Middle Santa Ana River
Water Quality Monitoring Plan

PREPARED BY
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ON BEHALF OF
Santa Ana Watershed Project Authority
San Bernardino County Stormwater Program
Riverside County Flood Control District
Cities of Chino, Chino Hills, Claremont, Corona, Fontana, Montclair, Norco, Ontario, Pomona, Rancho Cucamonga, Rialto, Riverside, and Upland
Milk Producers Council, and Chino Watermaster Agricultural Pool

Tier 2 Source Evaluation Addendum

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A-1 Introduction

Since adoption in 2012, the MS4 programs have been actively implementing the CBRP. To date, the Tier 1 source evaluations have been completed and individual cities have been implementing local studies to identify elevated sources of bacterial indicators to Tier 1 sample locations. The findings from the Tier 1 source evaluation was submitted to the Santa Ana Regional Water Quality Control Board (RWQCB) on February 11, 2013. This report included a recommended prioritization of Tier 1 drainage areas for Tier 2 source evaluation activities (Figure A-1).

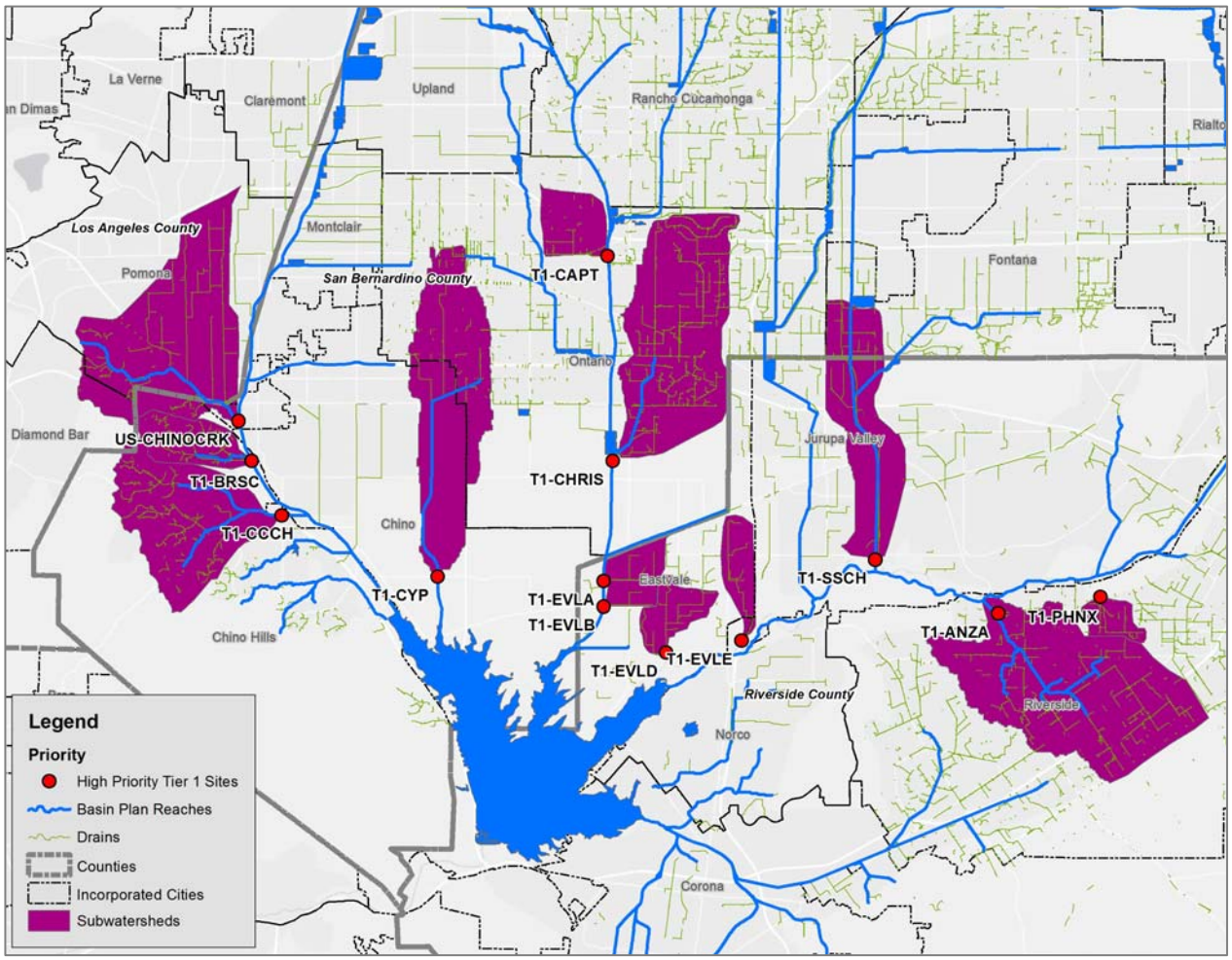

Figure A-1
Map of Prioritized Tier 1 MS4 Drainage Areas

The CBRP includes a schedule of activities, which in the 2013 and 2014 dry seasons includes implementation of Tier 2 source evaluation activities. The goal of Tier 2 source evaluations is to identify specific urban sources of fecal bacteria within MS4 drainages areas and to take action wherever possible to eliminate these sources. Prioritization of MS4 drainage areas to Tier 1 sites, based on 10 weeks of dry season

source evaluation monitoring in 2012, found certain areas that were of greatest concern for either bacterial indicator loading or for presence of human sources of fecal bacteria. Tier 2 activities will focus on these drainage areas; however, the principles of Tier 2 source evaluation can be applied to any drainage area regardless of priority.

This addendum to the MSAR Water Quality Monitoring Plan ("Monitoring Plan") describes the MSAR Permittees approach to conducting Tier 2 bacteria source evaluation activities within the MS4s upstream of prioritized Tier 1 sites. MS4s upstream of Tier 1 sites include many miles of underground drainage facilities, which would be nearly impossible to monitor at the same levels as was done for the Tier 1 outfalls to receiving waters. Therefore, it was necessary to develop alternative approaches to source evaluation that can be effective at identifying specific MS4 sources of bacterial contamination with limited resources.

This addendum provides details of two source evaluation approaches to guide individual MSAR Permittees in the implementation of the Monitoring Plan for Tier 2. For each prioritized Tier 1 drainage area, MSAR Permittees will select one of these alternatives to apply in the 2013 dry season. Table 1 provides a summary of the high priority MS4 drainage areas as determined from the Tier 1 monitoring. The jurisdictions shown in Table A-1 will be conducting Tier 2 source evaluation activities within these MS4 drainages.

Non-human sources are known to exist in the MSAR watershed and include birds, bats, other wildlife, sediment resuspension, and agricultural lands. Concurrent to the Tier 2 source evaluations in the 2013/14 dry seasons, MSAR Permittees are leading parallel efforts by the entire Task Force to evaluate non-human sources of bacteria in the TMDL waterbodies. Specifically, bird and bat studies are planned for implementation in the 2014 dry season to identify the potential species common to the MSAR watershed and research their potential to contribute bacterial indicators to waterbodies (i.e., their related life history attributes, e.g., reproductive cycles, nesting requirements, etc.).

Table A-1. Prioritized Tier 1 Drainage Areas for Tier 2 Source Evaluation Activities

Site ID	Jurisdictions	Drainage Acres	Human Presence[1]	MS4 Drainage Features
T1-EVLD	Eastvale	852	30%	Storm drains
T1-EVLE	Eastvale	798	100%	Storm drains
T1-CYP	Chino, Ontario	4,952	20%	Open channel with storm drain outfalls
T1-EVLB	Eastvale	334	80%	Storm drains
T1-ANZA	Riverside	7,313	20%	Open channel with storm drain outfalls
T1-CAPT	Ontario	1,050	40%	Storm drains
T1-CHRIS	Ontario	5,774	30%	Open channel with storm drain outfalls, culverts
T1-SSCH	Jurupa Valley, Fontana	3,337	40%	Open channel with storm drain outfalls
T1-EVLA	Eastvale	498	10%	Storm drains
CHINOCRK	Pomona, Claremont	6,032	30%	Storm drains
T1-PHNX	Riverside	503	10%	Storm drains
T1-CCCH	Chino Hills	3,934	0% [1]	Open channel with storm drain outfalls
T1-BRSC	Chino Hills	1,160	10%	Open channel with storm drain outfalls

1) Although no human *Bacteroides* was detected in the 2012 dry season at T1-CCCH and it was not determined to be a high priority MS4 drainage area in the Tier 1 source evaluation report, 2013 dry weather monitoring from a lateral of concern along Woodglen Ct. showed persistent human *Bacteroides* detection.

A-2 Source Evaluation Approach

Within the MS4 drainage areas there is a vast drainage system that would be nearly impossible to completely monitor in a timely basis using water quality sample collection and analysis alone. To optimize resources, CDM Smith has identified alternative monitoring methods that are recommended for use to track controllable sources of human fecal bacteria in prioritized MS4 drainage areas. Many of these methods are adapted from Center for Watershed Protection guidance documents and supporting memorandum.

Two bacteria source evaluation approaches are available for use by any MSAR Permittee within any high priority drainage area; referred to as broad-brush and subregional in this Monitoring Plan. The difference in these approaches involves the

order of different types of investigation and the number of sites and frequency of water quality sample collection. Each approach is described below:

A-2.1 Broad-brush Approach

The broad-brush approach attempts to identify specific sources of human fecal bacteria by initially performing extensive field reconnaissance and screening investigations. These relatively low cost activities include field reconnaissance (Section A-3.1) and deployment of secondary screening tools (see Section A-3.2), and can be implemented at a large number of Tier 2 sites.

Results from field reconnaissance and secondary screening tool deployment will be used to identify Tier 2 sites for bacterial water quality sample collection (see Section A-3.3). On days when samples are collected from Tier 2 sites within the MS4s, samples will also be collected from downstream Tier 1 sites to assess the relative role of the Tier 2 measurements in downstream bacteria characteristics.

The broad-brush approach provides a spatially robust dataset and has the potential to pinpoint specific management actions at an individual property scale to eliminate bacteria sources. MSAR Permittees will use results from field reconnaissance, secondary screening, and bacterial water quality analysis to guide implementation of short term management actions that address bacteria sources of concern. At the end of the dry season, a follow-up snapshot survey will be performed to determine the effectiveness of any management actions implemented.

The risk of this approach comes from the temporal variability in human Bacteroides detection, which was typically less than 40 percent of samples in the 2012 dry season at the downstream Tier 1 sites. Accordingly, there is a greater chance of missing the human fecal bacteria signal taking an approach with a single snapshot survey. Table A-2 provides a schedule of activities for implementation in the 2013 dry season if employing the broad-brush approach.

A-2.2 Subregional Approach

The subregional approach attempts to develop a better understanding of dry weather flow and water quality from subareas within the prioritized Tier 1 MS4 drainages. This approach involves weekly sample collection from the downstream Tier 1 site and at one or more major trunk confluences within the MS4 drainage system (Tier 2 sites). Samples will be analyzed for *E. coli* (see Section A-3.3) over ten consecutive weeks to develop a baseline longitudinal characterization. Secondary screening tools (see Section A-3.2) will be used in 5 of the 10 weeks to assess water quality at Tier 2 sites selected for IC/ID source evaluation in neighborhood scale subareas upstream of each baseline bacterial water quality site. Field reconnaissance (Section A-3.1) will be

important to identify the Tier 2 sites for baseline characterization in the initial weeks, and then to aid in selection of Tier 2 sites for IC/ID source evaluation incorporating secondary screening tracer sample collection in the middle of the dry season. Lastly, in the latter portion of the dry season, samples will be collected and analyzed for human *Bacteroides* at a subset of the Tier 2 sites based on information gathered from secondary screening and field reconnaissance. MSAR Permittees will use results from all phases of the source evaluation to guide implementation of short term management actions that address bacteria sources of concern.

Table A-2. Tier 2 Bacteria Source Evaluation Schedule for 2013 Dry Season

Broadbrush Approach	**7/29**	**8/5**	**8/12**	**8/19**	**8/26**	**9/2**	**9/9**	**9/16**	**9/23**	**9/30**	**10/7**	**10/14**
Field Reconnaissance - DWF presence/absence assessment, planning for secondary screening tool implementation												
Secondary Screening Tools - Tracking of human sources in portions of MS4s containing DWF, mapping locations for water quality sample collection												
Snapshot bacterial water quality sample collection, delivery to labs for *E. coli* and human *Bacteroides* analysis						●	●				●	●
Take action to eliminate human sources of DWF												
Subregional Approach	**7/15**	**7/22**	**7/29**	**8/5**	**8/12**	**8/19**	**8/26**	**9/2**	**9/9**	**9/16**	**9/23**	**9/30**
Field Reconnaissance - Initial DWF presence/absence assessment, planning for baseline water quality sample collection												
Baseline bacterial water quality sample collection, delivery to labs for *E. coli* analysis			●	●	●	●	●	●	●	●	●	●
Secondary Screening Tools - Tracking of human sources in portions of MS4s containing DWF, mapping locations for potential management actions												
Bacteroides analysis at Tier 2 sites with evidence of potential human fecal bacteria										●	●	●
Take action to eliminate human sources of DWF												

The risk of this approach comes from the aggregation of large spatial areas, which may not provide the resolution needed to identify specific sources for focusing of short-term management actions. However, since the Tier 2 source evaluations will occur over two dry seasons (2013 and 2014), a subregional approach in the first year could be followed by adopting the broad-brush approach in smaller more manageable subareas in the second year of the program. Table A-2 provides a schedule of

activities for implementation in the 2013 dry season if employing the subregional approach.

A-3 Source Evaluation Methods

A-3.1 Field Reconnaissance

Field reconnaissance involves a passive inspection of MS4 facilities and their upstream drainage areas. The objective of field reconnaissance activities include:

- Identification of any obvious and significant sources of DWF within the watershed (both permitted and illicit discharges will be documented)
- Locating points in MS4s where there is no DWF and therefore portions of the drainage area can be excluded from further source evaluation
- For the subregional approach, information from field reconnaissance will provide the basis for Tier 2 site selection for water quality sample collection
- For the broadbrush approach, information form field reconnaissance will be used to focus application of secondary screening tools in areas with the greatest potential for human fecal contamination

Source evaluation tools that will be used during field reconnaissance include windshield surveys of watershed areas and major MS4 facilities. Sensory observations will be noted based on odor (e.g. rotten eggs), visual water quality (e.g. foamy), and watershed inspection for human behaviors (e.g. loitering). Table A-3 describes the types of information that will be gathered during field reconnaissance source evaluation activities. Secondary screening tools can be used during field reconnaissance, if determined to be appropriate by the field team.

DWF assessments will be conducted systematically to ensure correct conclusions are reached and to be as efficient as possible. Two systematic approaches to DWF assessment are described below:

- Upstream to downstream – Similar to the method, "Moving Down the Watershed" detailed in the Center for Watershed Protection (CWP) technical memorandum titled Techniques for Identifying and Correcting Illicit and Inappropriate Discharges (CWP, 2002). This approach involves moving from headwaters downstream until DWF is observed or evidence of intermittent DWF is observed at a junction. Once observed, the laterals with DWF are explored to determine the source of DWF. Conversely, for junctions that have

no evidence of DWF, sandbags may be used as a tool at the outflow point to confirm absence of DWF from these drainage areas.

- Downstream to upstream – This approach begins at the Tier 1 site and involves observation of DWF at each junction. Laterals that are determined to have no evidence of DWF are not investigated, and sandbags may be used as a tool at the outflow point to confirm absence of DWF from these drainage areas. The reconnaissance continues to follow DWF upstream until a junction with no evidence of DWF is reached. All MS4 drainage area upstream of this junction would not be investigated.

Table A-3. Source Evaluation Activities during Field Reconnaissance

Activity	Method	Types of Observations
Watershed inspection	Tour priority subwatersheds and observe human behavior and associated DWFs	Leaks in irrigation systems and other water waste Ordinance violations Transient encampments and loitering Illegal dumping
Assess Odor of DWF	Stand close to DWF in gutter, street inlet or open manhole and assess the odor	*Rotten eggs* (raw sewage, decomposing organic matter/hydrogen sulfide) *Rancid/sour* (raw or partially treated sewage, livestock waste) *Petroleum/gas Sharp/pungent (*chemicals or pesticides) *Sweet/fruity* (commercial wash water, wastewater)
Assess visual water quality of DWF	Stand close to DWF in gutter, street inlet or open manhole and assess water quality	*Suds* – rated based on their foaminess and staying power. Suds that travel several feet before breaking up should be considered as a possible illicit discharge. *Sheen* (Naturally-produced or bacteria induced if sheet-like film breaks if disturbed, Petroleum/Oil) *Tan Foam* (churns water containing organic materials causing harmless foam) *White Foam* (soap) *Yellow, Brown, Black Film* (pine, cedar, and oak pollens form film on surface in slow moving water)

The results of the field reconnaissance will provide the MSAR Permittees with a map of MS4 facilities containing DWF that require additional source evaluation. In addition, data collected from watershed inspections will be geospatially linked to downstream MS4 facilities to develop initial concepts for relationships between specific watershed sources and downstream water quality. Water quality data will be collected using a combination of secondary screening tools and water quality sample collection.

In several of the prioritized drainage areas, there are open channels which convey DWF from underground drains to the TMDL waterbody. Field reconnaissance in these areas will include driving or walking within the open channel to characterize DWF at outfalls. These types of Tier 2 sites are well suited for assessments using secondary screening tools, because it would be simple to collect a water sample relative to a completely underground MS4.

A-3.2 Secondary Screening Tools

There are several useful monitoring procedures that can be used to conduct secondary screening for bacteria source tracking. The following section summarizes a menu of options that can be applied for evaluating the potential sources of bacteria from an outfall or storm drain exhibiting dry weather flow.

A-3.2.1 Dry Weather Flow Assessment

Determination of flow within a storm drain during dry weather can provide an understanding of the magnitude of an illicit discharge during dry weather. MSAR Permittees will visually inspect inside the storm drain for the presence or absence of dry weather flow. If flow is presence, other observations regarding the storm drain discharge may include presence of staining, odors, floatable materials, or colors. Record observations on field sheet or log book.

Where possible the MSAR Permittees will measure the depth of flow using the following procedures:

- Remove manhole cover
- Prepare steel measuring tape with lead weight at end or telescoping survey rod for use by running carpenter chalk along the last few feet of the tape or survey rod.
- Place the steel tape or survey rod into the manhole and ensure that they are completely submerged, reaching the bottom of the manhole. Care should be taken to ensure the steel tap or rod stay perpendicular to the bottom of the manhole and that the steel tape does not bend.

- Pull the tape or rod back up to ground surface and observe the point at which a color change between dry and wet chalk occurs. This line denotes the length of tape/road that was immersed in water.

- Record the depth measurement on field sheet or log book.

A-3.2.2 Water Quality Screening Tools

There are several useful monitoring procedures that server as a menu for MSAR Permittees to use in conducting secondary screening for bacteria source tracking. The following section summarizes this menu of options that can be applied for evaluating the potential sources of bacteria from an outfall or storm drain exhibiting dry weather flow. Each MSAR Permittee will use at least one of these tools to support Tier 2 source evaluation activities in prioritized Tier 1 drainage areas.

Tracers may be monitored in the field with test strips or kits, or may be sent to a laboratory. Table A-4 shows potential ranges for these tracers that may be indicative of a specific source of DWF.

Table A-4. Potential Ranges for Chemical Tracers that may be used by MSAR Permittees for Bacteria Source Evaluation (from Pitt, 2001)

Parameter	Natural	Tap	Sewage	Septage	Car Wash	Laundry
Ammonia (mg/L)	0-1	0.01-0.07	12-50	23-129		
Potassium (mg/L as K)	<5		7-15	1-121		
Copper (mg/L)	<0.1	<0.01			0-0.86	
Detergents (mg/L as MBAS)		<0.01				12.6-101.3

Section A-3.3 describes additional methods that may be necessary to collect a water sample from Tier 2 sites to use these screening tools. It should also be noted that these tests may generate waste that is considered hazardous. This waste cannot be dumped into the sanitary sewer system but must be collected and disposed of properly.

Ammonia

Nitrogen is a fundamental nutrient in the aquatic ecosystem and is required for survival by all plants and animals. In aquatic ecosystems, nitrogen is present in different forms: nitrate, nitrite, ammonia, and organic nitrogen. Of particular interest

to storm drain systems is ammonia-nitrogen, which could indicate illegal wastewater connections to the sanitary sewer system, poorly functioning septic systems, or wildlife. If done in the field, this approach will require that the field personnel be equipped with ammonia test strips by Hach or similar.

Chlorine

Chlorine is used in water treatment and wastewater treatment processes to disinfect water. Presence of chlorine in storm drain discharges could indicate an illicit connection with the water supply system, wastewater effluent or another human source. There are different types of chlorine analyses available for use in the field. Test strips are available from Hach for chlorine residual (i.e., free chlorine); test kits are also available using the DPD method which will cause a color change which can then be evaluated using color discs or field spectrophotometers.

Copper

Copper is a metallic element essential to human growth and is literally found all over the world. Detection of copper during secondary screening may indicate an illicit discharge into the storm drain system from human sources, such as algaecides, copper pipes, or electrical components. There are different types of copper field analyses available for use. Test strips are available from Hach for copper providing readings between 0 and 3 mg/L while colormetric test kits are also available and provide more precise readings between 0.2 and 5 mg/L.

Potassium

Potassium should be useful in distinguishing natural waters from waters which have been used domestically, or commercial wash waters. Pitt (2001) suggests using potassium in combination with other tracers to identify specific types of human sources as follows:

- If the surfactant concentrations are high, but the ammonia and potassium concentrations are low, then the contaminated source may be laundry wastewaters.

- Conversely, if ammonia, potassium, and surfactant concentrations are all high, then sanitary wastewater is the likely source.

Surfactants/Detergents

Many illicit discharges into storm drains will have elevated concentrations of surfactants and detergents. Industrial cleaning, commercial wash water and car washes may also be sources of surfactants and detergents in storm drains. Leaking sanitary sewers could also contribute detergents used in household cleaning. If done

in the field, this approach will require that the field personnel be equipped with Hach Detergents Test Kit or similar.

Sucralose

Sucralose is an artificial sweetener that is used in Splenda®. With the widespread use of Splenda® as a sugar substitute, sucralose has potential to serve as a potential tracer for domestic wastewater. Studies have shown that sucralose is an excellent tracer for domestic wastewater because it is water soluble, has a long environmental half-life, and lab methods exist to detect the molecule at very low concentrations (Florida DEP, 2012).

A-3.2.3 Canine scent tracking

The use of canines to track human sources of storm drain illicit discharges has been reported as an accurate method that results in very few false positives (Murray et al., 2011). Canine scent tracking may be used by MSAR Permittees to assist in locating specific sources of human-specific bacteria within MS4s. One of the benefits of canine scent tracking is the large number of MS4 facilities that can be evaluated in a monitoring event relative to methods that require collection of a water sample.

A-3.3 Water Quality Analysis

Water quality sampling procedures that are unique to Tier 2 source evaluation are limited. The same constituents from the original USEP and in Tier 1 will continue to be analyzed in samples collected for Tier 2 source evaluation. Also, the same laboratories will perform the water quality analyses. The primary difference involves the nature of sample collection. Samples collected for Tier 2 source evaluation may require accessing underground MS4 facilities, which differs from the receiving water and outfall monitoring performed in previous monitoring activities, where the sampler can access the water surface. The exception is for prioritized drainage areas with open channels that convey DWF from underground drains to the TMDL waterbody. In these areas, water quality sample collection will be designed to focus on outfalls to these open channel tributaries, thereby avoiding the need to monitor from manholes, by adopting the subregional approach to Tier 2 source evaluation.

Sample collection may involve opening manhole covers. The QAPP provides additional procedures for proper opening of manhole covers. Individual Permittees may also have SOPs for accessing MS4 facilities that must be followed. To avoid climbing down into the manholes, the MSAR Permittees may construct pole mounted sample collection devices. These devices should be constructed so that it is possible to collect dry weather flow that is typically has limited depth. One option is to use sampling bags instead of bottles, as shown in the example below. If the manhole is within the road right-of-way, it will be important to divert road and foot traffic away

from the manhole using traffic cones. Prior to fully uncovering the manhole, MSAR Permittees will monitor for harmful gases to ensure safety of the field team.

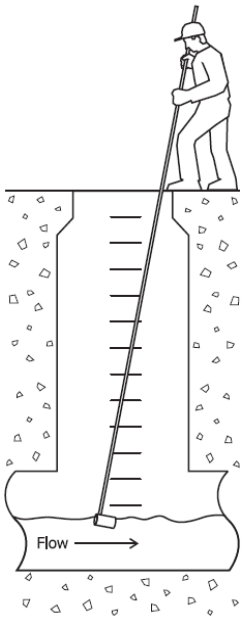

Figure A-2
Sampling from Manhole with Extension Pole
(Washington State Department of Ecology. 2010. How to do Stormwater Sampling: A guide for industrial facilities. Available online at: https://fortress.wa.gov/ecy/publications/publications/0210071.pdf

Lastly, the MSAR Permittees will also evaluate non-human sources of bacteria in the TMDL waterbodies, coordinating efforts through the Task Force. Non-human source evaluation will, under certain conditions and availability of specific markers, involve collection of water quality samples for analysis of specific sources of wildlife that are found to reside within the riparian areas surrounding the TMDL waterbodies.