APPENDIX A

AUTOMATED STORMWATER MONITORING EQUIPMENT

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1 Automated Stormwater Monitoring Equipment

Monitoring of stormwater runoff at the receiving water/TMDL site and Watershed Segmentation monitoring sites will require use of automated stormwater sampling equipment. This section addresses equipment and sampling procedures that will be used for LCC1, PWS and SWS sites.

Flow-weighted and time-weighted sampling will generally require similar equipment. Similar equipment will be necessary regardless of the selected sampling approach. Time-weighted composite samples simply allow for more mobile installations that do not require flow meters, rain gauges, solar panels, or communication equipment. In lieu of communications equipment, such sites require added field personnel to monitor and track performance of the equipment along with added sensors to trigger the equipment to initiate the sampling.

For purposes of this CIMP, it is assumed that all sites requiring collection of flow-weighted composite samples will be established as “permanent” or “long-term” sites with appropriate security to protect the equipment and intake structures from debris coming down the stream or vandalism. As noted, collection of time-weighted samples will be utilize the same types of autosamplers and composite containers but will not include flow meters, rain gauges and telecommunication packages. Monitoring stations designed to take time-weighted composite samples will require sensors to detect initial flows and trigger the sampler. This will allow for use of smaller security enclosures that can temporally be secured at a site or, if necessary, equipment can be deployed in a manhole.

Fixed monitoring sites will utilize automated stormwater sampling stations that incorporate an autosampler (American Sigma or Isco), a datalogger/flow module to monitor flow and pace the autosampler, a rain gauge to monitor and record local rainfall, and telecommunications to allow for remote monitoring and control of each site. Sites without access to AC power will be powered by deep-cycle marine batteries. Sites without direct access to AC power will utilize solar panels to provide the energy needed to maintain the charge on two deep cycle batteries used to power the autosampler, flow meter and datalogger. Providing reliable telecommunications for real-time access to data and to provide command and control functionality has greatly improved efficiency and contributed to improved stormwater data.

Both types of automated stormwater monitoring systems considered for this monitoring program use peristaltic pumping systems. When appropriate measures are taken, it has been demonstrated that these types of systems are capable of collecting blanks that are uncontaminated and high quality, reproducible data using detection limits appropriate to water quality criteria. In order to accomplish this, extreme care must be taken to avoid introduction of contaminants.

Requirements include:

- Assuring that all materials coming into contact with the samples are intrinsically low in trace metals and do not adsorb/absorb metals or other target.

- Materials coming into contact with the sample water are subjected to intensive cleaning using standardized protocol and subjected to systematic blanking to demonstrate and document that blanking standards are met.
- All cleaned sampling equipment and bottles are appropriately tracked so that blanking data can be associated with all component deployed in the field.
- Samples are collected, processed and transported taking care to avoid contamination from field personnel or their gear, and
- Laboratory analysis is conducted in a filtered air environment using ultrapure reagents.

Table 2-1 of the USGS National Field Manual (http://pubs.water.usgs.gov/twri9A/) provides a summary of acceptable materials for use sampling organic and inorganic constituents. The stormwater monitoring stations will primarily utilize 20-L borosilicate glass media bottles for the composite samples, FEP tubing for the sample hose and either 316 SS or Teflon-coated intake strainers. Ten (10) liter borosilicate glass media bottles will be considered for sites where required sample volumes are low and lower sample volumes are acceptable. The peristaltic hose is a silicone-base material that is necessary for operation of the autosamplers. The peristaltic hose can be as source of silica which is not a target compound.

Although the technical limitations of autosamplers are often cited, they still provide the most practical method for collecting representative samples of stormwater runoff for characterization of water quality and have been heavily utilized for this purpose for the past 20 years. The alternative, manual sampling, is generally not practical for collection of flow-weighted composite samples from a large number of sites or for sampling events that occur over an extended period of time. Despite the known drawbacks, autosamplers combined with accurate flow metering remain the most common and appropriate tool for monitoring stormwater runoff.

1.1 Sampler Intake Strainer, Intake Tubing and Flexible Pump Tubing

Intake strainers will be used to prevent small rocks and debris from being drawn into the intake tubing and causing blockages or damage to the pump and peristaltic pump tubing. Strainers will be constructed of a combination of Teflon and 316 stainless or simply stainless steel. The low profile version is typically preferred to provide greater ability to sample shallow flows. Although high grade stainless steel intake strainers are not likely to impact trace metal measurements, it is preferable to use strainers coated with a fluoropolymer coating. If the stainless steel intake is not coated, the strainer will not be subjected to cleaning with acids. Cleaning will be limited to warm tap water, laboratory detergents and MilliQ water rinses.

Tubing comprised of 100% FEP (Fluorinated Ethylene Propylene) will be used for the intake tubing. Several alternative fluoropolymer products are available but 3/8" ID solid FEP tubing has the chemical characteristics suitable for sampling metals and organics at low levels and appropriate physical characteristics. The rigidity of FEP tubing provides resistance to collapse at high head differentials but still is manageable for tight configurations.

The peristaltic hose used in autosamplers is a medical-grade silicon product. The specifications for the peristaltic pump hoses used in these samplers are unique to the samplers. It is very important that hose specified and provided by the manufacturers of the autosamplers be used. Minor differences in the peristaltic hose can cause major deterioration in performance of the samplers. Use of generic peristaltic pump hose from other sources can lead to problems with the ability to calibrate the samplers and maintain intake velocities of greater than 2.5 feet per second with higher lift requirements.

The peristaltic hose is connected to the FEP tubing and fed through the pump head leaving the minimum amount necessary to feed the peristaltic pump hose into the top of the composite bottle. The composite container will always have a lid to prevent dust from settling in the container.

1.2 Composite Containers

The composite containers used for monitoring must be demonstrated to be free of contaminants of interest at the desired levels (USEPA 1996). Containers constructed of fluoropolymers (FEP, PTFE), conventional or linear polyethylene, polycarbonate, polysulfone, polypropylene, or ultrapure quartz are considered optimal for metals but borosilicate glass has been shown to be suitable for both trace metals and organics at limits appropriate to EPA water quality criteria. High capacity borosilicate media bottles (20-liters or ~5-gallons) are preferred for storm monitoring since they can be cleaned and suitably blanked for analysis of both metals and organic compounds. The transparency of the bottles is also a useful feature when subsampling and cleaning the containers for reuse.

Figure 1. Composite Bottle with Label and installed Tubing inside Brute® Container.

These large media bottles are designed for stoppers and thus do not come with lids. Suitable closure mechanisms must be fabricated for use during sampling, transport and storage of clean bottles. The preferred closure mechanism is a Teflon® stopper fitted with a Viton® O-ring (2 3/8" - I.D. x 23/4"- O.D.) that seals the lid against the media bottle. A polypropylene clamp (Figure 2) is used to seal the Teflon® stopper and O-ring to the rim of the composite sample bottle. Two polypropylene bolts with wing-nuts are used to maintain pressure on the seal or to assist in removal of the lid.

Every composite bottle requires one solid lid for use in protecting the bottle during storage and transport. A minimum of one Teflon® stopper should be available for each monitoring site during storm events. Each field sampling crew should have additional stoppers with holes ("sampling stopper") that would be available if a sampling stopper is accidentally contaminated during bottle changes or original installations.

Figure 2. Composite bottle showing bottle bag used for transport and lifting.

The holes in the sampling stoppers should be minimally larger than the external diameter of the peristaltic hose. If a tight fit exists, the pressure created when water is pumped into the bottle will cause the hose to be ejected and the sampling event will to be abandoned.

Transporting composite bottles is best accomplished by use of 10-gallon Brute® containers to both protect them from breakage and simplify handling. They also provide additional capacity for ice while transporting full bottles to the laboratory or subsampling site.

Bottle bags (Figure 2) are also useful in allowing full bottles to be handled easier and reduce the need to contact the bottles near the neck. They are important for both minimizing the need to handle the neck of the bottle and are also an important Health and Safety issue. The empty bottles weigh 15 pounds and they hold another 40 pounds of water when full. These can be very slippery and difficult to handle when removing them from the autosamplers. Bags can be easily fabricated out of square-mesh nylon netting with nylon straps for handles. Use of bottle bags allows two people to lift a full bottle out of the ice in the autosampler and place it in a Brute® container. Whether empty or full, suitable restraints should be provided whenever the 20-L composite bottles and Brute® containers are being transported.

1.3 Flow Monitoring

Retrieval of flow-weighted stormwater samplers requires the ability to accurately measure flow over the full range of conditions that occur at the monitoring site. The ability to accurately measure flow at an outfall site should be carefully considered during the initial site selection process. Hydraulic characteristics necessary to allow for accurate flow measurement include a relatively straight and uniform length of pipe or channel without major confluences or other features that would disrupt establishment of uniform flow conditions. The actual measurement site should be located sufficiently downstream from inflows to the drainage system to achieve well-mixed conditions across the channel. Ideally, the flow sensor and sample collection inlet should be placed a minimum of five pipe diameters upstream and ten pipe diameters downstream of any confluence to minimize turbulence and ensure well-mixed flow. The latest edition of the *Isco Open Channel Flow Measurement Handbook* (Walkowiak 2008) is an invaluable resource to assist in selection of the most appropriate approach for flow measurements and information on the constraints of each method.

The existing mass emission site has an established flow rating curve (Stage-Flow relationships) that only requires measurement of water level to estimate flow. Additional sites requiring flow monitoring are expected to utilize area-velocity sensors that use Doppler-based sensors to measure the velocity of water in the conveyance, a pressure sensor to measure water depth, and information regarding channel dimensions to allow for real-time flow measurements to pace the autosamplers.

1.4 Rainfall Gauges

Electronic tipping bucket rain gauges will be installed at each fixed monitoring location to provide improved assessment of rainfall in the smaller drainages. Use of a localized rain gauge provides better representation of conditions at the site. A variety of quality instruments are available but all require substantial maintenance to ensure maintenance of high data quality.

Tipping bucket rain gauges with standard 8-inch diameter cones will be used at each site. These provide 1 tip per 0.01" of rain and have an accuracy of ± 2% up to 2"/hr. The accuracy of tipping bucket rain gauges can be impacted by very intense rainfall events but errors are more commonly due to poor installation.

Continuous data records will be maintained throughout the wet season with data being output and recorded for each tip of the bucket. The rainfall data is downloaded at the same rate as the flow and stormwater monitoring events.

1.5 Power

Stormwater monitoring equipment can generally be powered by battery or standard 120VAC. If 120VAC power is unavailable, external, sealed deep-cycle marine batteries will be used to power the monitoring site. Even systems with access to 120VAC will be equipped with batteries that can provide backup power in case of power outages during an event. All batteries will be placed in plastic marine battery cases to isolate the terminals and wiring. A second battery will be provided at each site to support the telecommunication packages. Sites relying on battery power will also be equipped with a solar panel to assure that a full charge is available when needed for a storm event.

1.6 Telecommunication for System Command/Control and Data Access

The ability to remotely communicate with the monitoring equipment has been shown to provide efficient and representative sampling of stormwater runoff. Remote communication facilitates preparation of stations for storm events and making last minute adjustments to sampling criteria based upon the most recent forecasts. Communication with the sites also reduces the number of field visits by monitoring personnel. Remote two-way communication with monitoring sites allows the project manager (storm control) to make informed decisions during the storm as to the best allocations of human resources among sampling sites. By remotely monitoring the status of each monitoring site, the manager can more accurately estimate when composite bottles will fill and direct field crews to the site to avoid disruptions in the sampling. Real time access to flow, sampling and rainfall data also provides important information for determining when sampling should be terminated and crews directed to collect and process the samples. Increases in both efficiency and sample quality make two-way communication with monitoring stations a necessity for most monitoring programs.

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APPENDIX B

CLEANING AND BLANKING PROTOCOL

FOR

EQUIPMENT AND SUPPLIES USED IN COLLECTION OF FLOW OR TIME-WEIGHTED COMPOSITES

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CLEANING PROTOCOL FOR:

20-L Borosilicate Glass Composite Bottles (Media Bottles) and Closures

1.0 SCOPE

This Standard Operating Procedure (SOP) describes the procedures for the cleaning of 20-liter composite sample bottles and the related equipment necessary to complete the task. The purpose of these procedures is to ensure that the sample bottles are contaminant-free and to ensure the safety of the personnel performing this procedure.

2.0 APPLICATION

This SOP applies to all laboratory activities that comprise the cleaning of 20-liter composite sample bottles and stoppers.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The cleaning of 20-liter composite-sample bottles and associated equipment involves hazardous materials. Skin contact with all materials and solutions should be minimized by wearing appropriate personal protective equipment (PPE) including: chemical-resistant gloves, laboratory coats, chemical-resistant aprons, and goggles. To ensure that you are aware of the hazards involved, the material safety data sheets (MSDSs) for nitric acid and laboratory detergents should be reviewed before beginning any of these procedures.

Note: Preparations should be made to contain and neutralize any spillage of acid. Be aware of the location of absorbent, neutralizing, and containment materials in the bottle cleaning area.

4.0 DEFINITIONS

4.1 **Composite sample bottle** - 20 liter borosilicate glass bottle that is used with autosamplers to collect a stormwater composite sample.

4.2 **Stopper** - a Teflon® cap used to seal the composite sample bottle (either solid, or drilled with holes for the silicon inlet tubing).

4.3 **O-Ring** - Viton O-ring 23/8"- I.D. x 23/4"- O.D. that is located around the base of stopper.

4.4 **Clamp** - Polypropylene clamp, 2 bolts, and wing nuts specifically designed to fasten the stopper and the O-ring to the rim of the composite sample bottle.

4.5 **De-ionized (DI) water -** commercial de-ionized water (12-13 Megohm/cm)

4.6 **Laboratory Detergent** - 2% solution of Contrad 70® or Micro-90® detergent

5.0 EQUIPMENT

5.1 Instrumentation:

1) Peristaltic pump with a protocol-cleaned sub-sampling hose setup

5.2 Reagents:

1) ACS Reagent Grade nitric acid in a 2 Normal solution (2N HNO_3)
2) Contrad 70® non-phosphate laboratory detergent
3) Contrad 70® anti-foaming agent
4) Micro-90® non-phosphate laboratory detergent
5) Baking soda or equivalent to neutralize acid
6) pH paper

5.3 Apparatus:

1) Bottle Rolling Rack
2) DI Rinse Rack
3) Yellow Neutralization Drip Bucket
4) Neutralization Tank

5.4 Documentation:

The status of each composite sample bottle must be tracked. Bottles should be washed in batches of 10, 20, or 30 and the status of each batch must be made apparent to all personnel by posting a large status label (including the start date) with each batch. This will ensure that all required soak times have been attained and that each bottle was subjected to the proper cleaning procedures. Information on each batch of bottles cleaned (including bottle number, QA batch, date cleaning started, date finished, date blanked, and cleaning technicians) should be entered in the **Bottle Cleaning Log Sheet**.

6.0 CLEANING PROCEDURES

Care must be taken to ensure that no contaminants are introduced at any point during this procedure. If the wash is not performed with this in mind, the possibility for the introduction of contaminants (i.e., from dust, dirty sub-sampling tubing tips, dirty fingers/gloves, automobile emissions, etc.) is increased significantly.

6.1 Teflon® Bottle Stoppers with Holes and Field Extras:

To be performed whenever required for field use.

1) Wash with laboratory detergent using a clean all-plastic brush.
2) Rinse thoroughly (minimum of three times) with tap water.

3) Rinse thoroughly (minimum of three times) with DI water.

4) Wash three times with 2N nitric acid squirt bottle.

5) Rinse thoroughly (minimum of three times) with DI water.

6) Allow to dry in a dust-free environment.

7) Store in two sealed clean Ziploc® bags.

6.2 NPS 20 liter composite sample bottle Cleaning:

6.2.1 Preliminary Bottle Cleaning:

Bottles should undergo a preliminary rinse with tap water as soon as possible after they are available. This includes dumping any remaining stormwater into a sanitary drain and rinsing the bottles and stoppers. This prevents material from adhering to the interior surface of the bottle.

6.2.2 **48 Hour Soak:** Place the bottle to be cleaned into a secondary containment bucket. Prepare a 2% solution of laboratory detergent with tap water directly in the bottle. Note: Since laboratory detergent is a foaming solution, add 3/4 of the tap water first, add the detergent, then add the rest of the water. Should excessive foam be generated, a few drops of Contrad 70® anti-foaming agent may be added. **Make sure that the bottle is filled to the rim and scrub the rim with an all-plastic scrub brush.** Scrub a Teflon® stopper with 2% solution of laboratory detergent and place stopper over the full bottle so overflowing happens. This will allow both the stopper and the bottle to soak for 48 hours. After the 48 hour soak, this solution may be may be retained for reuse (i.e., siphoned into other dirty bottles) or it can be poured off into a sanitary drain.

6.2.3 Teflon® Bottle Stopper and O-ring Cleaning:

This procedure should be performed prior to the bottle washing process so that the stopper can follow the bottle through the acid wash.

1) Rinse thoroughly (minimum of three times) with tap water.

2) Rinse thoroughly (minimum of three times) with DI water.

3) Store temporarily in a similarly cleaned

6.2.4 **Tap Water Rinse:** Tap water rinses detergent better than DI water. Flush upside down bottle with tap water for 20 sec. Rinse each bottle 3 times with tap water being careful not to contaminate the clean surfaces.

6.2.5 **DI Rinse:** Rinse the top and neck of the bottles with DI water using a squirt bottle and then rinse upside down for three minutes on the DI rinse rack for bottles. Make sure to tip bottles from side to side for a more thorough rinsing. Allow 1-2 minutes for the bottles to drain as much as possible. Rinse each stopper with DI water squirt bottle 3 times (being careful not to touch the clean surfaces).

6.2.6 **<u>Acid Wash:</u>** Note that it is important to Wash the bottle with 2N nitric acid according to the following procedure:

1) Place the empty bottle near the 2N nitric acid carboy and peristaltic pump. The location should be able to safely contain a spill if the 20L bottle breaks.

2) Pump acid into the bottle using the peristaltic pump fitted with a protocol-cleaned sub-sampling hose setup

3) Fill the bottle slightly more than half full.

4) Place a protocol-cleaned solid Teflon® stopper (with a properly seated O-ring) (Refer to Section 6.2.3 above) on the bottle and clamp it securely.

5) **Carefully** lift and place the bottle on the roller rack and check for leakage from the stopper. Neutralize any spillage. Often small leaks can be corrected by a slight tightening of the clamp. Roll the bottles for twenty minutes.

6) Pump the acid into another bottle for rolling or back into the 2N nitric acid carboy.

6.2.7 **<u>DI Rinse for Sub-sampling Hose</u>**: After use, the sub-sampling hose setup should be rinsed by pumping 1-2 gallons of DI water through the hoses and into a neutralization tank. Carefully rinse the outside of the hose to remove any acid that may be on the exterior of the hose. pH paper should be used to insure that the fluid in and on the hose is 6.8 or higher. Continue rinsing until your reach neutral pH. Store hose in a clean, large plastic bag between uses. Dispose of rinsate in accordance with all federal, state, and local regulations

6.2.8 **<u>DI Rinse for Bottles</u>**: Allow the bottles to drain into a yellow neutralization bucket for at least 1 minute. Place four bottles at a time on the DI rinse rack and rinse for 5 minutes. Move bottles around to ensure complete and thorough rinsing. Rinse the outside of the bottle with tap water. Allow bottles to drain for 2 minutes.

6.2.9 **<u>DI Rinse for Stoppers</u>**: Rinse caps thoroughly 3 times over neutralization tank. Place on a clean surface where the clean side of the stopper will not be contaminated.

6.3 **<u>Storage:</u>** Clamp a stopper (one that went through the entire cleaning procedure) on the bottle. Properly label the bottle as to the date cleaned and by whom and place on the bottle storage rack or in a secondary containment bucket in a safe area. Also, fill out the **Bottle Cleaning Log Sheet**.

7.0 QUALITY ASSURANCE REQUIREMENTS

7.1 The NPS 20 liter sample bottles must be evaluated ("blanked") for contaminants after they have completed the decontamination procedure. The analytical laboratory performing the evaluation should supply Milli-Q® water that is used as a blanking rinsate, and sample bottles for the appropriate constituents of concern. This evaluation will be accomplished by randomly blanking 10% of the washed bottles, or 1 bottle per batch (whichever is greater) and having the blanking rinsate analyzed by the laboratory for the appropriate constituents.

7.2 If any of the bottles fail the analyses (concentration of any analytes are at or above the limit of detection), all of the bottles from that batch must be decontaminated. Again, 10% of these bottles must be subjected to the blanking process as described-above.

7.3 If results of the evaluation process show that the bottles are not contaminant-free, the cleaning procedure must be re-evaluated. Consult with the Quality Assurance/Quality Control Officer to determine the source of contamination.

CLEANING PROTOCOL FOR:

Miscellaneous Laboratory Equipment used for Cleaning and Blanking

1.0 SCOPE

This Standard Operating Procedure describes the procedures for cleaning the miscellaneous items necessary to complete the tasks of cleaning 20- liter composite sample bottles and hoses. The purpose of these procedures is to ensure that the items are contaminant-free and to ensure the safety of the personnel performing this procedure.

2.0 APPLICATION

This SOP applies to all laboratory activities that comprise the cleaning of ancillary items necessary to complete the tasks of cleaning 20 liter composite sample bottles and NPS hoses.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The cleaning of the following items may involve contact with hazardous materials. Skin contact with all materials and solutions should be minimized by wearing appropriate personal protective equipment (PPE) including: chemically-resistant protective gloves, laboratory coats, chemically-resistant aprons, and goggles. In addition, to ensure that you are aware of the hazards involved and of any new revisions to the procedure, the material safety data sheets (MSDSs) for nitric acid and the laboratory detergent should be reviewed before beginning any of these procedures.

4.0 DEFINITIONS

4.1 Polyethylene Squirt Bottles - ½ and 1 liter squirt bottles for washing and/or rinsing with DI water or nitric acid.

4.2 Polycarbonate and Polyethylene De-ionized Water Jugs - For holding DI water.

4.3 Polyethylene Bucket - For holding tap water, DI water or detergent solutions during hose washing procedures.

4.4 Four-inch Teflon® Connector - For connecting two lengths of silicon peristaltic tubing together.

4.5 Four-inch Silicon Connector - For connecting two lengths of Teflon® hose together.

4.6 Orange Polypropylene Hose Caps - For placing over the ends of clean Teflon® hose to prevent contamination.

4.7 De-ionized (DI) water - Commercial de-ionized water

4.8 Laboratory Detergent - 2% solution of Contrad 70® or Micro-90® detergent.

5.0 EQUIPMENT

5.1 Instrumentation: Not applicable.

5.2 Reagents:

1) ACS Reagent Grade nitric acid as a 2 Normal solution (2N HNO_3)

2) Micro-90® non-phosphate laboratory detergent

3) Contrad 70® non-phosphate laboratory detergent

4) Contrad 70® anti-foaming agent.

5) pH paper or pH meter

6) Baking soda ($NaHCO_3$) or equivalent to neutralize acid

5.3 Apparatus:

1) Clean polyethylene squirt bottles.

2) Clean polyethylene trays or 2000 ml glass beakers.

3) Neutralization Tank

5.4 Documentation:

Label each squirt bottle, DI jug, storage container holding clean items, etc. as to the date each was cleaned and the initials of the cleaning technician.

6.0 CLEANING PROCEDURES

Care must be taken to ensure that no contaminants are introduced at any point during these procedures. If the wash is not performed with this in mind, the possibility for the introduction of contaminants (i.e., from dirty sinks, dirty counter tops, dirty fingers/gloves, dirty hose ends, etc.) is increased significantly.

Rinsing properly is essential to ensure proper cleaning. This is done by squirting the liquid over the item to be cleaned in a top-down fashion, letting the water flow off completely **before** applying the next rinse. Rinse the item in this fashion **a minimum** of three times. **Numerous rinses of relatively small volumes are much better than one or two rinses of higher volume.** Be aware of handling: use clean gloves (it is best if they have gone through the same prior wash as the item to be rinsed) and rinse off the fingers prior to grasping the item to be cleaned. Try to grasp the item in a slightly different place between rinses so ones fingers do not cover a portion of the item throughout the rinses.

6.1 Polyethylene Squirt Bottles:

1) Soak in a 2% solution of laboratory detergent in a protocol-cleaned bucket for 48 hours.

2) Rinse thoroughly (minimum of three times) with tap water.

3) Rinse thoroughly (minimum of three times) with DI water.

4) Wash three times with 2N (10%) nitric acid.

5) Rinse thoroughly (minimum of three times) with DI water. Neutralize and dispose of rinsate in accordance with all federal, state, and local regulations.

6.2 Polycarbonate and Polyethylene DI Water Jugs:

1) Fill to the rim with a 2% solution of laboratory detergent, cap the jug, and let soak for 48 hours. Wash cap with an all-plastic scrub brush after soak.

2) Rinse thoroughly (minimum of three times) with tap water.

3) Rinse thoroughly (minimum of three times) with DI water.

4) Wash three times with 2N (10%) nitric acid.

5) Rinse thoroughly (minimum of three times) with DI water. Neutralize and dispose of rinsate in accordance with all federal, state, and local regulations.

6.3 Polyethylene Bucket:

1) Fill to the rim with a 2% solution of laboratory detergent and let soak for 48 hours.

2) Rinse thoroughly (minimum of three times) with tap water.

3) Rinse thoroughly (minimum of three times) with DI water.

4) Wash three times with 2N (10%) nitric acid squirt bottle.

5) Rinse thoroughly (minimum of three times) with DI water. Neutralize and dispose of rinsate in accordance with all federal, state, and local regulations. **Label as to the date cleaned and initial.**

6.4 Four-inch Teflon® and Silicon Hose Connectors and Orange Polypropylene Hose Caps. The purpose of the four-inch sections of Teflon® and silicon hose is to connect longer lengths of each type of hose together during the hose cleaning procedures. The orange polypropylene hose caps are for the ends of cleaned FEP hoses to prevent contamination prior to use in the field or laboratory.

1) Using a 2% solution of laboratory detergent, soak the four-inch sections of FEP hose, silicon tubing, and orange caps for 48 hours.

2) Rinse thoroughly with tap water (minimum of three rinses).

3) Rinse thoroughly with DI water (minimum of three rinses).

4) Using a squirt bottle filled with 2N (10%) HNO3, thoroughly rinse the interior and exterior of the connectors and caps thoroughly OR, roll/agitate them in a shallow layer of 2N (10%) HNO3 in a laboratory detergent cleaned glass beaker or other appropriate, clean container for a more thorough washing.

5) Thoroughly rinse connectors and caps with DI water (minimum of three rinses). Neutralize and dispose of rinsate in accordance with all federal, state, and local regulations. Keep clean connectors and caps in a similarly cleaned (or certified clean) widemouth glass jar or detergent-cleaned resealable bag and **label as clean, date cleaned, and initial**.

NPS 20-Liter Bottle Subsampling Procedure

1.0 Scope

This Standard Operating Procedure (SOP) describes the procedures for the compositing and sub-sampling of non-point source (NPS) 20 liter sample bottles. The purpose of these procedures is to ensure that the sub-samples taken are representative of the entire water sample in the 20-L bottle (or bottles). In order to prevent confusion, it should be noted that in other KLI SOPs relating to 20-L bottles they are referred to as "composite" bottles because they are a composite of many small samples taken over the course of a storm; in this SOP the use of "compositing" generally refers to the calculated combining of more than one of these 20-L "composite" bottles.

2.0 Application

This SOP applies to all laboratory activities that comprise the compositing and sub-sampling of NPS 20 liter sample bottles.

3.0 Health and Safety Considerations

The compositing and sub-sampling of NPS 20 liter sample bottles may involve contact with contaminated water. Skin contact with sampled water should be minimized by wearing appropriate protective gloves, clothing, and safety glasses. Avoid hand-face contact during the compositing and sub-sampling procedures. Wash hands with soap and warm water after work is completed.

4.0 Definitions

4.1 **20 liter sample bottle:** 20 liter borosilicate glass bottle that is used to collect multiple samples over the course of a storm (a composite sample).

4.2 **Large-capacity stirrer**: Electric motorized "plate" that supports a 20 liter bottle and facilitates the mixing of sample water within the bottle by means of spinning a pre-cleaned magnetic stir-bar which is introduced into the bottle.

4.3 **Stir-bar**: Teflon-coated magnetic "bar" approximately 2-3 inches in length which is introduced into a 20 liter bottle and is spun by the stirrer, thereby creating a vortex in the bottle and mixing the sample. Pre-cleaned using cleaning protocols provided in KLI SOP for *Cleaning Procedures for Miscellaneous Items Related to NPS Sampling*.

4.4 **Sub-sampling hose**: Two ~3-foot lengths of Teflon tubing connected by a ~2-foot length of silicon tubing. Pre-cleaned using cleaning protocols provided in SOP for *Teflon Sample Hose and Silicon Peristaltic Tubing Cleaning Procedures*. Used with a peristaltic pump to transfer sample water from the 20-L sample bottle to sample analyte containers.

4.6 **Volume-to-Sample Ratio (VSR):** A number that represents the volume of water that will flow past the flow-meter before a sample is taken (usually in liters but can also be in kilo-cubic feet for river deployments). For example, if the VSR is 1000 it means that every time 1000 liters passes the flow-meter the sampler collects a sample (1000 liters of flow per 1 sample taken). Note: The VSR indicates when a sample should be taken and is NOT an indication of the sample size.

5.0 EQUIPMENT

5.1 Instrumentation: Not applicable

5.2 Reagents: Not applicable.

5.3 Apparatus

1) Large capacity stirrer.

2) Stir bar.

3) Sub-sampling hose.

4) Peristaltic pump.

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APPENDIX C

QUALITY ASSURANCE/QUALITY CONTROL

1. Quality Assurance/Quality Control

Elements of a Quality Assurance and Quality Control (QA/QC) Plan have been incorporated into the CIMP in order to detail critical activities conducted to assure that both chemical and physical measurements meet the standard of quality needed to evaluate measurements at levels relevant to applicable water quality criteria. With many different monitoring programs being implemented within the region, comparability should remain of the primary goals of the QA/QC monitoring program. The Intergovernmental Task Force on Monitoring Water Quality (ITFM, 1995) defines comparability as the "characteristics that allow information from many sources to be of definable or equivalent quality so that it can be used to address program objectives not necessarily related to those for which the data were collected."

One important aspect of comparability is the use of analytical laboratories that are accredited under a program such as the National Environmental Laboratory Accreditation Program (NELAP), California's Environmental Laboratory Accreditation Program (ELAP) or a well-qualified research laboratory. In addition, the laboratory should be a participant in a laboratory proficiency and intercalibration program. Laboratories have not been selected for this program but participation in the Stormwater Monitoring Coalition's (SMC) intercalibration program will be a primary consideration. Unfortunately, the SMC has not fully completed implementation of a program the full range of analyses included in the MRP Table E-2 list.

Evaluation of data quality will be based upon protocols provided in the *National Functional Guidelines for Inorganic Superfund Data Review (USEPA540-R-10-011)* (USEPA 2010), *National Functional Guidelines for Superfund Organic Methods Data Review (EPA540/R-08-01),* and the *Guidance on the Documentation and Evaluation of Trace Metals Data Collected for Clean Water Act Compliance Monitoring (EPA/821/B/95/002)* (USEPA 1996).

The sections that follow address activities associated with both field sampling and laboratory analyses. Quality assurance activities start with procedures designed to assure that errors introduced in the field sampling and subsampling processes are minimized. Field QA/QC samples are collected and used to evaluate potential contamination and sampling error introduced into a sample prior to its submittal to the analytical laboratory. Laboratory QA/QC activities are used to provide information needed to assess potential laboratory contamination, analytical precision and accuracy, and representativeness.

1.1.1 Sample Handling, Containers and Holding Times.

Table **1** provides a summary of the types of sample volumes, container types, preservation and holding times for each analytical method. Analytical methods requiring the same preservation and container types may be transferred to the laboratory in one container in order to minimize handling prior to transfer to the laboratory.

Table 1. Constituents, Sample Container, Preservation and Holding Times.

Analyte	EPA Method Number	Holding Time	Container Size	Container Type	Preservation	Minimum Level/ Resolution	Units
Conventionals							
pH	150.1	15 minutes		glass or PE	none	+/- 0.1	std. units
Oil and Grease	1664A	28 days	1 L	Glass	HCl	5	mg/L
TPH	418.1	28 days	1 L	Glass	HCl	5	mg/L
Total Phenols	420.1	28 days	500mL-1 L	Glass	H_sSO_4	5	mg/L
Cyanide	SM4500-CN-E	14 days	500 mL	HDPE	NaOH	0.003	mg/L
Turbidity	SM2130B	48 hours	100-250mL	Glass	4-6°C	1	NTU
TSS	160.2	7 days	1 L	HDPE	4-6°C	4	mg/L
SSC[1]	ASTMD3977B	7 days	1 L	HDPE	4-6°C	4	mg/L
TDS	160.1	7 days	1 L	HDPE	4-6°C	1	mg/L
VSS	160.4	7 days	1 L	HDPE	4-6°C	1	mg/L
TOC; DOC	415.1	28 days	250 mL	glass	4°C and HCl or H_2SO_4 to pH<2	1	mg/L
BOD_5	SM5210B	48 hours	600mL-1L	HDPE	4-6°C	3	mg/L
COD	410.1	28 days	20-250 mL	Glass	H_sSO_4	4	mg/L
Alkalinity	SM 2320B	Filter ASAP, 14 days	100-250 mL	HDPE	4-6°C	1	mg/L
Conductivity	SM 2510	28 days	100-250 mL	HDPE	4°C; filter if hold time >24 hours	1	µmho/cm
Hardness	130.2	6 months	100-250 mL	HDPE	and HNO_3 or H_2SO_4 to pH<2	1	mg/L
MBAS	425.1	48 hours	250-500 mL	HDPE	4-6°C	0.02	mg/L
Chloride	300	28 days	250-500 mL	HDPE	4-6°C	2	mg/L
Fluoride	300	28 days	250-500 mL	HDPE	4-6°C	0.1	mg/L
Perchlorate	314.0	28 days	100-250 mL	HDPE	4-6°C	4	µg/L
Volatile Organics							
MTBE	624	14 days	3 40mL VOA	Glass	HCl	1	µg/L

Analyte	EPA Method Number	Holding Time	Container Size	Container Type	Preservation	Minimum Level/ Resolution	Units
Bacteria							
Total Coliform	SM9221B	6 hr-8 hr	100 mL	Sterile HDPE	4-6°C	20-2,400,000	MPN/100mL
Fecal Coliform	SM9221B	6 hr-8 hr	100 mL	Sterile HDPE	4-6°C	20-2,400,000	MPN/100mL
Enterococcus	SM9230B or C	6 hr-8 hr	100 mL	Sterile HDPE	4-6°C	20-2,400,000	MPN/100mL
E. coli	SM 9223 COLt	6 hr-8 hr	100 mL	Sterile HDPE	4-6°C	20-2,400,000	MPN/100mL
Nutrients							
TKN	351.1	28 days	500mL-1L	Amber glass	H_sSO_4	0.5	mg/L
Nitrate-N	300	48 hours	50-125mL	HDPE	4-6°C	0.1	mg/L
Nitrite-N	300	48 hours	50-125mL	HDPE	4-6°C	0.05	mg/L
Total Nitrogen	Calculation					NA	mg/L
Ammonia-N	350.1	28 days	500mL-1L	Amber glass	H_sSO_4	0.1	mg/L
Total Phosphorus	SM4500-P,EorF	28 days	100-250 mL	glass	H_sSO_4	0.1	mg/L
Dissolved Phosphorus	SM4500-P,EorF	28 days	100-250 mL	glass	4-6°C	0.1	mg/L
Organic Compounds (pesticides and herbicides)							
Organochlorine Pesticides & PCBs[1]	608 & 8270	7days:40days	1L	Amber glass	4-6°C	0.005-0.5	µg/L
Organophosphate Pesticides	507	14days	1L	Amber glass	$Na_sS_2O_3$ 4-6°C	0.01-1	µg/L
Glyphosate	547	14days	250mL	Amber glass	$Na_sS_2O_3$ 4-6°C	5	µg/L
Chlorinated Acids	515.3	14days	250mL	Amber glass	$Na_sS_2O_3$ 4-6°C		
2,4-D						0.02	µg/L
2,4,5-TP-Silvex						0.2	µg/L
Semivolatile Organic Compounds	625;8270D	7days;40days	1L	Amber glass	4-6°C	0.05-10	µg/L

Metals (Total and Dissolved)

Analyte	EPA Method Number	Holding Time	Container Size	Container Type	Preservation	Minimum Level/ Resolution	Units
Aluminum	200.8	If practical, filter immediately after subsampling. Otherwise filter in laboratory for dissolved fraction and preserve not more than 24 hours after subsampling; 6 months to analysis	250 to500 mL	HDPE	4°C and HNO_3 to pH<2	100	µg/L
Antimony	200.8					0.5	µg/L
Arsenic	200.8					0.5	µg/L
Beryllium	200.8					0.5	µg/L
Cadmium	200.8					0.25	µg/L
Chromium (Total)	200.8					0.5	µg/L
Copper	200.8					0.5	µg/L
Iron	200.8					25	µg/L
Lead	200.8					0.5	µg/L
Nickel	200.8					1	µg/L
Selenium	200.8					1	µg/L
Silver	200.8					0.25	µg/L
Thallium	200.8					0.5	µg/L
Zinc	200.8					1	µg/L
Chromium (Hexavalent)	218.6	Filter as above 24 hours	250 ml	HDPE	4°C	5	µg/L
Mercury	245.1	Filter as above 28 days	250 ml	Glass or Teflon	4°C and HNO3 to pH<2	0.2	µg/L
Mercury	1631E	Filter as above 28 days	250 ml	Glass or Teflon	4°C and HNO3 to pH<2	0.0005	µg/L

Abbreviations

TSS=Total Suspended Solids
SSC=Suspended Sediment Concentration
TDS=Total Dissolved Solids
TPH=Total Petroleum Hydrocarbons
VSS=Volatile Suspended Solids
TOC=Total Organic Carbon
BOD_5=Five-day Biochemical Oxygen Demand
COD=Chemical Oxygen Demand
MBAS=Methylene Blue Active Substances
MTBE= Methyl Tertiary Butyl Ether
TKN=Total Kjeldahl Nitrogen
PCBs=Polychlorinated Biphenyls

1. Monitoring for PCBs will be reported as the summation of aroclors and a minimum of 50 congeners. 54 PCB congeners include: 8, 18, 28, 31, 33, 37, 44, 49, 52, 56, 60, 66, 70, 74, 77, 81, 87, 95, 97, 99, 101, 105, 110, 114, 118, 119, 123, 126, 128, 132, 138, 141, 149, 151, 153, 156, 157, 158, 167, 168, 169, 170, 174, 177, 180, 183, 187, 189, 194, 195, 201, 203, 206, and 209. These include all 41 congeners analyzed in the SCCWRP Bight Program and dominant congeners used to identify the aroclor

1.1.2 Precision, Bias, Accuracy, Representativeness, Completeness, and Comparability

The overall quality of analytical measurements is assessed through evaluation of precision, accuracy/bias, representativeness, comparability and completeness. Precision and accuracy/bias are measured quantitatively. Representativeness and comparability are both assessed qualitatively. Completeness is assessed in both quantitative and qualitative terms. The following sections examine how these measures are typically applied.

1.1.2.1 Precision

Precision provides an assessment of mutual agreement between repeated measurements. These measurements apply to field duplicates, laboratory duplicates, matrix spike duplicates, and laboratory control sample duplicates. Monitoring of precision through the process allows for the evaluation of the consistency of field sampling and laboratory analyses.

The Relative Percent Difference (RPD) will be used to evaluate precision based upon duplicate samples. The RPD is calculated for each pair of data is calculated as:

$$RPD=[(x_1-x_2)*100]/[(x_1+x_2)/2]$$

Where:

x_1=concentration or value of sample 1 of the pair

x_2=concentration or value of sample 2 of the pair

In the case of matrix spike/spike duplicate, RPDs are compared with measurement quality objectives (MQOs) established for the program. MQOs will be established to be consistent with the most current SWAMP objectives in the SWAMP Quality Assurance Project Plan (2008) including the most recent updates as well as consultations with the laboratories performing the analyses. In the case of laboratory or field duplicates, values can often be near or below the established reporting limits. The most current SWAMP guidelines rely upon matrix spike/spike duplicate analyses for organic compounds instead of using laboratory duplicates since one or both values are often below detection limits or are near the detection limits. In such cases, RPDs do not provide useful information.

1.1.2.2 Bias

Bias is the systematic inherent in a method or caused by some artifact or idiosyncrasy of the measurement system. Bias may be either positive or negative and can emanate from a number of different points in the process. Although both positive and negative biases may exist concurrently in the same sample, the net bias is all that can be reasonably addressed in this project. Bias is preferably measured through analysis of spiked samples so that matrix effects are incorporated.

1.1.2.3 Accuracy

Accuracy is a measure of the closeness of a measurement or the average of a number of measurements to the true value. Accuracy includes of a combination of random error as measured by precision and systematic error as measured by bias. An assessment of the accuracy of measurements is based on determining the percent difference between measured values and known or "true" values applied to surrogates, Matrix Spikes (MS), Laboratory Control Samples (LCS) and Standard Reference Materials (SRM). Surrogates and matrix spikes evaluate matrix interferences on analytical performance, while laboratory control samples, standard reference materials and blank spikes (BS) evaluate analytical performance in the absence of matrix effects.

Assessment of the accuracy of measurements is based upon determining the difference between measured values and the true value. This is assessed primarily through analysis of spike recoveries or certified value ranges for SRMs. Spike recoveries are calculated as Percent Recovery according to the following formula:

$$\text{Percent Recovery} = [(t-x)/\alpha]*100\%$$

Where:

t=total concentration found in the spiked sample

x=original concentration in sample prior to spiking, and

α=actual spike concentration added to the sample

1.1.2.4 Representativeness, Comparability and Completeness

Representativeness is the degree to which data accurately and precisely represents the natural environment. For stormwater runoff, representativeness is first evaluated based upon the automated flow-composite sample and the associated hydrograph. To be considered as representative, the autosampler must have effectively triggered to capture initial runoff from the pavement and the composite sample should:

- be comprised of a minimum number of aliquots over the course of the storm event,
- effectively represent the period of peak flow,
- contain flow-weighted aliquots from over 80% of the total runoff volume, and
- demonstrate little or no evidence of "stacking".

Stacking occurs when the sampling volume is set too low and commands back up in the memory of an autosampler causing it to continuously cycle until it catches up with the accumulation of total flow measured by the stormwater monitoring station.

Representativeness is also assessed through the process of splitting or subsampling 20 L composite bottles into individual sample containers being sent to the laboratory. The first subsamples removed from the composite bottle should have the same composition as the last. Subsampling should be conducted in accordance with guidance in the subsampling SOP. This SOP is based upon use of large laboratory magnetic stir plate, an autosampler, and precleaned subsampling hoses to minimize variability. Sample splitting can introduce a substantial amount of error especially if significant quantities of coarse sediments (greater than 250 µm) represent as significant fraction of the suspended sediments. Use of a USGS Teflon churns or Decaport cone splitter may also be used but would require development of a separate SOP.

Comparability is the measure of confidence with which one dataset can be compared to another. The use of standardized methods of chemical analysis and field sampling and processing are ways of insuring comparability. Application of consistent sampling and processing procedures is necessary for assuring comparability among data sets. Thorough documentation of these procedures, quality assurance activities and a written assessment of data validation and quality are necessary to provide others with the basic elements to evaluate comparability.

Completeness is a measure of the percentage of the data judged valid after comparison with specific validation criteria. This includes data lost through accidental breakage of sample containers or other activities that result in irreparable loss of samples. Implementation of standardized Chain-of-Custody procedures which track samples as they are transferred between custodians is one method of maintaining a high level of completeness.

A high level of completeness is essential to all phases of this study due to the limited number of samples. Of course, the overall goal is to obtain completeness of 100%, however, a realistic data quality indicator of 95% insures an adequate level of data return.

1.1.3 Laboratory Quality Assurance/Quality Control

The quality of analytical data is dependent on the ways in which samples are collected, handled and analyzed. Data Quality Objectives provide the standards against which the data are compared to determine if they meet the quality necessary to be used to address program objectives. Data will be subjected to a thorough verification and validation process designed to evaluate project data quality and determine whether data require qualification.

The three major categories of QA/QC checks are accuracy, precision, and contamination were discussed in the previous section. As a minimum, the laboratory will incorporate analysis of method blanks, and matrix spike/spike duplicates with each analytical batch. Laboratory duplicates will be analyzed for analytical tests where matrix spike/spike duplicate are not analyzed. Use of Certified Reference Materials (CRM) or Standard Reference Materials (SRM) is also recommended as these allow assessment of long term performance of the analytical methods so that representativeness can be assessed. Laboratories often use an internal CRM that is analyzed with each batch to evaluate any potential long-term shift in performance of the analytical procedures. Recommended minimum quality control samples will be based upon SWAMP QAPP (2008) and the associated 2013 Quality Control and Sample Handling Tables for water (http://www.swrcb.ca.gov/water_issues/programs/swamp/mqo.shtml).

1.1.4 Field QA/QC

1.1.4.1 Blanks

A thorough system of blanking is an essential element of monitoring. Much of the blanking processes are performed well in advance of the actual monitoring in order to demonstrate that all equipment expected to contact water is free of contaminants at the detection limits established for the program. Equipment components are cleaned in batches. Subsamples from each cleaning batch are rinsed with Type 1 laboratory blank water and submitted to the laboratory for analysis. If hits are encountered in any cleaning batch, the entire batch is put back through the cleaning and blanking process until satisfactory results are obtained. If contaminants are measured in the blanks, it is often prudent to reexamine the cleaning processes and equipment or materials used in the cleaning process. Equipment requiring blanks and the frequency of blanks is summarized below and in Table 2.

Table 2. Summary of Blanking Requirements for Field Equipment.

System Component	Blanking Frequency
Intake Hose	One per batch
Peristaltic Pump Hose	One per batch[1] or 10% for batches greater than 10
Composite Bottles	One per batch or 10% for batches greater than 10
Subsampling Pump Hose	One per batch or 10% for batches greater than 10
Laboratory Sample Containers	2% of the lot[2] or batch, minimum of one
Capsule Filter Blank[3]	One per batch or 10% for batches greater than 10
Churn/Cone Splitter[4]	When field cleaning is performed, process one blank per session

[1] A batch is a group of samples that are cleaned at the same time and in the same manner.

[2] If decontaminated bottles are sent directly from the manufacturer, the batch would be the lot designated by the manufacturer in their testing of the bottles.

[3] If filtration is performed in the laboratory, the capsule filter blanks would be considered part of laboratory QA/QC.

[4] This is applicable to use of a churn or cone splitter to subsample flow-weighted composite samples into individual containers. Splitting may be performed by the sampling team in a protected, clean area or by the laboratory.

1.1.4.2 Field Duplicates

Composite subsampling duplicates associated with flow-weighted composite samples are often referred to as field duplicates but, in fact, they are subsampling replicates. These replicates help assess combined variability associated with subsampling from the composite container and variability associated with the analytical process. They are evaluated against the same criteria as used for laboratory duplicates.

1.1.5 Equipment Cleaning, Blanking and Tracking

Sample collection, handling, and processing materials can contribute and/or sorb trace elements within the time scales typical for collection, processing and analysis of runoff samples. Sampling artifacts are especially important when measured concentrations that are at or near analytical detection limits (Horowitz 1997). Therefore, great care is required to collect and process samples in a manner that will minimize potential contamination and variability in the sampling process (Breault and Granato 2000).

Sampling conducted to measure dissolved metals and other trace contaminants at levels relevant to EPA water quality criteria requires documentation that all sampling equipment is free of contamination and that the processes used to obtain and handle samples do not introduce contamination. This requires documentation that methods used to collect, process and analyze the samples do not introduce contamination. Documentation for the CIMP includes written procedures provided in Appendix B for cleaning all components of the sampling system, blanking processes necessary to verify that system components and sample handling are not introducing contamination, and a system of tracking deployment of protocol-cleaned equipment in the field as described in this section.

All composite containers and equipment used for sample collection in the field and/or sample storage in the laboratory will be decontaminated and cleaned prior to use. These include the FEP tubing, Teflon® lids, strainers and hoses/fittings that are used in the subsampling process (USGS 1993). Personnel assigned to clean and handle the equipment are thoroughly trained and familiar with the cleaning, blanking, and tracking procedures. In addition, all field sampling staff will be trained to be familiar with these processes so that they have a better understanding of the importance of using clean sampling procedures and the effort required to eliminate sources of contamination.

Sample contamination has long been considered one of the most significant problems associated with measurement of dissolved metals and may be accentuated with use of High Resolution Mass Spectroscopy (HRMS) methods for trace levels of organic constituents at levels three orders of magnitude lower than conventional GCMS methods. One of the major elements of QA/QC documentation is establishing that clean sampling procedures are used throughout the process and that all equipment used to collect and process the water samples are free of contamination.

Cleaning protocols are consistent with ASTM (2008) standard D5088 – 02 that covers cleaning of sampling equipment and sample bottles. The generalized cleaning process is based upon a series of washings that typically start with tap water with a phosphate-free detergent, a tap water rinse, soaking in a 10% solution of reagent grade nitric acid, and a final series of rinses with ASTM Type 1 water. Detailed procedures for decontamination of sampling equipment are provided in Appendix A. In addition, Appendix G of the most recent Caltrans Stormwater Monitoring Guidance Manual (Caltrans, 2013) provides alternative cleaning procedure that incorporate use of methylene chloride to remove potential organic contaminants. Experience indicates that this step can be eliminated and still result in blanking data suitable for most target organic contaminants. Addition of this cleaning step or a comparable step to address organic contaminants may be necessary if satisfactory equipment blanks cannot be attained. Significant issues exist with respect to use of methylene chloride. This chemical is highly toxic, must be handled and disposed as a hazardous waste and is difficult to fully remove from the 20-L media bottles used as composite containers.

In order to account for any contamination introduced by sampling containers, blanks must be collected for composite bottles and laboratory bottles used for sample storage for trace contaminants. A sampling container blank is prepared by filling a clean container with blank water and measuring the concentrations of selected constituents (typically metals and other trace contaminants for composite bottles and metals analysis only for metals storage bottles). Blanking of the 20-L composite bottles will be performed by using the minimum amount of blank water necessary for the selected analytical tests. This is typically requires one to two liters. The bottle is capped and then manipulated to assure that all surfaces up to the neck of the bottle are rinsed. The water is then be allowed to sit for a minimum of one hour before decanting the rinse water into sample containers. In order to provide adequate control, media bottles are labelled and tracked. All media bottles cleaned and blanked in one batch are tracked to allow for recall if laboratory analyses reveal any contamination. Further tracking is required in the field to document where bottles from each cleaning batch are used and to assist in tracking of any contamination that might be detected after bottles have been deployed since laboratory turnaround in the middle of the storm season may require use of decontaminated bottles prior to receiving the results of the blank analyses.

Selected constituents for blanking will be dependent upon the list of contaminants with reasonable potential to be present at levels that could impact sample results. Minimum parameters used for blank analyses will include total recoverable trace metals, TDS, TOC and nutrients. Analysis of total metals will allow for detection of any residual metal contamination which will be of concern for all sampling. Nutrients, particularly nitrogen compounds, will assure that residual nitrogen from acid cleaning has been fully removed. TDS and TOC are useful for accessing presence of any residual contaminants. Additional blanking may be added when sampling other constituents with ultra-low analytical methods. These blanks may be submitted "blind" to the laboratory by field personnel or prepared internally by the laboratory.

Certified pre-cleaned QC-grade laboratory containers can be used. These bottles are cleaned using acceptable protocol for the intended analysis and tracked by lots. They come with standard certification forms that document the concentration to which the bottles are considered "contaminant-free" but these concentrations are not typically suitable for program reporting limits required for measurement of dissolved metals. Manufacturers may provide an option of certification to specific limits required by a project but it is preferable to purchase the QC bottles that are tracked by lot and conduct internal blanking studies. Lots not meeting project requirements should be returned to the manufacturer and exchanged for containers from another lot. At least 2% of the bottles in any "lot" or "batch" should be blanked at the program detection limits with a minimum frequency of one bottle per batch. A batch is considered to be a group of samples that are cleaned at the same time and in the same manner; or, if decontaminated bottles are sent directly from the manufacturer, the batch would be the lot designated by the manufacturer in their testing of the bottles. Cleaned bottles are stored in a clean area with lids properly secured.

Subsampling hoses consist of a length of peristaltic hose with short lengths of FEP tubing attached to each end. These are required to be cleaned inside and out since the FEP tubing is immersed in the composite bottle during the subsampling process. Once cleaned, the ends of the subsampling hoses are bagged. All hoses associated with the batch are then stored in large zip-lock containers labeled to identify the cleaning batch. Blanking of subsampling hoses is conducted as part of the composite bottle blanking process. A clean subsampling hose is used to decant blank water from the 20-L composite bottles into clean laboratory containers. Detection of any contaminants in the bottle blanks therefore requires that the subsampling hoses also are subjected another decontamination process. After cleaning, the subsampling hoses should only be handled while wearing clean, powder-free nitrile gloves.

APPENDIX D

NON-STORMWATER IC/ID AND OUTFALL TRACKING

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Operation Procedures	
Illicit Discharge Detection & Elimination: Initial Outfall Screening	
Purpose:	This provides a basic checklist for field crews conducting initial survey of storm drainage system outfalls for use in identification of illicit discharges

Reference: Brown et al., *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments,* Center for Watershed Protection, Ellicott City, 2004.

Planning Considerations:

- Employees should have reviewed and understand the information presented in Chapter 11 of the reference manual
- Inspections are to occur during dry weather (no runoff producing precipitation in last 72 hours)
- Conduct inspections with at least two staff per crew
- Conduct inspections during low groundwater (if appropriate).
- Complete ***Site Info section on Outfall Reconnaissance Inventory Form*** before leaving the office. Additional forms should be available for undocumented outfalls

Field Methods:

- Ensure outfall is accessible.
- Inspect outfall only if safe to do so.
- Characterize the outfall by recording information on the ***LCC Outfall Reconnaissance Inventory Form.***
- Photograph the outfall with a digital camera (use dry erase board to identify outfall).
- Enter flow information on form if dry weather flow is present and ***easily*** obtained. If not, provide rough estimate of flow.
- Document clean, dry outfalls for potential elimination during future screening programs.
- Water samples will not be collected during the initial survey. In-situ measurements of temperature, conductivity, and pH should be taken if significant flow is present.
- Do not enter private property without permission.
- Photograph each site with the site identification written on the dry erase board.

Equipment List:

1. System map
2. Outfall Reconnaissance Inventory Forms
3. City identification or business cards
4. Digital camera (spare batteries)
5. Cell phone
6. GPS unit
7. Clip board and pencils
8. Dry erase board and pens
9. Hand Mirror
10. Flashlight (spare batteries)
11. Disposable gloves
12. Folding wood ruler or comparable
13. Temperature, Conductivity probe
14. pH probe/strips
15. ***Ammonia test strips***
16. ***Ten1-liter (polyethylene) sample bottles***
17. Watch with second hand
18. Calculator
19. Hand sanitizer
20. Safety vests
21. First aid kit
22. ***Cooler***
23. Permanent marker

Bolded, italicized items will only be needed for later surveys. No water quality samples will be taken for laboratory analysis during the first survey.

Los Cerritos Channel Outfall Reconnaissance Inventory/ Sample Collection Field Sheet

Section 1: Background Data

Subbasin:		Outfall ID:	
Today's date:		Time (Military):	
Investigators:		Form completed by:	
Temperature (°F):	Rainfall (in.): Last 24 hours: Last 48 hours:		
Latitude:	Longitude:	GPS Unit:	GPS LMK #:
Camera:		Photo #s:	

Land Use in Drainage Area (Check all that apply):

- ☐ Industrial
- ☐ Ultra-Urban Residential
- ☐ Suburban Residential
- ☐ Commercial
- ☐ Open Space
- ☐ Institutional
- Other: ____
- Known Industries: ________________________________

Notes (e.g.., origin of outfall, if known):

Section 2: Outfall Description

LOCATION	MATERIAL	SHAPE		DIMENSIONS (IN.)	SUBMERGED
☐ **Closed Pipe**	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other: __________	☐ Circular ☐ Elliptical ☐ Box ☐ Other: _____	☐ Single ☐ Double ☐ Triple ☐ Other: _____	Diameter/Dimensions: ______________________	In Water: ☐ No ☐ Partially ☐ Fully With Sediment: ☐ No ☐ Partially ☐ Fully
☐ **Open drainage**	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: _____	☐ Trapezoid ☐ Parabolic ☐ Other: _____		Depth: _____ Top Width: _____ Bottom Width: _____	
☐ **In-Stream**	**(applicable when collecting samples)**				
Flow Present?	☐ Yes ☐ No ***If No, Skip to Section 5***				
Flow Description (If present)	☐ Trickle ☐ Moderate ☐ Substantial				

Section 3: Quantitative Characterization

FIELD DATA FOR FLOWING OUTFALLS				
PARAMETER		**RESULT**	**UNIT**	**EQUIPMENT**
☐Flow #1	Volume		Liter	Bottle
	Time to fill		Sec	
☐Flow #2	Flow depth		In	Tape measure
	Flow width	_____' _____"	Ft, In	Tape measure
	Measured length	_____' _____"	Ft, In	Tape measure
	Time of travel		S	Stop watch
Temperature			°F	Meter
pH			pH Units	Meter
Ammonia			mg/L	Test strip

Los Cerritos Channel Outfall Reconnaissance Inventory Field Sheet

Section 4: Physical Indicators for Flowing Outfalls Only

Are Any Physical Indicators Present in the flow? ☐ Yes ☐ No *(If No, Skip to Section 5)*

INDICATOR	CHECK if Present	DESCRIPTION	RELATIVE SEVERITY INDEX (1-3)		
Odor	☐	☐ Sewage ☐ Rancid/sour ☐ Petroleum/gas ☐ Sulfide ☐ Other:	☐ 1 – Faint	☐ 2 – Easily detected	☐ 3 – Noticeable from a distance
Color	☐	☐ Clear ☐ Brown ☐ Gray ☐ Yellow ☐ Green ☐ Orange ☐ Red ☐ Other:	☐ 1 – Faint colors in sample bottle	☐ 2 – Clearly visible in sample bottle	☐ 3 – Clearly visible in outfall flow
Turbidity	☐	See severity	☐ 1 – Slight cloudiness	☐ 2 – Cloudy	☐ 3 – Opaque
Floatables -Does Not Include Trash!!	☐	☐ Sewage (Toilet Paper, etc.) ☐ Suds ☐ Petroleum (oil sheen) ☐ Other:	☐ 1 – Few/slight; origin not obvious	☐ 2 – Some; indications of origin (e.g., possible suds or oil sheen)	☐ 3 - Some; origin clear (e.g., obvious oil sheen, suds, or floating sanitary materials)

Section 5: Physical Indicators for Both Flowing and Non-Flowing Outfalls

Are physical indicators that are not related to flow present? ☐ Yes ☐ No *(If No, Skip to Section 6)*

INDICATOR	CHECK if Present	DESCRIPTION	COMMENTS
Outfall Damage	☐	☐ Spalling, Cracking or Chipping ☐ Peeling Paint ☐ Corrosion	
Deposits/Stains	☐	☐ Oily ☐ Flow Line ☐ Paint ☐ Other:	
Abnormal Vegetation	☐	☐ Excessive ☐ Inhibited	
Poor pool quality	☐	☐ Odors ☐ Colors ☐ Floatables ☐ Oil Sheen ☐ Suds ☐ Excessive Algae ☐ Other:	
Pipe benthic growth	☐	☐ Brown ☐ Orange ☐ Green ☐ Other:	

Section 6: Overall Outfall Characterization

☐ Unlikely ☐ Potential (presence of two or more indicators) ☐ Suspect (one or more indicators with a severity of 3) ☐ Obvious

Section 7: Data Collection

1. Sample for the lab?	☐ Yes	☐ No		
2. If yes, collected from:	☐ Flow	☐ Pool		
3. Intermittent flow trap set?	☐ Yes	☐ No	If Yes, type: ☐ OBM	☐ Caulk dam

Section 8: Any Non-Illicit Discharge Concerns (e.g., trash or needed infrastructure repairs)?

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APPENDIX E

MAJOR AND MINOR OUTFALLS TO THE LOS CERRITOS CHANNEL WATERSHED

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Major Outfalls (=>36 inches) in the Los Cerritos Channel Watershed

LDISCHARGE POINT	DESCRIPTION	DISCHARGE POINT LATITUDE	DISCHARGE POINT LONGITUDE	OWNER	SIDE (R/L)	DISTANCE FROM CHANNEL STARTING POINT (km)	JURISDICTION	MODEL SUB WATERSHED	UNIQUE ID	PHOTO UNIQUE ID	CHANNEL UNIQUE ID
CLARK CHANNEL											
N. Charlemagne Ave/E. Pageantry St	36" Discharge	33.81315	-118.12997	Long Beach	R	1.925	Long Beach	BI9A-5	BI9A-5-001		CC-0.273
N. Rutgers Ave/E. Pageantry St	36" Discharge	33.81317	-118.12970	Long Beach	L	1.927	Long Beach	BI9A-5	BI9A-5-002		CC-0.275
N Charlemagne Ave/E. Mezzanine Way	72" Discharge	33.81519	-118.12998	Long Beach	R	2.141	Long Beach	BI9A-5	BI9A-5-003		CC-0.494
N Rutgers Ave/E. Mezzanine Way	54" Discharge	33.81519	-118.12971	Long Beach	L	2.152	Long Beach	BI9A-5	BI9A-5-004		CC-0.507
3343 Rutgers Ave/E. Wardlow Rd	36" Discharge	33.81791	-118.12970	UNK	L	2.449	Long Beach	BI9A-5	BI9A-5-005		CC-0.793
N. Charlemagne Ave/E. Wardlow Rd	42" Discharge	33.81870	-118.12997	LACFCD	R	2.528	Long Beach	BI9A-5	BI9A-5-006		CC-0.877B
N. Rutgers Ave/E. Wardlow Rd	42" Discharge	33.81869	-118.12971	LACFCD	L	2.528	Long Beach	BI9A-5	BI9A-5-007		CC-0.877A
N. Charlemagne/E. Monlaco Rd	150" Discharge	33.82273	-118.12977	LACFCD	R	2.993	Long Beach	BI9A-5	BI9A-5-015		CC-1.342
N. Rutgers Ave/E. Keynote St	63" Discharge	33.82355	-118.12967	LACFCD	L	3.070	Long Beach	BI9A-4	BI9A-4-001		CC-1.419
E. Conant St/N. Charlemagne Ave	39" Discharge	33.82505	-118.12990	LACFCD	R	3.238	Long Beach	BI9A-4	BI9A-4-002		CC-1.586
Carson St/N. Bellflower Blvd	63" Discharge	33.83124	-118.13056	LACFCD	L	3.960	Long Beach	BI9A-4	BI9A-4-007		CC-2.309

Carson St/N. Greenbrier Rd	48" Discharge	33.83215	-118.13235	LACFCD	R	4.164	Long Beach	BI9A-4	BI9A-4-008		CC-2.512
Carson St/N. Greenbrier Rd	45" Discharge	33.83233	-118.13233	LACFCD	R	4.206	Long Beach	BI9A-4	BI9A-4-011		CC-2.555
Harvey Way/N. Greenbrier Rd	51" Discharge	33.83612	-118.13233	LACFCD	R	4.599	Long Beach	BI9A-4	BI9A-4-016		CC-2.948
Harvey Way/Heather Rd	81" Discharge	33.83613	-118.13205	LACFCD	L	4.602	Long Beach	BI9A-4	BI9A-4-017		CC-2.950
E. Centralia St/N. Greenbrier Rd	42" Discharge	33.83954	-118.13225	LACFCD	R	4.976	Long Beach	BI9A-3	BI9A-3-001		CC-3.324A
E. Centralia St/Heather Rd	42" Discharge	33.83951	-118.13206	LACFCD	L	4.976	Long Beach	BI9A-3	BI9A-3-002		CC-3.324B
E. Arbor Rd/Clark Ave	36" Discharge	33.84300	-118.13226	LACFCD	R	5.348	Long Beach	BI9A-3	BI9A-3-007		CC-3.696
E. Arbor Rd/Clark Ave	39" Discharge	33.84297	-118.13225	LACFCD	R	5.357	Long Beach	BI9A-3	BI9A-3-008		CC-3.705
4763 Fidler Ave/Del Amo Blvd	36" Discharge	33.84500	-118.13203	Long Beach	L	5.586	Long Beach	BI9A-3	BI9A-3-011		CC-3.934
Del Amo Blvd/Fidler Ave	138" Discharge	33.84697	-118.13223	LACFCD	C	5.807	Lakewood	BI9A-3	BI9A-3-014		CC-4.155
Civic Center/Clark Ave	36" Discharge	33.84922	-118.13228	LACFCD	R	6.052	Lakewood	BI9A-2	BI9A-2-002		CC-4.413
Candlewood St/Fidler Ave	57" Discharge	33.85360	-118.13219	LACFCD	L	6.521	Lakewood	BI9A-2	BI9A-2-009		CC-4.882
Candlewood St/Fidler Ave	126" Discharge	33.85379	-118.13221	LACFCD		6.586	Lakewood	BI9A-1	BI9A-1-002		CC-4.916
Candlewood St/Clark Ave	72" Discharge	33.85442	-118.13226	LACFCD	R	6.625	Lakewood	BI9A-1	BI9A-1-003		CC-4.986
5443 Fidler Ave/Michelson St	36" Discharge	33.85618	-118.13213	LACFCD	L	6.818	Lakewood	BI9A-1	BI9A-1-008	BI9A-1-007	CC-5.179
Clark Ave/Michelson St	126" Discharge	33.85684	-118.13225	LACFCD		6.889	Lakewood	BI9A-1	BI9A-1-010		CC-5.250
South St/Fidler Ave	39" Discharge	33.86017	-118.13219	LACFCD	L	7.255	Lakewood	BI9A-1	BI9A-1-013		CC-5.616A

South St/Dagwood Ave	57" Discharge	33.86017	-118.13232	LACFCD	R	7.255	Lakewood	BI9A-1	BI9A-1-014		CC-5.616B
											CC-5.652
South St/Dagwood Ave	132" Discharge	33.86046	-118.13225	LACFCD	C	7.290	Lakewood	BI9A-1	BI9A-1-017		CC-5.651
Hedda St/Fidler Ave	39" Discharge	33.86411	-118.13232	LACFCD	L	7.696	Lakewood	BI9A-1	BI9A-1-018		CC-6.057B
Hedda St/Fidler Ave	39" Discharge	33.86409	-118.13234	LACFCD	R	7.696	Lakewood	BI9A-1	BI9A-1-019		CC-6.057A
Ashworth St/Fidler Ave	75" Discharge	33.86780	-118.13235	LACFCD	R	8.109	Lakewood	BI9A-1	BI9A-1-022		CC-6.469
Ashworth St/Fidler Ave	132" Discharge	33.86836	-118.13233	Lakewood	L	8.162	Lakewood	BI9A-1	BI9A-1-025		CC-6.522
Clark Ave/Ashworth St	87" Discharge	33.86848	-118.13355	LACFCD		8.282	Lakewood	BI9A-1	BI9A-1-026		CC-6.643
DEL AMO CHANNEL											
Del Amo Blvd/Whitewood Ave	36" Discharge	33.84696	-118.13552	UNK	L	0.286	Lakewood	BI9B-2	BI9B-2-003	BI9B-2-003	DAC-0.331
Del Amo Blvd/Faculty Ave	36" Discharge	33.84696	-118.13695	LACFCD	L	0.421	Lakewood	BI9B-2	BI9B-2-004	BI9B-2-004	DAC-0.466
Del Amo Blvd/Graywood Ave	42" Discharge	33.84698	-118.13783	LACFCD	L	0.508	Lakewood	BI9B-2	BI9B-2-005	BI9B-2-005	DAC-0.554
Del Amo Blvd/Graywood Ave	36" Discharge	33.84699	-118.13797	LACFCD	L	0.516	Lakewood	BI9B-2	BI9B-2-006	BI9B-2-005	DAC-0.561
Del Amo Blvd/Hazelbrook Ave	36" Discharge	33.84694	-118.19539	LACFCD	L	0.664	Lakewood	BI9B-2	BI9B-2-010	BI9B-2-010	DAC-0.709
Del Amo Blvd/Blackthorne Ave	36" Discharge	33.84697	-118.14041	LACFCD	R	0.737	Lakewood	BI9B-2	BI9B-2-011	BI9B-2-011	DAC-0.782

Del Amo Blvd/N. Blackthorne Ave	18" Discharge	33.84698	-118.14024	LACFCD	L	0.7388	Lakewood	BI9B-2	BI9B-2-012		DAC-0.784
Del Amo Blvd/N. Pepperwood Ave	36" Discharge	33.84699	-118.14126	LACFCD	L	0.820	Lakewood	BI9B-2	BI9B-2-014	BI9B-2-014	DAC-0.865
Del Amo Blvd/Lakewood Blvd	36" Discharge	33.84701	-118.14200	LACFCD	L	0.902	Lakewood	BI9B-2	BI9B-2-016	BI9B-2-016	DAC-0.947
Del Amo Blvd/Lakewood Blvd	45" Discharge	33.84699	-118.14226	LACFCD	L	0.917	Lakewood	BI9B-2	BI9B-2-018	BI9B-2-018	DAC-0.963
Del Amo Blvd/Lakewood Blvd	36" Discharge	33.84700	-118.14255	UNK	L	1.960	Lakewood	BI9B-2	BI9B-2-020	BI9B-2-020	DAC-1.004
Del Amo Blvd/Hayter Ave	48" Discharge	33.84702	-118.14598	LACFCD	L	1.253	Lakewood	BI9B-2	BI9B-2-024	BI9B-2-024	DAC-1.253
Del Amo Blvd/Hayter Ave	45" Discharge	33.84684	-118.14629	LACFCD	R	1.289	Lakewood	BI9B-2	BI9B-2-027	BI9B-2-027	DAC-1.334B
Del Amo Blvd/Downey Ave	48" Discharge	33.84703	-118.15051	LACFCD	R	1.666	Lakewood	BI9B-2	BI9B-2-029	BI9B-2-029	DAC-1.711
Downey Ave/Eckleson St	114" Discharge	33.84884	-118.15047	LACFCD		1.911	Lakewood	BI9B-2	BI9B-2-032		DAC-1.911
DOWNEY CHANNEL											
Candlewood St/Downey Ave	42" Discharge	33.853717	-118.150524	UNK	R	0.551	Lakewood	BI447A	BI447A-003	BI447A-003	DNC-0.5514
Candlewood St/Downey Ave	42" Discharge	33.854243	-118.150513	UNK	R	0.609	Lakewood	BI447A	BI447A-005	BI447-005	DNC-0.6093
Candlewood St/Downey Ave	42" Discharge	33.854297	-118.150527	Lakewood	R	0.618	Lakewood	BI447A	BI447A-006	BI447A-006	DNC-0.618
Candlewood St/Downey Ave	72" Discharge	33.854368	-118.150421	Lakewood	L	0.624	Lakewood	BI447A	BI447A-007	BI447A-007	DNC-0.624
Saint Pancratius Pl/Verdura Ave	117" Discharge	33.858402	-118.150459	Lakewood	L	1.072	Lakewood	BI447A	BI447A-008		DNC-1.072B

Saint Pancratius Pl/Verdura Ave	117" Discharge	33.858405	-118.15051	Lakewood	R	1.072	Lakewood	BI447A	BI447A-009		DNC-1.072A
Candlewood St/Downey Ave	72" Discharge	33.854382	-118.15029	Lakewood		0.633	Lakewood	BI447A	BI447A-010		DNC-0.796
Obispo Ave/Eckleson St	36" Discharge	33.849078	-118.154687	LACFCD	R	2.332	Lakewood	BI9B-1	BI9B-1-004		DNC-2.332
Obispo Ave/Eckleson St	60" Discharge	33.849074	-118.154747	LACFCD	R	2.336	Lakewood	BI9B-1	BI9B-1-005		DNC-2.336
Obispo Ave/Eckleson St	36" Discharge	33.849083	-118.154825	UNK	R	2.347	Lakewood	BI9B-1	BI9B-1-006		DNC-2.347
Obispo Ave/Eckleson St	48" Discharge	33.849183	-118.154825	UNK	L	2.347	Lakewood	BI9B-1	BI9B-1-007		DNC-2.347
Paramount Blvd/Eckleson St	66" Discharge	33.849146	-118.159614	LACFCD	L	2.804	Lakewood	BI9B-1	BI9B-1-008	BI9B-1-008	DNC-2.804A
Paramount Blvd/Eckleson St	66" Discharge	33.849096	-118.159614	LACFCD	R	2.804	Lakewood	BI9B-1	BI9B-1-009	BI9B-1-008	DNC-2.804B
LOS CERRITOS CHANNEL											
Knoxville Ave/E. Atherton St	36" Discharge (1 of 3)	33.78867	-118.10368	Long Beach	R	7.386	Long Beach	LCERR-5	LCERR-5-003		LCC-0.030
Knoxville Ave/E. Atherton St	36" Discharge (2 of 3)	33.78884	-118.10370	Long Beach	R	7.386	Long Beach	LCERR-5	LCERR-5-004		LCC-0.031
Knoxville Ave/E. Atherton St	36" Discharge (3 of 3)	33.78902	-118.10369	Long Beach	R	7.387	Long Beach	LCERR-5	LCERR-5-005		LCC-0.032
Vuelta Grande Ave/E. Atherton St	42" Discharge	33.78917	-118.10331	Long Beach	L	7.417	Long Beach	LCERR-5	LCERR-5-006		LCC-0.062
2040 Knoxville Ave	48" Discharge (1 of 3)	33.79319	-118.10369	LACFCD	R	7.876	Long Beach	LCERR-5	LCERR-5-007		LCC-0.521
2040 Knoxville Ave	48" Discharge (2 of 3)	33.79336	-118.10368	LACFCD	R	7.877	Long Beach	LCERR-5	LCERR-5-008		LCC-0.522

2040 Knoxville Ave	48" Discharge (3 of 3)	33.79356	-118.10369	LACFCD	R	7.878	Long Beach	LCERR-5	LCERR-5-009		LCC-0.523
Vuelta Grande Ave/N. Hidden Ln	42" Discharge	33.79304	-118.10333	LACFCD	L	7.899	Long Beach	LCERR-5	LCERR-5-010		LCC-0.544
Vuelta Grande Ave/E. Stearns St	48" Discharge	33.79565	-118.10330	LACFCD	L	8.135	Long Beach	LCERR-4	LCERR-4-001		LCC-0.780
Vuelta Grande Ave/E. la Marimba St	36" Discharge	33.79793	-118.10332	Long Beach	L	8.387	Long Beach	LCERR-4	LCERR-4-004		LCC-1.032
2372 Knoxville Ave/E. Cantel St	36" Discharge	33.80000	-118.10472	Long Beach	R	8.682	Long Beach	LCERR-4	LCERR-4-007		LCC-1.327
6400 Willow St/Palo Verde Ave	42" Discharge	33.80262	-118.10779	Long Beach	L	9.071	Long Beach	LCERR-4	LCERR-4-008		LCC-1.716
6220 Willow St/Palo Verde Ave	48" Discharge	33.80304	-118.10890	PVRT	R	9.181	Long Beach	LCERR-4	LCERR-4-009		LCC-1.826
Spring St/San Anseline Ave	66" Discharge	33.81035	-118.12130	LACFCD	L	0.725	Long Beach	LCERR-3	LCERR-3-002		LCC-3.388
Spring St/Bellflower Blvd	36" Discharge	33.81043	-118.12552	LACFCD	L	1.115	Long Beach	LCERR-3	LCERR-3-006		LCC-3.778
Spring St/Montair Ave	45" Discharge	33.81014	-118.12680	Long Beach	R	1.230	Long Beach	LCERR-3	LCERR-3-009		LCC-3.892
Heather Rd/Spring St	45" Discharge	33.81026	-118.13101	UNK	R	0.135	Long Beach	LCERR-2	LCERR-2-002		LCC-4.301A
Clark Ave/Spring St	96" Discharge	33.81034	-118.13376	LACFCD	C	0.392	Long Beach	LCERR-2	LCERR-2-004		LCC-4.558

N. Lakewood Blvd/E. Spring St	96" Discharge	33.81303	-118.13950	LACFCD		1.077	Long Beach	LCERR-2	LCERR-2-007		LCC-5.221
Lakewood Blvd/Spring St	36" Discharge	33.81306	-118.13949	LACFCD	L	1.045	Long Beach	LCERR-2	LCERR-2-005		LCC-5.229
Spring St/Lakewood Blvd	54" Discharge	33.81313	-118.14033	LACFCD	R	1.135	Long Beach	LCERR-2	LCERR-2-006		LCC-5.319
Spring St/Lakewood Blvd	108" Discharge	33.81316	-118.14235	LACFCD	L	1.322	Long Beach	LCERR-1	LCERR-1-001		LCC-5.506
Spring St/Lakewood Blvd	120" Discharge	33.81288	-118.14249	LACFCD	R	1.341	Long Beach	LCERR-1	LCERR-1-002		LCC-5.525
WARDLOW CHANNEL											
Clark Ave/Keynote St	228" Discharge	33.82331	-118.13408	LACFCD		5.885	Long Beach	BI9C	BI9C-001		WC-5.883
Lakewood Blvd	36" Discharge	33.82333	-118.13822	LACFCD	L	6.194	Long Beach	BI9C	BI9C-004		WC-6.264
Lakewood Blvd	42" Discharge	33.82332	-118.14130	LACFCD	L	6.482	Long Beach	BI9C	BI9C-005		WC-6.555
Lakewood Blvd	228" Discharge	33.82332	-118.14165	LACFCD		6.520	Long Beach	BI9A-5	BI9A-5-017		WC-6.586
PALO VERDE CHANNEL											
WOODRUFF AVE / SPRING ST	54" Discharge	33.81090	-118.11427	Long Beach	R	0.430	Long Beach	BI9E-2	BI9E-2-006		PVC-0.430
3055 SHADYPARK DR/McNab Ave	36" Discharge	33.81224	-118.11410	Long Beach	L	0.584	Long Beach	BI9E-2	BI9E-2-007		PVC-0.584

LOS CERRITOS DRAIN LINE E / LOS COYOTES DIA/E.Pagentry St	36" Discharge (1 of 2)	33.81329	-118.11409	LACFCD	R	0.723	Long Beach	BI9E-2	BI9E-2-009		PVC-0.723
LOS CERRITOS DRAIN LINE E / LOS COYOTES DIA/E.Pagentry St	36" Discharge (2 of 2)	33.81359	-118.11407	LACFCD	R	0.727	Long Beach	BI9E-2	BI9E-2-010		PVC-0.727
LOS COYOTES DIA / GONDAR AVE	48" Discharge	33.81550	-118.11258	LACFCD	R	0.987	Long Beach	BI9E-2	BI9E-2-014		PVC-0.987
6228 WARDLOW RD/Los Coyotes Dia W	36" Discharge	33.81864	-118.10980	Long Beach	R	1.426	Long Beach	BI9E-2	BI9E-2-016		PVC-1.426
Los Coyotes Dia/Conquista Ave	42" Discharge	33.82054	-118.10802	Long Beach	L	1.684	Long Beach	BI9E-2	BI9E-2-019		PVC-1.684
PALO VERDE AVE / LOS COYOTES DIA	36" Discharge (1 of 2)	33.82110	-118.10793	LACFCD	L	1.748	Long Beach	BI9E-2	BI9E-2-021		PVC-1.747
PALO VERDE AVE / LOS COYOTES DIA	36" Discharge (2 of 2)	33.82110	-118.10793	LACFCD	L	1.748	Long Beach	BI9E-2	BI9E-2-022		PVC-1.748
3778 PALO VERDE AVE/Harco St	36" Discharge	33.82715	-118.10795	LACFCD	L	2.434	Long Beach	BI9E-2	BI9E-2-026		PVC-2.434
3788 CONQUISTA AVE/Harco St	48" Discharge	33.82758	-118.10811	LACFCD	R	2.470	LA County(LBC-254)	BI9E-2	BI9E-2-027		PVC-2.470
Palo Verde Ave/E. Parkcrest St	72" Discharge	33.83025	-118.10793	LACFCD	L	2.778	Los Angeles County	BI9E-2	BI9E-2-028		PVC-2.778A
	72" Discharge	33.83026	-118.10793	LACFCD	L	2.7779	Los Angeles County	BI9E-2	BI9E-2-029		PVC-2.778B
Carson St/Palo Verde Ave	48" Discharge	33.83232	-118.10832	Long Beach	L	3.008	Long Beach	BI9E-1	BI9E-1-034		PVC-3.008
Harvey Way/Palo Verde Ave	36" Discharge	33.83585	-118.10829	LACFCD	L	3.418	Lakewood	BI9E-1	BI9E-1-006	BI9E-1-006	PVC-3.417
Harvey Way/Palo Verde Ave	36" Discharge	33.83592	-118.10840	LACFCD	R	3.418	Lakewood	BI9E-1	BI9E-1-007	BI9E-1-007	PVC-3.418

Harvey Way/Palo Verde Ave	36" Discharge	33.83613	-118.10839	LACFCD	R	3.438	Lakewood	BI9E-1	BI9E-1-008	BI9E-1-008	PVC-3.437
Centralia St/Palo Verde Ave	48" Discharge	33.83948	-118.10822	LACFCD	L	3.827	Lakewood	BI9E-1	BI9E-1-013	BI9E-1-013	PVC-3.827
Henrilee Lateral/Conquista Ave	6'x7' Trap Channel Discharge	33.84132	-118.10834	LACFCD	R	4.017	Lakewood	BI9E-1	BI9E-1-032	BI9E-1-032	PVC-4.017
Turnergrove Dr/Silva St	48" Discharge (1 of 2)	33.84822	-118.10873	LACFCD	R	4.793	Lakewood	BI9E-1	BI9E-1-025	BI9E-1-025	PVC-4.793
Turnergrove Dr/Silva St	48" Discharge (2 of 2)	33.84824	-118.10873	LACFCD	R	4.795	Lakewood	BI9E-1	BI9E-1-026	BI9E-1-025	PVC-4.795
Palo Verde Ave/Carfax Ave	48" Discharge	33.84925	-118.10918	LACFCD	L	4.905	Lakewood	BI9E-1	BI9E-1-027	BI9E-1-027	PVC-4.905
Candlewood St/Carfax Ave	51" Discharge	33.85309	-118.11127	LACFCD	L	5.368	Lakewood	BI9E-1	BI9E-1-030	BI9E-1-030	PVC-5.368
Candlewood St/Carfax Ave	54" Discharge	33.85313	-118.11142	LACFCD	R	5.374	Lakewood	BI9E-1	BI9E-1-031	BI9E-1-031	PVC-5.374
South St/Canehill Ave	63" Discharge	33.85820	-118.11151	LACFCD	L	5.960	Lakewood	BI446B	BI446B-004	BI446B-004	PVC-5.960
South St/Canehill Ave	42" Discharge	33.85854	-118.11148	LACFCD	L	6.004	Lakewood	BI446B	BI446B-007	BI446B-007	PVC-6.004
Snowden Ave/Charlwood St	36" Discharge	33.85921	-118.11171	LACFCD	R	6.080	Lakewood	BI446B	BI446B-008	BI446B-000	PVC-6.080
Allington St/Canehill Ave	72" Discharge	33.86546	-118.11160	LACFCD	L	6.792	Lakewood	BI446B	BI446B-011	BI446B-011	PVC-6.793B
Allington St/Canehill Ave	75" Discharge	33.86546	-118.11161	LACFCD	R	6.792	Lakewood	BI446B	BI446B-012	BI446B-011	PVC-6.793A

Minor Outfalls (12-36 inches) in the Los Cerritos Channel Watershed

DISCHARGE POINT	EFFLUENT DESCRIPTION	DISCHARGE POINT LATITUDE	DISCHARGE POINT LONGITUDE	OWNER	SIDE (L/R)	DISTANCE FROM CHANNEL STARTING POINT (km)	JURISDICTION	MODEL SUB WATERSHED	UNIQUE ID	PHOTO UNIQUE ID	CHANNEL UNIQUE ID
CLARK CHANNEL											
Charlemagne Ave/Spring St	24" Discharge	33.81081	-118.13000	LACFCD	R	1.662	Long Beach	LCERR-3	LCERR-3-011		CC-0.009A
Rutgers Ave/Spring St	18" Discharge	33.81079	-118.12973	LACFCD	L	1.662	Long Beach	LCERR-3	LCERR-3-012		CC-0.009B
N. Charlemagne Ave/E. Wardlow Rd	18" Discharge	33.81895	-118.12994	Long Beach	R	2.565	Long Beach	BI9A-5	BI9A-5-008		CC-0.914B
E. Wardlow Rd/N. Rutgers Ave	18" Discharge	33.81897	-118.12970	Long Beach	L	2.565	Long Beach	BI9A-5	BI9A-5-009		CC-0.914A
Stanbridge Ave/E. Wardlow Rd	24" Discharge	33.81936	-118.12971	LACFCD	L	2.612	Long Beach	BI9A-5	BI9A-5-010		CC-0.961
E. Monlaco Rd/N. Rutgers Ave	18" Discharge	33.82216	-118.12968	Long Beach	L	2.924	Long Beach	BI9A-5	BI9A-5-012		CC-1.273
E. Monlaco Rd/N. Rutgers Ave	18" Discharge	33.82236	-118.12967	Long Beach	L	2.941	Long Beach	BI9A-5	BI9A-5-013		CC-1.290A
E. Monlaco Rd/N. Charlemagne Ave	18" Discharge	33.82233	-118.12995	Long Beach	R	2.941	Long Beach	BI9A-5	BI9A-5-014		CC-1.290B
E. Conant St/N. Charlemagne Ave	15" Discharge	33.82498	-118.12992	Long Beach	R	3.239	Long Beach	BI9A-4	BI9A-4-003		CC-1.587
E. Conant St/N. Charlemagne Ave	15" Discharge	33.82517	-118.12992	Long Beach	R	3.256	Long Beach	BI9A-4	BI9A-4-004		CC-1.605
N. Charlemagne Ave/E. Brittain St	24" Discharge	33.82604	-118.12991	Long Beach	R	3.354	Long Beach	BI9A-4	BI9A-4-005		CC-1.703
Carson St/N. Bellflower Blvd	12" Discharge	33.83070	-118.12970	LACFCD	L	3.865	Long Beach	BI9A-4	BI9A-4-006		CC-2.214
Carson St/N. Greenbrier Rd	24" Discharge	33.83223	-118.13231	Long Beach	R	4.168	Long Beach	BI9A-4	BI9A-4-009		CC-2.517A
Carson St/Heather Rd	24" Discharge	33.83223	-118.13210	Long Beach	L	4.168	Long Beach	BI9A-4	BI9A-4-010		CC-2.517B
Carson St/N. Greenbrier Rd	24" Discharge	33.83246	-118.13231	Long Beach	R	4.211	Long Beach	BI9A-4	BI9A-4-012		CC-2.560A
Carson St/Heather Rd	24" Discharge	33.83246	-118.13209	Long Beach	L	4.211	Long Beach	BI9A-4	BI9A-4-013		CC-2.560B
Harvey Way/Heather Rd	18" Discharge	33.83606	-118.13204	Long Beach	L	4.598	Long Beach	BI9A-4	BI9A-4-014		CC-2.947A

Harvey Way/Heather Rd	18" Discharge	33.83606	-118.13232	Long Beach	R	4.598	Long Beach	BI9A-4	BI9A-4-015		CC-2.947B
Harvey Way/N. Greenbrier Rd	18" Discharge	33.83620	-118.13231	Long Beach	R	4.610	Long Beach	BI9A-4	BI9A-4-018		CC-2.958A
Harvey Way/Heather Rd	18" Discharge	33.83620	-118.13205	Long Beach	L	4.610	Long Beach	BI9A-4	BI9A-4-019		CC-2.958B
E. Centralia St/N. Greenbrier Rd	18" Discharge	33.83969	-118.13227	Long Beach	R	4.994	Long Beach	BI9A-3	BI9A-3-003		CC-3.342A
E. Centralia St/Heather Rd	18" Discharge	33.83967	-118.13203	Long Beach	L	4.994	Long Beach	BI9A-3	BI9A-3-004		CC-3.342B
E. Centralia St/Pan American Park	15" Discharge	33.84087	-118.13202	Long Beach	L	5.129	Long Beach	BI9A-3	BI9A-3-005		CC-3.477
E. Arbor Rd/Pan American Park	15" Discharge	33.84154	-118.13203	Long Beach	L	5.205	Long Beach	BI9A-3	BI9A-3-006		CC-3.554
E. Arbor Rd/N. Charlemagne	24" Discharge	33.84312	-118.13202	Long Beach	L	5.379	Long Beach	BI9A-3	BI9A-3-009		CC-3.728
E. Arbor Rd./Fidler Ave	30" Discharge	33.84351	-118.13202	Long Beach	L	5.416	Long Beach	BI9A-3	BI9A-3-010		CC-3.764
Del Amo Blvd/Fidler Ave	33" Discharge	33.84693	-118.13217	LACFCD	L	5.801	Lakewood	BI9A-3	BI9A-3-012	BI9A-3-012	CC-4.149
Del Amo Blvd/Fidler Ave	18" Discharge	33.84701	-118.13216	UNK	L	5.802	Lakewood	BI9A-3	BI9A-3-013	BI9A-3-013	CC-4.150
Del Amo Blvd/Civic Center Way	30" Discharge	33.84721	-118.13220	UNK	L	5.834	Lakewood	BI9A-2	BI9A-2-001		CC-4.182
Civic Center/Del Amo Blvd	24" Discharge	33.84984	-118.13231	UNK	R	6.123	Lakewood	BI9A-2	BI9A-2-003		CC-4.484
Civic Center Way/Hardwick St	30" Discharge	33.85077	-118.13222	LACFCD	L	6.215	Lakewood	BI9A-2	BI9A-2-004		CC-4.575
Civic Center Way/Candlewood St	12" Discharge	33.85243	-118.13229	UNK	R	6.401	Lakewood	BI9A-2	BI9A-2-007		CC-4.762
Civic Center Way/Candlewood St	18" Discharge	33.85268	-118.13229	Lakewood	R	6.422	Lakewood	BI9A-2	BI9A-2-008		CC-4.783
Candlewood St/Clark Ave	18" Discharge	33.85382	-118.13222	LACFCD	R	6.545	Lakewood	BI9A-1	BI9A-1-001		CC-4.906
Candlewood St/Clark Ave	12" Discharge	33.85493	-118.13235	UNK	R	6.674	Lakewood	BI9A-1	BI9A-1-004		CC-5.035
Clark Ave/Michelson St	12" Discharge	33.85577	-118.13230	UNK	R	6.774	Lakewood	BI9A-1	BI9A-1-005		CC-5.135
Clark Ave/Michelson St	12" Discharge	33.85594	-118.13231	UNK	R	6.791	Lakewood	BI9A-1	BI9A-1-006		CC-5.151
Clark Ave/Michelson St	12" Discharge	33.85612	-118.13231	UNK	R	6.807	Lakewood	BI9A-1	BI9A-1-007		CC-5.168
Clark Ave/Michelson St	12" Discharge	33.85631	-118.13231	UNK	R	6.834	Lakewood	BI9A-1	BI9A-1-009		CC-5.194
Fidler Ave/Bigelow St	12" Discharge	33.85765	-118.13232	UNK	R	6.981	Lakewood	BI9A-1	BI9A-1-011		CC-5.342
Clark Ave/South St	24" Discharge	33.85968	-118.13228	Lakewood	R	7.192	Lakewood	BI9A-1	BI9A-1-012		CC-5.553
South St/Dagwood Ave	20" Discharge	33.86046	-118.13233	UNK	R	7.289	Lakewood	BI9A-1	BI9A-1-015		CC-5.649
South St/Fidler Ave	30" Discharge	33.86045	-118.13219	UNK	L	7.291	Lakewood	BI9A-1	BI9A-1-016		CC-5.652
Hedda St/Fidler Ave	15" Discharge	33.86417	-118.13221	UNK	L	7.697	Lakewood	BI9A-1	BI9A-1-020		CC-6.058

Hedda St/Fidler Ave	15" Discharge	33.86427	-118.13221	UNK	L	7.708	Lakewood	BI9A-1	BI9A-1-021		CC-6.089
Ashworth St/Fidler Ave	15" Discharge	33.86783	-118.13225	Lakewood	L	8.112	Lakewood	BI9A-1	BI9A-1-023		CC-6.472
Ashworth St/Fidler Ave	15" Discharge	33.86799	-118.13227	Lakewood	L	7.708	Lakewood	BI9A-1	BI9A-1-024		CC-6.485
DEL AMO CHANNEL											
Del Amo Blvd/Fidler Ave	24" Discharge	33.84697	-118.13290	UNK	L	0.079	Lakewood	BI9B-2	BI9B-2-001	BI9B-2-001	DAC-0.079
Del Amo Blvd/Whitewood Ave	24" Discharge	33.84697	-118.13540	Lakewood	L	0.283	Lakewood	BI9B-2	BI9B-2-002	BI9B-2-002	DAC-0.328
Del Amo Blvd/Graywood Ave	18" Discharge	33.84680	-118.13791	Long Beach	R	0.517	Lakewood	BI9B-2	BI9B-2-007	BI9B-2-007	DAC-0.562
Del Amo Blvd/Graywood Ave	15" Discharge	33.84680	-118.13827	Long Beach	R	0.538	Lakewood	BI9B-2	BI9B-2-008	BI9B-2-008	DAC-0.583
Del Amo Blvd/Graywood Ave	15" Discharge	33.84680	-118.13930	Long Beach	R	0.554	Lakewood	BI9B-2	BI9B-2-009	BI9B-2-009	DAC-0.599
Del Amo Blvd/Hazelbrook Ave	36" Discharge	33.84694	-118.13953		L	0.6642	Lakewood	BI9B-2	BI9B-2-010		DAC-0.709
Del Amo Blvd/Blackthorne Ave	18" Discharge	33.84680	-118.14030	Long Beach	R	0.742	Lakewood	BI9B-2	BI9B-2-013	BI9B-2-013	DAC-0.784
Del Amo Blvd/N. Blackthorne Ave	18" Discharge	33.84698	-118.14024	LACFCD	L	0.739	Lakewood	BI9B-2	BI9B-2-012	BI9B-2-012	DAC-0.787
Del Amo Blvd/N. Pepperwood Ave	15" Discharge	33.84681	-118.14139	Long Beach	R	0.836	Lakewood	BI9B-2	BI9B-2-015	BI9B-2-015	DAC-0.881
Del Amo Blvd/Lakewood Blvd	15" Discharge	33.84682	-118.14225	Long Beach	R	0.908	Lakewood	BI9B-2	BI9B-2-017	BI9B-2-017	DAC-0.953
Del Amo Blvd/Lakewood Blvd	18" Discharge	33.84700	-118.14241	Long Beach	L	0.924	Lakewood	BI9B-2	BI9B-2-019	BI9B-2-019	DAC-0.970
Del Amo Blvd/Lakewood Blvd	12" Discharge	33.84689	-118.14267	Lakewood	L	1.005	Lakewood	BI9B-2	BI9B-2-021	BI9B-2-021	DAC-1.005
Del Amo Blvd/Lakewood Blvd	18" Discharge	33.84681	-118.14264	Long Beach	R	1.961	Lakewood	BI9B-2	BI9B-2-022	BI9B-2-021	DAC-1.006
Del Amo Blvd/Oliva Ave	30" Discharge	33.84683	-118.14493	UNK	R	1.207	Lakewood	BI9B-2	BI9B-2-023	BI9B-2-023	DAC-1.252
Del Amo Blvd/Hayter Ave	30" Discharge	33.84686	-118.14618	UNK	R	1.289	Lakewood	BI9B-2	BI9B-2-026	BI9B-2-026	DAC-1.324
Del Amo Blvd/Hayter Ave	30" Discharge	33.84701	-118.14623	UNK	L	1.279	Lakewood	BI9B-2	BI9B-2-025	BI9B-2-025	DAC-1.334A
Del Amo Blvd/Verdura Ave	24" Discharge	33.84705	-118.14970	UNK	L	1.614	Lakewood	BI9B-2	BI9B-2-028	BI9B-2-028	DAC-1.659
Del Amo Blvd/Downey Ave	18" Discharge	33.84723	-118.15061	UNK	R	1.693	Lakewood	BI9B-2	BI9B-2-030	BI9B-2-030	DAC-1.738
DOWNEY CHANNEL											
Hardwick St/Downey Ave	30" Discharge	33.85025	-118.15041	UNK	L	0.165	Lakewood	BI447A	BI447A-001		DNC-0.165
Hardwick St/Downey Ave	30" Discharge	33.85031	-118.15054	UNK	R	0.173	Lakewood	BI447A	BI447A-002	BI447A-002	DNC-0.173
Candlewood St/Downey Ave	24" Discharge	33.85372	-118.15039	UNK	L	0.554	Lakewood	BI447A	BI447A-004	BI447A-004	DNC-0.554

Downey Ave/Eckleson St	18" Discharge	33.84919	-118.15089	Lakewood	L	1.985	Lakewood	BI9B-1	BI9B-1-001		DNC-1.985
Downey Ave/Eckleson St	21" Discharge	33.84920	-118.15121	UNK	L	2.019	Lakewood	BI9B-1	BI9B-1-002		DNC-2.019
Downey Ave/Eckleson St	18" Discharge	33.84908	-118.15121	UNK	R	2.022	Lakewood	BI9B-1	BI9B-1-003		DNC-2.022
LOS CERRITOS CHANNEL											
Knoxville Ave/E. el Progreso St	24" Discharge	33.79599	-118.10369	Long Beach	R	8.172	Long Beach	LCERR-4	LCERR-4-002		LCC-0.817
Vuelta Grande Ave/Stearns St	24" Discharge	33.79599	-118.10328	Long Beach	L	8.173	Long Beach	LCERR-4	LCERR-4-003		LCC-0.818
Vuelta Grande Ave/Los Arcos St	33" Discharge	33.79944	-118.10356	Long Beach	L	8.555	Long Beach	LCERR-4	LCERR-4-005		LCC-1.199
Vuelta Grande Ave/Ladoga Ave	21" Discharge	33.80006	-118.10427	LACFCD	L	8.649	Long Beach	LCERR-4	LCERR-4-006		LCC-1.294
Vuelta Grande Ave/Snowden Ave	24" Discharge	33.80557	-118.11188	Long Beach	L	9.678	Long Beach	LCERR-4	LCERR-4-010		LCC-2.323
Spring St/Lomina Ave	21" Discharge	33.81012	-118.12110	LACFCD	R	0.721	Long Beach	LCERR-3	LCERR-3-001		LCC-3.384
Spring St/San Anseline Ave	18" Discharge	33.81036	-118.12163	LACFCD	L	0.759	Long Beach	LCERR-3	LCERR-3-003		LCC-3.422
Spring St/Bellflower Blvd	21" Discharge	33.81013	-118.12411	LACFCD	R	1.000	Long Beach	LCERR-3	LCERR-3-004		LCC-3.663
Spring St/Bellflower Blvd	15" Discharge	33.81041	-118.12514	LACFCD	L	1.085	Long Beach	LCERR-3	LCERR-3-005		LCC-3.748
Spring St/Montair Ave	15" Discharge	33.81042	-118.12562	LACFCD	L	1.135	Long Beach	LCERR-3	LCERR-3-007		LCC-3.798
Spring St/Montair Ave	18" Discharge	33.81041	-118.12674	Long Beach	L	1.222	Long Beach	LCERR-3	LCERR-3-008		LCC-3.885
Charlemagne Ave/Spring St	15" Discharge	33.81051	-118.13042	Long Beach	L	0.078	Long Beach	LCERR-2	LCERR-2-001		LCC-4.245
Heather Rd/Spring St	24" Discharge	33.81023	-118.13107	Long Beach	R	0.135	Long Beach	LCERR-2	LCERR-2-003		LCC-4.301B
WARDLOW CHANNEL											
Clark Ave/Keynote St	18" Discharge	33.82335	-118.13495	Long Beach	L	5.885	Long Beach	BI9C	BI9C-002		WC-5.964
Clark Ave/Keynote St	18" Discharge	33.82337	-118.13574	Long Beach	L	5.918	Long Beach	BI9C	BI9C-003		WC-6.038
Lakewood Blvd	18" Discharge	33.82331	-118.14151	Long Beach	L	6.519	Lakewood	BI9A-5	BI9A-5-016		WC-6.571
SOUTH OF ATHERTON											
Vuelta Grande Ave/Espanita St	30" Discharge	33.78581	-118.10343	Long Beach	L	7.049	Long Beach	LCERR-5	LCERR-5-001		LCC-7049.1
Vuelta Grande Ave/E. Driscoll St	30" Discharge	33.78644	-118.10384	Long Beach	R	7.116	Long Beach	LCERR-5	LCERR-5-002		LCC-7116.2
PALO VERDE CHANNEL											
WOODRUFF AVE / VUELTA GRANDE AVE	24" Discharge	33.80836	-118.11435	Long Beach	R	0.156	Long Beach	BI9E-2	BI9E-2-001		PVC-0.156

6036 SPRING ST/Woodruff Ave	15" Discharge	33.81039	-118.11423	Long Beach	L	0.377	Long Beach	BI9E-2	BI9E-2-002		PVC-0.377
WOODRUFF AVE / SPRING ST	18" Discharge	33.81039	-118.11432	Long Beach	R	0.378	Long Beach	BI9E-2	BI9E-2-003		PVC-0.378
SPRING ST / WOODRUFF AVE	18" Discharge	33.81064	-118.11431	LACFCD	R	0.408	Long Beach	BI9E-2	BI9E-2-004		PVC-0.408
SPRING ST / WOODRUFF AVE	15" Discharge	33.81065	-118.11431	Long Beach	R	0.408	Long Beach	BI9E-2	BI9E-2-005		PVC-0.408
3128 LOS COYOTES DIA/E. Pageantry St	24" Discharge	33.81311	-118.11411	LACFCD	R	0.705	Long Beach	BI9E-2	BI9E-2-008		PVC-0.705
3143 LOS COYOTES DIA/E. Pagentry St	30" Discharge	33.81394	-118.11397	Long Beach	R	0.775	Long Beach	BI9E-2	BI9E-2-011		PVC-0.775
3142 LOS COYOTES DIA/E. Pagentry St	21" Discharge	33.81406	-118.11376	Long Beach	L	0.792	Long Beach	BI9E-2	BI9E-2-012		PVC-0.792
3169 LOS COYOTES DIA/N. Hayfield Dr	15" Discharge	33.81449	-118.11347	Long Beach	R	0.848	Long Beach	BI9E-2	BI9E-2-013		PVC-0.848
3302 LOS COYOTES DIA/Metz St	21" Discharge	33.81666	-118.11144	Long Beach	L	1.154	Long Beach	BI9E-2	BI9E-2-015		PVC-1.154
3425 LOS COYOTES DIA/Canehill Ave	21" Discharge	33.81940	-118.10913	Long Beach	R	1.527	Long Beach	BI9E-2	BI9E-2-017		PVC-1.527
LOS COYOTES DIA / PALO VERDE AVE	21" Discharge	33.82048	-118.10807	Long Beach	L	1.676	Long Beach	BI9E-2	BI9E-2-018		PVC-1.676
LOS COYOTES DIA / PALO VERDE AVE	18" Discharge	33.82081	-118.10792	LACFCD	L	1.721	Long Beach	BI9E-2	BI9E-2-020		PVC-1.721
PALO VERDE AVE/E. Monlaco Rd	24" Discharge	33.82224	-118.10796	Long Beach	R	1.878	Long Beach	BI9E-2	BI9E-2-023		PVC-1.878
Palo Verde Ave/E. Keynote St	27" Discharge	33.82280	-118.10793	Long Beach	L	1.937	Long Beach	BI9E-2	BI9E-2-024		PVC-1.937
3702 CONQUISTA AVE/Palo Verde Ave	27" Discharge	33.82505	-118.10798	Long Beach	R	2.201	Long Beach	BI9E-2	BI9E-2-025		PVC-2.201
Carson St/Palo Verde Ave	12" Discharge	33.83210	-118.10836	Long Beach		2.985	Long Beach	BI9E-1	BI9E-1-001		PVC-2.985
Carson St/Palo Verde Ave	18" Discharge	33.83235	-118.10832	Long Beach	L	3.009	Long Beach	BI9E-1	BI9E-1-002		PVC-3.009
Carson St/Palo Verde Ave	18" Discharge	33.83241	-118.10833	UNK	L	3.030	Lakewood	BI9E-1	BI9E-1-033	BI9E-1-033	PVC-3.030
Carson St/Palo Verde Ave	30" Discharge	33.83240	-118.10843	UNK	R	3.031	Lakewood	BI9E-1	BI9E-1-003	BI9E-1-003	PVC-3.031
4139 Palo Verde Ave/Harvey Way	18" Discharge	33.83433	-118.10831	UNK	L	3.228	Lakewood	BI9E-1	BI9E-1-004	BI9E-1-004	PVC-3.228
4222 Conquista Ave/Harvey Way	18" Discharge	33.83500	-118.10841	UNK	R	3.300	Lakewood	BI9E-1	BI9E-1-005	BI9E-1-005	PVC-3.300
Harvey Way/Palo Verde Ave	18" Discharge	33.83611	-118.10829	Lakewod	L	3.438	Lakewood	BI9E-1	BI9E-1-009	BI9E-1-009	PVC-3.438
Harvey Way/Palo Verde Ave	18" Discharge	33.83615	-118.10828	UNK	L	3.444	Lakewood	BI9E-1	BI9E-1-010	BI9E-1-010	PVC-3.444
Centralia St/Palo Verde Ave	15" Discharge	33.83775	-118.10824	UNK	L	3.622	Lakewood	BI9E-1	BI9E-1-011	BI9E-1-011	PVC-3.622

Centralia St/Palo Verde Ave	15" Discharge	33.83936	-118.10822	UNK	R	3.804	Lakewood	BI9E-1	BI9E-1-012	BI9E-1-012	PVC-3.804
Centralia St/Palo Verde Ave	24" Discharge	33.83947	-118.10842	UNK	R	3.824	Lakewood	BI9E-1	BI9E-1-014	BI9E-1-014	PVC-3.824
Centralia St/Palo Verde Ave	15" Discharge	33.83958	-118.10822	UNK	L	3.829	Lakewood	BI9E-1	BI9E-1-015	BI9E-1-015	PVC-3.829
Conquista Ave/Arbor Rd	15" Discharge	33.84135	-118.10821	UNK	L	4.020	Lakewood	BI9E-1	BI9E-1-016	BI9E-1-016	PVC-4.020
Arbor Rd/Palo Verde Ave	15" Discharge	33.84306	-118.10820	UNK	L	4.208	Lakewood	BI9E-1	BI9E-1-017	BI9E-1-017	PVC-4.208
Arbor Rd/Palo Verde Ave	24" Discharge	33.84326	-118.10841	UNK	R	4.228	Lakewood	BI9E-1	BI9E-1-018	BI9E-1-018	PVC-4.228
Arbor Rd/Palo Verde Ave	30" Discharge	33.84327	-118.10841	UNK	L	4.229	Lakewood	BI9E-1	BI9E-1-019	BI9E-1-019	PVC-4.229
Arbor Rd/Palo Verde Ave	18" Discharge	33.84332	-118.10820	UNK	L	4.235	Lakewood	BI9E-1	BI9E-1-020	BI9E-1-020	PVC-4.235
Arbor Rd/Palo Verde Ave	15" Discharge	33.84507	-118.10822	UNK	L	4.434	Lakewood	BI9E-1	BI9E-1-021	BI9E-1-021	PVC-4.434
Del Amo Blvd/Palo Verde Ave	15" Discharge	33.84685	-118.10819	UNK	L	4.628	Lakewood	BI9E-1	BI9E-1-022	BI9E-1-022	PVC-4.628
Del Amo Blvd/Palo Verde Ave	18" Discharge	33.84713	-118.10821	LACFCD	L	4.659	Lakewood	BI9E-1	BI9E-1-023	BI9E-1-023	PVC-4.659
Del Amo Blvd/Palo Verde Ave	24" Discharge	33.84714	-118.10836	LACFCD	R	4.659	Lakewood	BI9E-1	BI9E-1-024	BI9E-1-024	PVC-4.660
5023Carfax Ave/E. Hardwick St	18" Discharge	33.85007	-118.10960	UNK	L	4.962	Lakewood	BI9E-1	BI9E-1-028	BI9E-1-028	PVC-4.962
6251 McKnight Dr/Chesteroark Dr	24" Discharge	33.85057	-118.11001	UNK	R	5.075	Lakewood	BI9E-1	BI9E-1-029	BI9E-1-029	PVC-5.075
Candlewood St/Carfax Ave	24" Discharge	33.85321	-118.11132	UNK	L	5.403	Lakewood	BI446B	BI446B-001		PVC-5.403
Candlewood St/Cardale St	30" Discharge	33.85389	-118.11155	Lakewood	L	5.489	Lakewood	BI446B	BI446B-002		PVC-5.489
Candlewood St/Capetown St	27" Discharge	33.85441	-118.11167	Lakewood	R	5.543	Lakewood	BI446B	BI446B-003	BI446B-003	PVC-5.543
South St/Canehill Ave	18" Discharge	33.85822	-118.11172	UNK	R	5.970	Lakewood	BI446B	BI446B-005		PVC-5.970
South St/Canehill Ave	12" Discharge	33.85827	-118.11172	Lakewod	R	5.980	Lakewood	BI446B	BI446B-006		PVC-5.980

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APPENDIX F

GENERAL FIELD SAMPLING PROCEDURES

FOR

COMPOSITE AND GRAB SAMPLES

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GENERAL FIELD SAMPLING PROCEDURE FOR:

Composite Samples

1.0 SCOPE

This Standard Operating Procedure (SOP) describes the procedures for the compositing and sub-sampling of non-point source (NPS) "composite" sample bottles. The purpose of these procedures is to ensure that the sub-samples taken are representative of the entire water sample in the "composite" bottle (or bottles). In order to prevent confusion, it should be noted that the bottles are referred to as "composite" bottles because they are a composite of many small samples taken over the course of a storm; in this SOP the use of "compositing" generally refers to the calculated combining of more than one of these "composite" bottles.

2.0 APPLICATION

This SOP applies to all laboratory activities that comprise the compositing and sub-sampling of NPS composite sample bottles.

3.0 HEALTH AND SAFETY CONSIDERATIONS

The compositing and sub-sampling of composite sample bottles may involve contact with contaminated water. Skin contact with sampled water should be minimized by wearing appropriate protective gloves, clothing, and safety glasses. Avoid hand-face contact during the compositing and sub-sampling procedures. Wash hands with soap and warm water after work is completed.

4.0 DEFINITIONS

4.1 "Composite" sample bottle: A borosilicate glass bottle that is used to collect multiple samples over the course of a storm (a composite sample).

4.2 Large-capacity stirrer: Electric motorized "plate" that supports composite bottle and facilitates the mixing of sample water within the bottle by means of spinning a pre-cleaned magnetic stir-bar which is introduced into the bottle.

4.3 Stir-bar: Pre-cleaned teflon-coated magnetic "bar" approximately 2-3 inches in length which is introduced into a composite bottle and is spun by the stirrer, thereby creating a vortex in the bottle and mixing the sample.

4.4 Sub-sampling hose: Two pre-cleaned ~3-foot lengths of Teflon tubing connected by a ~2-foot length of silicon tubing. Used with a peristaltic pump to transfer sample water from the composite sample bottle to sample analyte containers.

4.5 Volume-to-Sample Ratio (VSR): A number that represents the volume of water that will flow past the flow-meter before a sample is taken (usually in liters but can also be in kilo-cubic feet for river deployments). For example, if the VSR is 1000 it means that every time 1000 liters passes the flow-meter the sampler collects a sample (1000 liters of flow per 1 sample taken). Note: The VSR indicates when a sample should be taken and is NOT an indication of the sample size.

5.0 EQUIPMENT

5.1 Instrumentation: Not applicable

5.2 Reagents: Not applicable.

5.3 Apparatus:

1) Large capacity stirrer.

2) Stir bar.

3) Sub-sampling hose.

4) Peristaltic pump.

5.4 Documentation: Information from the field logbook should include the volume-to-sample ratio for each composite sample bottle, each bottle's ID number, and the time of the last sample taken at a particular sampling site (for purposes of holding times). Previous documentation should exist for the cleaning batch numbers for the 20-L bottles and the sub-sampling hoses.

6.0 COMPOSITING AND SUB-SAMPLING PROCEDURES

Compositing sample water prior to sub-sampling may be necessary if more than one composite sample bottle was filled (or partially filled) during the course of a storm at a particular sampling site. Care must be taken to ensure that no contaminants are introduced at any point during this procedure. If the compositing is not performed with this in mind, the possibility for the introduction of contaminants (i.e., from dust, dirty sub-sampling hose tips, dirty fingers/gloves, engine emissions, etc.) is increased significantly.

6.1 Determining the Fraction of Each Sample Bottle to be Composited: This is essential to producing a composite that is representative of the entire storm sampled and is not biased/weighted toward the first part of the storm (Bottle 1) or the last part of the storm (last bottle). In general, either the bottles have been sampled using the same volume-to-sample ratio (VSR), <u>OR</u> the VSR has been increased for the Bottle 2 in order to prevent over-filling of another bottle; this happens when the amount of rainfall and resulting runoff volume was underestimated.

6.1.1 Consult the field logbook and confirm that the bottles are from the same sampling station. Inspect the bottles' "ID" tags and confirm that the volume-to-sample ratio (VSR) numbers are the same as in the logbook.

6.1.2 If both bottles have the same VSR then equal parts of each sample should be mixed.

6.1.3 If the VSR of Bottle 2 is double that of Bottle 1 then 2-parts from Bottle 2 should be mixed with 1-part from Bottle 1. This is because Bottle 1 is, in a sense, twice as concentrated as Bottle 2, having sampled half as much flow per sample aliquot.

6.1.4 If there are more than two bottles to composite simply follow the rules above but apply it to all three bottles. For example, if Bottles 1, 2, and 3 had VSRs of 100, 200, and 400, respectively, then the composite would be composed of 4-parts from Bottle 3, 2-parts from Bottle 2, and 1-part from Bottle 1.

6.1.5 Volume-to-Sample Ratios are typically multiples of each other and are rarely fractions of each other. This is simply to make compositing bottles with different VSRs easier.

6.1.6 Rarely does an instance occur in which the VSR of Bottle 1 is HIGHER than that of Bottle 2. The only reason for this would be if the runoff was grossly overestimated and "Sample Control" instructed a field crew to pull Bottle 1 early and lower the VSR for Bottle 2.

6.2 **Determining Water Volume Needed and the Fate of Any Excess Water:** Compositing multiple composite bottles can often be done using only those bottles, or may require "dirtying" or "sacrificing" a clean composite bottle. The different reasons are described below.

6.2.1 **Determine sample volume needed:** The minimum volume of sample water needed for filling the numerous sample analyte containers must be known, or calculated on the spot. This is done by simply adding up the volumes of all sample containers to be filled. If there is not enough sample water (after compositing) to fill all the containers then consult with the project manager to determine what the order of priority is for the analyses (i.e., in what order to fill the containers). It is also useful to know the absolute minimum sample volumes needed by the laboratory to perform each analysis; some sample containers may not need to be filled completely.

6.2.2 **Determine if excess water is to be saved:** If the composite bottles are mostly full then it is likely that much of the sample water will be left over from the sub-sampling process. In this case it is sometimes prudent to save the left over sample water (on ice) for several days in case problems occur with the laboratory and more water is needed. Always check with the project manager on this point because it may require dirtying (sacrificing) a clean composite bottle to make the composite in. If any excess water is not to be saved then compositing can always be done in the existing composite sample bottles: while being homogenized on a stir plate the excess sample water is simply discarded (pumped out in a calculated fashion), making room for the final composite.

6.2.3 **Plan on making as large a composite as possible:** If, for example, only 8 liters of sample water are needed but there is enough water to make a higher volume composite then it is prudent to do so. This is to account for any accidental spills and, if required, to the save enough excess water for possible re-analysis. There generally will never be a need to make a composite greater than a single 20-L composite bottle.

6.2.4 **If only one composite bottle exists from a station:** Simply follow the procedures for sub-sampling into numerous sample containers described in Section 6.5.

6.3 **Compositing Without Saving Excess Water:** This procedure also applies to instances in which there may not be excess water. For the sake of clarity an example will be used to explain the following steps. In this example three 20-L composite bottles are involved in creating a composite: Bottle 1 has 20 liters of sample water and was filled at a Volume to Sample Ratio (VSR) of 100; Bottle 2 has 20 liters and a VSR of 200; Bottle 3 has 20 liters and a VSR of 400. Sample water will be composited in Bottle 3. Most bottles have 1 liter graduations; if some don't then sample depth must be used to figure the fraction of water to be transferred.

6.3.1 Carefully place Bottle 3 on a large spin plate and gently drop a pre-cleaned stir-bar into the bottle and adjust the speed of the spin plate to optimize the mixing of the sample water throughout the bottle. The speed at which the stir-bar is spun should be adjusted so that even mixing is achieved. Speeds that are too fast will create a large vortex within the composite bottle that can actually concentrate heavier particles and should be avoided. Settling on a particular speed is based on a subjective visual assessment of what speed produces the most even, random mixing throughout the composite bottle.

6.3.2 Install a pre-cleaned sub-sampling hose into a peristaltic pump. Carefully remove the plastic cover which protects the approximately 18 inches of its exterior surface which has been cleaned. Insert this end into Bottle 3. Uncap the other end of the sub-sampling hose and ready it over a waste bucket.

6.3.3 While being mixed on the stir plate pump 10 liters into the waste bucket, leaving 10 liters in Bottle 3. This is best performed by two people. One person is responsible for filling the waste bucket and one person is responsible for moving the intake tubing up and down in the water column of the composite sample and controlling the pump. Based on experimental evidence, this up and down movement of the intake helps obtain (or, in this case discard) a more representative sample. This is because there can still be some stratification of heavier particles in the sample bottle despite the mixing created by the stirrer. The up and down movement of the intake tubing should be limited to 80-90 percent of the water depth and should never touch the bottom of the sample bottle.

6.3.4 Remove Bottle 3 from the stir plate and replace with Bottle 2 and insert a new stir-bar and mix as described in Section 6.3.1. Keeping the sub-sampling hose clean (avoid setting it down or bumping it into objects), insert the intake end into Bottle 2. Using the methods described in Section 6.3.3 pump only 5 liters from Bottle 2 into Bottle 3, making a total of 15 liters. **NEVER INSERT THE "DIRTY" EFFLUENT END OF THE HOSE INTO ANY BOTTLE.**

6.3.5 Repeat the actions in Section 6.3.4 with Bottle 1, pumping only 2.5 liters of Bottle 1 into Bottle 3, making a total of 17.5 liters of composited water.

6.3.6 Note that this process cannot generate any excess composite water because there is none left from Bottle 3 that has not been contaminated in the waste bucket.

6.4 **Compositing While Also Saving Excess Water:** This is identical to the procedures described in Section 6.3 with one difference: the first 10 liters of Bottle 3 is pumped into a clean 20-L bottle instead of into a waste bucket. This "dirties" a fourth bottle but ensures that excess sample water can be kept and composited again, if desired.

6.5 **Sub-sampling Composited Water into Sample Containers:** This is the final stage in successfully filling a suite of sample analyte containers with composited water that is representative of an entire sampling event.

6.5.1 Place the composite bottle containing the composited water on the stir plate and achieve proper mixing.

6.5.2 Uncap and arrange all the sample containers to be filled in such a way that they can be easily filled. Due to the vibration of the peristaltic pump on the sub-sampling hose it takes a very steady hand to efficiently guide the stream of sample water into the containers. **NEVER INSERT THE "DIRTY" EFFLUENT END OF THE HOSE INTO THE SAMPLE CONTAINERS.** It is often necessary to steady the sample containers with a second hand so they do not fall over.

7.0 PERSONNEL

Only personnel that have been trained in the use of the proper safety equipment, as per the are allowed to complete this task. . The Laboratory Supervisor is responsible for training personnel in the proper procedures in composite sample bottle, teflon sample hose and silicon peristaltic tubing, and stir bar cleaning.

8.0 QUALITY ASSURANCE REQUIREMENTS

The composite sample bottles and sub-sampling hoses must have been evaluated ("blanked") for contaminants after their initial decontamination procedure.

GENERAL FIELD SAMPLING PROCEDURE FOR:

Grab Samples

1.0 SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) describes the procedures involved in the discrete manual sampling (grab sampling) of storm water for a nonpoint source (NPS) monitoring program. The purpose of these procedures is to ensure contaminant free samples, and to ensure the safety of the personnel involved.

2.0 DEFINITIONS

2.1 **Sample Containers** – any EPA or laboratory specified clean container that is used to collect sample water.

2.2 **Grab Pole** – used to obtain grabs from locations where it is impossible or too dangerous (fast current, storm drain pipe, etc.) to manually obtain a sample.

3.0 PERSONNEL

Only personnel that have been trained in the use of the proper safety equipment are allowed to complete this task. Training needs to include the proper sampling techniques and station hazards that will be encountered while performing this task. The Project Manager is responsible for training personnel in these procedures.

4.0 EQUIPMENT

4.1 **Instrumentation** – see section 12.0 Physical Parameters

4.2 **Reagents** – preservatives will be supplied by the laboratory that supplies the sample bottles. Usually, the preservative is a concentrated acid (HNO_3, H_2SO_4, HCl or other).

4.3 **Apparatus** – a telescoping grab pole with a bottle holding device secured to one end. The bottle holding device is made of plastic and Velcro. It is designed to hold in place sample bottles of various sizes and types.

4.4 **Documentation** – time, date, location, number of containers and type of grab (whether for chemical analysis or physical parameters) must be noted in the station log book for that station.

5.0 PROCEDURES

Grab sampling methods will be discussed for the following analytes:

Metals and Total Cyanide

Oil and Grease

Fecal Coliform and Fecal Streptococci

Volatile Organic and Aromatic Compounds (VOA's)

Organic Compounds (Pesticides, PAHs, PCBs, SVOCs, etc.)

Physical Parameters

6.0 GRAB SAMPLING TECHNIQUES

6.1 Grab sampling may be conducted at any time during the storm event, depending upon the specific project requirements. The type of grab study might vary as the storm season progresses and the scope requirements deem necessary. These might include:

6.1.1 **Discrete Grabs** – Taken once during the storm event at a predetermined time, usually at peak flow.

6.1.2 **Persistent Grabs** – A schedule of discrete grabs which continue through the end of the storm to show a rate of change over time.

6.1.3 **First Flush** – A type of discrete grab to be taken within the first thirty minutes of the storm event.

For the majority of grab sample studies, discrete grabs will be required. Grabs will be taken on the rising hydrocurve of the storm event and as close to peak stage as is feasible. The times of these grabs will be decided by the Storm Control and/or Shift Leader and will be relayed to the field crews.

6.2 Depending upon then type of analyte being sampled, the technique may vary but all sampling **MUST** follow these general rules to minimize contamination:

6.2.1 Grab bottles are to be filled as near to the intake as is safely possible.

6.2.2 When unable to obtain a sample near the intake, take one as near to the center of flow as possible or in an area of sufficient velocity to ensure good mixing

6.2.3 The field personnel taking grab samples must be standing downstream from the sample bottle when filling.

6.2.4 The mouth of the bottle must be facing into the current.

6.2.5 Raise and lower the bottle through the water column so the sample is not biased with only one level sampled.

6.2.6 Manhole sites and inaccessible stream sites are best sampled with a grab pole.

7.0 METALS AND TOTAL CYANIDE

Samples to be analyzed for metals and cyanide are grabbed in a plastic or Teflon® container. Metals and total cyanide will require a preservative in the container (see Section 4.2). These grabs require extra care so as to not overfill the container and spill out any of the preservative, or allow the preservative to come into contact with the skin.

Metals sample bottles contain an acid preservative (HNO_3) and total cyanide sample bottles contain a base (NaOH) for a preservative. When the grab container is being filled manually, the level of water can be watched so the container is not overfilled. When the sample cannot be taken by hand and must be taken with a grab pole, the filling becomes a bit more difficult. Lower the container with the grab pole and watch for escaping air bubbles when submerged. Pull the sample bottle out frequently to check the water level accumulated and quit filling when that level has reached the "shoulder" of the bottle. Be sure **NOT TO OVERFILL THE SAMPLE BOTTLE**; this would spill the preservative compromising the sample and possibly endangering the person sampling.

8.0 OIL AND GREASE

Oil and grease samples are very similar to metals in that the bottles contain preservative and **MUST NOT BE OVERFILLED**. Oil and grease analysis requires that the sample be taken in glass containers, usually amber and usually in duplicate (in case of breakage). Fill these containers in the same exact way as mentioned above for metals analysis.

9.0 FECAL COLIFORM AND FECAL STREPTOCOCCI

Fecal coliform and fecal streptococci are usually grabbed in bacteria bottles or urine analysis cups. They contain a residual chlorine removal preservative tablet and should be filled to the sample container fill line when sampling. Wear protective gloves so that there is no skin contact with the interior of the container. The main precaution is not to contaminate the sample when opening the cup. Fill each cup completely and secure the cap.

10.0 VOLATILE ORGANIC AND AROMATIC COMPOUNDS (VOA'S)

Collecting water for Volatile Organic Compounds (VOA) requires extreme care. VOA's volatilize (enter the gaseous phase very quickly), thus, sample vials are designed to prevent this. These vials will leave no headspace (air bubbles) in a properly filled container because they have a septa cap , thereby minimizing loss of analyte to the atmosphere.

To fill a VOA vial, lower it into the water column and allow it to **FILL UP COMPLETELY** (until a water dome is formed over the top of the vial). VOA's must be preserved with HCl so take extra care not to spill any of this preservative. Very carefully place the septa cap onto the vial so no air is introduced, start with the cap tilted to one side and gently lower it until it is seated onto the threads of the vial and secure. Make sure there is no air in the vial by inverting the sample. If air bubbles show, a new sample must be taken using a new vial and the bad container and sample must be returned to the lab for proper disposal. **See Section 13.0 for additional precautions to be taken with VOA vials.**

11.0 ORGANIC COMPOUNDS (PESTICIDES, PAHs, PCBs, SVOCS, etc.)

Organic compound samples are collected in glass containers, usually amber. These samples generally do not require preservatives but should be filled in the same way as those collected for metals, and oil and grease analyses.

12.0 PHYSICAL PARAMETERS

Each time a station is visited during a storm event, certain physical parameters must be measured. Generally, at a minimum, pH and temperature are measured. Follow the instructions that are included with the field instrumentation used for the best results. There are many different brands of meters that require different techniques.

Take the measurements as close to the grab sampling point as possible while keeping safety a priority. A grab sample may be taken and analyzed somewhere more convenient and safe than the stream edge. Remember that the analysis on a grab sample should be performed "as soon as possible" to ensure as accurate measurements (pH, temperature, etc.) as possible. Record all results in the log book for that station and be sure to write in the units of measurement.

13.0 QUALITY CONTROL LIMITS

Grab sample containers must come from a reputable distributor and be certified clean for the analyte to be sampled. They must also be properly preserved and labeled prior to sampling. Transport the bottles in clean coolers accompanied with any required paperwork or instructions.

Immediately upon completion of sampling, return the sample bottles to a clean cooler and ice them down to 4°C. Recheck to be certain that all the information on the label is correct (date, time, location, analysis, preservative, etc.). Fill out the required paperwork and station log book sheets and transfer the samples to a predetermined pick-up location for the Analytical Laboratory.

13.1 For some storm sampling events, different Quality Assurance and Quality Controls (QA/QC) will be implemented. These will include:

13.1.1 Field Duplicates – Additional set of sample bottles grabbed at the same location and time as the actual sample. This sample may be given its own mock station identification and be submitted to the Analytical Laboratory blind.

13.1.2 Field Blanks – This is a full set of sample bottles (usually minus TSS and turbidity) containing reagent grade analyte free water provided by the Analytical Laboratory that will be doing the analysis. These samples are poured by hand from clean bottles containing the blank water into a labeled sample container. These sample bottles may be given a mock station identification and submitted blind as well.

13.1.3 Trip Blanks – Usually required for very sensitive samples (VOA's). The Analytical Laboratory will provide sample bottles already filled with reagent grade analyte free water that will make the full "trip" from the lab, out into the field and back into the lab. **THESE CONTAINERS ARE NOT TO BE OPENED**.

Trip blanks are only analyzed if contamination is suspected. If analyzed and contamination is found, they usually warrant further investigation and subsequent sampling.

13.1.4 **Matrix Spiking and Lab Replicates** – These analyses can usually be taken from a sample bottle already sent into the field and do not require extra bottles, however, extra volume may be required at these stations.

13.2 While performing or preparing for grab sampling, be sure that no "outside" contamination will occur:

13.2.1 No engines are running in the general vicinity of sampling.

13.2.2 Sample containers are clean and intact.

13.2.3 Sample containers are properly labeled and meet bottle requirements for that analyte (size, type, preservative, type of cap liners, etc.).

13.2.4 Sample techniques are proper and safe.

13.3 **Volatile Organic and Aromatic Compounds (VOA's)** – require very special handling.

13.3.1 VOA vials are very fragile. Protect with adequate foam packing material.

13.3.2 VOA bottles should have no headspace (see Section 10.0). This means that they are subject to freezing. **Prevent direct contact of VOA vial with ice by using additional packaging.**

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APPENDIX G

Stormwater Outfall Inspections

Los Cerritos Channel Watershed*

* Due to size, file type and associated additional materials including KMZ files, photos, and log book scans, this appendix will be submitted separately