
# City of Yuma

# Surface Water Analytical Monitoring Plan (AMP)

# for Stormwater Discharges into the Colorado River

**Revised: June 28, 2018**

# Table of Contents

## 1.0 Acronyms:

1.1 ACM: Additional Control Measure

1.2 ADEQ: Arizona Department of Environmental Quality

1.3 A&WW: Aquatic and wildlife warm water

1.4 AZPDES: Arizona Pollutant Discharge Elimination System

1.5 BMP: Best Management Practice

1.6 CFR: Code of Federal Regulations

1.7 City: City of Yuma, Arizona

1.8 CWA: Clean Water Act

1.9 DO: dissolved oxygen

1.10 MS4: Municipal Separate Storm Sewer System

1.11 NOI: Notice of Intent

1.12 NPDES: National Pollutant Discharge Elimination System

1.13 NURP: Nationwide Urban Runoff Program

1.14 SOP: Standard Operating Procedures

1.15 SWMP: Stormwater Management Program

1.16 SWPPP: Stormwater Pollution Prevention Plan

1.17 SWQS: Surface Water Quality Standards

1.18 TMDL: Total Maximum Daily Load

## 2.0 Definitions:

2.1 Additional Control Measure (ACM): means, as used in this plan, an additional part of the SWMP that describes how the SWMP will control the discharges of 303(d) listed pollutants and to ensure to the maximum extent practicable that discharges from the MS4 will not cause or contribute to the exceedances of surface water quality standards. The ACM must also identify BMPs to control discharges and include monitoring of their effectiveness.

2.2 Aquatic and wildlife warm water (A&Ww): means the use of surface water by animals, plants, or other warm-water organisms, generally occurring at an elevation less than 5,000 feet or habitation, growth or propagation.

2.3 Arizona Pollutant Discharge Elimination System (AZPDES): means the point source discharge permitting program established under 18A.A.C9, Article 9.

2.4 Arizona Surface Water Quality Standards: are state regulations or rules that protect lakes, rivers, streams and other surface water bodies from pollution. These rules contain beneficial use designations; numeric levels and narrative statements (water quality criteria) that are protective of the use designations; and procedures for applying the water quality criteria to wastewater discharges and other sources of pollution. Arizona's surface water quality standards apply to all surface waters within the state (A.A.C. R18-11-101(41)), with the exception of those waters that are within Indian Country, as defined in 18 U.S.C. Section 1151. Surface waters include rivers, lakes, streams, wetlands, and reservoirs.

2.5 Backfill: earth used to fill a trench or excavation. A backfill can be compacted or not compacted.

2.6 BMP: Best Management Practice: Means schedules of activities, prohibitions of practices, maintenance procedures and other management practices to prevent and reduce the discharge of pollutants to the waters of the United States. BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

2.7 Biochemical oxygen demand (BOD): BOD is the quantity of oxygen needed by microorganisms in a water body to decompose the organic matter present. BOD is an index of pollution. High levels indicate polluted surface water bodies.

2.8 Canal: an artificial open channel.

2.9 Catch Basin: a drainage structure that collects water. A catch basin maybe either a structure where water enters from the side or through a grating.

2.10 Chemical oxygen demand (COD): as it relates to BOD, COD is a measure of the maximum oxidizable substance in a water body. High levels of COD indicate good quality of stormwater flow for aquatic life.

2.11 Clean Water Act (CWA): The Federal Water Pollution Control Act enacted in 1972 by Public Law 92-500 and amended by the Water Quality Act of 1987. The CWA prohibits the discharge of pollutants to Waters of the United States unless said discharge is in accordance with an NPDES permit. The 1987 amendments include guidelines for regulating municipal, industrial, and construction stormwater discharges under the NPDES program.

2.12 Coefficient of Runoff: percentage of gross rainfall that appears as runoff.

2.13 Construction Activity: includes clearing, grading, or excavation and contractor activities that result in soil disturbance.

2.14 Debris: any material including floating woody materials and other trash, suspended sediment, or bed load moved by a flowing stream.

2.15 Degradation: general and progressive lowering of the longitudinal profile of a channel by erosion.

2.16 Design Storm: that particular storm that contributes runoff that the drainage facilities were designed to handle. This storm is selected for design based on its probability of exceedance or average recurrence interval.

2.17 Detention: the process of temporarily collecting and holding back stormwater for later release to receiving waters.

2.18 Discharge: when used without qualification means the discharge of pollutant.

2.19 Dissolved Oxygen (DO): is the amount of oxygen dissolved, and hence available to sustain marine life, in a water body such as a river or lake. DO is the most important indicator of the health of a water body and its capacity to support a balanced aquatic ecosystem of plants and animals.

2.20 Disturbed Areas: areas that have been purposefully cleared, grubbed, excavated, or graded; ground surface that has been disrupted by construction activities, including construction access/roads, staging, and storage sites producing significant areas of exposed soil and soil piles.

2.21 Ditch: small artificial channel, usually unlined.

2.22 Drainage: (1) the process of removing surplus ground or surface water by artificial means. (2) The system by which the waters of an area are removed.

2.23 Drainage Area: a geographical area that drains to a specified point, such as an outfall, on a water body.

2.24 Dry Weather Flows: a small amount of water that flows almost continually due to lawn watering, irrigation or springs.

2.25 Erosion: The wearing away of land surface by running water, wind or other geological agents. Often the eroded debris (silt or sediment) becomes a pollutant via stormwater runoff. Erosion occurs naturally but can be intensified by human-made activities such as development, farming and agriculture.

2.26 Erosion Control: a measure or activity that prevents erosion.

2.27 Excavation/Grading: the process of removing earth, stone, or other materials and/or fill placement of material upon a land surface to create a desired slope or elevation.

2.28 Existing Vegetation: any vegetated areas that have not been cleared and grubbed.

2.29 Filter: a porous article or mass (such as fabric or even-graded mineral aggregate) through which water will freely pass but that will block the passage of soil particles.

2.30 General Permit: a general permit for stormwater discharges associated with industrial or construction activity issued by EPA or a delegated state under the NPDES stormwater regulations.

2.31 Groundwater: all water that is underground as opposed to on the surface of the ground. Usually refers to water in saturated zones below the water table.

2.32 Hydraulic: pertaining to fluid in motion and the mechanics of the motion.

2.33 Hydrologic: pertaining to the cyclic phenomena of waters of the earth; successively as precipitation, runoff, storage and evaporation, and quantitatively as to distribution and concentration.

2.34 Hydrology: the science dealing with the occurrence and movement of water upon and beneath the earth. Overlaps and includes portions of other sciences such as meteorology and geology.

2.35 Impaired Water: waters that have been assessed by ADEQ, under the Clean Water Act, as not attaining a water quality standard for at least one designated use, and are listed in Arizona's current 303(d) List or on the 305(b) Category 4 list.

2.36 Impervious: a surface that cannot be easily penetrated; for instance, rain does not readily penetrate asphalt or concrete surfaces.

2.37 Infiltration: the passage of water through the ground surface into the soil.

2.38 Inlet: an entrance into a ditch, storm drain, or other water conveyance system.

2.39 Municipal Separate Storm Sewer System that is:

2.39.1 Owned or operated by the United States, a state, city, town, borough, county, parish, district, association, or other public body created by or pursuant to state law having jurisdiction over disposal of sewage, industrial wastes, stormwater, or other wastes, including special districts under state law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribe organization, or a designated and approved management agency under section 208 of the Clean Water Act that discharges to the waters of the United States; or

2.39.2 Not defined as large or medium municipal separate storm sewer systems.

2.40 National Pollutant Discharge Elimination System "NPDES": the US Environmental Protection Agency's program to control the discharge of pollutants to waters of the U.S. NPDES is part of the Federal Clean Water Act which requires point and non-point dischargers to obtain permits. Theses permits are referred to as NPDES permits.

2.41 Nationwide Urban Runoff Program (NURP). NURP is the most comprehensive study for urban stormwater runoff, conducted by US EPA during the period from 1978 to 1983. It was conducted in order to examine the characteristics of urban stormwater runoff and

similarities or differences between urban land uses, the extent to which this runoff is a significant contributor to water quality problems nationwide and the performance characteristics and effectiveness of management practices to control pollution loads from urban stormwater runoff.

2.42 Non-point source Pollution: Pollution from any source other than from any discernible, confined and discrete conveyances, and shall include, but not be limited to, pollutants from agricultural, silvi-cultural, mining, construction, subsurface disposal and urban runoff sources.

2.43 Notice of Intent (NOI): a formal notice to EPA or ADEQ that a municipality, construction site or industrial facility seeking coverage under a General Permit is about to begin.

2.44 Notice of Termination (NOT): a formal notice to the EPA or ADEQ that the work under a General Permit is complete and site is stabilized.

2.45 Off-Site Drainage: flow of water that originates outside a certain drainage area.

2.46 Outfall: discharge or point of discharge of a drainage system into a water body (see definition of drainage system above). For the purpose of this plan, it refers to City of Yuma stormwater outfalls at the Colorado River.

2.47 Percolating Waters: waters that have infiltrated the surface of the land and moved slowly downward through groundwater aquifers until they reach water table.

2.48 Permeability: the property of soils that permits the passage of any fluid. Permeability depends on grain size, void ratio, shape and arrangement of pores.

2.49 Permeable: open to the passage of fluids, as for (1) previous soils and (2) bank-protection structures.

2.50 Permit: means the 2016 Arizona Pollutant Discharge Elimination System General Permit for Stormwater Discharges from Small Municipal Separate Storm Sewer Systems to the Waters of the United States (Permit No. AZG2016-002).

2.51 Phase II Community: is a municipality that is located in an area that serves 10,000 or more people or located fully or partially within an urbanized area as determined by the latest Decennial Census by the Bureau of Census.

2.52 Point Source Pollution: means any discernible, confined, or discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, vessel or other floating craft from which pollutants are or may be discharged. This definition does not include return flows from irrigated agriculture or agricultural stormwater runoff.

2.53 Pollutant: means fluids, contaminants, toxic wastes, toxic pollutants, dredged spoil, solid waste, substance and chemicals, pesticides, herbicides, fertilizers, and other agricultural chemicals, incinerator residue, sewage, garbage, sewage sludge, munitions, petroleum

products, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and mining, industrial, municipal and agricultural wastes and any other liquid, solid or gaseous, or hazardous substance.

2.54 Practicable: capable of being done within reasonable natural, social, and economic constraints.

2.55 Precipitation: discharge of atmospheric moisture as rain, snow or hail, measured in depth of fall or in terms of intensity of fall in unit time.

2.56 Receiving waters: All waters that are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters subject to the ebb and flow of the tide. Waters of the United States include all interstate waters and intrastate lakes, rivers, streams (including intermittent streams), mudflats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds.

2.57 Retention: the holding of runoff in a basin without release except by means of evaporation, infiltration, or emergency bypass.

2.58 Riprap: a layer, facing, or protective mound of broken concrete, sacked concrete, rock, rubble, or stones placed to prevent erosion, scour, or sloughing of a structure or embankment; also, the stone used for this purpose.

2.59 Runoff: (1) the surface waters that exceed soil's infiltration rate and retention areas. (2) The portion of precipitation that appears as flow in streams. Drainage or flood discharge that leaves an area as surface flow or a pipeline flow, having reached a channel or pipeline by either surface or subsurface routes.

2.60 Sediment: soil particles, both mineral and organic, that are in suspension, are being transported, or have been removed from its site of origin by air, water, and gravity and have come to rest on the earth's surface.

2.61 Sedimentation: gravitational deposit of transported material in flowing or standing water.

2.62 Storm: a disturbance of the ordinary, average conditions of the atmosphere that, unless specifically qualified, may include any or all meteorological disturbances, such as wind, rain, snow, hail, or thunder.

2.63 Storm Drain: that portion of a drainage system expressly for collecting and conveying runoff in an enclosed conduit. Often referred to as a "storm sewer", storm drains include inlet structures, conduit, junctions, manholes, outfalls and other appurtenances.

2.64 Stormwater: Any surface flow, runoff, and drainage consisting entirely of water from any form of natural precipitation, and resulting solely from such precipitation.

2.65 Stormwater Pollution Prevention Plan (SWPPP): A plan that is required by the City or the State and includes site map(s), an identification of construction/contractor activities that could cause pollutants in the stormwater, and a description of measures or practices to

control these pollutants. The SWPPP must include an Erosion and Sediment Control Plan per (ESCP) Section 156 of Yuma City Code.

2.66 Stormwater Management Program (SWMP): means a comprehensive program to manage the quality of stormwater discharged from the municipal separate storm sewer system. For the purposes of this plan, the SWMP is considered a single document, but may actually consist of separate programs (e.g. "chapters") for each permittee.

2.67 Total Maximum Daily Load (TMDL): means an estimation of the total amount of a pollutant from all sources that may be added to a surface water body while still allowing the water to achieve and maintain applicable surface water quality standards. Each total maximum daily load shall include allocations for sources that contribute the pollutant to the water, as required by section 303(d) of the Clean Water Act and regulations implementing that statute to achieve applicable surface water quality standards.

2.68 Total Suspended Solids (TSS): are the particles of soil that remain suspending in the stormwater. As levels of TSS increase a water body starts to lose its ability to support aquatic life. TSS absorbs heat from sunlight, which increases water temperature and subsequently decreases levels of dissolved oxygen.

2.69 Turbidity means the clarity of water expressed as nephelometric turbidity units (NTU) and measured with a calibrated turbidimeter.

2.70 Urban Runoff: a substance, such as rain, that runs off of surfaces in a watershed in excess of the amount absorbed by the surfaces (usually the ground). Urban runoff can contain sediments and contaminants (non-point source pollution) that can add to water quality degradation in the watershed. Increases in impervious surface area usually result in increased urban runoff.

2.71 Waters of the United States: means all waters that are currently used were used in the past or may be susceptible to use in interstate or foreign commerce, including all waters subject to the ebb and flow of the tide. Waters of the United States include all interstate waters and interstate lakes, rivers, streams (including intermittent streams), mudflats, sand flats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds.

2.72 Watershed: see definition of drainage area.

2.73 303 (d) List: Section 303 “Water Quality Standards and Implementation Plans” of the Clean Water Act. This section of the CWA authorizes each state to identify waters within its boundaries for which the effluent limitations required by the CWA are not stringent enough to implement any water quality standard applicable to such waters.

## 3.0 Background & Introduction:

Since March, 2003 the City of Yuma (City) has been regulated by the Arizona Department of Environmental Quality (ADEQ) and the US Environmental Protection Agency (EPA) as a Phase II community. Phase II communities must comply with the State and Federal stormwater regulations known as the Arizona Pollutant Discharge Elimination System (AZPDES). The AZPDES program is a multiple permits package stemming from the Clean Water Act (CWA). The intent of the program is to prevent and reduce the introduction of pollutants into surface waters from different sources. The City, as a small municipality, is covered under the Small Municipal Separate Storm Sewer System (MS4) Permit No. AZG2016-002 and will continue to be covered under the 2016 MS4 permit (hereafter called the Permit). ADEQ and EPA have specified six minimum control measures that the City must implement through its Stormwater Management Program (SWMP) to ensure compliance with the Permit.

In Arizona's 2012/14 Impaired Waters list, ADEQ designated the Colorado River (River) segment from the Main Canal to the Mexico border (a 32.2-mile segment) as impaired due to low dissolved oxygen and high total selenium levels. The impairment was first listed in 2006. The impairment has been designated as Category 5. ADEQ defines Category 5 as "Impaired surface waters where a Total Maximum Daily Load (TMDL) analysis is required". Despite ADEQ scheduling the initiation of a TMDL during 2010, no TMDL has been established as of the date of this plan.

In January, 2013 ADEQ conducted an audit visit to review the City's SWMP and subsequently summarized the audit findings in a letter to the City dated April 5, 2013. During the audit visit ADEQ required the City to establish a monitoring program and perform testing for 303(d) listed pollutants that discharge into the Colorado River (River) impaired segment; provide sampling data collected from the River and to submit this data to ADEQ. In response to ADEQ's requirements and in the absence of approved TMDLs for dissolved oxygen (DO) and selenium, the City prepared and implemented a visual monitoring program.

To meet the requirements of Section 1.4.5 of the Permit the City modified its SWMP by adding Additional Control Measure No. 1 (ACM No. 1) to address the impairment of the River.

As stated in Section 1.4.5 of the Permit if a municipality discharges to a water for which a TMDL has been established then the SWMP must identify Best Management Practices (BMPs) to meet waste load allocations or load allocations and include monitoring for associated pollutants; however; if a municipality discharges to a 303 (d)-listed water with no TMDL has been established and the SWMP includes an additional control measure

(ACM) as defined above, the ACM must also identify BMPs to control discharges and include monitoring of their effectiveness. On December 9, 2015 ADEQ met with City to discuss the type of monitoring required by the City. Subsequent to that meeting through additional discussions between ADEQ and the City, the City has agreed to implement a monitoring plan that includes testing and sampling.

The City of Yuma recognizes the benefits of prevention and reduction of the discharge of 303 (d)-listed pollutants on the River, as well as to the environment. The City will implement this monitoring plan while recognizing no previous data has been established, by the City, to assess water quality for DO and selenium in this segment of the River. Land uses of the areas contributing discharges of stormwater to the River are limited to residential, commercial and light industrial.

The knowledge gained by implementation of this monitoring plan will be used by ADEQ and the City to design effective BMPs to prevent and reduce depletion of DO and exceedance of selenium to the maximum extent practicable.

## 4.0 Purpose & Determination:

The purpose of this plan is to develop a water quality monitoring plan to prevent and reduce the discharge of stormwater pollutants, and in particular, any discharges that cause reduction in dissolved oxygen or exceedance in selenium levels from the City's MS4 based on the latest surface water quality standards (SWQS) provided by ADEQ. A limited area has a physical connection to the River with five stormwater outfalls: Madison Avenue, 9$^{th}$ Avenue, 17$^{th}$ Avenue, 19$^{th}$ Avenue and stormwater drain of the East Mesa Drainage that comes from Pacific Avenue. The Pacific Avenue outfall is located outside the impaired segment of the River and therefore will not be included it in this plan.

The City and ADEQ adopted a cooperative approach that resulted in the City developing a monitoring plan that assesses the quality of the City's stormwater runoff. The purpose of this plan is to assess and investigate ways to improve water quality other than enforcement action by ADEQ should the City's discharges violate current SWQS for selenium or dissolved oxygen. Analytical monitoring will be performed based on latest SWQS; however, if a TMDL is established in the future the City and ADEQ will amend this document based on available data.

## 5. Arizona's 2012/14 Impaired Waters list, Impaired Segment of Colorado River & Causes of Impairment:

Dissolved Oxygen (DO):

The quantity of oxygen molecules dissolved in water is a major indicator of water quality. Like the air we breathe, the survival of aquatic life depends on a sufficient level of oxygen dissolved in water. When it drops below levels necessary for sustaining aquatic life, it becomes significant water quality impairment, often referred to as low DO.

Unlike air, which is normally about 21 percent oxygen, water contains only a fraction of a percentage of dissolved oxygen. In water DO is usually expressed in milligrams per liter (mg/L), parts per million (ppm), or percent of saturation. Typical DO concentrations in 100-percent saturated fresh water will range from 7.56 mg/L (or 7.56 parts oxygen in 1,000,000 parts water) at 86ºF to 14.62 mg/L at 0ºF.

Causes of Low DO:

Rapidly moving water and young rivers tend to contain higher levels of DO; whereas stagnant water contains less (such is the case in the Lower Colorado River). Bacteria in water also consume oxygen as organic matter decays. Thus, excess organic material in lakes and rivers can cause eutrophic conditions, which is an oxygen-deficient situation that can cause a water body to degrade and affect aquatic life.

The concentration of DO in surface water is affected by factors such as temperature, salinity, suspended solids (sediment), nutrients, and organic particles from decomposing materials. All these factors have both a seasonal and a daily cycle. Cold water can hold more dissolved oxygen than warm water. In winter and early spring, when the water temperature is low, the dissolved oxygen concentration is high. In summer and fall, when the water temperature is high, the dissolved-oxygen concentration is low.

Dissolved oxygen in surface water is used by all forms of aquatic life; therefore, this constituent typically is measured to assess the "health" of the water body. Oxygen enters a stream from the atmosphere and from ground-water discharge. The contribution of oxygen from ground-water discharge is significant, however, only in areas where ground water represents a large component of stream flow, such as in areas of glacial deposits, which is not the case in Yuma. One of the intents of this plan is to test, sample and monitor City stormwater discharges in reference to the latest SWQS, to identify sources that cause depletion of DO.

In the Yuma area, the critical conditions for stream DO usually occur during the late summer season when water temperatures are high for extended periods with normally high evaporation low stream flow rates.

The River at Yuma is located at the downstream end of the watershed. Before reaching Yuma the River is used upstream, by several municipal communities, for urban stormwater point sources, non-point sources and agricultural return discharges. Also the climate in Yuma is arid and characterized by long hot summers with high evaporation rates. This distinctive situation creates potentials of lack of DO in the River even without the stormwater discharges from the City.

Selenium:

Selenium is a metal found in natural deposits such as ores containing other elements. It is among the list of elements that lead to contamination in mining aqueous waste streams. It is a naturally occurring substance that is toxic at high concentrations in marine sedimentary rock formations but is also a nutritionally essential element that is widely distributed in the environment. The greatest use of selenium compounds is in electronic and photocopier components, but they are also widely used in glass, pigments, rubber, metal alloys, textiles, petroleum, medical therapeutic agents, and photographic emulsions.

At trace concentrations selenium is an essential nutrient for plants and animals and it is important to human health; however, higher concentrations of selenium in diet of plants, animals or humans and the concentrations that can cause toxicity or poisoning.
Short-term exposure to selenium by inhalation results primarily in negative health effects in the respiratory system and skin, hair loss, loss of finger/toe nails and tooth decay.

Causes of High Concentrations of Selenium:

In nature, selenium usually occurs combined with other compounds, such as sulfur and the ores of other metals such as silver, copper, lead and nickel. Average concentrations of selenium found in sediments and soils usually range from 0.01 to 0.02 mg/kg with most seleniferous soils containing less than 2 mg/kg. Enrichment of selenium in soils and groundwater commonly occurs in arid and semi-arid irrigated areas such as Yuma, where application of irrigation water accelerates weathering processes and mobilizes of selenium in the soil profile. Arid climate amplifies further evaporation related enrichment that takes place in water bodies resulting in selenium concentrations potentially reaching toxic levels. One of the intents of this plan is to test, sample and monitor City stormwater discharges in reference to the latest SWQS, to identify sources of selenium.

## 6.0 Analytical Monitoring Procedures:

6.1 Overview of Monitoring Requirements:

As agreed by the City and ADEQ, the City will perform analytical monitoring based on sampling and testing per the latest SWQS and reporting of those monitoring results to ADEQ. The City will conduct two types of Analytical Monitoring based on numeric testing of DO and selenium per ARS R18-905(B):

6.1.1 Wet-weather monitoring at outfalls for compliance with Arizona SWQS. This monitoring includes testing and performance of visual monitoring to identify, monitor and eliminate illicit discharges and to ensure compliance with the effluent limitations of the Permit. Wet weather Visual Monitoring form is part of the SWMP; and

6.1.2 Dry-weather field screening and visual monitoring, as part of the Illicit Discharge Detection and Elimination (IDDE) program in accordance with the Permit requirement and the SWMP, to detect and eliminate illicit discharges.

This plan identifies the following parameters:

6.1.3 Locations of Monitoring

Wet weather monitoring will be performed in Madison Avenue outfall, 9th Avenue, 17th Avenue and 19th Avenue. City will collect Samples from the following outfalls at the Colorado River:

Outfall Number 1: Madison Avenue

Outfall Number 2: 9th Avenue

Outfall Number 3: 17th Avenue

Outfall Number 4: 19th Avenue

6.1.4 Parameters and Frequency of Monitoring

A minimum of two sampling events per wet season at each outfall will be performed. Per Section 7.1.d.3 of the Permit the first wet season extends from June 1 to October 31 and the second wet season extends from November 1 to May 31. The City will collect samples during the first two hours of the discharge with the first 30 minutes of discharge (first flush) collected whenever possible. Three samples will be collected for each outfall during each discharge event, with the intention that the results be averaged. With four outfalls and the collection of three samples, the City is expected to perform 48 sampling events as a minimum per year. If conditions are not safe or possible to collect samples from a certain outfall, the

City will try collecting a sample to the maximum extent practicable or from a different outfall.

6.1.5 Tracking and Documentation requirements

The City will keep all records required by this plan for a period of at least three years. Records such as this plan, any monitoring results, copies of reports, records of screening, follow up and elimination of illicit discharges, maintenance documents, inspection records, data used in the development of the notice of intent, SWMP and annual reports and all other documents deemed necessary to support this plan or the SWMP.

6.1.6 Reporting of monitoring results

The City will report, as required and in its annual report the monitoring results at its outfalls. In addition, ADEQ will be notified if a SWQS exceedance occurs during a sampling event.

6.2 Outfall Wet Weather Monitoring:

Protection of a surface water body receiving discharges from an MS4 is often the ultimate goal of stormwater management. However, the City MS4 may not be the only non-point source discharge into the River and the achievement of the City monitoring goals may not eliminate the impairment of the River for DO and selenium. It may be crucial to identify other point-source discharge that contributes to the impairment of the River. This may include facilities covered under the Multi-Sector General Permit (MSGP) or other jurisdictions in the watershed such as the Bureau of Reclamation, Indian tribes, Yuma County, and local irrigation districts. The purpose of this plan is to monitor by sampling and testing all four of the stormwater outfalls to the River, per Sections 7.1 and 7.2 of the Permit, to:

6.2.1 Assess the impacts of the discharges of DO and selenium to the River from the City MS4.

6.2.2 Characterize stormwater discharges into the River.

6.2.3 Identify sources of discharges that contribute to depletion of DO and the exceedance of selenium beyond thresholds established by the SWQS.

6.2.4 Assess the overall health and evaluate long-term trends in water quality of the River.

6.2.5 Sampling and testing will be conducted according to test procedures approved in Arizona Revised Statutes R18-9-A905 (B).

6.3 Objectives of Monitoring:

The objective of this monitoring plan is to assess the City stormwater discharges from its MS4 to the River and evaluate the quality of such discharges in exceeding DO and selenium limits set by the current SWQS. Evaluation will be performed through testing DO and selenium by approved EPA methods.

DO will be tested by collection of samples and analysis at field while selenium will be tested, through the state-approved laboratory of TestAmerica Phoenix, using EPA test procedure No. 200.8; however, the City may use Method 1638 if laboratory tests report consistently below 2 µg/L. Refer to Appendices B and C for the Standard Operating Procedures for DO and selenium testing.

## 7.0 Method to Calculate Pollutants' Loads:

7.1 Introduction of the Simple Method:

This plan will utilize the Simple Method per NURP data of 1998 and Certified Professional in Stormwater Quality by the International Erosion Control Association, February 2005. The Simple Method estimates stormwater runoff pollutant loads for urban areas. This method is a constant concentration method (opposed to pollutant loading method) that is best used to evaluate short-term effects and to determine pollutants loads at outfalls. The Simple Method is a technique used for estimating stormwater pollutant export delivered from urban development sites. This method provides an easy yet reasonably accurate means of predicting the change in pollutant loadings in response to development. It is suitable for this plan since it helps making rational non-point source pollution decisions from areas discharging to the River. The method works better for drainage areas less than one square mile (the case in all areas under this plan); however, for larger drainage areas it may sacrifice precision for the sake of simplicity and generality.

7.2 Simple Method Equation and Parameters:

$L = [(P \times P_j \times R_v)/12] \times C \times A \times 2.72$

Where:

L = pollutant load, in pounds per year.

P = rainfall depth in inches for 2 year, 24-hour storm from Yuma City Code P = 0.98 inches.

$P_j$ = Correction factor for storm that produces no runoff. Many of the storms that occur during the year are so minor that no runoff can be detected. A reasonable value of $P_j$ can be taken as 0.9.

$R_v$ = measure of site response to rainfall events = r/P, where r is the stormwater runoff. The primary influence for this factor is the site imperviousness. Also $R_v = 0.05 + 0.009$ I, where I is the percent of site imperviousness. "I" is defined as surfaces in the landscape of the drainage area that cannot infiltrate rainfall consisting of rooftops, pavement, sidewalks, driveway, etc. and will be estimated by area.

C = average flow-weighted pollutant concentration. Obtained from monitoring data or published land use information such as the NURP per section 8.

A = is the total contributing area in acres.

## 8.0 Area Contributing to Impaired Segment of River:

The area contributing stormwater drainage to the River is termed, per the City's SWMP, the "Priority Area" or the P.A. The P.A. is bounded at the north by the Colorado River, 8th Street at the south, Gila Street and 4th Avenue at the east and Avenue B at the west. From a zoning perspective, the P.A. has multiple land usages ranging from light industrial to residential (see attached zoning map). The total area is approximately 0.53 square miles (340 acres).

The P. A. can be divided into the following sub drainage areas:

1. Northeast area
2. Northwest area

### 8.1 Northeast Area

Boundaries: 3rd Street at south, the River at north, 4th Avenue at west, Gila Street at east.

Description: this area is developed and the ratio of imperiousness is more than 90% with extensive roof tops and parking lots. Businesses and some residential is the main zoning pattern. The drainage pattern is surface flow on streets collected by collection system (curb, gutter, inlets, catch basins, drains). Approximate total drainage area = 120 acres.

Stormwater drainage outfall at the River: Madison Avenue.

This area is subdivided into: south, southwest, northeast, and northwestern. Potential pollutants are:

1. Motor oil, hydrocarbons and brake pads from parking lots: 25% of pollutants' total load
2. Heavy metals from roof tops: 20% of pollutants' total load
3. Trash and floatable: 25% of pollutants' total load

4. Sediment from construction sites and redevelopment sites: 30% of pollutants' total load
5. Nutrient runoff from agricultural or residential fertilizer applications

Soil types Per USNRCS Soil Survey of Yuma and Wellton Area:

| Soil Name | Location in Area | Classification Per USCS* | Hydrologic Soil Group | Runoff Potential | Permeability in/hr | Area in Acre | Max Slope (%) |
|---|---|---|---|---|---|---|---|
| Rositas Sand | South and Southwest | SP-SM Silty sand | A | Low | 6-high infiltration rates | 50 | 0.2 |
| Carrizo Sand | Northeast | SM-GP | A | Low | 20, very high rates | 50 | 0.2 |
| Indio Silt Loam | Northwestern | ML | B | Moderate | 0.6, moderate rates | 20 | 0.2 |

*USCS: Unified Soil Classification System

Pollutants Parameters:

| Sub-Area | K factor | LS | C, Cover Management Factor | P |
|---|---|---|---|---|
| South and Southwest | 0.15 | 0.06 | 0.2 | 0.9 |
| Northeast | 0.10 | 0.27 | 0.9 | 0.9 |
| Northwest | 0.10 | 0.27 | 0.9 | 0.9 |

Calculations of $Q_p$:

Formula Used: $Q_p = CIA$, and $T = 95\ (V.Q_p)^{0.56}\ K.LS.C.P$

Design storm: 2 year, 24 hours and "C" values: reference Ordinances No. 1670 and No. 1836

Total rainfall of 2 year = 0.98 inch, I is the rainfall intensity = 0.98 inch/24 hours = 0.041 in/hr

| Sub-Area | C | I, in/hour | A, acres | $Q_p$, cfs | V, acre-feet | T, tons per storm |
|---|---|---|---|---|---|---|
| South & Southwest | 0.51 | 0.041 | 50 | 1.0412 | 2.065 | 0.237 |
| Northeast | 0.51 | 0.041 | 50 | 1.0412 | 2.065 | 0.237 |
| Northwest | 0.51 | 0.041 | 20 | 0.4165 | 0.830 | 1.146 |
| Total | | | | | | 1.620 |

Volumes of Pollutants of Concern per Design Storm:

| Area | Sediment, tons | High Temperature Runoff, acre-feet | Other (oil, hydrocarbons, trash and metals), tons |
|---|---|---|---|
| South and Southwest | 0.079 | 0.830 | 0.211 |
| Northeast | 0.079 | 0.830 | 0.211 |
| Northwest | 0.017 | 0.332 | 0.046 |
| Total | 0.175 | 1.992 | 0.468 |

8.2 Northwest Area

Boundaries: West Main Canal at south, the River at north, 22nd Avenue at west, 4th Avenue at east.

Description: this area is developed and the ratio of imperiousness is more than 90% with extensive roof tops and streets. Residential and few commercial are the main zoning pattern. The drainage pattern is surface flow on streets collected by collection system (curb, gutter, inlets, catch basins, drains). Approximate total drainage area = 220 acres.

Stormwater drainage outfall at the River: 9th Avenue, 17th Avenue and 19th Avenue.

Potential pollutants are:

1. Motor oil, hydrocarbons and brake pads from parking lots: 20% of pollutants' total load
2. Heavy metals from roof tops: 20% of pollutants' total load
3. Trash and floatable: 30% of pollutants' total load
4. Sediment from construction sites and redevelopment sites: 30% of pollutants' total load
5. Nutrient runoff from agricultural or residential fertilizer applications

Soil Information per USNRCS Soil Survey of Yuma and Wellton Area:

| Soil Name | Location in Area | Classification Per USCS* | Hydrologic Soil Group | Runoff Potential | Permeability in/hr | Area in Acre | Max Slope (%) |
|---|---|---|---|---|---|---|---|
| Indio Silt Loam | Area drains to 9th Avenue | ML | B | Moderate | 0.6, moderate rates | 100 | 0.90 |
| Indio Silt Loam | Area drains to 17th Avenue | ML | B | Moderate | 0.6, moderate rates | 80 | 0.90 |
| Indio Silt Loam | Area drains to 19th Avenue | ML | B | Moderate | 0.6, moderate rates | 40 | 0.50 |

*USCS: Unified Soil Classification System

Pollutants Parameters:

| Sub-Area | K factor | LS | C, Cover Management Factor | P |
|---|---|---|---|---|
| 9th Ave Area | 0.80 | 0.06 | 0.2 | 0.9 |
| 17th Ave Area | 0.80 | 0.06 | 0.2 | 0.9 |
| 19th Ave Area | 0.80 | 0.06 | 0.2 | 0.9 |

Calculations of $Q_p$:

Formula Used: $Q_p = CIA$, and $T = 95 (V.Q_p)^{0.56} K.LS.C.P$

Design storm: 2 years, 24 hours and "C" values: reference Ordinances No. 1670 and No. 1836

Total rainfall of 2 years = 0.98 inch, I = 0.98 inch/24 hours = 0.041 in/hr

| Sub-Area | C | I, in/hour | A, acres | $Q_p$, cfs | V, acre-feet | T, tons per storm |
|---|---|---|---|---|---|---|
| 9th Ave | 0.51 | 0.041 | 100 | 2.091 | 4.147 | 13.76 |
| 17th Ave | 0.51 | 0.041 | 80 | 1.673 | 3.318 | 11.00 |
| 19th Ave | 0.51 | 0.041 | 40 | 0.836 | 1.659 | 5.50 |
| Total | | | | | | 30.26 |

Volumes of Pollutants of Concern per Design Storm:

| Area | Sediment, tons | High Temperature Runoff, acre-feet | Other (oil, hydrocarbons, trash and metals), tons |
|---|---|---|---|
| 9th Ave | 4.128 | 1.659 | 9.632 |
| 17th Ave | 3.30 | 1.327 | 7.70 |
| 19th Ave | 1.650 | 0.664 | 3.85 |
| Total | 9.078 | 3.65 | 21.182 |

| Sub-Area | K factor | LS | C, Cover Management Factor | P |
|---|---|---|---|---|
| East Area | 0.15 | 0.06 | 0.2 | 0.9 |
| Middle Area | 0.15 | 0.06 | 0.2 | 0.9 |
| South Area | 0.15 | 0.06 | 0.2 | 0.9 |

Calculations of $Q_p$:

Formula Used: $Q_p = CIA$, and $T = 95\ (V.Q_p)^{0.56}\ K.LS.C.P$

Design storm: 2 years, 24 hours and "C" values: reference Ordinances No. 1670 and No. 1836

Total rainfall of 2 years = 0.98 inch

| Sub-Area | C | I, in/hour | A, acres | $Q_p$, cfs | V, acre-feet | T, tons per storm |
|---|---|---|---|---|---|---|
| East Area | 0.51 | 0.041 | 180 | 3.764 | 7.465 | 0.997 |
| Middle Area | 0.51 | 0.041 | 120 | 2.509 | 4.977 | 0.633 |
| South Area | 0.51 | 0.041 | 160 | 3.346 | 6.636 | 0.873 |
| Total | | | | | 19.078 | 2.503 |

Volumes of Pollutants of Concern per Design Storm:

| Area | Sediment, tons | High Temperature Runoff, acre-feet | Other (oil, hydrocarbons, trash and metals), tons |
|---|---|---|---|
| East Area | 0.299 | 2.986 | 0.698 |
| Middle Area | 0.1899 | 1.991 | 0.443 |
| South Area | 0.262 | 2.544 | 0.611 |
| Total | 0.751 | 7.631 | 1.752 |

## 9.0 Zoning Classification and Presence of Low DO and Selenium in City Discharges:

The City will conduct analytical monitoring on the four stormwater outfalls per Section 6 of this plan. If testing reveals exceedance of water quality standards for either DO or selenium, the City will follow the Standard Operating Procedures (SOP) described in the Enforcement Response Plan (ERP) with reporting to ADEQ.

Zoning classification of the areas drain to 9th, 17th and 19th Avenues outfalls are residential with less than 10% commercial and light industrial zoning classification. Zoning classification of the area that drains to the Madison Avenue outfalls is residential with approximately 15-20% commercial and light industrial zoning classification.

## 10. Hydrologic Data:

The Yuma area experiences 3-4 days with precipitation that results in discharge every year; however, several storm cells and minor precipitation events may occur that does not produce quantifiable discharges to the River. Below is a table that shows average monthly precipitation and average high temperature during period from January 2015 to December 2015:

| Month | Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average Precipitation, inches | 0.85 | 0.89 | 0.61 | 0.24 | 0.12 | 0.00 | 0.37 | 0.49 | 0.47 | 0.24 | 0.35 | 0.61 |
| Average High Temp, F$^{o}$ | 70 | 74 | 81 | 87 | 94 | 103 | 107 | 106 | 101 | 91 | 78 | 69 |

Source: The Weather Underground Organization (WUO), commonly known as the Weather Underground, was founded on the Ann Arbor campus of the University of Michigan.

## 11. References:


1. Arizona Pollutant Discharge Elimination System Stormwater Municipal Permit, 2015 (MS4 2015).
2. City Ordinance Numbers 1670 & 1836 (Drainage Policy)
3. Chapter 192 of the Yuma City Code: Stormwater Runoff in New Developments
4. City Stormwater Management Program (SWMP)
5. West Yuma Mesa Storm Drainage Discharge System, by Cellar Barr & Associates
6. Hydrologic and Drainage Design Report: Avenue B Storm Drain: 16$^{th}$ Street to 1$^{st}$ Street
7. Soil Survey of the Yuma-Wellton Area, by Natural Resources Conservation Service
8. City Stormwater Collection System atlas March 2012 (stormwater atlas)
9. US Environmental Protection Agency website
10. ADEQ 2005, A Manual of Procedures for Sampling of Surface Waters
11. Weather Underground Organization
12. Nationwide Urban Runoff Program (NURP)
13. Certified Professional in Stormwater Quality by the International Erosion Control Association, February 2005.

## 12. Evaluation of Results, Need for Best Management Practices (BMPs) and Termination of Monitoring:

If average results of testing of DO or selenium show exceedance of SWQS, City in coordination with ADEQ will recommend the introduction of structural and non-structural BMPs at locations upstream of stormwater outfalls to improve stormwater quality runoff by reducing selenium, sediment and lower the temperature of runoff to reduce depletion of DO in the River.

Pollutant: Dissolved Oxygen, concentration in mg/L:

| Outfall at River | Average Concentration in 1st Wet Season | Average Concentration in 2nd Wet Season | Annual Average Concentration | Arizona SWQS Limit | BMP Modification Required? |
|---|---|---|---|---|---|
| 9th Avenue | | | | | |
| 17th Avenue | | | | | |
| 19th Avenue | | | | | |
| Madison Avenue | | | | | |

Pollutant: Dissolved Oxygen, percent of saturation:

| Outfall at River | Average Percent in 1st Wet Season | Average Percent in 2nd Wet Season | Annual Average Percent | Arizona SWQS Limit | BMP Modification Required? |
|---|---|---|---|---|---|
| 9th Avenue | | | | | |
| 17th Avenue | | | | | |
| 19th Avenue | | | | | |
| Madison Avenue | | | | | |

Pollutant: Selenium:

| Outfall at River | Average Concentration in 1st Wet Season | Average Concentration in 2nd Wet Season | Annual Average Concentration | Arizona SWQS Limit | BMP Modification Required? |
|---|---|---|---|---|---|
| 9th Avenue | | | | | |
| 17th Avenue | | | | | |
| 19th Avenue | | | | | |
| Madison Avenue | | | | | |

Selection of adequate BMPs, per City Standards No. 10-140 through 10-160 will depend on the following factors:

1. Volume of runoff contributing to point before the outfall
2. Design storm (flood control or water quality)
3. Time of concentration
4. Size, age, condition, type of existing stormwater infrastructure
5. Compatibility of recommended BMP with existing infrastructure
6. Targeted pollutants (DO, sediment) from zoning designation and site conditions
7. Durability of BMP, cost effectiveness and maintenance issues
8. Per selection matrix of Engineering Standards
9. Practicability of the BMP
10. Economic feasibility

City will develop regular inspection and maintenance programs for newly-installed BMP to assess efficiency.

If City testing and sampling show no exceedance of SWQS for DO and/or selenium for two consecutive years, the City will discuss the issue with ADEQ for termination of analytical monitoring.

# Appendix A

## Records of Analytical Monitoring

Outfall Number 1: Madison Avenue Stormwater Outfall Wet Season Monitoring:

General Information for Sampling and Testing Total Selenium:

Limit of total selenium set by page 6 of Table 1 of Appendix A (Numeric Water Quality Standards) of Arizona SWQS = 2 µg/L for Aquatic and wildlife warm water (A&Ww).

Description of outfall: 36" Reinforced Concrete Pipe with flap gate and screen bars. Age, condition & accessibility: More than fifty years old and partially clogged. Outfall is accessible.

Name of person collecting Sample: Ibrahim Osman, P.E., CPSWQ

Date: January 9, 2018

MS4 Annual Reporting Date: September 30, 2018

Time when sample collected: 03:05 pm, January 9, 2018

Name of laboratory: TestAmerica

Address of laboratory: 4625 E Cotton Center Blvd, Suite 189

Phoenix, AZ 85040

Type of Monitoring (wet or dry): Wet

Wet Season of year (1st or 2nd): 2nd

Total precipitation: 0.17 inch

Ambient Temperature: 62ºF

Average of selenium concentration: Total Selenium = 4.4 µg/L

Average of selenium concentration: Dissolved Selenium = 1.0 µg/L

Equipment used to collect sample: Containers provided by TestAmerica

EPA method used: 200.8 LL

| Sample Number | Sample Collected During 1st Flush? | Sample Physical Description: Clear/Turbid/Odor | Lab Test Result | ASWQS Limit | Other Visually Present Pollutants |
|---|---|---|---|---|---|
| 1 | Yes | Semi-clear, no odor | 4.4 µg/L Total selenium | 2 µg/L | None |
| 2 | Yes | Semi-clear, no odor | 1.0 µg/L Dissolved selenium | 2 µg/L | None |

Outfall Number 1: Madison Avenue Stormwater Outfall Wet Season Monitoring:

General Information for Sampling and Testing DO:

Limit of DO set by Arizona SWQS R18-11-109(E) = 6 mg/L for Aquatic and wildlife warm water (A&Ww). Also, per Arizona SWQS R18-11-109(E-3): surface water meets the SWQS for DO if the percent saturation of DO equals to or greater than 90%.

Name of person collecting Sample: Ibrahim Osman, P.E., CPSWQ

Date: January 9, 2018

MS4 Annual Reporting Date: September 30, 2018

Time when sample collected: 03:08 pm, January 9, 2018

Name of laboratory: None

Type of Monitoring (wet or dry): Wet

Wet Season of year (1st or 2nd): 2nd

Total precipitation: 0.17 inch

Ambient Temperature: 65-66ºF

Average of DO concentration: 12.4 mg/L

Average DO percent saturation: Not available

Equipment used to collect sample: EXTECH Dissolved Oxygen Meter 407510

| Sample No. | Sample Collected During 1st Flush? | Physical Description: Clear/Turbid/ Odor | DO Field Concentration, mg/L | DO Field Percent Saturation | ASWQS Limit, mg/L | ASWQS Limit in %age of saturation |
|---|---|---|---|---|---|---|
| 1 | Yes | Semi-clear, no odor | 8.4 mg/L | N/A | 6 mg/L | 90% |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |

Outfall Number 2: 9th Avenue Stormwater Outfall Wet Season Monitoring:

Description of outfall: 42" Reinforced Concrete Pipe without a gate or screen bars. Age, condition & accessibility: More than fifty years old and partially clogged. Outfall is accessible.

General Information for Sampling and Testing Total Selenium:

Limit of total selenium set by page 6 of Table 1 of Appendix A (Numeric Water Quality Standards) of Arizona SWQS = 2 µg/L for Aquatic and wildlife warm water (A&Ww).

Name of person collecting Sample: Ibrahim Osman, P.E., CPSWQ

Date: _____

MS4 Annual Reporting Date: _____

Time when sample collected: _____

Name of laboratory: _____

Address of laboratory: _____

_____

Type of Monitoring (wet or dry): _____

Wet Season of year (1st or 2nd): _____

Total precipitation: _____

Ambient Temperature: _____

Average of selenium concentration: _____

Equipment used to collect sample: _____

EPA Method Used: _____

| Sample Number | Sample Collected During 1st Flush? | Sample Physical Description: Clear/Turbid/Odor | Lab Test Result | ASWQS Limit | Other Visually Present Pollutants |
|---|---|---|---|---|---|
| 1 | | | | 2 µg/L | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |

Outfall Number 2: 9th Avenue Stormwater Outfall Wet Season Monitoring:

General Information for Sampling and Testing DO:

Limit of DO set by Arizona SWQS R18-11-109(E) = 6 mg/L for Aquatic and wildlife warm water (A&Ww). Also, per Arizona SWQS R18-11-109(E-3): surface water meets the SWQS for DO if the percent saturation of DO equals to or greater than 90%.

Name of person collecting Sample: Ibrahim Osman, P.E., CPSWQ

Date: _____

MS4 Annual Reporting Date: _____

Time when sample collected: _____

Type of Monitoring (wet or dry): _____

Wet Season of year (1st or 2nd): _____

Total precipitation: _____

Ambient Temperature: _____

Average of DO concentration: _____

Average DO percent saturation: _____

Equipment used to collect sample: _____

| Sample No. | Sample Collected During 1st Flush? | Physical Description: Clear/Turbid/ Odor | DO Field Concentration, mg/L | DO Field Percent Saturation | ASWQS Limit, mg/L | ASWQS Limit in %age of saturation |
|---|---|---|---|---|---|---|
| 1 | | | | | 6 mg/L | 90% |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |

Outfall Number 3: 17th Avenue Stormwater Outfall Wet Season Monitoring:

Description of outfall: 36" Reinforced Concrete Pipe without a gate or screen bars. Age, condition & accessibility: More than fifty years old and exposed to clogging. Outfall is accessible.

General Information for Sampling and Testing Total Selenium:

Limit of total selenium set by page 6 of Table 1 of Appendix A (Numeric Water Quality Standards) of Arizona SWQS = 2 µg/L for Aquatic and wildlife warm water (A&Ww).

Name of person collecting Sample: Ibrahim Osman, P.E., CPSWQ

Date: _____

MS4 Annual Reporting Date: _____

Time when sample collected: _____

Name of laboratory: _____

Address of laboratory: _____

_____

Type of Monitoring (wet or dry): _____

Wet Season of year (1st or 2nd): _____

Total precipitation: _____

Ambient Temperature: _____

Average of selenium concentration: _____

Equipment used to collect sample: _____

EPA Method Used: _____

| Sample Number | Sample Collected During 1st Flush? | Sample Physical Description: Clear/Turbid/Odor | Lab Test Result | ASWQS Limit | Other Visually Present Pollutants |
|---|---|---|---|---|---|
| 1 | | | | 2 µg/L | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |

Outfall Number 3: 17th Avenue Stormwater Outfall Wet Season Monitoring:

General Information for Sampling and Testing DO:

Limit of DO set by Arizona SWQS R18-11-109(E) = 6 mg/L for Aquatic and wildlife warm water (A&Ww). Also, per Arizona SWQS R18-11-109(E-3): surface water meets the SWQS for DO if the percent saturation of DO equals to or greater than 90%.

Name of person collecting Sample: Ibrahim Osman, P.E., CPSWQ

Date: _____

MS4 Annual Reporting Date: _____

Time when sample collected: _____

Type of Monitoring (wet or dry): _____

Wet Season of year (1st or 2nd): _____

Total precipitation: _____

Ambient Temperature: _____

Average of DO concentration: _____

Average DO percent saturation: _____

Equipment used to collect sample: _____

| **Sample No.** | **Sample Collected During 1st Flush?** | **Physical Description: Clear/Turbid/ Odor** | **DO Field Concentration, mg/L** | **DO Field Percent Saturation** | **ASWQS Limit, mg/L** | **ASWQS Limit in %age of saturation** |
|---|---|---|---|---|---|---|
| 1 | | | | | 6 mg/L | 90% |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |

Outfall Number 4: 19th Avenue Stormwater Outfall Wet Season Monitoring:

Description of outfall: 15" Reinforced Concrete Pipe without a gate or screen bars. Age, condition & accessibility: More than fifty years old and partially clogged. Outfall is accessible.

General Information for Sampling and Testing Total Selenium:

Limit of total selenium set by page 6 of Table 1 of Appendix A (Numeric Water Quality Standards) of Arizona SWQS = 2 µg/L for Aquatic and wildlife warm water (A&Ww).

Name of person collecting Sample: Ibrahim Osman, P.E., CPSWQ

Date: _____

MS4 Annual Reporting Date: _____

Time when sample collected: _____

Name of laboratory: _____

Address of laboratory: _____

_____

Type of Monitoring (wet or dry): _____

Wet Season of year (1st or 2nd): _____

Total precipitation: _____

Ambient Temperature: _____

Average of selenium concentration: _____

Equipment used to collect sample: _____

EPA Method Used: _____

| Sample Number | Sample Collected During 1st Flush? | Sample Physical Description: Clear/Turbid/Odor | Lab Test Result | ASWQS Limit | Other Visually Present Pollutants |
|---|---|---|---|---|---|
| 1 | | | | 2 µg/L | |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |

Outfall Number 4: 19th Avenue Stormwater Outfall Wet Season Monitoring:

Description of outfall: 15" Reinforced Concrete Pipe without a gate or screen bars. Age, condition & accessibility: More than fifty years old and partially clogged. Outfall is accessible.

General Information for Sampling and Testing DO:

Limit of DO set by Arizona SWQS R18-11-109(E) = 6 mg/L for Aquatic and wildlife warm water (A&Ww). Also, per Arizona SWQS R18-11-109(E-3): surface water meets the SWQS for DO if the percent saturation of DO equals to or greater than 90%.

Name of person collecting Sample: Ibrahim Osman, P.E., CPSWQ

Date: _____

MS4 Annual Reporting Date: _____

Time when sample collected: _____

Type of Monitoring (wet or dry): _____

Wet Season of year (1st or 2nd): _____

Total precipitation: _____

Ambient Temperature: _____

Average of DO concentration: _____

Average DO percent saturation: _____

Equipment used to collect sample: _____

| Sample No. | Sample Collected During 1st Flush? | Physical Description: Clear/Turbid/ Odor | DO Field Concentration, mg/L | DO Field Percent Saturation | ASWQS Limit, mg/L | ASWQS Limit in %age of saturation |
|---|---|---|---|---|---|---|
| 1 | | | | | 6 mg/L | 90% |
| 2 | | | | | | |
| 3 | | | | | | |
| 4 | | | | | | |

# Appendix B

## Standard Operating Procedure (SOP)
## Testing Dissolved Oxygen in Stormwater

1. Scope and Application:

This method of testing dissolved oxygen is recommended for those samples containing materials, which affect the accuracy of the modified Winkler procedure (EPA Method 360.2) such as some salts, organic substances or sediment.

2. EPA Reference:

Method No. 360.1 is called the membrane electrodes method. This method provides an excellent tool for DO analysis in polluted waters caused by urban stormwater runoff. It is recommended as a substitute for the modified Winkler procedure in monitoring of streams, lakes, outfalls, etc., where it is desired to obtain a continuous record of the dissolved oxygen content of the water under observation.

3. Summary of Method:

The determination of dissolved oxygen in stormwater depends upon electrochemical reactions. Oxygen-sensitive membrane electrodes of the polarographic or galvanic type are composed of two solid metal electrodes in contact with supporting electrolyte separated from the test solution by a selective membrane.

3.2. Under steady-state conditions, the current or potential can be correlated with DO concentrations.

3.3. the "diffusion current" is linearly proportional to the concentration of molecular oxygen.

3.4. the current can be converted easily to concentration units (e.g., mg/L) by a number of calibration procedures.

4 Interfacial dynamics at the probe-sample interface are a factor in probe response and a significant degree of interfacial turbulence is necessary. For precision performance, turbulence should be constant.

5 Sample Handling and Preservation

5.1 Since membrane electrodes offer the advantage of analysis in situ they eliminate errors caused by sample handling and storage.

5.2 Where surface water samples are collected from shallow depths (less than 5 feet), use of an APHA-type sampler is recommended.

5.3 Use of a Kemmerer type sampler is recommended for surface water samples collected from depths of greater than 5 feet.

5.4 Care must be taken to prevent turbulence and the formation of bubbles when filling bottle.

5.5 At time of sampling, the sample temperature should be recorded as precisely as required.

5.6 Do not delay the determination of dissolved oxygen in the samples.

6. Interferences:

6.1 Dissolved organic materials are not known to interfere in the output from dissolved oxygen probes.

6.2 Dissolved inorganic salts are a factor in the performance of dissolved oxygen probe.

6.2 Probes with membranes respond to partial pressure of oxygen, which in turn is a function of dissolved inorganic salts.

6.3 Conversion factors for brackish water may be calculated from dissolved oxygen saturation versus salinity data (Table I).

7 Prolonged use of membrane electrodes in waters containing gases such as hydrogen sulfide (H2S) tends to lower cell sensitivity. This interference can be reduced or eliminated by frequently changing and calibrating the membrane electrode.

8 Dissolved oxygen probes are temperature sensitive, and the DO meter provides temperature compensation.

9 Plastic films used with membrane electrode systems are permeable to a variety of gases besides oxygen, although none is depolarized easily at the indicator electrode.

10 Apparatus:

10.1 VWR Scientific Dissolve Oxygen Meter, Model No. 4000

10.2 Sample bottles-300 mL ±3 mL capacity BOD incubation bottles with tapered ground glass pointed stoppers and flared mouths.

10.3 Reagent

10.4 Reagent Water

10.5 Compressed Air

10.6 Sodium Sulfite, $Na_2SO_3$

11 Instrument Check Out Procedure, Calibration and Operation:

Follow manufacturer's instructions for check out procedure, calibration, operation, maintenance and troubleshooting.

Appendix C

# Standard Operating Procedure (SOP)
# Testing Selenium in Stormwater

Testing to be performed by a state-licensed laboratory, per EPA method 200.8 and or Method 1638 if laboratory tests report consistently below 2 µg/L.