample bottles collected from each site. Check (-1) if a single sample was collected, (-2) if a field duplicate was collected, (-FB) if a field blank was collected. For chlorophyll a samples include the volume filtered.

Site	TSS		Nutrients		TN/TP		TDN/TDP		Bacteria		CBOD		Chlorophyll a			
#	-1	-2	-1	-2	-1	-2	-1	-2	-1	-2	-1	-2	-1	vol	-1	vol

Post-Storm Event Sampling Field Data Sheet

Lagoon		**Field Leader**
Sampling Date		**Field Assistant**
Time Start	**Time End**	**Field Assistant**
Index Period	**Rainfall**	**Field Assistant**

Record the post-storm event sediment sampling site number, the nearest segment site number, the GPS latitude and longitude, and check where sediment samples from the top two centimeters were collected into separate containers for grain size, percent organic carbon and percent total nitrogen, and percent total phosphorus. If a single sample for each was collected check under the (-1) box, if a field replicated was collected check under the (-2) box.

Site #	Segment #	Latitude	Longitude	Grain size		%OC/%TN		%TP	
				-1	-2	-1	-2	-1	-2