# 2017 Annual Report

**For the period of July 1, 2017 – June 30, 2018**
**Prepared by the Streets and Stormwater Department**

Save Our Streams

CITY OF Tulsa
A New Kind of Energy

Municipal Stormwater
Discharge Permit #OKS000201

# Annual Report

OPDES Stormwater Permit #OKS000201
July 1, 2017 to June 30, 2018

**Co-Permittees:**

Oklahoma Turnpike Authority

Oklahoma Department of Transportation

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# CERTIFICATION STATEMENT
OPDES Permit No. OKS000201
Review of Stormwater Annual
Report

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing of violations.

Roy N. Teeters
Manager
Stormwater Management Division

10.12.18
Date

# Section 1
# The Status of Implementing the Stormwater Management Program (SWMP)

The Stormwater Management Program (SWMP) of the City of Tulsa's municipal stormwater discharge permit #OKS000201, Part II, consists of 12 separate programs. A brief review of each of the individual programs and tasks performed during the period of July 1, 2017 through June 30, 2018, will result in the effective assessment of permit compliance.

## Part II(A)(1) Structural Controls and Stormwater Collection System Operation

*Status: Compliant and Ongoing*

The City of Tulsa's SWMP provides for the maintenance of both above and below ground structural stormwater controls including detention ponds, inlets, conduits and channels. The primary purpose of this program is to assure proper operation of these structural controls for better control of stormwater quantity. Additionally, stormwater quality benefited from the removal of sediment, floatables, and regular inspections of all structures. The following table is an inventory of the work performed on these structures during this reporting period.

### Maintenance of Above Ground Stormwater Structural Controls

| ABOVE GROUND STRUCTURE(S) | INVENTORY (FOR REPORTING PERIOD) | OPERATIONS & MAINTENANCE (O&M) ACTIVITY | O&M ACTIVITY (COMPLETED EACH REPORTING PERIOD) |
|---|---|---|---|
| Channels/ Streams/ Detention Ponds | 1,676 acres | Mowing | 11 x/year of mowable property (totaling 18,434 acres) |
| Channels & Streams/ Detention Ponds | 1,736 acres | Weed control (Herbicide) | All parcels 1 x/year for broad leaf weed control (totaling 1,736 acres) |
| Channels & Streams (Hydro Mulch Plus) | 425 acres | Weed Control (Herbicide) | All parcels 5 x/year for growth control (totaling 2125 acres) |
| Channels & Streams (Inhouse) | 280 acres | Weed Control (Herbicide) | All parcels 5 x/year for growth control (totaling 1,402 acres) |
| Wet Ponds | 64 acres | Algae Control | All ponds 5 x/year for growth control (totaling 320 acres) |
| Channels/ Streams/ Detention Ponds | 1,369 acres | Cleaning/ Sediment Removal (Ponds/Streams) | 83,930 cubic yards/period |
| Roadside Ditches | 974 miles | Sediment Removal (Roadside Ditching) | 47,753 linear feet/period |

## Maintenance of Below Ground Stormwater Structural Controls

| BELOW GROUND STRUCTURE(S) | INVENTORY (FOR REPORTING PERIOD) | OPERATIONS & MAINTENANCE (O&M) ACTIVITY | O&M ACTIVITY (COMPLETED EACH REPORTING PERIOD) |
|---|---|---|---|
| Storm Sewer Pipe (all pipe - driveway pipe, crossover pipe, etc…) | 1,178 miles | Inspect<br>Flush/clean<br>Repair or Replace | 7.2 miles/period<br>8.4 miles/period<br>5,549 linear feet units/period |
| Catch Basin/Inlets | 68,453 units | Inspect & Clean<br>Repair | 11,968 units/period<br>368 units/period |
| Pump Station | 14 units | Clean interior, Inspect & Maintain | 1,251 maintenance activities |

Additionally, prior to mowing of all stormwater control structures, all trash was collected and disposed of properly. Detention ponds that are multi-use had trash cans for disposal of litter. These cans were emptied on a regular basis.

Compliance shall be based on completion of the O&M ACTIVITY column found in the charts.

## Part II(A)(2) Areas of New Development and Significant Redevelopment

*Status: Compliant and ongoing*

This requirement was met through the continued implementation of the Stormwater Master Drainage Plan, Stormwater Design Criteria Manual and ordinances (Title 11-A, Chapter 3, Watershed Development Regulations; Title 11-A, Chapter 5, Pollution; Title 42, Chapter 11, Planned Unit Development) that relate to any new development and significant re-development that occurs in Tulsa. These documents were created in order to reduce flooding due to new development and significant re-development. A secondary benefit was to reduce the impact on water quality as a result of construction. The City of Tulsa follows a city-wide Comprehensive Plan. This plan addresses all facets of activities including water quality and has recently (August 2016) undergone an update with guidance from many groups, including Stormwater Quality and Engineering Services - Stormwater Design Section. The City of Tulsa also utilizes the Master Drainage plans, which are planning tools used to determine areas of watersheds that need capital improvements to reduce flooding that is caused from development as well as providing solutions to stormwater drainage, maintenance and management issues

which are prioritized based on benefits and costs. These Master Drainage Plans are being updated as funds become available.

The City of Tulsa continues to implement the Tulsa Stormwater Design Criteria Manual. This manual, created and adopted in 1994, is a comprehensive manual designed to assist engineers, designers and construction operators in aspects of stormwater runoff control before, during and after construction activities are completed. This includes both water quality and quantity. The Stormwater Design Criteria Manual has several purposes including minimizing water quality degradation by preventing siltation and erosion of the City waterways and preserving environmental quality. This manual is utilized by City of Tulsa staff, as well as site development engineers during the design and review phases of all new developments and significant redevelopment projects that occur within the City of Tulsa. Tulsa is in the process of updating this document to reflect more current policies and practices. This update is still undergoing final review and should be completed soon. Additionally, the Watershed Development Regulations (Title 11-A, Chapter 3) lists the current practices regarding regulation of new development and significant redevelopment for the control of stormwater runoff.

Anyone planning to develop or redevelop areas of Tulsa has to follow a process with the Development Services Division of the City of Tulsa. This process requires developers to follow extensive planning, designing, and review. This ensures the area targeted for development meets all City requirements, including reducing the impact of flooding, impacts on city owned utilities, traffic needs, etc., after construction is completed.

The City of Tulsa had recently completed work on a major update of its zoning code. However incorporating additional landscape requirements into the initial update would have delayed the overall project, so it was decided that the Landscaping Chapter would be updated separately. This process began in March of 2017 and a Stormwater Quality representative has been involved in the working group and draft updates to ensure Low Impact development (LID) impediments are removed and LID is incentivized to the maximum extent practicable. This update is still in progress, but should be finalized soon.

The Subdivision and Development Regulations have also recently undergone an update completed in May 2018. This effort was a recommended strategy from our Comprehensive Plan, PLANiTULSA, which was approved by City Council in 2010. The guiding principles of this plan include a desire for Tulsa to become a more environmentally and fiscally sustainable city. The City of Tulsa hired a contractor to perform tasks associated with the subdivision regulation update outlined in a

Request for Proposals. Stormwater Quality staff had been actively involved in working group to remove barriers and encourage LID.

As mentioned above, the Stormwater Design Criteria Manual is undergoing an update, including Chapter 1100, now titled Low Impact Development. This Chapter simply references the Low Impact Development Design Manual which is currently nearing completion, led by Dr. Jason Vogel at the University of Oklahoma. When this Manual is completed, Tulsa will have taken a big step toward promoting and providing guidance on LID projects in Tulsa. The City of Tulsa is also working with Dr. Vogel on a LID Maintenance and Inspection Manual. This process began in early 2018. Workshops will be held with regulators and developers to fine tune these documents before implementation. Further promotion of LID was accomplished by implementation of the following:

- LID was promoted at 76 educational functions, particularly those with key personnel, including engineers and planners.
- Continued review of Tulsa's development regulations to determine if they are LID friendly.
- Conducted public education events promoting LID, especially with developers/contractors.
- Continued LID workgroup to work on incentivizing LID as well as design and maintenance specifications.
- Developed "Guide to Low Impact Development" literature that is distributed at public events.

The City of Tulsa is continuing the pervious pavement pilot project where five concrete companies poured their pervious pavement mix and Tulsa. Tulsa, in cooperation with Oklahoma State University and the University of Oklahoma, continues to monitor and maintain the site and showcase it to the development and construction communities.

The City of Tulsa has adopted an already existing City of Tulsa Program to recognize Low Impact Development practices in Tulsa. The program, Partners for A Clean Environment (PACE) is a voluntary, non-regulatory recognition program coordinated by the City of Tulsa's Quality Assurance and Stormwater Quality groups. The focus of the program is to provide recognition to businesses, individuals and groups who go above and beyond environmental regulations in an effort to be better stewards of our land and water. Currently there are 19 members of this program, though more LID features have been implemented in Tulsa but not requested to be in this program.

Further promotion of LID in Tulsa has been accomplished through the continued effort of the LID workgroup. The Stormwater Quality group coordinates these regularly scheduled meetings. The working group meets to discuss a variety of LID related topics and is currently developing design guidelines for LID practices, the maintenance and inspection, as well as requiring/incentivizing LID. The group consists of City of Tulsa employees from a variety of departments: Engineering Services, Development Services, Planning and Stormwater Quality, as well as faculty and students from the University of Oklahoma, landscape architects, INCOG and surrounding municipalities.

## Part II(A)(3) Roadways

*Status: Compliant and ongoing*

This requirement was met through the City's street sweeping and mowing activities performed and managed by the Streets and Stormwater Department.

Through the utilization of private contractors, Streets and Stormwater swept arterial streets 8 times. Emphasis was placed on sweeping after de-icing material was no longer required as a result of a snow or ice event. Residential streets were swept 4 times. The program's progress is measured in curb miles swept and $yds^3$ of material removed. Arterial and residential mileage per year may vary due to weather variations as well as contractor issues from one year to the next. BMP's that prevent run-off from deicing material are in place at Tulsa's east and west maintenance yards. All of Tulsa's trucks washing facilities drain to the sanitary sewer, thus avoiding potential contamination in the storm sewer.

Street Sweeping

| Type | Sweeping Requirement | Sweeping completed | O & M Activity (for reporting period) | Material Removed |
|---|---|---|---|---|
| **Arterial** | ~8x annually | 8 | 5,200 miles | 2,726 $yds^3$ |
| **Residential** | ~4x annually | 4 | 10,489 miles | 27,118 $yds^3$ |

Contractors have reviewed the MS4 Permit and the Pollution Ordinance, in order to be familiar with the MS4 regulations and requirements, to prevent contamination of the waters of the State. As contracts for sweeping and mowing come up for renewal, addendums were and will continue to be added to include a water quality

requirement. This addendum will require the contractor to review and sign off on the SWMP, Pollution Ordinance and the MS4 permit.

During this reporting period, trash removal was also conducted on all street right-of-ways prior to any mowing. Numbers for inmate work crews are as follows:

Litter Removal from Roadways

| Collected by | Amount Collected | |
|---|---|---|
| **Inmate work crews** | 16,896 bags | 582.3 tons |

Tulsa Stadium Improvement District (TSID) conducted concentrated street and sidewalk cleaning efforts in the Central Business District, of the downtown area of Tulsa. This area consists of 1.4 square miles containing 58.37 curb miles.

Central Business District

| Type of Activity | Interval |
|---|---|
| **Street sweeping** | 58 curb miles/week |
| **Storm sewer intake structure cleaning** | 1x/week |
| **110 sidewalk mounted trash cans (inspect/clean)** | 5x/week |
| **4 Pet Waste Stations (refilled)** | Weekly |

The Streets and Stormwater Department continued to warn citizens and companies not to sweep or blow grass/leaves/debris into the street or storm sewer as it is a violation of Tulsa's Ordinance's and could result in a fine. In addition literature was distributed titled "Landscaping BMP". This literature is given to anyone believed to be disposing of leaves and grass into the MS4 (Municipal Separate Storm Sewer System). It directs the alleged disposer against further disposal of this material into the MS4.

Permit compliance was achieved with the completion of the specified street sweeping and litter removal.

## Part II(A)(4) Flood Control Projects

*Status: Compliant and ongoing*

To address this program requirement, the City of Tulsa has continued to implement the following activities:

1. Flood Management Project Design Review

2. Utilization of the NPDES Permit Evaluation Study – Water Quality Enhancement Assessment of Existing Flood Control Detention Facilities, September 15, 1998.

A discussion of the procedures for each activity is presented below.

**Flood Management Project Design Review**

To ensure that proposed flood control projects assess the impacts on the water quality of receiving water bodies, the City has and will perform a project design review for all current and future major flood control projects. The project design review utilizes criteria derived from design considerations included in the Stormwater Design Criteria Manual.

By definition, the purpose of a flood control project is to reduce flood damage. Flood control and water quality management strategies differ greatly. Flood control projects are designed to manage stormwater runoff resulting from large, infrequent storm events. Normally, these projects are designed to quickly convey runoff resulting from up to a 100-year storm event. Conversely, water quality management facilities are designed to handle runoff from much smaller, more frequent storm events (1-2 year storm event). In a given year, 70-90 percent of all runoff (and generally the associated pollutants) typically result from storm events producing less than 2 inches of rainfall. Water quality management facilities attempt to slow stormwater runoff, maximizing hydraulic detention periods to facilitate sedimentation and biological uptake. Therefore, this program element does not attempt to provide comprehensive water quality management utilizing "flood control" structures. The goal is to assure that project impacts to receiving waters are assessed and minimized through the use of sound engineering design principles. Where possible, water quality treatment principles will be incorporated into the design of flood control projects.

Sections 700 and 900 of the City of Tulsa Stormwater Design Criteria Manual document minimum design criteria. These criteria address the following design considerations:

- Channel Design
  - -Maximum velocity
  - -Channel geometry, side slopes
  - -Channel material/stabilization
  - -Side slope vegetation

Additional City review will take into consideration:

- Detention Structure Design
  - -Storage volume to maximize residence time
  - -Outflow structure design to slowly release detained flows without causing flooding
  - -Energy Dissipaters to slow velocity

- Location
  - -Downstream effects
  - -Existing receiving water quality
  - -Maintainability
  - -Proximity in the watershed with respect to impervious areas

**Existing Flood Control Structure Evaluation - NPDES Permit Evaluation Study**

In September 1998, Tulsa evaluated the feasibility of retrofitting 19 existing flood control structures to provide additional pollutant removal. This study recommended using upper watershed BMP's or control of pollutants at the source rather than retrofitting existing flood control structures. This is currently addressed through the implementation of a number of stormwater management programs. This includes street sweeping, construction site erosion control and public education. These programs will continue to be utilized.

The City of Tulsa has guidelines for development in the upper 1/3 of drainage basins to have detention. These detention ponds help slow the rate of stormwater runoff as well as improve the quality of runoff by allowing pollutants to settle out.

Compliance will be based upon the assessment of the impact(s) to receiving water quality during the design phase of flood control project. Where possible, water quality treatment principles will be incorporated into the design of these projects.

**Part II(A)(5) Pesticide, Herbicide, and Fertilizer Application**
*Status: Compliant and ongoing*

All City of Tulsa personnel, as well as all contract applicators that applied pesticides and herbicides were required to be licensed and subject to all regulations under the Oklahoma Pesticide Applicators Law, including re-certification. City personnel that applied pesticides, herbicides and fertilizers received annual in-house training on specific types of pesticides, herbicides and fertilizers.

Section 1 – Status of Implementing the Stormwater Management Program

Stormwater Management employees attended the following events regarding the proper application and disposal of pesticides, fertilizers and herbicides:

5/23/2018 – In-house training, Corner Stone, SDS – Tulsa, OK

4/5/2018 – In-house training, Round Up Custom, SDS – Tulsa, OK

3/22/2018 – Tree Care – OSU Stillwater, OK

3/8/2018 – In-house training, Chemical mixing – Tulsa, OK

3/1/2018 - Oklahoma Vegetation Management Association Spring Conference – Oklahoma City

11/28-29/2017 – Oklahoma Turfgrass Conference – OSU Stillwater, OK

10/12/2017 – Winfield Solutions Workshop – Tulsa, OK

10/3-5/2017 - Oklahoma Vegetation Management Association Fall Conference – Catoosa, OK

Tulsa Parks employees attended training at:

Winfield Academy in October 2017 and Okla. Turf Conference in November 2017.

With the issuance of the Environmental Protection Agency's (EPA) (now Oklahoma Department of Agriculture Food and Forestry's) Pesticide General Permit in October 2011, the City of Tulsa was required to formulate a Pesticide Discharge Management Plan (PDMP) as per the "Weed and Algae Control" category. The primary purpose of the PDMP is to protect water quality from abuse and misuse of pesticides. The City of Tulsa is compliant with all requirements of the PDMP and will continue to remain vigilant in their protection of waterways from pesticide misuse.

The Master Gardeners Program, available through the Oklahoma State University (OSU) Cooperative Extension Service, is a free service that offers expert advice to the public on all aspects of gardening, including the proper application of pesticides, herbicides and fertilizers as well as other gardening and lawn care tips and information. This service is available to the public either by visiting the extension services

at 4116 East 15th, accessing the website www.tulsamastergardeners.org/ or utilizing the telephone hotline at (918) 746-3701. The Tulsa Master Gardeners answers approximately 100,000 garden related questions annually.

These questions are answered by volunteers trained in various horticultural issues including proper application of pesticides, herbicides and fertilizers. This program also distributes "Fact Sheets", which discuss choice of chemicals and application rates for most of the common uses of pesticides and fertilizers in urban areas. Gardening education is further accomplished by various media outlets including TV, radio, print, and online newsletters. This is also accomplished by numerous Home and Garden Shows throughout the year. The Master Gardener Program was also promoted through distribution of the "City Life" newsletter in July 2017 and March 2018. The City of Tulsa further promoted the Master Gardeners Program through the distribution of brochures and on the City of Tulsa's stormwater quality website. See Attachment A for a list of brochures distributed.

In accordance with Part II(13)(5)(b) of Tulsa's current MS4 permit, in FY 14-15, Tulsa sent a letter to 227 pesticide applicators licensed by the Oklahoma Department of Food and Forestry to apply pesticides in Tulsa County. This letter contained information on the importance of proper application of pesticides, herbicides and fertilizers, instructions not blow grass clippings and/or leaves into the street and advised applicators that non-compliance is a violation of the City of Tulsa's Pollution Ordinance, which could result in a fine.

Tulsa continued to maintain a website that is accessible to the public, which contains guidance for pesticide and fertilizer application for both commercial and residential applicators. This website is located at www.cityoftulsa.org/sos and is regularly promoted. The number of pageviews has remained high with over 5,000 pageviews during this time.

See Part II(A)(10)(c) "Public Education" for additional public education on the proper use, storage and disposal of pesticides, herbicides and fertilizers by Tulsa during this period.

## Part II(A)(6) Illicit Discharge and Improper Disposal

*Status: Compliant and ongoing*

The location and removal of illicit discharges and improper disposal continued to be an important aspect of the City of Tulsa's SWMP. Many departments within the City of Tulsa maintain various programs that involve locating and removing non-stormwater discharges to the storm sewer system and/or educating the public on proper disposal practices.

**a.**) Non-stormwater discharges

Tulsa allows the discharge of exempt non-stormwater discharges, as defined by 40 CFR 122.26(d)(2)(iv)(B)(1), to the storm sewer unless these discharges are determined to be contributing significant amounts of pollutants to the storm sewer. When an exempt non-stormwater discharge is found to be contributing significant amounts of pollutants to the storm sewer, enforcement action will be taken using Tulsa's Pollution Ordinance.

Other categories of allowable non-stormwater discharges to the MS4 are:

- Car Washing (non-commercial and charity)
- Swimming Pool / Hot Tub
- Outside Washing (pavement washing)

For the above discharges, Tulsa has established BMP's that must be implemented prior to allowing the discharge to the MS4. Failure to implement these measures may result in a violation of the Pollution Ordinance.

Discharges from emergency firefighting activities were monitored during all phases of Tulsa's firefighting activities for potential releases of pollutants. This was accomplished through the continued implementation of Tulsa's Fire Department (TFD) policies. These polices were implemented to ensure public health and safety and reduce the release of pollutants.

During this reporting period 238 investigations were conducted identifying 17 illicit discharges to the storm sewers. Tulsa's Pollution Ordinance was adopted November 1995 and continues to be utilized for the removal of non-stormwater discharges (see Section 6). This Ordinance allows the City of Tulsa to recover cleanup cost from the responsible party.

Additionally, the City of Tulsa achieves permit compliance by performing industrial stormwater inspections at City of Tulsa facilities. These inspections are performed to control pollutants that may be discharged into the MS4 system through routine operations and maintenance. These inspections focus on the proper storage of outdoor parts and materials, the condition of tanks and containers that store liquids and processes that may be conducted outdoors. Twenty City facility inspections were conducted during this time and are now compliant with Permit objectives.

Once an illicit discharge was identified, the responsible party was required to stop the discharge, redirect the discharge to the sanitary sewer or obtain an OPDES wastewater discharge

permit from the Oklahoma Department of Environmental Quality (ODEQ). This was accomplished through the use of the Pollution Ordinance.

Fliers titled, "Responsible Pet Ownership" and "Stormwater Quality Programs", were distributed at events and activities during this reporting period. These flyers educated the reader on the negative aspects of not collecting and disposing of pet waste properly. These programs were also promoted on the City of Tulsa's Stormwater Quality website.

The City of Tulsa co-sponsored the "Bark in the Park" theme night at the Tulsa Drillers baseball games as well as two Tulsa Roughneck soccer games. "Responsible Pet Ownership" flyers and pet waste bags were passed out to Tulsa area pet owners. The attendance at those games averaged 4,200 and 3,100 respectively.


In an effort to control runoff from pet waste, seven Tulsa parks have a total of 27 pet waste signs. Pet stations provide pet waste disposal bags to properly dispose of pet waste in the trash. The stations are checked weekly and filled as needed.

Public reporting of an illicit discharge or illegal disposal by concerned citizens (via the 311 call center or directly to the Stormwater Management Division), other City departments and government agencies (ODEQ or the EPA) are regularly promoted on the city's website or at educational events (see Attachment B). Multiple channels for reporting illicit discharges are a valuable part of the City's effort to locate illicit discharges and improper disposals. This year Stormwater Quality staff responded to 124 service requests. Forty-one of these came from the 311 call center. Dry weather field screening and dry weather flow follow-up continue to be used, resulting in the location, identification and removal of illicit discharges and improper disposals that occurred during this reporting period (see Part II(A)(6)(e)) and Part II(A)(6)(f)).

**b.)** Sanitary sewer overflows

In a continuing effort to eliminate sanitary sewer overflows during this reporting period, the City initiated three sanitary sewer manhole and/or pipeline rehabilitation projects. No sanitary sewer evaluation studies was initiated during this reporting period but two previous evaluation studies were completed. No un-sewered area project was completed during this reporting year which would have reduced the risks of failed septic tank effluent entering the MS4. Excess wet weather flow to the sanitary sewer was diverted to seven flow equalization basins which reduce the amount of non-target rainwater from entering the sanitary sewer system. One upgrade of a flow equalization basin occurred during this time, upgrading capacity from 12 million to 18 million gallons.

The City of Tulsa's Working in Neighborhood's Department utilizes two programs that help eliminate sanitary sewer contamination of waterways. The Emergency Repair Grant consists of a $5,000 maximum grant to very low income residents to make emergency repairs to conditions that threaten the health and safety of the occupants. Areas of service include: electrical, plumbing, roofs, heating, and sewer lines. The Rehabilitation Loan Program is a $35,000 maximum rehabilitation loan available for moderate to very low income residents to assist citizens with home repairs, weatherization, and energy efficiency. Each residence is given a rigorous inspection to include lead based paint (LBP), electrical/mechanical/plumbing (EMP), structural, and interior repairs. Areas of service include: lead based paint, electrical, plumbing, security (doors and windows), roofs, heating, interior issues, weatherization, and sewer lines. Twenty-five sewer lines were repaired/rehabilitated under these programs in the past fiscal year.

Sewer cleaning crews specifically targeted 43.54 miles of sewer lines known for grease accumulation problems. This maintenance program reduced the likelihood of sanitary sewer backups and overflows. Emergency cleaning of 50.88 miles of sanitary sewer was also conducted to remove grease and reduce sanitary sewer overflows. Additionally, in an effort to reduce grease blockages that result in sanitary sewer overflows, Tulsa continued its grease abatement program, better known as FOG (Fats, Oils, Grease) Best Management Practices Program, for the sanitary sewer. This voluntary program encourages restaurant owners to follow best management practices that ensure proper kitchen and grease management practices. Various meetings with business owners also facilitated discussion on the proper care and maintenance for trash receptacles, grease rendering bins, and parking lots.

As a result of the FOG BMP program the following actions took place during this reporting period:

| Action | Results |
|---|---|
| **Businesses Inspected** | 1,513 |
| **Fog Trainings Conducted** | 3 trainings/ 108 total attendees |
| **Businesses Participating in the FOG Program** | 359 |
| **Samples Obtained** | 14 |
| **Number of Enforcement Actions** | 10 |
| **Fines Issued** | $275 |

Tulsa continued efforts to reduce sanitary sewer overflows into storm sewer through the use of TV inspection and smoke testing techniques. Work completed during the reporting period included:

161.47 miles of sanitary sewer TV inspected
213 sanitary manholes raised to grade
128 main line sanitary sewer repairs
10,556 feet of main line sanitary sewer replaced or rehabilitated

In addition to investigating the private sewer defects located through smoke testing, the smokie inspector program also investigates private businesses that have a history of sewer defects. These businesses include apartment complexes, nursing homes and assisted living apartments, mobile home and RV parks, office complexes, motels, hotels, hospitals, schools, and shopping centers. The following statistics are from some of these sources. For the fiscal year 2017 – 2018, the smokie inspectors investigated and closed 171 cases. Twenty-six of these cases were closed by cleanout cap replacement done by the inspectors.

These repairs reduced stormwater inflow to the sanitary sewer, which in turn reduced sanitary sewer overflows and illicit discharges to the stormwater sewer. Permit compliance was achieved through implementation of these programs.

The number of sanitary sewer overflows during this time was 115. This is a significant reduction from previous years primarily because of decreased rain resulting in fewer wet weather overflows and apparent increased effectiveness of the maintenance and capital rehabilitation programs. Sewer Operations and Maintenance Key Performance Indicator is less than 10 overflows per 100 miles of sewer per year, or 199 overflows (1990 miles of sewer).

**c.)** Floatables

The City of Tulsa, the "Keep Oklahoma Beautiful" organization and the Metropolitan Environmental Trust (the M.e.t.) sponsor many programs that directly or indirectly target litter control. These programs include but are not limited to:

- *Annual Creek Cleanup* – Co-sponsored by Tulsa County Conservation District (TCCD) and the City of Tulsa on May 19, 2018, 25 volunteers removed litter from Joe Creek. Not only did this clean-up remove litter from the creek, it also helped to bring attention to the importance of reducing litter discharges to urban streams and waterways.

- *Earth Month* – This program throughout the month of April consisted of activities targeting the protection of resources including the reduction of litter and non-point source pollution.

- *Earth Day* – April 22, 2017 was set aside to draw attention to environmental efforts by citizens and area businesses, including reduction of litter and pollutants.

Tulsa took advantage of the opportunity to educate citizens on the importance of eliminating litter at many special events during this reporting period. Public education at these events usually involved setting up a display and handing out materials such as brochures, pencils, etc. These events included:

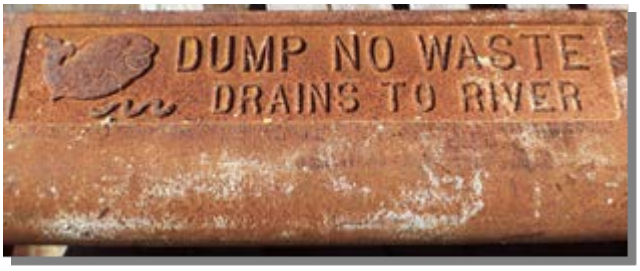
- The Greater Tulsa Home and Garden Show: March 8th 2018
- Tulsa University Earth Day Celebrate ComUNITY: April 27th 2018
- Enviro-Expo at Bartlett Square: April 18th 2018
- Tulsa Community College EcoFest: March 31st 2018

A full list of public education activities conducted by the City of Tulsa can be found in Attachment B.

Tulsa's exhibit booth at "The Greater Tulsa Home and Garden Show" introduced citizens to recycling, pollution prevention, proper use and disposal of fertilizers and pesticides and reminded Tulsans about the monthly curbside recycling program.

The Curbside Recycling Program continued offering every week pick-up of plastic, glass, paper, bimetals, aluminum, and other recyclables. Approximately 109,000 Tulsans participated which has resulted in the collection of approximately 19,606 tons of recyclables for this reporting period. This program is promoted on the City website.

Environmental educational activities were conducted this year at various children's events. These events involved 6,515 children who were educated on the importance of reducing litter, non-point source pollution and recycling through various activities. Other education activities included the use of videos, hands on landscape displays (i.e."Enviroscape"), distribution of hand outs and material containing non-point source pollution information, hands on stream monitoring of the creeks and performing park clean-ups.




Tulsa, in conjunction with the Tulsa County Conservation District/Blue Thumb historically had a storm sewer inlet placarding program which included the message "No Dumping Save Our Streams Tulsa" or "Dump No Waste Drains to River" and has a telephone number to report violators. All new storm

sewer inlets have a similar message prestamped on the hood. Therefore any placarded inlets will eventually be replaced with stamped inlets, making the placarding program obsolete.

Tulsa's Stormwater Quality group began a litter monitoring program in September of 2017 with the goal of better understanding the litter problem in Tulsa and doing more targeted education. The litter assessment program monitors litter accumulations over a 50 meter distance on a quadrant of Tulsa creeks at a time. The types of litter observed are broken down to identify trends and potential sources. Generally speaking, an increased amount of litter was found in stream segments with nearby convenient stores or apartment complexes. In the 2017-2018 year, Joe creek and Southpark creek had an excessive amount of litter, so a top-down stream assessment was done on those creeks. Special attention was paid to businesses, apartment complexes, and other potential litter sources along those creeks in an attempt to reduce litter. Thirty businesses and apartment complexes were spoken to about litter prevention.

Below is a breakdown of the results from the litter monitoring program:

| | Ford | Fred | Fryditch | Haikey | Joe | Southpark | Spunky | Vensel |
|---|---|---|---|---|---|---|---|---|
| Bags | 23 | 8 | 63 | 94 | 198 | 87 | 2 | 40 |
| Food Related | 90 | 15 | 30 | 122 | 260 | 336 | 22 | 60 |
| Clothing | 0 | 1 | 0 | 3 | 9 | 4 | 3 | 2 |
| Organic | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 |
| Other | 103 | 18 | 35 | 57 | 103 | 110 | 16 | 38 |
| Bottles/ cans | 39 | 11 | 21 | 42 | 98 | 86 | 15 | 24 |
| Total Items: | 255 | 53 | 149 | 318 | 668 | 623 | 59 | 168 |

Two sets of litter BMP's were created and printed in the month of June, one targeted towards businesses and the other towards citizens. Two hundred BMP's were distributed to employees at the State Farm office in an attempt to educate them on proper cigarette disposal. In addition, State Farm installed three butt bins and posted signs in areas where cigarette butts were frequently improperly disposed of.

The Metropolitan Environmental Trust (M.e.t.) continued to operate 11 recycling depots that are conveniently located throughout the metropolitan Tulsa area. Citizens can bring plastics, newspapers, glass, aluminum, batteries, cooking grease, used motor oil and antifreeze for recycling. These depots were also used for the distribution of environmental educational information, including brochures and posters at some locations addressing the reduction of litter. Additionally, the M.e.t. distributed approximately 300 car litterbags, and displayed anti-litter posters at the depots and booths throughout the year. The M.e.t. supplied trash bags and gloves for Scouts and civic groups who have picked up litter. In FY 17/18, the M.e.t. provided these items for one group. In addition, the M.e.t. staff had roughly 80 educational

booths, as well as gave 71 speeches to school classrooms and scouting groups on trash, recycling and litter.

Tulsa Parks emptied 1,154 trash containers (placed at 102 parks and 15 stormwater detention sites) 1-2 times per week. Stormwater detention structures are multiple use facilities, which serve as city parks when not in use for stormwater detention. Additional trash containers were placed in parks to serve special events and scheduled activities. In addition, maintenance crews picked up loose trash from parks a minimum of once per week. Trash containers with hinged lids have replaced opened topped barrels which have resulted in a reduction of loose trash.

The Stormwater Management Division has crews that removed litter from 12 wet ponds and miles of lined and earthen channels that comprise Tulsa's storm sewer, thus reducing the amount of floatables discharged to waters of the state.
The City of Tulsa's Public Facilities Section continued to utilize inmate work crews to remove litter along streets and expressways throughout Tulsa in an effort to keep the city free of roadside trash and debris. Stormwater Management also has a crew that collects trash and other material discarded along roads, right of ways, and other city property. During this fiscal year they spent 110.37 hours collecting 32.35 cubic yards of debris.

Streets within the Inner Dispersal Loop (Downtown Business District) were cleaned on a daily basis. During this cleaning, crews simultaneously removed debris from the storm sewer intake structures. Pole mounted trashcans were inspected and emptied daily as needed.

The removal of 1,404 tons of trash was accomplished by placing 30 $yd^3$ trash dumpsters 1,494 times in neighborhoods throughout Tulsa. Tulsa had approximately 20,665 requests by citizens to pick up bulky waste (appliances, white goods, furniture), of which 310 Freon bearing items were properly evacuated.

The illegal dumping program uses the visual observation efforts of various field officers and citizen reports to identify and locate dumpsites throughout the City of Tulsa. Active sites are monitored through the use of visual observation and when possible, concealed surveillance. After these activities are completed, the sites are cleaned, charted and monitored for new dump activity. These activities serve to deter the reactivation of dumping in the area and encourage the use of proper disposal methods. Signage at six routine illegal dumping locations which read "No Dumping" and describe the enforcement possible if someone were caught.

This year, the Solid Waste division located 3,018 illegal dumpsites and conducted 52 investigations of illegal dumpsites within the city limits. Four citations were issued based on these investigations.Dumpsite contents were from construction activities, demolitions, green waste, furniture, appliances, tires and other household items. During this fiscal year, they collected 530 tons of debris.

The City of Tulsa Security Patrol also made 119 field inspections of chronic illegal dumpsites, but no arrests or tickets were given as a result of their inspections. There is an increase of homeless site complaints and clean-ups totaling 243 homeless site cleaned up.

In addition, the City of Tulsa continued to collect and dispose of trash at its five floatable monitoring locations (see Section 4-Monitoring Data).

**d.)** Collection of used motor vehicle fluids and household hazardous wastes

Financial support continued for the M.e.t.'s recycling depots, which accept oil, antifreeze (only 2 of the 11 locations collect antifreeze), cooking grease and batteries, as well as other recyclable materials. All depots are open 24 hours per day (attended approximately 6 to 8 hours/day), seven days per week and are located throughout the Tulsa Metro area.

The amount of material collected at these depots for the reporting period can be found in the following table. These numbers reflect totals from all the recycling depots and a pilot program that is collecting from eight restaurant/bars located throughout the greater Tulsa metropolitan area.

| **Material** | Amount |
|---|---|
| **Oil** | 29,500 gals. |
| **Antifreeze** | 1,325 gals. |
| **Plastics** | 325,739 lbs. |
| **Aluminum** | 74,418 lbs. |
| **Glass** | 981,980 lbs. |
| **Batteries** | 15,971 lbs. automobile<br>38,420 lbs. household |
| **Newspaper** | 734,700 lbs. |
| **Cooking Grease** | 4,114 gals. |

Also, on 10/23/17, 2/24/18 and 6/2/18, The M.e.t. had specialty collection events in Tulsa to collect fire extinguishers, smoke alarms, batteries, thermometers, thermostats and fluorescent bulbs (tube style). During these events, The M.e.t. handed out fliers on the City of Tulsa Household Pollutant Collection Facility. The combined events total:

- 47 fire extinguishers
- 42 smoke alarms
- 5 thermometers
- 51 thermostats
- 92 bulbs

The City sponsored two household pollutant collection events during this reporting period. The events took place on Nov. 14th, 2017 and March 24-25th, 2018. These events differed from the routine collection of household pollutants by accepting items such as medicine, ammunition, tires, and large electronics. Local radio and television news spots, utility bill stuffers, distribution of brochures, Facebook posts, Twitter, and organizational newsletters were all utilized to advertise these events.

The events were very successful with participation of 636 vehicles from Tulsa and surrounding communities resulting in the collection of the following:

| Material | Amount |
|---|---|
| Tires | 694 tires |
| Ammunition | 650 lbs. |
| Medicine | 456 lbs |
| Electronics | 7,900 lbs. |

During this collection event, educational fliers were distributed to the public. Each car
received fliers regarding the following topics: locations of the recycling depots, latex paint disposal, grease, stormwater quality issues and alternative cleaning products.

On January 6, 2016 the City of Tulsa opened the new Household Pollutant Collection Facility at 4502 South Galveston Ave. The facility is open 2 days a week (Wednesdays and Saturdays) from 8:00am till 4:30pm. This facility will replace the biannual collection events and will result in an easier and quicker method of pollutant disposal for Tulsans and the surrounding communities.

Below is a summary of the amounts of pollutants collected this fiscal year:

Total weight collected: 130,078
Total Tulsa customers: 1,670
Total Met customers: 469
Total Customers from outside Tulsa and Met communities: 3
The following is a breakdown of the total amount of weight collected per category:

| Wastestream | Amount Collected (lbs.) |
|---|---|
| Toxic Liquid | 11,768 |
| Toxic Solid | 8480 |
| Aerosols | 9962 |
| Low Viscous Flammable | 12796 |
| High Viscous Flammable | 13004 |
| Bulbs | 1796 |
| Bases | 4820 |
| Acids | 3358 |
| Oxidizers | 2196 |
| Loosepack Flammable | 3152 |
| Foaming Aerosols | 276 |

In addition to the above household pollutants, the facility also collected and disposed of:

- 2500 gallons of used oil
- 1,800 gallons of antifreeze
- 9,844 lbs. of batteries
- 400 gallons of cooking oil
- 2 – 55 ga. drums of propane cylinders
- 2 – 55 ga. drums of fire extinguishers

Through a voucher system, The M.e.t. staff answered thousands of calls the past FY17/18 year answering questions from non-Tulsa citizens on what to do with their pollutants. Staff has educated citizens on where to take items or handle responsibly. Staff gave out voucher numbers to citizens who live in outlying communities so the citizen is able to use the Tulsa facility at no charge (if their disposal is below 60 pounds). The charge is given to the community through a contract arrangement.

**e.)** Locate and eliminate illicit discharges and improper disposal

Dry weather field screening was conducted on approximately 48.55 square miles (31,105.67 acres) of the Tulsa's storm sewer system during the period of July 1, 2017 to June 30, 2018. Thus compliance with this section of the permit was achieved by screening 26 % of the Tulsa's MS4. The dry weather field screening program was designed to locate illicit discharges and illegal disposals into Tulsa's storm sewer.

A total of 153 outfalls were screened, of which 34 contained flows during dry weather periods. Once dry weather flow was located, the flow was sampled and tested for pH, temperature, appearance, conductivity, detergents, chlorine, copper, ammonia and fluoride (See Section 4 for specific data collected during dry weather field screening). If contaminants were identified in concentrations above action levels then a dry weather flow follow-up investigation was conducted. Dry weather flow follow-up investigations continued until the source of the flow was identified. When the source of the illicit discharge was identified it was eliminated.

The Stormwater Management Division continued to conduct random industrial inspections. Inspections were conducted to achieve compliance with Part II(A)(8) Industrial and High Risk Runoff. During these inspections, inspectors were checking for illicit discharges to the MS4 or the potential for an illicit discharge. If an illicit discharge was found, action was taken to halt the discharge using the Pollution Ordinance.

As addressed in Part II(A)(6)(b), Tulsa continued efforts to reduce sanitary sewer overflows into storm sewers during this reporting period. This was accomplished through the use of TV inspections and smoke testing techniques. Work completed during the reporting period included:

161.47 miles of sanitary sewer TV inspected
7.2 miles of storm sewer TV inspected
213 sanitary manholes raised to grade
5,549 linear feet of main line storm sewer repairs
128 main line sanitary sewer repairs
10,556 feet of main line sanitary sewer replaced or rehabilitated

These repairs resulted in the reduction of stormwater inflow and infiltration into the sanitary sewer, which in turn reduced sanitary sewer overflows and illicit discharges to the storm sewer system. Rehabilitation projects supplemented Tulsa's efforts by correcting known structural storm sewer problem areas (see Part II(A)(6)(b) Sanitary Sewer Overflows).

As previously mentioned, investigation/complaint procedures currently in place continue to be very effective in locating illicit discharges and improper disposal practices during this reporting period.

**f.)** Removal of illicit discharges

Once the source of an illicit discharge was located the responsible party was required to halt the discharge, redirect the discharge to the sanitary sewer or obtain an OPDES wastewater discharge permit from the ODEQ. Seventeen illicit discharges were eliminated from Tulsa's MS4 during this reporting period as a result of enforcement of the Pollution Ordinance.

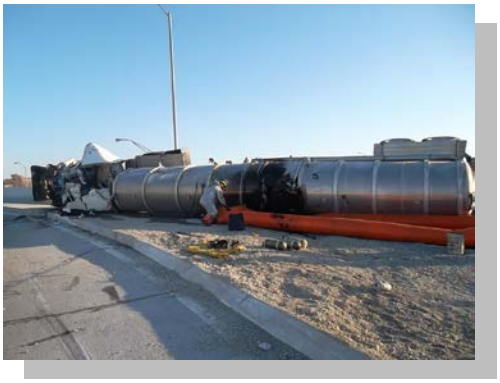
**g.)** Maintain a list of OPDES permit holders within the City of Tulsa

Databases are maintained for all OPDES permits for all discharges from construction, industrial activities, and OPDES wastewater discharge permittees within Tulsa. These databases include the name, address, OPDES permit number, contact person, SIC code(s) and other information. Updates were made when information became available. This information is usually obtained through inspections or ODEQ notification.

## Part II(A)(7) Spill Prevention and Response

*Status: Compliant and ongoing*

All agencies and City Departments responding to spills are instructed to follow the City's Pollution Ordinance. This ordinance requires the removal of a pollutant rather than disposing to the storm sewer, unless there is an immediate threat to life and health. The Pollution Ordinance provides Stormwater Management with the authority to require the responsible party to clean up the spill. This Ordinance also gives the Stormwater Management Division the authority to recoup all cost incurred from the responsible party. The Stormwater Management Division has authority to oversee all clean-up work involving spills within the City of Tulsa.



This requirement was achieved as delineated in a Memorandum of Agreement between the Tulsa Fire Department (TFD) Hazardous Materials Unit, the Tulsa City – County Health Department and the Streets and Stormwater Department. In accordance with Section 300 of the TFD Emergency Operation Procedures, all agencies and City departments responding to spills ensured compliance with the Pollution Ordinance by removing spilled pollutants rather than flushing it into the storm sewer, unless there was an immediate threat to public health and safety.

The TFD Haz-Mat Unit responded to incidents involving spills or possible releases of chemicals or pollutants which either had the potential to, or were discharged to the City's sanitary or storm sewer. Whenever the TFD responded to a spill that had entered either the sanitary or storm sewer system, the Streets and Stormwater Department was notified to evaluate impact on sewer systems and coordinate remediation activities.

If the responsible party was identified, they were required to conduct the clean up or hire a remediation company. In cases involving remediation, all work was inspected to ensure a proper and thorough clean up.

Below is a summary of the investigations conducted by the Stormwater Management Division:

| Number of Investigations | Description of Investigations |
|---|---|
| **20** | **Construction** (relating to construction site potential violations) |
| **16** | **Hazmat** (relating to potential discharges of pollutants from fire department responses involving the hazardous materials unit) |
| **238** | **Stormwater** (relating to potential releases of pollutants to the storm sewer or violations of the Pollution Ordinance) |
| **11** | **Drug Labs** (relating to the potential release of pollutants from drug lab remediation to the storm sewer or violations of the Pollution Ordinance) |
| **285** | **Total number of investigations for this reporting year** |

Stormwater Management inspectors conducted 481 industrial stormwater runoff inspections, each involving a discussion regarding spill prevention and management with industrial representatives.

Agreements have been put into place between Tulsa and both the Oklahoma Turnpike Authority (OTA) and the Oklahoma Department of Transportation (ODOT) that address spills that occur on OTA or ODOT MS4s within Tulsa.

**Part II(A)(8) Industrial & High Risk Runoff**
*Status: Compliant and ongoing*

Tulsa continued to use the Industrial & High Risk Runoff program to identify, monitor and control

pollutants from municipal landfills; treatment, storage and disposal facilities for municipal waste; facilities subject to EPCRA (Emergency Planning and Community Right-to-know Act) Title III, Section 313 reporting requirements; and any other industrial or commercial discharge the City determined had the potential to contribute substantial pollutant loading to the City's storm sewer system. This program contains procedures for inspecting, monitoring and controlling pollution from the aforementioned sources. A database of industrial stormwater sources discharging to the City's storm sewer continues to be maintained.

During this reporting period, 481 industrial stormwater inspections were conducted. Five enforcement actions were taken against industries or facilities in order to eliminate illegal or illicit discharges. $450 in fines were associated with these enforcement actions.

This program has also provided an opportunity to educate owners and operators of industrial or commercial facilities concerning stormwater quality regulations and requirements as per ordinances and regulations.

## Part II(A)(9) Construction Site Runoff

*Status: Compliant and ongoing*

**a.**) Structural and non-structural best management practices

Through inspections and enforcement actions, Tulsa required construction sites to implement and maintain adequate structural and non-structural (BMPs) during this reporting period. The use and maintenance of structural and nonstructural best management practices (BMPs) to reduce pollutants discharged to the City's storm sewer from construction sites has been achieved through control measures provided in the Pollution Ordinance, Title 11-A, Chapter 3 (Watershed Development Regulations), Chapter 5 (Pollution Ordinance), Title 35 Infrastructure Development Process (IDP), and building permits.

During this reporting period Tulsa's Development Services section issued:

1,074 Watershed Development permits, which include Earth Change permits.

188 Stormwater Drainage permits

697 Stormwater Connection permits

179 Floodplain permits

7 Floodway permit

These permits require the operator to have adequate erosion control measures in place and maintained prior to, and throughout the duration of the project until final stabilization. Prior to receiving an Earth Change permit; applicants were required to submit an NOI and storm water pollution prevention plan for all sites disturbing at least one acre. Additionally, 127 Stormwater Pollution Prevention plans were

reviewed to ensure the use and maintenance of structural and nonstructural erosion control BMPs at construction sites.

**b.)** Inspection and control of construction sites

Inspection and enforcement of control measures to reduce soil erosion at construction sites is shared between several City groups (Stormwater Management, Development Services and Engineering Services). Stormwater Management conducted a total of 1,809 construction site inspections for compliance with erosion control measures and issued 14 enforcement actions. The total amount of fines and penalties collected was $400.

Development Services conducted 1,301 soil erosion inspections at construction sites.
The "Inspection Services Soil Erosion Control Program" was utilized by Development Services during this reporting period. This program defines the roles and responsibilities of building inspectors regarding erosion control at construction sites and appropriate action to be taken if construction sites are non-compliant with City Ordinance. The inspector contacts the builder and informs him/her of the actions which must be taken to come into compliance. If voluntary compliance is not achieved, the Stormwater Management Division conducts follow-up inspection to ensure compliance with the Pollution Ordinance. If the site is still non-compliant appropriate enforcement action is taken. Building permits were not issued for construction sites larger than one acre until a stormwater pollution prevention plan was in place.

Engineering Services Division conducted daily inspections on 119 city and 76 privately funded Infrastructure Development Process (IDP) projects. Implementation and continued compliance with the Pollution Ordinance was enforced. Appropriate structural and nonstructural erosion control measures were inspected during these site inspections. If the existing erosion control methods were inadequate, additional structural or nonstructural BMPs were required. Engineering Services has the authority to revoke Watershed Development Permits as a result of failure to implement and maintain adequate erosion control measures. None of these permits were revoked during this reporting period, but violations were reported to the contractors at weekly progress meetings. This resulted in corrective action leading to compliance.

**c.)** Education and training of construction site operators

The brochure "Construction Site Best Management Practices" was available to construction operators at the Permit Center. Construction operators must visit the Permit Center in order to obtain Watershed Development permits from the City of Tulsa. This brochure lists erosion and sediment controls that can be utilized at construction activities. This brochure was also available at other events (see

Attachment B). There were 532 of these brochures distributed during this reporting period.

To assist local developers and builders with the use, installation and maintenance of erosion control measures, City of Tulsa representatives attended monthly Builders Council as well as Developer Council meetings held at the Greater Tulsa Home Builders Association.

Whenever a contractor was out of compliance, Field Engineering took the time to train contractors on the correct installation of erosion control measures.

City inspectors conducting soil erosion control inspections at construction sites, informed construction site operators on aspects of use and maintenance of appropriate structural and nonstructural BMP's. Additionally, City of Tulsa supervisors answered questions regarding construction site OPDES requirements and erosion control requirements.

**d.)** Building permit applicants notification

Building permit applicants of all private developments were notified of their responsibility under the OPDES permitting program during the building permit application review process and during any pre-submittal meetings. Through the infrastructure development process (IDP), proposed developments were reviewed and applicants were notified of the OPDES erosion and sediment control requirements prior to issuing IDP project permits. The City of Tulsa offers pre-development meetings to those considering a new development within the City. These meetings are site specific and provide guidance on all requirements. Included in the discussion are the requirements for erosion control throughout the construction period and the permanent requirements to prevent stormwater pollution.

In addition, the City explains stormwater pollution including the use of Low Impact Development (LID) as an effective Best Management Practice. Utilizing the predevelopment meetings and the IDP process to open the discussion about implementing LID practices before any development has actually taken place makes successful implementation of practices more likely to occur. In addition, the City

explains stormwater pollution requirements and the benefits of LID when conducting presentations or training to the development and building communities.

Developers and design engineers were provided the "OPDES General Permit for Stormwater Discharges from Construction Activities (OKR10)" information. Anyone obtaining an OPDES General Permit for Stormwater Discharges from Construction Activities (OKR10) submitted a stormwater pollution prevention plan along with an NOI, for review and approval prior to receiving an Earth Change permit. A stormwater pollution prevention plan checklist was utilized during the review process.

## Part II(A)(10) Public Education

*Status: Compliant and ongoing*

Recently the City of Tulsa significantly increased its public education efforts by implementing a more robust stormwater quality media campaign. The Stormwater Quality group, through a competitive bid process, collaborated with Grasshorse Studios to develop two endearing characters and a series of six commercials to help deliver stormwater quality public education messages. The characters developed are Sgt. Red, a sharp-tongued red ear slider turtle, who happens to be a drill sergeant. Sgt. Red allows no “dishonorable discharges” to the storm drain. Mingo, the orange-throat darter (a native fish to the Tulsa area that is pollution intolerant) is Sgt. Red’s friend and suffers from the effects of pollution. The below table shows the number of views from the commercials, in addition to the number of radio and billboard impressions.

| Media | Impressions (# of views/listens) |
|---|---|
| KOKI Fox23 | 2,251,660 |
| KOTV Channel 6 | 3,599,572 |
| KTUL Channel 8 | 5,091,000 |
| I Heart Radio | 1,463,000 |
| Cox Radio | 582,900 |
| Billboards (Lamar) | 3,130,533 |

The City of Tulsa passes out tote bags, pens, pencils, rain gauges all with the City of Tulsa website printed on them, pet waste bags with City of Tulsa printed on them, temporary tattoos of Sgt. Red and Mingo, fishing poles with a sticker that has our SOS logo, website and phone number on it.

Tulsa and its educational partners continued to educate the public on the prevention of pollution at the source. To get the most from each educational opportunity, many public educational activities targeted multiple sources of non-point source pollution, including vehicle fluids, pesticides, herbicides, fertilizers and erosion control practices. Stormwater education material was viewed approximately 2,734,243 during the reporting period. The significant increase in

this number from last reporting period is due to the implementation of the stormwater quality media campaign mentioned at the beginning of this section. A detailed description of the City of Tulsa's public education efforts can be found in Section 6(c).


The following groups participated in various public education events during this reporting period:

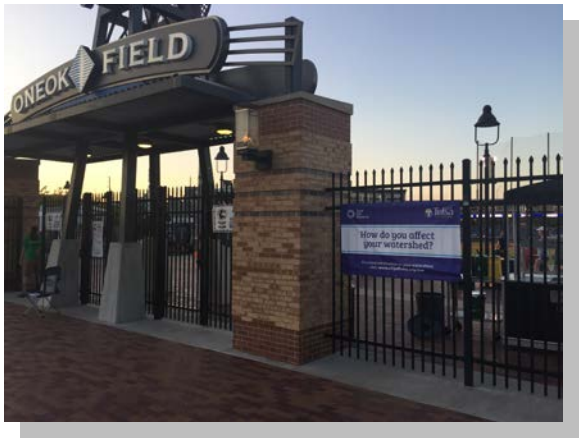
- City of Tulsa
  - Streets and Stormwater Department
  - Parks Department
  - Communications Department
  - Planning and Economic Development Department
  - Water and Sewer Department
- Tulsa County Conservation District (Blue Thumb Program)
- Metropolitan Environmental Trust (M.e.t.)

Education Activities Included:

- Displays at workshops and conferences
- Public presentations at conferences and seminars
- Presentations at local schools
- Presentations at home owners associations and neighborhood gatherings
- Creation and distribution of educational material (brochures, activity sheets, note pads, etc.) at a number of events

- Environmental awareness at numerous events (Enviro Expo, TPS Earth Day Festival, TCC Eco Fest, and Household Pollutant Collection Facility)
- Utility bill stuffer – stormwater information sent to all citizens that purchase water and sewer as well as pay utility bills to the City of Tulsa
- Billboards, TV commercials, newsletters and radio advertisements
- Handing out literature at HPCF.

See Attachment B for a full list of Educational Activities.




During this reporting period, Tulsa continued to create and utilize existing brochures, pamphlets and handouts to meet and exceed all its public education requirements. A complete listing of this material can be found as Attachment A "Educational Material Distributed 2017-2018". Attachment B "Education Events 2017-2018" is a complete listing of all the public education events the Stormwater Quality group participated in during this reporting period. Both these attachments can be found in the appendix of Section 6.

The Tulsa County Blue Thumb Program continued its efforts to reduce non-point source pollution. The Tulsa County Conservation District (TCCD) is involved with this Clean Water Act Section 319 funded program, which utilizes citizen volunteers. Volunteers have contributed 42,127 hours of work to the Blue Thumb program's activities. The program's goal is to make citizens of Tulsa aware of non-point source pollution and to encourage the adoption of practices that protect Tulsa's streams. This program has contributed greatly to the education of the public through the organization and training of citizen watershed monitoring groups and distribution of the "Blue Thumb Fish Prints". The Blue Thumb Program continues to collect data from area streams and uses this data to focus educational activities within the affected watersheds. This education involves informing local citizens on how to protect their streams against non-point source pollution. The TCCD continues to promote the Blue Thumb Program and encourage participation at public events, such as the Greater Tulsa Home and Garden Show and the Enviro Expo.

The Stormwater Quality group administers an electronic newsletter that is sent out quarterly to an estimated 1,944 email addresses. The newsletter is sent out a total of four time per year, usually in March, June, September and December which is equivalent to 7,776 contacts a year. There is also a special Spring Events newsletter

sent out in April every year. Through this newsletter recipients are educated on stormwater issues such as proper disposal of grass clippings, businesses that are practicing Best Management Practices are recognized and stormwater quality educational events are promoted. The public is informed of ways they can help improve and maintain stormwater quality, how they can contact the City of Tulsa for more information, request personnel to come speak at an event and how to report illicit discharges. Additionally, through the newsletter, the City of Tulsa provides recognition of an environmental steward of the quarter. This includes highlighting things such as good building practices, litter cleanup teams, and other water quality advocates.

The Stormwater Quality group partners with the City of Tulsa's Working in Neighborhoods (WIN) department to further public education efforts. The WIN department has a weekly newsletter that goes out to approximately 470 neighborhood leaders and 28,500 citizens via the Nextdoor app. The Stormwater Quality group utilizes this newsletter to help spread the word about upcoming educational events and programs. Details of WIN newsletter announcements can be found in Appendix B.

**a.**) Public reporting of illicit discharges and improper disposal

Numerous publications that promote the public reporting of illicit discharges and improper disposal were created and distributed by the City of Tulsa. Regular distribution locations included Tulsa Parks and Recreation Centers. Material was also distributed at events such as the Greater Tulsa Home and Garden Show, Environmental Expo, TCC Eco Fest, and all school educational demonstrations. The following is a partial list of publications distributed:

> *"Stormwater Quality Programs"* is a general brochure highlighting the current stormwater quality programs in the City of Tulsa. Also provided in the brochure are ten solutions to stormwater pollution, including the reporting of illicit discharges, and lists a telephone number and instructions on how to do so. This number is promoted all educational material distributed through our stormwater quality programs.
>
> *"City of Tulsa – General Guide to Regulatory Floodplains"* is a map designed to guide the public through floodplain requirements within the City of Tulsa. It provides a telephone number and encourages the public to report illegal discharges into the storm sewer.
>
> *"City of Tulsa Official 2017 Flood Notice – Flood Hazard Information About Your Property",* are two brochures that were sent to approximately 15,000 residences last year who live in or near the floodplain, have the potential to experience flooding and what to do in case of flooding. It provides a contact telephone number and encourages the public to report illegal discharges into the storm sewer.

During this reporting period, information was placed into two monthly utility bill stuffers July 2017 and March 2018 encouraging the public to report illegal discharges. These articles gave instructions on the proper procedures for reporting along with telephone numbers for the 311 Center, which is the primary method for reporting of citizen concerns. Additionally the 311 Center has 'on hold' messages that deliver stormwater quality information to callers. Last year 612,338 customers utilized the Customer Care Center.

Tulsa maintains a website, www.cityoftulsa.org/sos that has several links to tips that promote ways to reduce stormwater runoff pollution including the public reporting of illegal discharges to the storm sewer. The number of website pageviews has remained high with over 5,000 visits. While conducting inspections, City of Tulsa personnel continued to instruct citizens, business owners or operators to report any unusual discharge into the City's storm sewer immediately.

Tulsa's annual Creek Cleanup was co-sponsored by Tulsa County Conservation District (TCCD) and the City of Tulsa on May 19, 2017. Twenty-five volunteers removed litter from Joe Creek. Not only did this clean-up remove litter from the creek, it also helped to bring attention to the importance of reducing litter discharges to urban streams and waterways.

As a result of public awareness of the reporting of illicit discharges and improper disposal, 238 investigations were conducted involving the identification and removal of 17 illicit discharges to the storm sewer during this reporting period.

**b.)** Proper management and disposal of used motor vehicle fluids and household hazardous wastes

Public education in the proper management and disposal of used motor vehicle fluids and household hazardous wastes was accomplished through various methods. These methods include the distribution of the following educational material:

> *"Motor Oil"* is a brochure distributed during this reporting period that targeted the proper use, storage and disposal of motor oil.
>
> *"Stormwater Quality Programs"* is a brochure given to the public detailing our stormwater quality programs. Included in the brochure is information on the adverse effects of household chemicals on the environment as well as instructions on how to dispose of chemicals properly.
>
> *"City of Tulsa 2017 Official Flood Notice" and "Flood Hazard Information"* are two brochures that were sent to approximately 15,828 residences last year who had the potential to experience flooding and what to do in case of

flooding. It also encourages the public to dispose of used motor oil and antifreeze properly.

*"City of Tulsa – General Guide to Regulatory Floodplains"* is a map designed to guide the public through floodplain requirements within the City of Tulsa. It provides a telephone number and encourages the public to report illegal discharges into the storm sewer.

On January 6, 2016, the City of Tulsa opened the new Household Pollutant Collection Facility at 4502 South Galveston Ave. The facility is open 2 days a week (Wednesdays and Saturdays) from 8:00 am till 4:30 pm. See Part II(A)(6)(d) for a summary of the pollutants collected this year.

The following is a list of some of the events where material was distributed to the public:

| **Educational Events** | |
|---|---|
| Enviro Expo | STEM Alliance |
| Tulsa State Fair | Household Pollutant Collection Event |
| Greater Tulsa Home and Garden Show | TPS Earth Day Event |

Currently, The M.e.t. has 11 drop-off recycling depots with collection containers for used motor oil, cooking grease and batteries. Two of the eleven locations have containers for antifreeze collections. The "Recycling Locations" map flier and the "Tulsa Area Recycling Directory" both provide locations to the depots. These handouts are given during speeches, booths and events. The website, www.metrecycle.com promotes the event (now Household Pollutant Collection Facility) and depots. Fliers are distributed at booths, speeches and events throughout the year (see list below).

The following is a list detailing the quantity of materials the M.e.t. distributed:

FY 17/18 distribution estimates below:
Fairgrounds Pollutant Collects: delete
City of Tulsa Pollutant Collection Facility and Outlying Areas: 1425
Tulsa area Recycling Directory: 1754
Latex Paint and the Environment: 300
Don't Flush Your Unused Medications and Tulsa Medication Flier: 40
Deep Green Clean: 916
Recycling Locations Map: 1355
Electronic Waste Flier: 32
All Batteries Every Day: 30
What is Fluorescents: 25
Mercury in Your Home: 277

The revised specifications for new storm sewer inlet hoods include the message "Dump No Waste, Drains to River". These specifications were accepted by the City of Tulsa and the new inlet hoods have been obtained. As a result, all new or repaired catch basins will now have the message permanently cast into the hood therefore not requiring a placard.

Environmental educational activities were conducted at the Back to School STEM event, Groggs Green Barn Camp, and the University of Tulsa Celebrate Community event. Combined these events involved approximately 6515 children. Activities included videos, handouts, demonstrations and arts and craft. More details about this program can be found on Attachment C in the appendix of Section 6.

**c.)** Proper use, application and disposal of pesticides, herbicides and fertilizers

The responsibility of educating the public on the proper use, application and disposal of pesticides, herbicides and fertilizers was accomplished through the distribution of educational material (brochures, bookmarks, notepads, stickers, etc.), public speaking engagements, and utility bill stuffers. The following section lists some of the materials and activities used to comply with this requirement. An extensive list along with the number of pamphlets distributed can be found in Appendix A and B of Section 6.

> *"Fertilizers" and "Pesticides"* are two brochures which emphasize the proper application and disposal for the use of pesticides and fertilizers. It also lists alternatives to chemicals to control pests and fertilize lawns.
>
> *"Stormwater Quality Programs"* is a brochure given to the public detailing our stormwater quality programs. Included in the brochure is information on the adverse effects of pesticides and fertilizers on the environment as well as instructions on how to dispose of them properly.
>
> *"Pollution Prevention Plan"* is a Best Management Practice (BMP) created to guide citizens to do their part to keep our storm sewer clean. It addresses a number of pollutants including but not limited to fertilizers, herbicides and pesticides.

The Master Gardeners Program sponsored by Oklahoma State University - Tulsa Cooperative Extension Office maintains a telephone information service for the public regarding all aspects of gardening and landscaping, including the proper application and disposal of pesticides, herbicides and fertilizers. This service is offered five days a week, between 9 a.m. and 4 p.m. and has numerous brochures available to the public. See Part II (A) (5) "Pesticide, Herbicide and Fertilizer Application" for more information about this program. This program was publicized by Tulsa through the distribution of the *"Fertilizers"* brochure. OSU provided additional advertising through various means.

The City of Tulsa requires all City personnel, as well as all City contractors that apply pesticides and herbicides to be licensed and subject to all the regulations under the Oklahoma Pesticide Applicators Law, including re-certification. City personnel that apply pesticides, herbicides and fertilizers received annual in-house training on specific types of pesticides, herbicides and fertilizers that are applied. When available, employees attended workshops, conferences and additional training on pesticides, herbicides and fertilizers application and disposal. The Tulsa Parks Department received training in October and November of 2017. The City of Tulsa's Stormwater Management Division received training many times throughout the fiscal year.

Tulsa's website contains guidance for pesticide and fertilizers application for both commercial and residential applicators. This website is located at www.cityoftulsa.org/sos and is regularly promoted.

Public education and outreach in the proper management and disposal of household grease waste was accomplished through the City of Tulsa's FOG grease abatement program. Through this program 2,374 FOG BMP door hangers and 2,881 apartment packets (can toppers, grease bags, FOG BMP literature) were handed to residents involved in grease-related sewer blockage/overflow investigations. The FOG program ran television commercials highlighting the importance of proper household grease disposal through the trash rather than through the sanitary sewer.

The commercials were aired on the following television networks.

| Television Network | Frequency (# times aired) | Impressions (# views) |
|---|---|---|
| KOTV Channel 6 | 505 | 688,200 |
| KJRH Channel 2 | 60 | 176,250 (banner ads) |
| KTUL Channel 8 | 32 | NA |
| Cox Cable | 164 | NA |
| FOX 23 | 65 | NA |

In addition to television, the FOG program ran radio advertisements 100 times on Scripps Radio stations (KBEZ-FM and KHTT-FM) for a total of 181,100 impressions. AM 740 KRMG ran the FOG commercial 98 times for a total of 695,000 impressions.

The Journal Broadcast Group's stations (106.9 KHITS and 92.9 BOBFM). AM 740 KRMG ran the FOG commercial 59 times. I-heart Radio (KIZS and RIZS) ran the FOG commercial 252 times.

The FOG program increases residential educational activities during the holiday months to prevent residential grease blockages due to holiday cooking activities. A fryer oil collection event was held which collected 159 gallons of fryer oil for proper disposal. 1 FOG Workshop and had 38 attendees. Four FOG booths were set up at community events and had approximately 4,000—5,000 visitors to the booths.

## Part II(A)(11) Employee Education

*Status: Compliant and ongoing*

Presentations were made to personnel from Sewer Operations Maintenance, Engineering Services, and Stormwater Management on their responsibilities at facilities and job sites. Open discussion followed the presentation where information was exchanged resulting in program improvement.

All new employees at the City of Tulsa are required to attend new employee orientation. Stormwater quality information including how to report illicit discharges and what they can do as a City of Tulsa employee is placed in the information they receive during this orientation.

City of Tulsa Stormwater Management personnel attended an EPA MS4 Region 6 Stormwater Conference in Texas in 2017. The conference featured presentations on stormwater management including topics on low impact development and green infrastructure, TMDLs, construction and industrial stormwater and stormwater programs and training.

All City of Tulsa contractors as well as all employees that are required to apply pesticides, herbicides and fertilizers are required to be licensed under the Oklahoma Pesticide Applicators Law. In-house training regarding the application of various chemicals was conducted for city applicators during this reporting period. See Part II (A) (5) Pesticide, Herbicide, and Fertilizer Application.

City contractors responsible for herbicide, pesticide and fertilizer application, as well as landscape specialists and other lawn care providers were specifically educated on the proper use of chemicals, disposal thereof and spill prevention procedures. The City of Tulsa requires all contract applicators to be licensed under the Oklahoma Combined Pesticide Law and Rules (Title 2 of the Oklahoma Statues). This license requires each applicator to properly apply, dispose and address spills in an environmentally friendly manner.

## Part II(A)(12) Monitoring Programs

*Status: Compliant and ongoing*

**a.**) Dry weather field screening program

The dry weather field screening program continued during this reporting period. The details of this program are previously mentioned in Part II (A) (6) (e).

**b.)** Watershed characterization program

See Section 4

**c.)** Industrial and high risk runoff

The following table is a list of facilities classified under the SWMP as "Industrial and High Risk Runoff". This designation requires them to conduct self monitoring of their stormwater runoff. A summary of the number of industries that conducted monitoring during the permit life are as follows:

| I&HRR Facility Categories | # of facilities identified | # conducting monitoring |
|---|---|---|
| Municipal landfills | **1** | **0** |
| Other treatment, storage and disposal facilities of municipal waste (e.g. transfer stations, incinerators, etc.) | **4** | **0** |
| Hazardous waste treatment, storage, disposal and recovery facilities | **5** | **0** |
| Facilities that are subject to EPCRA Title III, Section 313 | **56** | **0** |
| Industrial or commercial discharges the permittee determines are contributing a substantial pollutant loading to the MS4. | **8** | **1** |

Letters informing industries of their responsibility to conduct monitoring were sent out at the end of FY 13-14. All monitoring results were required to be submitted to the Stormwater Management Division within one year. All monitoring results were reviewed and placed in the industry's activity file. Additional information regarding this program can be found at Part II (A) (8) Industrial & High Risk Runoff.

## Legal Authority

The City of Tulsa utilizes several Ordinances to ensure compliance with OPDES Permit #OKS000201. The following is a list of the most commonly used Ordinances accompanied by a brief description.

**Title 11-A Chapter 3 (Watershed Development Regulations)** – This Ordinance allows for the regulation of the methods for handling and disposing of stormwater run-off; the development, excavation, grading, regrading, paving, land filling, berming and diking of land; allows for the regulation of development within flood plains in order to assure that development is not dangerous to health, safety or property due to stormwater run-off; and allows for the regulation of the connection to and use of the stormwater drainage system. Through this Ordinance, Tulsa permits construction activities that are one acre or greater.

**Title 11-A, Chapter 5 (Pollution)** – This Ordinance was adopted in November of 1995 in order to give Tulsa the legal authority needed to comply with all of the municipal separate storm sewer system discharge permit requirements that were not covered by existing Ordinances. It prohibits illicit discharges to the storm sewer; allows for the control and monitoring of stormwater runoff; provides Tulsa with the legal means to inspect and investigate potential sources of pollution to the storm sewer; and contains judicial enforcement remedies. This Ordinance was revised during 2006-2007 reporting period to include provision for recovery of cost incurred by Tulsa against violators of this Ordinance. Maximum amount of fines per violation per day is $1,000.00.

**Title 11-C, Chapter 12 (Requirements For Industrial Users To Discharge To The Sanitary Sewer Systems)** – This Ordinance provides general sewer use requirements; allows for wastewater discharge permit issuance and inspection of all industries that discharge to the sanitary sewer; prohibit the inflow of stormwater into the sanitary sewer system; and contains judicial enforcement remedies.

**Title 24, Chapters 1 and 2 (Nuisances)** - These Ordinances provides for abatement of nuisances, including litter, industrial wastes, sewage, etc. from any area lake, basin, public park, alley, highway or street through enforcement actions including total cost recovery to the City of Tulsa from the any person, firm corporation, partnership, or other legal entity who commits or who permits the creation or continuation of a nuisance.

**Title 42, Chapter 11 (Planned Unit Development) –** This ordinance encourages innovative land development while maintaining appropriate limitation on the character and intensity of use and assuring compatibility with adjoining and proximate properties. It also promotes greater flexibility within the development to best utilize the unique physical features of a particular site. Creative land use design and open space preservation are also promoted in this Ordinance. Further, the final purpose of this Ordinance is to achieve a continuity of function and design within the development.

# Section 2

# Proposed Changes to the Stormwater Management Program

The City of Tulsa is currently in the process of negotiating a renewal of Permit OKS000201. The permit changes the City of Tulsa is recommending are aimed to improve the performance of the Stormwater Management Program. Any changes made in the requirements of the permit during the negotiation process will be incorporated into the SWMP within 6 months of effective date of the final permit. This requirement is in accordance with Tulsa's MS4 Permit OKS000201 Part III(A)(1).

# Section 3

## Revisions, if necessary, to the assessment of controls and the fiscal analysis reported in the permit application under OAC 252.606-1-3(b)(3)(L) adopting and incorporating by reference 40 CFR 122.26(d)(2)(iv) and (d)(2)(v)

No revisions to the "Controls" have been made during this reporting period.

# Section 4

# A Summary of the Data/Monitoring Data Accumulated Throughout the Reporting Year

To comply with the permit, individual programs were created or adopted and then implemented. Implementation resulted in the creation of databases that track dry weather field screening and floatables monitoring. Data was collected during this reporting period, reviewed for accuracy and completeness and then entered into specific databases. Each program is explained in the following paragraphs along with associated data.

## Dry Weather Field Screening

Dry weather field screening was continued during this reporting period in an ongoing effort to detect the presence of illicit connections and improper disposal. One hundred fifty-three outfalls were screened, covering approximately 31,105.67 acres (48.55 square miles). Of the 153 outfalls screened, 33 contained dry weather flow. Once dry weather flow was located, the flow was sampled and tested for pH, temperature, appearance, conductivity, detergents, chlorine, copper, ammonia and fluoride. If contaminants were identified in concentrations above action levels, then dry weather flow follow-up activities were implemented. Dry weather flow follow-up procedures continued until the source was identified. When an illicit discharge was identified, it was eliminated. Specific numbers for this reporting period are as follows:

| **Total # of outfalls screened** | **153** |
|---|---|
| **Total area screened** | 31,105.67 acres<br>48.55 sq. mi. |
| **# of outfalls that did not require follow-up (without flow)** | 119 |
| **# of outfalls with dry weather flows not requiring follow-up (flows present but pollutant concentration below action levels)** | 33 |
| **# of outfalls requiring dry weather flow follow-up (flow with concentrations of pollutants above the action levels)** | 1 |

## Floatable Monitoring Summary

Data was obtained from five floatable monitoring locations Inspections were performed after rainfall events (> 0.1 in.) during this reporting period. If floatables were present during an inspection, they were collected and data was gathered

regarding the quantity in cubic yards and make-up in percent (organic and inorganic). A summary of the data is as follows:

**Floating Monitoring Summary**
Station: 4800 W. 8th St.

| Date | Floatables Present | Collection (Cubic Yards) | % Organic | % Inorganic |
|---|---|---|---|---|
| 7/5/17 | no | 0 | 0% | 0% |
| 7/11/17 | no | 0 | 0% | 0% |
| 7/18/17 | no | 0 | 0% | 0% |
| 7/28/17 | no | 0 | 0% | 0% |
| 8/1/17 | no | 0 | 0% | 0% |
| 8/4/17 | yes | 1 | 90% | 10% |
| 8/8/17 | yes | 0.75 | 50% | 50% |
| 8/11/17 | yes | 0.5 | 50% | 50% |
| 8/17/17 | yes | 0.5 | 50% | 50% |
| 9/19/17 | no | 0 | 0% | 0% |
| 9/27/17 | yes | 1.25 | 70% | 30% |
| 10/4/17 | yes | 0.5 | 80% | 20% |
| 10/5/17 | yes | 1.25 | 60% | 40% |
| 10/10/17 | yes | 0.25 | 90% | 10% |
| 10/17/17 | yes | 1 | 70% | 30% |
| 10/24/17 | yes | 1 | 70% | 30% |
| 11/29/17 | yes | 0.45 | 50% | 50% |
| 12/19/2017 | yes | 0.5 | 80% | 20% |
| 12/20/2017 | yes | 0.15 | 20% | 80% |
| 12/27/17 | no | 0 | 0% | 0% |
| 1/9/18 | yes | 0.5 | 70% | 30% |
| 2/20/18 | no | 0 | 0% | 0% |
| 2/21/18 | yes | 0.5 | 80% | 20% |
| 2/22/18 | no | 0 | 0% | 0% |
| 2/24/18 | yes | 0.5 | 50% | 50% |
| 2/28/2018 | yes | 1 | 50% | 50% |
| 3/27/18 | yes | 0.5 | 20% | 80% |
| 4/10/18 | no | 0 | 0% | 0% |
| 4/24/18 | no | 0 | 0% | 0% |
| 4/25/2018 | yes | 0.25 | 50% | 50% |
| 5/2/18 | yes | 0.15 | 50% | 50% |
| 5/17/18 | no | 0 | 0% | 0% |
| 5/23/18 | yes | 0.15 | 90% | 10% |
| 5/24/18 | yes | 0.5 | 60% | 40% |
| 5/30/18 | yes | 1.25 | 60% | 40% |
| 5/31/18 | no | 0 | 0% | 0% |
| 6/12/18 | no | 0 | 0% | 0% |
| 6/26/2018 | yes | 0.25 | 80% | 20% |
| Total Cubic Yards | | 14.15 | | |
| Average Floatable Makeup (%) | | | 62% | 38% |

| Floating Monitoring Summary<br>Station: Osage Detention, 1101 West Pine Street | | | | |
|---|---|---|---|---|
| **Date** | **Floatables Present** | **Collection (Cubic Yards)** | **% Organic** | **% Inorganic** |
| 7/5/17 | yes | 2 | 70% | 30% |
| 7/11/17 | no | 0 | 0% | 0% |
| 7/18/17 | yes | 2 | 70% | 30% |
| 7/28/17 | no | 0 | 0% | 0% |
| 8/1/17 | no | 0 | 0% | 0% |
| 8/4/17 | no | 0 | 0% | 0% |
| 8/8/17 | yes | 2 | 80% | 20% |
| 8/11/17 | yes | 0.5 | 70% | 30% |
| 8/17/17 | yes | 0.5 | 80% | 20% |
| 9/19/17 | no | 0 | 0% | 0% |
| 9/27/17 | no | 0 | 0% | 0% |
| 10/4/17 | yes | 1.5 | 90% | 10% |
| 10/5/17 | | 13 | 100% | |
| 10/10/17 | no | 0 | 0% | 0% |
| 10/17/17 | yes | 0.25 | 100% | 0% |
| 10/24/17 | yes | 1 | 80% | 20% |
| 11/29/2017 | no | 0 | 0% | 0% |
| 12/19/2017 | no | 0 | 0% | 0% |
| 12/20/17 | no | 0 | 0% | 0% |
| 12/27/17 | no | 0 | | |
| 1/9/18 | yes | 1 | 80% | 20% |
| 2/22/18 | yes | 0.5 | 80% | 20% |
| 2/28/18 | yes | 0.8 | 60% | 40% |
| 4/10/18 | no | 0 | 0% | 0% |
| 4/24/18 | no | 0 | 0% | 0% |
| 4/25/18 | yes | 0.5 | 60% | 40% |
| 5/2/18 | yes | 0.5 | 50% | 50% |
| 5/17/18 | no | 0 | 0% | 0% |
| 5/23/18 | no | 0 | 0% | 0% |
| 5/24/18 | no | 0 | 0% | 0% |
| 5/30/18 | no | 0 | 0% | 0% |
| 5/31/18 | no | 0 | 0% | 0% |
| 6/12/18 | no | 0 | 0% | 0% |
| 6/26/18 | yes | 0.15 | 90% | 10% |
| Total Cubic Yards | | 26.2 | | |
| Average Floatable Makeup (%) | | | 77% | 33% |

| Floating Monitoring Summary<br>Station: Reed Park 4200 S. Union Ave. | | | | |
|---|---|---|---|---|
| **Date** | **Floatables Present** | **Collection (Cubic Yards)** | **% Organic** | **% Inorganic** |
| 7/5/17 | no | 0 | 0% | 0% |
| 7/11/17 | no | 0 | 0% | 0% |
| 7/18/17 | yes | 0.25 | 100% | 0% |
| 7/28/17 | no | 0 | 0% | 0% |
| 8/1/17 | no | 0 | 0% | 0% |
| 8/4/17 | no | 0 | 0% | 0% |
| 8/8/17 | no | 0 | 0% | 0% |
| 8/11/17 | no | 0 | 0% | 0% |
| 8/17/17 | yes | 0.25 | 50% | 50% |
| 9/19/17 | no | 0 | 0% | 0% |
| 9/27/17 | yes | 0.25 | 90% | 10% |
| 10/4/17 | no | 0 | 0% | 0% |
| 10/5/17 | no | 0 | 0% | 0% |
| 10/10/17 | no | 0 | 0% | 0% |
| 10/17/17 | yes | 0.25 | 100% | 0% |
| 10/24/17 | no | 0 | 0% | 0% |
| 11/29/17 | yes | 4 | 95% | 5% |
| 12/19/2017 | no | 0 | 0% | 0% |
| 12/20/2017 | yes | 3 | 95% | 5% |
| 12/27/17 | no | 0 | | |
| 1/9/18 | yes | 3 | 90% | 10% |
| 2/22/18 | no | 0 | 0% | 0% |
| 2/24/18 | no | 0 | 0% | 0% |
| 2/28/18 | no | 0 | 0% | 0% |
| 3/27/18 | Construction | | | |
| 04/24/208 | no | 0 | 0% | 0% |
| 4/25/18 | no | 0 | 0% | 0% |
| 5/2/18 | no | 0 | 0% | 0% |
| 5/17/18 | no | 0 | 0% | 0% |
| 5/23/18 | no | 0 | 0% | 0% |
| 5/30/18 | Construction | | | |
| 5/31/18 | no | 0 | 0% | 0% |
| 6/12/18 | Construction | 0 | | |
| 6/26/18 | Construction | 0 | | |
| Total Cubic Yards | | 11 | | |
| Average Floatable Makeup (%) | | | 89% | 11% |

| Floating Monitoring Summary<br>Station: Sheridan Park,10400 South 67th East Avenue | | | | |
|---|---|---|---|---|
| **Date** | **Floatables Present** | **Collection (Cubic Yards)** | **% Organic** | **% Inorganic** |
| 7/1/2017 | no | 0 | 0% | 0% |
| 7/5/17 | yes | 0.15 | 90% | 10% |
| 7/11/17 | no | 0 | 0% | 0% |
| 7/18/17 | no | 0 | 0% | 0% |
| 7/28/17 | yes | 1.5 | 90% | 10% |
| 8/1/17 | yes | 0.25 | 80% | 20% |
| 8/4/17 | yes | 1 | 80% | 20% |
| 8/8/17 | yes | 0.5 | 90% | 10% |
| 8/11/17 | no | 0 | 0% | 0% |
| 8/17/17 | yes | 0.25 | 100% | 0% |
| 9/19/17 | yes | 0.35 | 100% | 0% |
| 9/26/17 | yes | 0.5 | 100% | 0% |
| 10/4/17 | Underwater | 0 | 0% | 0% |
| 10/5/17 | yes | 0.25 | 100% | 0% |
| 10/10/17 | yes | 0.25 | 100% | 0% |
| 10/17/17 | yes | 1.25 | 80% | 20% |
| 10/24/17 | yes | 0.5 | 100% | 0% |
| 11/30/2017 | yes | 1.25 | 90% | 10% |
| 12/20/17 | yes | 0.25 | 100% | 0% |
| 12/27/17 | no | 0 | 0% | 0% |
| 1/9/18 | yes | 0.15 | 90% | 10% |
| 2/22/18 | yes | 1 | 90% | 10% |
| 2/28/18 | no | 0 | 0% | 0% |
| 3/27/18 | yes | 0.35 | 85% | 15% |
| 4/10/18 | yes | 0.15 | 100% | 0% |
| 4/24/18 | yes | 0.5 | 100% | 0% |
| 4/25/18 | no | 0 | 0% | 0% |
| 5/3/18 | yes | 0.25 | 80% | 20% |
| 5/15/18 | no | 0 | 0% | 0% |
| 5/17/18 | no | 0.25 | 50% | 50% |
| 5/23/18 | no | 0 | 0% | 0% |
| 5/24/18 | yes | 0.5 | 75% | 25% |
| 5/30/18 | yes | 0.5 | 100% | 0% |
| 5/31/18 | yes | 0.5 | 80% | 20% |
| 6/12/18 | yes | 0.25 | 100% | 0% |
| 6/26/18 | no | 0 | 0% | 0% |
| Total Cubic Yards | | 12.65 | | |
| Average Floatable Makeup(%) | | | 90% | 10% |

| Floating Monitoring Summary<br>Station: Vensel Creek 11100 S. Yale Ave. | | | | |
|---|---|---|---|---|
| **Date** | **Floatables Present** | **Collection (Cubic Yards)** | **% Organic** | **% Inorganic** |
| 7/1/2017 | yes | 0.25 | 80% | 20% |
| 7/11/17 | yes | 1 | 90% | 10% |
| 7/18/17 | no | 0 | 0% | 0% |
| 7/28/17 | yes | 1 | 90% | 10% |
| 8/1/17 | no | 0 | 0% | 0% |
| 8/4/17 | yes | 0.5 | 80% | 20% |
| 8/8/17 | no | 0 | 0% | 0% |
| 8/11/17 | yes | 0.5 | 100% | 0% |
| 8/17/17 | yes | 0.25 | 100% | 0% |
| 9/19/17 | yes | 0.25 | 90% | 10% |
| 9/26/17 | yes | 0.5 | 100% | 0% |
| 10/4/17 | no | 0 | 0% | 0% |
| 10/5/17 | yes | 0.25 | 100% | 0% |
| 10/10/17 | yes | 0.5 | 90% | 10% |
| 10/17/17 | yes | 1.25 | 100% | 0% |
| 10/24/17 | no | 0 | 0% | 0% |
| 11/30/2017 | yes | 0.5 | 100% | 0% |
| 12/20/17 | yes | 0.25 | 100% | 0% |
| 12/27/17 | no | 0 | 0% | 0% |
| 1/9/18 | no | 0 | 0% | 0% |
| 2/20/18 | yes | 0.25 | 90% | 10% |
| 2/27/18 | yes | 1 | 80% | 20% |
| 2/28/18 | yes | 1.5 | 90% | 10% |
| 3/27/18 | no | 0 | 0% | 0% |
| 4/10/18 | yes | 0.5 | 90% | 10% |
| 4/24/18 | yes | 0.5 | 100% | 0% |
| 4/25/18 | no | 0 | 0% | 0% |
| 5/3/18 | yes | 1 | 100% | 0% |
| 5/15/18 | no | 0 | 0% | 0% |
| 5/17/18 | yes | 0.25 | 80% | 20% |
| 5/23/18 | no | 0 | 0% | 0% |
| 5/24/18 | yes | 0.75 | 75% | 25% |
| 5/30/18 | yes | 0.25 | 90% | 10% |
| 5/31/18 | yes | 0.5 | 90% | 10% |
| 6/12/18 | yes | 0.5 | 80% | 20% |
| 6/26/18 | yes | 0.25 | 90% | 10% |
| Total Cubic Yards | | 14.25 | | |
| Average Floatable Makeup (%) | | | 91% | 9% |

# Watershed Characterization - Stream Monitoring Reports

# CITY OF TULSA
# WATERSHED CHARACTERIZATION PROGRAM

# Comprehensive Watershed Characterization Assessment Year 2 (2017-2018):

City of Tulsa Streets and Stormwater
Stormwater and Land Management Division
4502 South Galveston
Tulsa, OK 74107

Prepared by

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Watershed Characterization Project

**October 12, 2018**

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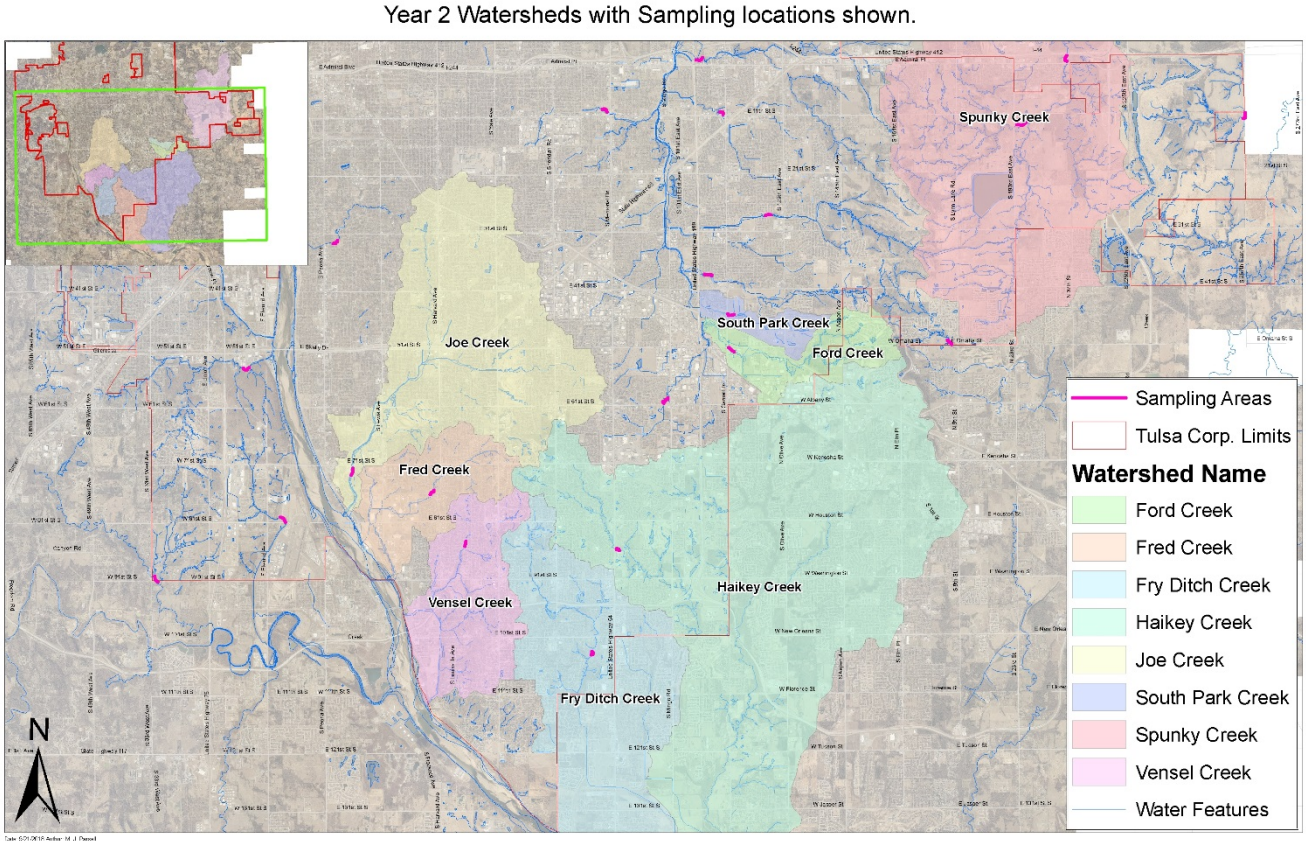
# 1.0 INTRODUCTION

## 1.1 Objective

The purpose of this document is to serve as a comprehensive report of results from the biological, habitat, and analytical assessments of Ford Creek, Fred Creek, Fry Ditch Creek, Haikey Creek, Joe Creek, South Park Creek, Spunky Creek, and Vensel Creek. These assessments were performed in order to comply with requirements set forth in Part II(A)(13)(12)(b) and (13)(a) and (b) and Part IV(A)(1) and (2) of Oklahoma Pollutant Discharge Elimination System (OPDES) municipal stormwater (MS4) Permit No. OKS000201 for the City of Tulsa, Oklahoma (ODEQ, OPDES Permit OKS000201, 2011). In addition, assessment results are applied to Oklahoma Water Quality Standards. These standards are described in both (OWRB, 2013a) and (OWRB, 2013b). Where applicable, reference conditions will not be established until the conclusion of the current permit. Until such references are established, those standards will result in an "insufficient data" designation with regards to support within the Fish and Wildlife propagation beneficial use. While these implementations describe a multitude of surface water quality standards, this document will compare and describe only the standards applicable to the parameters required in the Watershed Characterization Program sub section of the Municipal Separate Storm Sewer System permit (ODEQ, OPDES Permit OKS000201, 2011). All remaining parameter results without applicable water quality standards will still be included in this report.

The data presented in this comprehensive report was collected over a one year period beginning in July of 2017 with completion in June of 2018 with the exception of benthic macroinvertebrate data which requires a minimum of four sampling events within a two year period. Field collection and assessment methodology followed project standard operating procedures (SOPs) as provided in the quality assurance project plans (QAPPs) for the biological component (CCRC & FTN, 2014) and the analytical component (CCRC & FTN, 2014). These QAPPs provide quality assurance and quality control procedures for all aspects of the watershed characterization program. They were submitted to and received approval from the Oklahoma Department of Environmental Quality as per MS4 permit requirements. All field data sheets were scanned electronically and archived at the City of Tulsa Stormwater and Land Management Division. All field measurements (in situ measurements, flows, observations), biological information (taxonomic identification, organism counts), and analytical results were compiled in Excel spreadsheets and verified (data entry, formula calculations) per project QA/QC procedures (CCRC & FTN, 2014) (CCRC & FTN, 2014). All raw data, SOPs, and QAPPs are available upon request.

Figure 1 – City of Tulsa watershed map



## Ford Creek
## WBID: 121300 NOT LISTED

Table 1 - Sampling location and events on Ford Creek

| Waterbody | Sample Location | | Watershed Area ($mi^2$)* | Sampling/Evaluation Date | | | |
|---|---|---|---|---|---|---|---|
| | Latitude | Longitude | | Fish | Benthic (Summer) | Benthic (Winter) | Habitat |
| Ford Creek | 36.089444 | -95.850000 | 2.41 | 08/25/2017 | 09/07/2016 | 02/17/2017 | 11/30/2017 |
| | | | | | 10/13/2017 | 02/15/2018 | |

* Collection area captured by sampling point

# 2.0 BENEFICIAL USES

**2.1 Agriculture –** Data collected on Total Dissolved Solids for Ford Creek indicates attainment of the agricultural beneficial use. The number of samples collected exceeds the number of samples required. The sample mean does not exceed the yearly standard and none of the samples exceeded the sample standard.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 314 | 390 | Sample: 470, Yearly: 387 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |

Table 2 – Agriculture standards for Ford Creek

## 2.2 Fish and Wildlife Propagation: Warm Water Aquatic Community

**2.2.1** Dissolved Oxygen - Data collected on Dissolved Oxygen concentrations shows the beneficial use is supported. The number of samples collected exceeds the number of required samples. Out of 12 samples, none were found to be below the standard. Therefore, less than 10% of the samples were outside the standard range.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| D.O. | 0 samples below 6.0 | na | April - June: 5.0 | 3 | 10 total | No more than 10% of samples outside range |
| | 0 samples below 5.0 | na | June - Mar: 6.0 | 9 | | |

Table 3 – Dissolved Oxygen standards for Ford Creek

**2.2.2** Toxicants/Metals - Data collected indicate full support of the beneficial use for Toxicants and Metals.

| Parameter | Sample Mean (µg/L) | Single Sample (µg/L) | Water Quality Standard (µg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Cadmium | 0.42 | 0.50 | Acute: 54.43, Chronic: 1.58 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper | 1.72 | 2.94 | Acute: 28.65, Chronic: 18.40 | 12 | 5 | |
| Lead | 0.49 | 1.10 | Acute: 140.30, Chronic: 5.47 | 12 | 5 | |
| Zinc | 12.23 | 24.60 | Acute: 167.79, Chronic: 151.97 | 12 | 5 | |

Table 4 – Toxicants/Metals standards for Ford Creek

**2.2.3** pH (Hydrogen Ion Activity) - Data collected on pH readings for Ford Creek show full support of the beneficial use. The number of pH measurements taken exceeds the number of required measurements. All pH measurements fell within the standard range.

| Parameter | Sample Range (s.u.) | Single Sample (s.u.) | Water Quality Standard Range (s.u.) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| pH | 6.8 – 8.0 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |

Table 5 – pH standards for Ford Creek

**2.2.4** Oil and Grease - Data collected on Oil and Grease concentrations through HEM laboratory analysis show support of the beneficial use. All samples taken showed Oil and Grease amounts to be below the detection limit.

**2.2.5** Suspended and Bedded Sediments - Using habitat assessment data to determine support of the beneficial use is conditional upon the support of turbidity data and fish collection data.

**2.2.5.1** *Turbidity* – Data collected on Turbidity readings for Ford Creek show full support of the beneficial use.

| Parameter | Sample Mean (NTU) | Single Sample (NTU) | Water Quality Standard (NTU) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Turbidity | 10.78 | 31.70 | 50 | 12 | 10 | No more than 10% exceeding sample standard |

Table 6 – Turbidity standards for Ford Creek

**2.2.5.2** *Habitat Assessment* - The resulting score of the habitat assessment on Ford Creek can be compared to the average score of high quality sites within the same ecoregion provided by the Oklahoma Conservation Commission using a scoring workbook derived from OWRB (OWRB, 2001). The results of the habitat assessment produced a score below average for the central irregular plains ecoregion.

| Metric | Score |
|---|---|
| Instream habitat | 18.7 |
| Pool bottom substrate | 5.4 |
| Pool variability | 0.0 |
| Canopy cover | 5.5 |
| Presence of rocky runs and riffles | 16.1 |
| Flow (at representative low flow) | 1.9 |
| Channel alteration | 5.0 |
| Channel sinuosity | 0.2 |
| Bank stability | 8.5 |
| Bank vegetation stability | 4.9 |
| Stream side Cover | 5.0 |
| **Total Score** | **71.20** |
| **Central Irregular Plains Mean Score** | **84.09** |

Table 7 – Habitat assessment metric and total results with ecoregion mean score

### 2.2.6 Biological

**2.2.6.1** *Fish Collections* - Data recorded from fish collections performed on Ford Creek show that the beneficial use is undetermined.

| Index of Biotic Integrity | Score |
|---|---|
| Sample Composition | 10 |
| Fish Condition | 15 |
| Score Key: 30 + Beneficial Use Supported : 23 - 29 Undetermined : < 22 Impaired | Total: 25 |

Table 8 – Fish IBI score for Ford Creek

| Family | Species Name | Common Name | Number of Fish | Percentage |
|---|---|---|---|---|
| Ictaluridae | *Ameirus melas* | Black bullhead | 1 | 0.1% |
| Centrarchidae | *Lepomis cyanellus* | Green sunfish | 6 | 0.4% |
| | *Lepomis microlophus* | Redear Sunfish | 1 | 0.1% |
| | *Micropterus salmoides* | Largemouth bass | 1 | 0.1% |
| Cyprinidae | *Campostoma anomalum* | Central stoneroller | 573 | 41.2% |
| | *Cyprinella lutrensis* | Red Shiner | 7 | 0.5% |
| Poeciliidae | *Gambusia affinis* | Mosquitofish | 803 | 57.7% |
| **Total Number:** | | | 1392 | 100.0% |
| **Total Number of Taxa:** | | | 7 | |

Table 9 – Fish collection counts for Ford Creek

^Photograph taken of Ford Creek sample site

**2.2.6.2** *Benthic Macroinvertebrate Collections* – Data recorded from benthic macroinvertebrate collections during the summer and winter index periods is undetermined (ODEQ, Continuing Planning Process, 2012).

| Sampling Event | Score |
|---|---|
| Summer 2016 | 52% |
| Winter 2017 | 74% |
| Summer 2017 | 52% |
| Winter 2018 | 67% |
| Ford Creek - (Central Irregular Plains): >80% Attaining : 50-80% - Undetermined : < 50% Impaired | |

Table 10 – Benthic macroinvertebrate metrics for summer and winter index periods at Ford Creek

| Genus | Common Class | 9/7/2016 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 9 | 8.4% |
| *Fallceon quilleri* | Minnow Mayfly | 28 | 26.2% |
| *Tricorythodes* sp. | Stout Crawler Mayfly | 1 | 0.9% |
| *Argia* sp. | Narrowwinged Damselfly | 1 | 0.9% |
| *Apedilum* sp. | Midge | 23 | 21.5% |
| *Cricotopus* sp. | | 7 | 6.5% |
| *Cryptochironomus* sp. | | 1 | 0.9% |
| *Dicrotendipes fumidus* | | 2 | 1.9% |
| *Dicrotendipes neomodestus* | | 13 | 12.1% |
| *Labrundinia* sp. | | 1 | 0.9% |
| *Microtendipes pedellus* gr. | | 1 | 0.9% |
| *Nanocladius* sp. | | 1 | 0.9% |
| *Pentaneura* sp. | | 3 | 2.8% |
| *Polypedilum flavum* | | 5 | 4.7% |
| *Polypedilum illinoense* gr. | | 6 | 5.6% |
| *Rheotanytarsus exiguus* gr. | | 1 | 0.9% |
| Enchytraeidae | Aquatic Worm | 1 | 0.9% |
| tubificoid Naididae w/o cap setae | Aquatic Worm (Bald) | 1 | 0.9% |
| *Physa* sp. | Lung Snail | 2 | 1.9% |
| Total | | 107 | 100.0% |
| Total Number of Taxa | | 19 | |

2016 Ford Creek Summer Index Period

| Genus | Common Class | 2/17/2017 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 25 | 24.5% |
| *Fallceon quilleri* | Minnow Mayfly | 3 | 2.9% |
| Heptageniidae | Flathead Mayfly | 2 | 2.0% |
| *Argia* sp. | Narrowwinged Damselfly | 2 | 2.0% |
| *Stenelmis* sp. | Riffle Beetle | 3 | 2.9% |
| *Cladotanytarsus* sp. | Midge | 1 | 1.0% |
| *Cricotopus bicinctus* gr. | | 4 | 3.9% |
| *Cricotopus* sp. | | 3 | 2.9% |
| *Cricotopus/Orthocladius* sp. | | 14 | 13.7% |
| *Cryptochironomus* sp. | | 6 | 5.9% |
| *Dicrotenipes neomodestus* | | 9 | 8.8% |
| *Orthocladius* sp. | | 11 | 10.8% |
| *Polypedilum flavum* | | 4 | 3.9% |
| *Polypedilum illinoense* gr. | | 2 | 2.0% |
| *Thienemanniella* sp. | | 1 | 1.0% |
| *Erpobdella* sp. | Leech | 3 | 2.9% |
| *Corbicula* sp. | Asian Freshwater Clam | 1 | 1.0% |
| Sphaeriidae | Pea Clam | 1 | 1.0% |
| *Galba* sp. | Lung snail | 2 | 2.0% |
| *Physa* sp. | Lung snail | 4 | 3.9% |
| *Hyalella* sp. | Scud | 1 | 1.0% |
| Total | | 102 | 100.0% |
| Total Number of Taxa | | 21 | |

2017 Ford Creek Winter Index Period

| Genus | Common Class | 10/13/2017 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 36 | 34.3% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 1 | 1.0% |
| *Hydroptila* sp. | Micro Caddisfly | 1 | 1.0% |
| *Argia* sp. | Narrowwinged Damselfly | 3 | 2.9% |
| *Erpetogomphus* sp. | Clubtail Dragonfly | 1 | 1.0% |
| *Dubiraphia* sp. | Riffle Beetle | 1 | 1.0% |
| *Stenelmis* sp. | | 2 | 1.9% |
| *Cricotopus bicinctus* gr. | Midge | 2 | 1.9% |
| *Cricotopus/Orthocladius* sp. | | 3 | 2.9% |
| *Dicrotendipes neomodestus* | | 10 | 9.5% |
| *Polypedilum flavum* | | 18 | 17.1% |
| *Polypedilum illinoense* gr. | | 1 | 1.0% |
| *Pseudochironomus* sp. | | 1 | 1.0% |
| *Rheotanytarsus exiguus* gr. | | 16 | 15.2% |
| *Thienemanniella* sp. | | 1 | 1.0% |
| *Thienemanniella* gr. sp. | | 1 | 1.0% |
| *Erpobdella* sp. | Leech | 1 | 1.0% |
| Bivalvia | Clam | 2 | 1.9% |
| *Physella* sp. | Lung Snail | 1 | 1.0% |
| *Hyalella* sp. | Scud | 3 | 2.9% |
| Total | | 105 | 100.0% |
| Total Number of Taxa | | 20 | |

2017 Ford Creek Summer Index Period

| Genus | Common Class | 2/15/2018 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 39 | 34.5% |
| *Fallceon* sp. | Minnow Mayfly | 3 | 2.7% |
| *Cricotopus bicinctus* gr. | Midge | 13 | 11.5% |
| *Cricotopus* sp. | | 27 | 23.9% |
| *Cricotopus/Orthocladius* sp. | | 7 | 6.2% |
| *Dicrotendipes* sp. | | 1 | 0.9% |
| *Orthocladius* sp. | | 4 | 3.5% |
| *Polypedilum flavum* | | 5 | 4.4% |
| *Polypedilum illinoense* gr. | | 4 | 3.5% |
| *Erpobdella* sp. | Leech | 1 | 0.9% |
| *Nais* sp. | Aquatic Worm | 1 | 0.9% |
| tubificoid w/o cap setae | Aquatic Worm (Bald) | 1 | 0.9% |
| *Physa* sp. | Lung snail | 2 | 1.8% |
| *Hyalella* sp. | Scud | 5 | 4.4% |
| Total | | 113 | 100.0% |
| Total Number of Taxa | | 14 | |

2018 Ford Creek Winter Index Period

Table 11 – Benthic macroinvertebrate counts for Ford Creek summer and winter index periods

**2.3 Primary Body Contact -** The data collected on *E. coli* and *Enterococcus* concentrations show that Ford Creek is impaired for *Enterococcus*. The number of samples collected exceeds the number of samples required. While the MS4 permit requires monthly sampling of bacteria, water quality standards only pertain to samples collected during the recreational period.

| Parameter | Sample Geometric Mean (MPN/100mL) | Single Sample (MPN/100mL) | Water Quality Standard (MPN/100mL) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| *E. coli* | 67 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| *Enterococcus* | 251 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |

Table 12 – *E. coli* and *Enterococcus* totals for Ford Creek

Figure 2 - *E. coli* Concentrations for Ford Creek

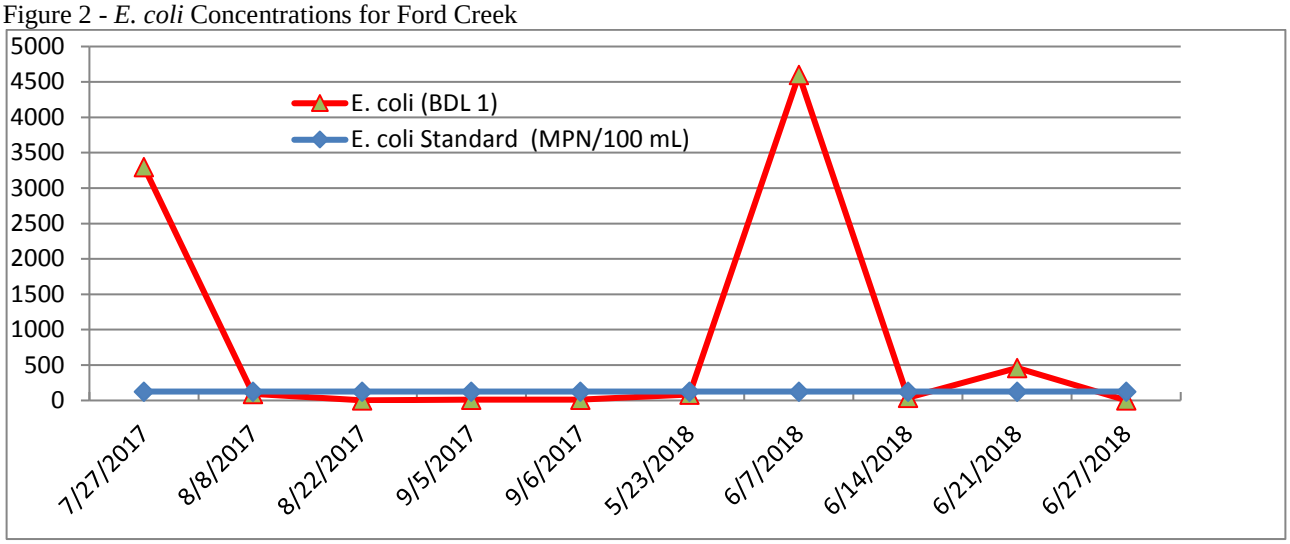
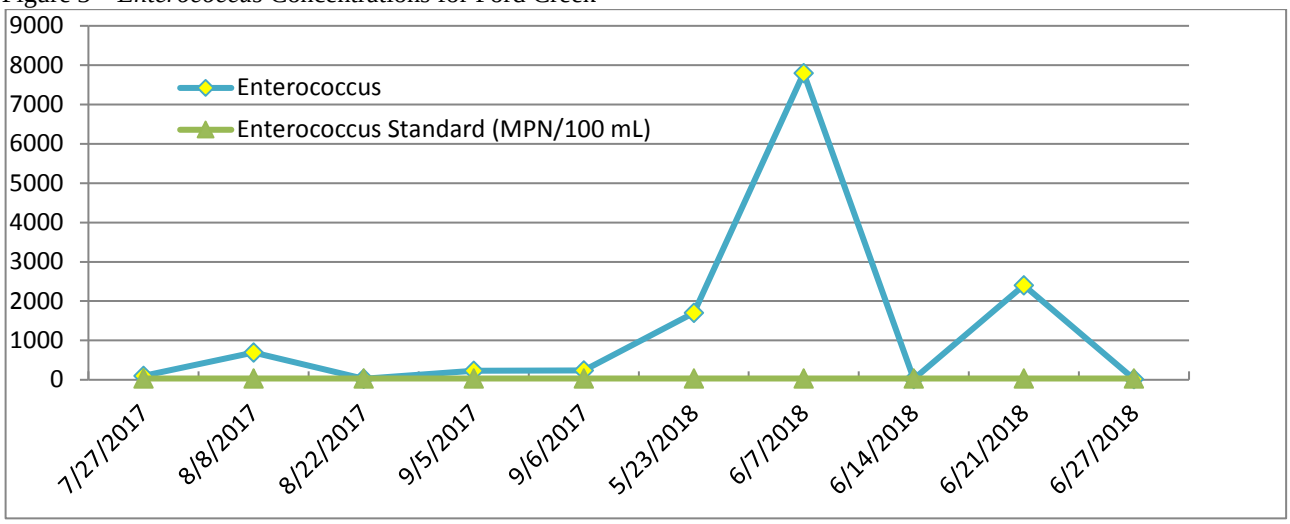



Figure 3 – *Enterococcus* Concentrations for Ford Creek



## 2.4 Anti-Degradation Policy

**2.4.1** Nutrients - Analytical results for Total Phosphorus and Nitrate/Nitrite show no need for further investigation to show support of the beneficial use. The number of samples collected exceeds the number of required samples, and less than 10% of samples exceeded the threshold for further sampling. While Nitrate/Nitrite concentrations have an action level, it is not a required parameter within the MS4 permit (ODEQ, OPDES Permit OKS000201, 2011).

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Threshold (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Phosphorus | 0.07 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| Nitrite - Nitrate | 0.23 | na | 4.95 | 12 | 10 | No more than 10% of samples outside range |

Table 13 – Nutrient totals for Ford Creek

## 3.0 SUMMARY

Analytically, Ford Creek does not reflect any water quality impacts to the stream during the year of sampling with the exception of *Enterococcus*. Fish collections reflected an undetermined classification according to water quality standards. A lack of intolerant species prevents full support, however an increase in species diversity would also be beneficial. A disappointing benthic macroinvertebrate IBI score could also be related to the lack of intolerant species which prevents support of the beneficial use. It is possible that the channelization of Ford Creek may prevent repopulation of fish and macroinvertebrates. The lower than average habitat assessment score may also be a contributing factor to the fish and macroinvertebrate scores. Ford Creek has very little canopy cover, streamside vegetation, and little sinuosity.

Table 14 – Oklahoma Water Quality Standards summary of collected data for Ford Creek

| Ford | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Sample Mean** | **Single Sample** | **Water Quality Standard** | **No. of Samples** | **No. of Samples Required (WQS)** | **How Standard is Violated** |
| Cadmium (µg/L) | 0.42 | 0.50 | Acute: 54.43, Chronic: 1.58 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper (µg/L) | 1.72 | 2.94 | Acute: 28.65, Chronic: 18.40 | 12 | 5 | |
| Lead (µg/L) | 0.49 | 1.10 | Acute: 140.30, Chronic: 5.47 | 12 | 5 | |
| Zinc (µg/L) | 12.23 | 24.60 | Acute: 167.79, Chronic: 151.97 | 12 | 5 | |
| Diazinon (µg/L) | 0.15 | na | Acute: 0.17 | 12 | 5 | |
| E. coli (MPN/100ml) | 67 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| Enterococcus (MPN/100ml) | 261 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |
| Oil and Grease (visual) | None | na | No visible sheen | 12 | 10 | No more than 10% of observations with oil & grease |
| Total Phosphorus (mg/L) | 0.07 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| *Nitrite – Nitrate (mg/L)* | *0.23* | *na* | *4.95* | *12* | *10* | *No more than 10% of samples outside range* |
| Total Dissolved Solids (mg/L) | 314 | 390 | Sample: 470, Yearly: 387 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |
| pH (s.u.) | 6.8 – 8.0 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |
| *D.O. (mg/L)* | *0 samples below 6.0* | *na* | *April 1-June 15: 6.0* | *3* | *10 total* | *No more than 10% of samples outside range* |
| | *0 samples below 5.0* | *na* | *June 16-Mar 31.: 5.0* | *9* | | |

*Analytes in italics not required by permit
*Analytes in red exceed standards*

| Analyte | Result | | |
|---|---|---|---|

| | Minimum | Mean | Maximum | Number of Samples | Number of Attempts |
|---|---|---|---|---|---|
| Oxygen Demand, 5-Day Biological (mg/L)(DL 3.0 mg/L) | -- | 3.06 | 5.80 | 12 | 12 |
| Cadmium, Total (µg/L) (DL 0.5 µg/L) | -- | 0.42 | 0.50 | 12 | 12 |
| Coliform, Fecal (CFU/100 mL)(DL 1 CFU/100 mL) | -- | 56 | 4800 | 12 | 17 |
| Conductivity µS | -- | 440 | 604 | 12 | 12 |
| Copper, Total (µg/L) (DL 0.5 µg/L) | -- | 1.72 | 2.94 | 12 | 12 |
| Diazinon (µg/L) (DL 0.17-5.0 µg/L) | -- | 0.15 | 0.17 | 12 | 12 |
| Dissolved Oxygen (mg/L) | 7.30 | 10.59 | 17.77 | 12 | 12 |
| *E. coli* (MPN/100 mL) (DL 1 MPN/100 mL) | -- | 67 | 4600 | 12 | 17 |
| *Enterococcus* (MPN/100 mL)(DL 1 CFU/100 mL) | -- | 261 | 7800 | 12 | 17 |
| Flow (cfs) | 0.02 | 0.38 | 1.59 | 12 | 12 |
| Hardness, Total (mg/L) (DL 3.6 mg/L) | 120 | 194 | 260 | 12 | 12 |
| Lead, Total (µg/L) (DL 0.5 µg/L) | -- | 0.49 | 1.10 | 12 | 12 |
| Nitrogen, Total Kjeldahl (mg/L)(DL 0.50 mg/L) | -- | 1.10 | 3.50 | 12 | 12 |
| Nitrogen, Nitrate-Nitrite (mg/L) (DL 0.2 mg/L) | -- | 0.23 | 0.55 | 12 | 12 |
| Nitrogen, Total as Nitrogen (mg/L)(DL 0.50 mg/L) | -- | 1.15 | 3.50 | 12 | 12 |
| Oil and Grease (mg/L) (DL 6.0-6.5 mg/L) | -- | 6.65 | 7.70 | 12 | 12 |
| Oxygen Demand, Chemical (mg/L)(DL 20 mg/L) | -- | 21 | 26 | 12 | 12 |
| pH (su) | 6.82 | 7.58 | 7.99 | 12 | 12 |
| Phosphorus, Total (mg/L) (DL 0.010 mg/L) | -- | 0.07 | 0.41 | 12 | 12 |
| Phosphorus, Dissolved (mg/L) (DL 0.010 mg/L) | -- | 0.05 | 0.40 | 12 | 12 |
| Solids, Total Dissolved (mg/L) (DL 10 mg/L) | -- | 314 | 390 | 12 | 12 |
| Solids, Total Suspended (mg/L) (DL 2.0 mg/L) | -- | 12.70 | 54.00 | 12 | 12 |
| Temperature, Water (°C) | 1.72 | 16.61 | 29.50 | 12 | 12 |
| Turbidity | -- | 10.78 | 31.70 | 12 | 12 |
| Zinc, Total (µg/L) (DL 10 µg/L) | -- | 12.23 | 24.60 | 12 | 12 |
| Results found to be below the detection limit are reported as the detection limit | | | | | |

Table 15 – MS4 permit required analytical sampling parameters result summaries for Ford Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/13/17 | 8/8/17 | 9/5/17 | 10/2/17 | 11/7/17 | 12/14/17 | 1/22/18 | 2/12/18 | 3/21/18 | 4/3/18 | 5/23/18 | 6/19/18 |
| BOD(5) Day (BDL 3) mg/L | 3.0 | 2.9 | 3.0 | 2.1 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 2.1 | 2.8 | 5.8 |
| Cadmium, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.50 | 0.001 | 0.001 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Conductivity µS | 430 | 332 | 488 | 409 | 429 | 425 | 403 | 414 | 510 | 486 | 604 | 355 |
| Copper, Total (BDL 0.5) µg/L | 1.92 | 2.94 | 2.16 | 2.00 | 0.005 | 0.005 | 1.20 | 1.75 | 1.80 | 1.53 | 2.37 | 2.94 |
| Diazinon (BDL 0.17) µg/L | 0.17 | 0.17 | 0.10 | 0.10 | 0.10 | 0.10 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| Dissolved Oxygen mg/L | 7.30 | 7.47 | 8.24 | 7.50 | 10.10 | 13.93 | 13.56 | 17.77 | 10.08 | 11.55 | 11.62 | 8.00 |
| Flow CFS | 0.17 | 1.49 | 0.09 | 0.04 | 0.09 | 0.07 | 0.12 | 0.13 | 0.25 | 1.59 | 0.49 | 0.02 |
| Hardness, Total (BDL 3.6) mg/L | 140 | 120 | 150 | 130 | 230 | 260 | 230 | 260 | 240 | 220 | 190 | 160 |
| Lead, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.501 | 0.0005 | 0.0005 | 0.50 | 1.10 | 0.50 | 0.654 | 0.50 | 0.634 |
| Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L | 0.86 | 2.70 | 0.50 | 0.63 | 0.52 | 0.50 | 0.50 | 0.71 | 3.50 | 0.56 | 0.75 | 1.50 |
| Nitrogen, Nitrate-Nitrite (BDL 0.2) mg/L | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.25 | 0.20 | 0.20 | 0.55 | 0.20 | 0.20 |
| Nitrogen, Total as N (BDL 0.5) mg/L | 0.86 | 2.70 | 0.50 | 0.63 | 0.52 | 0.50 | 0.50 | 0.71 | 3.50 | 1.10 | 0.75 | 1.50 |
| Oil and Grease HEM (BDL 6) mg/L | 6.70 | 6.20 | 6.30 | 7.50 | 6.10 | 6.40 | 6.20 | 7.40 | 7.70 | 6.80 | 6.30 | 6.20 |
| Oxygen Demand, Chemical (BDL 20) mg/L | 20 | 26 | 20 | 20 | 20 | 20 | 20 | 21 | 20 | 20 | 20 | 20 |
| pH (s.u.) | 7.69 | 7.80 | 7.83 | 7.73 | 7.64 | 7.65 | 7.46 | 7.31 | 7.47 | 7.58 | 7.99 | 6.82 |
| Phosphorus, Total (BDL 0.010) mg/L | 0.025 | 0.060 | 0.014 | 0.048 | 0.020 | 0.015 | 0.042 | 0.077 | 0.026 | 0.032 | 0.027 | 0.410 |
| Phosphorus, Total Dissolved BDL (0.010) mg/L | 0.011 | 0.028 | 0.013 | 0.037 | 0.010 | 0.010 | 0.017 | 0.022 | 0.010 | 0.018 | 0.013 | 0.400 |
| Solids, Total Dissolved (BDL 10) mg/L | 290 | 203 | 320 | 270 | 360 | 380 | 340 | 370 | 390 | 300 | 300 | 250 |
| Solids, Total Suspended (BDL 2.0) mg/L | 4.4 | 11.0 | 2.0 | 21.0 | 2.0 | 6.7 | 18.0 | 54.0 | 12.0 | 4.7 | 2.6 | 14.0 |
| Temperature, Water °C | 29.50 | 25.04 | 22.69 | 21.42 | 9.58 | 4.70 | 5.91 | 1.72 | 9.87 | 14.14 | 27.80 | 26.90 |
| Turbidity (NTU) | 5.45 | 11.40 | 1.90 | 16.60 | 7.18 | 6.18 | 20.30 | 31.70 | 7.54 | 6.31 | 2.27 | 12.50 |
| Zinc, Total (BDL 10) µg/L | 24.60 | 20.20 | 14.20 | 15.20 | 0.011 | 0.006 | 12.80 | 13.60 | 10.00 | 10.50 | 10.00 | 15.60 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 16 – Complete analytical sampling results for all parameters for Ford Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/13/17 | 8/8/17 | 8/22/17 | 9/5/17 | 9/6/17 | 10/12/17 | 11/7/17 | 12/14/17 | 1/22/18 | 2/12/18 | 3/21/18 | 4/3/18 |
| Coliform, Fecal CFU/100mL | 4800 | 69 | 17 | 110 | 11 | 47 | 160 | 28 | 22 | 3 | 3 | 19 |
| *E. coli* (BDL 1) MPN/100mL | 3300 | 93 | 2 | 12 | 12 | 26 | 200 | 44 | 44 | 3 | 4.1 | 23 |
| *Enterococcus* (BDL 1) MPN/100 mL | 100 | 690 | 26 | 230 | 140 | 17 | 19 | 24 | 23 | 7.5 | 5.2 | 47 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5/23/18 | 6/7/18 | 6/14/18 | 6/21/18 | 6/27/18 | | | | | | | |
| Coliform, Fecal CFU/100mL | 220 | 900 | 64 | 570 | 14 | | | | | | | |
| *E. coli* (BDL 1) MPN/100mL | 83 | 4600 | 38 | 460 | 3.1 | | | | | | | |
| *Enterococcus* (BDL 1) MPN/100 mL | 1700 | 7800 | 21 | 2400 | 22 | | | | | | | |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 17 – Complete analytical results for bacteria samples for Ford Creek

## Fred Creek
## WBID: 120420010060_00

Table 18 - Sampling location and events on Fred Creek

| Waterbody | Sample Location | | Watershed Area ($mi^2$)* | Sampling/Evaluation Date | | | |
|---|---|---|---|---|---|---|---|
| | Latitude | Longitude | | Fish | Benthic (Summer) | Benthic (Winter) | Habitat |
| Fred Creek | 36.053333 | -95.943055 | 1.71 | 10/03/2017 | 10/19/2016 | 02/24/2017 | 11/06/2017 |
| | | | | | 08/28/2017 | 01/31/2018 | |

* Collection area captured by sampling point

# 4.0 BENEFICIAL USES

**4.1 Agriculture –** Data collected on Total Dissolved Solids for Fred Creek indicates attainment of the agricultural beneficial use. The number of samples collected exceeds the number of samples required. The sample mean does not exceed the yearly standard and none of the samples exceeded the sample standard.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 392 | 550 | Sample: 1868, Yearly: 1496 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |

Table 19 – Agriculture standards for Fred Creek

## 4.2 Fish and Wildlife Propagation: Warm Water Aquatic Community

**4.2.1** Dissolved Oxygen - Data collected on Dissolved Oxygen concentrations shows the beneficial use is supported. The number of samples collected exceeds the number of required samples. Out of 12 samples, only one was found to be below the standard. Therefore, less than 10% of the samples were outside the standard range.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| D.O. | 1 samples below 6.0 | na | April - June: 5.0 | 3 | 10 total | No more than 10% of samples outside range |
| | 0 samples below 5.0 | na | June - Mar: 6.0 | 9 | | |

Table 20 – Dissolved Oxygen standards for Fred Creek

**4.2.2** Toxicants/Metals - Data collected indicate full support of the beneficial use for Toxicants and Metals.

| Parameter | Sample Mean (µg/L) | Single Sample (µg/L) | Water Quality Standard (µg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Cadmium | 0.38 | 0.50 | Acute: 102.36, Chronic: 2.46 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper | 1.84 | 5.16 | Acute: 48.56, Chronic: 29.69 | 12 | 5 | |
| Lead | 0.41 | 0.87 | Acute: 286.15, Chronic: 11.15 | 12 | 5 | |
| Zinc | 11.02 | 37.50 | Acute: 269.64, Chronic: 244.23 | 12 | 5 | |

Table 21 – Toxicants/Metals standards for Fred Creek

**4.2.3** pH (Hydrogen Ion Activity) - Data collected on pH readings for Fred Creek show full support of the beneficial use. The number of pH measurements taken exceeds the number of required measurements. All pH measurements fell within the standard range.

| Parameter | Sample Range (s.u) | Single Sample (s.u.) | Water Quality Standard Range (s.u) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| pH | 6.9 – 7.7 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |

Table 22 – pH standards for Fred Creek

**4.2.4** Oil and Grease - Data collected on Oil and Grease concentrations through HEM laboratory analysis show support of the beneficial use. All samples taken showed Oil and Grease amounts to be below the detection limit.

**4.2.5** Suspended and Bedded Sediments - Using habitat assessment data to determine support of the beneficial use is conditional upon the support of turbidity data and fish collection data.

**4.2.5.1** *Turbidity* – Data collected on Turbidity readings for Fred Creek show full support of the beneficial use.

| Parameter | Sample Mean (NTU) | Single Sample (NTU) | Water Quality Standard (NTU) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Turbidity | 10.22 | 30.20 | 50 | 12 | 10 | No more than 10% exceeding sample standard |

Table 23 – Turbidity standards for Fred Creek

**4.2.5.2** *Habitat Assessment* - The resulting score of the habitat assessment on Fred Creek can be compared to the average score of high quality sites within the same ecoregion provided by the Oklahoma Conservation Commission using a scoring workbook derived from OWRB (OWRB, 2001). The results of the habitat assessment produced a score below average for the central irregular plains ecoregion.

| Metric | Score |
|---|---|
| Instream habitat | 18.5 |
| Pool bottom substrate | 8.7 |
| Pool variability | 0.0 |
| Canopy cover | 0.7 |
| Presence of rocky runs and riffles | 4.1 |
| Flow (at representative low flow) | 1.3 |
| Channel alteration | 13.7 |
| Channel sinuosity | 2.3 |
| Bank stability | 4.6 |
| Bank vegetation stability | 0.2 |
| Stream side Cover | 5.0 |
| **Total Score** | **59.10** |
| **Central Irregular Plains Mean Score** | **84.09** |

Table 24 – Habitat assessment metric and total results with ecoregion mean score

### 4.2.6 Biological

**4.2.6.1** *Fish Collections* - Data recorded from fish collections performed on Fred Creek show that the beneficial use is impaired.

| Index of Biotic Integrity | Score |
|---|---|
| Sample Composition | 6 |
| Fish Condition | 13 |
| Score Key: 30 + Beneficial Use Supported : 23 - 29 Undetermined : < 22 Impaired | Total: 19 |

Table 25 – Fish IBI score for Fred Creek

| Family | Species Name | Common Name | Number of Fish | Percentage |
|---|---|---|---|---|
| Centrarchidae | *Lepomis cyanellus* | Green sunfish | 193 | 71.0% |
| | *Micropterus salmoides* | Largemouth bass | 2 | 0.7% |
| Cyprinidae | *Campostoma anomalum* | Central stoneroller | 67 | 24.6% |
| Poeciliidae | *Gambusia affinis* | Mosquitofish | 10 | 3.7% |
| | | **Total Number:** | 272 | 100.00% |
| | | **Total Number of Taxa:** | 4 | |

Table 26 – Fish collection counts for Fred Creek

^Photograph taken of Fred Creek sample site

**4.2.6.2** *Benthic Macroinvertebrate Collections* – Data recorded from benthic macroinvertebrate collections during the summer and winter index periods is undetermined and impaired (ODEQ, Continuing Planning Process, 2012).

| Sampling Event | Score |
|---|---|
| Summer 2016 | 65% |
| Winter 2017 | 59% |
| Summer 2017 | 45% |
| Winter 2018 | 59% |
| Fred Creek - (Central Irregular Plains): >80% Attaining : 50-80% - Undetermined : < 50% Impaired | |

Table 27 – Benthic macroinvertebrate metrics for summer and winter index periods at Fred Creek

| Genus | Common Class | 10/19/2016 | |
|---|---|---|---|
| | | Count | % |
| *Caenis sp.* | Squaregilled Mayfly | 23 | 21.7% |
| *Fallceon quilleri* | Minnow Mayfly | 5 | 4.7% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 2 | 1.9% |
| *Hydroptila sp.* | Micro Caddisfly | 3 | 2.8% |
| *Argia sp.* | Narrowwinged Damselfly | 3 | 2.8% |
| *Apedilum sp.* | Midge | 1 | 0.9% |
| *Cricotopus sp.* | Midge | 3 | 2.8% |
| *Cryptochironomus sp.* | Midge | 2 | 1.9% |
| *Dicrotendipes fumidus* | Midge | 3 | 2.8% |
| *Dicrotendipes neomodestus* | Midge | 6 | 5.7% |
| *Paratendipes sp.* | Midge | 2 | 1.9% |
| *Polypedilum flavum* | Midge | 9 | 8.5% |
| *Pseudochironomus sp.* | Midge | 2 | 1.9% |
| *Rheotanytarsus exiguus gr.* | Midge | 20 | 18.9% |
| *Thienemanniella sp.* | Midge | 1 | 0.9% |
| *Thienemannimyia gr. sp.* | Midge | 4 | 3.8% |
| *Caloparyphus/Euparyphus* | Soldier Fly | 1 | 0.9% |
| *Erpobdella sp.* | Leech | 1 | 0.9% |
| *Helobdella stagnalis* | Leech | 2 | 1.9% |
| *Lymnaeidae* | Lung Snail | 1 | 0.9% |
| *Physa sp.* | Lung Snail | 2 | 1.9% |
| *Hyalella sp.* | Scud | 10 | 9.4% |
| Total | | 106 | 100.0% |
| Total Number of Taxa | | 22 | |

2016 Fred Creek Summer Index Period

| Genus | Common Class | 8/28/2017 | |
|---|---|---|---|
| | | Count | % |
| *Caenis sp.* | Squaregilled Mayfly | 1 | 0.95% |
| *Fallceon sp.* | Minnow Mayfly | 3 | 2.9% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 7 | 6.7% |
| *Chimarra sp.* | Fingernet Caddisfly | 2 | 1.9% |
| *Ablabesmyia sp.* | Midge | 2 | 1.9% |
| *Chironomus sp.* | Midge | 1 | 1.0% |
| *Cricotopus sp.* | Midge | 11 | 10.5% |
| *Dicrotendipes neomodestus* | Midge | 33 | 31.4% |
| *Polypedilum flavum* | Midge | 19 | 18.1% |
| *Pseudochironomus sp.* | Midge | 4 | 3.8% |
| *Rheotanytarsus exiguus gr.* | Midge | 9 | 8.6% |
| *Thienemannimyia gr. sp.* | Midge | 3 | 2.9% |
| *Petrophila sp.* | Snout Moth | 1 | 1.0% |
| *Placobdella sp.* | Leech | 1 | 1.0% |
| *Physella sp.* | Lung Snail | 7 | 6.7% |
| *Planorbella sp.* | Lung Snail | 1 | 1.0% |
| Total | | 105 | 100.0% |
| Total Number of Taxa | | 16 | |

2017 Fred Creek Summer Index Period

| Genus | Common Class | 2/24/2017 | |
|---|---|---|---|
| | | Count | % |
| Fallceon quilleri | Minnow Mayfly | 8 | 7.6% |
| Cheumatopsyche sp. | Netspinner Caddisfly | 1 | 1.0% |
| Cladotanytarsus sp. | Midge | 2 | 1.9% |
| Cricotopus bicinctus gr. | | 4 | 3.8% |
| Cricotopus sp. | | 7 | 6.7% |
| Cricotopus/Orthocladius sp. | | 18 | 17.1% |
| Dicrotendipes modestus | | 6 | 5.7% |
| Hydrobaenus sp. | | 1 | 1.0% |
| Limnohyes sp. | | 1 | 1.0% |
| Orthocladius sp. | | 9 | 8.6% |
| Paratendipes sp. | | 1 | 1.0% |
| Polypedilum flavum | | 20 | 19.0% |
| Polypedilum illinoense gr. | | 1 | 1.0% |
| Polypedilum sp. | | 2 | 1.9% |
| Procladius sp. | | 1 | 1.0% |
| Rheotanytarsus exiguus gr. | | 3 | 2.9% |
| Tanytarsus sp. | | 3 | 2.9% |
| Thienemanniella sp. | | 6 | 5.7% |
| Thienemannimyia gr. sp. | | 7 | 6.7% |
| Hyalella sp. | Scud | 4 | 3.8% |
| Total | | 105 | 100.0% |
| Total Number of Taxa | | 20 | |

2017 Fred Creek Winter Index Period

| Genus | Common Class | 1/31/2018 | |
|---|---|---|---|
| | | Count | % |
| Caenis sp. | Squaregilled Mayfly | 22 | 22.9% |
| Cheumatopsyche sp. | Netspinner Caddisfly | 3 | 3.1% |
| Argia sp. | Narrowwinged Damselfly | 2 | 2.1% |
| Corynoneura sp. | Midge | 1 | 1.0% |
| Cricotopus bicinctus gr. | | 1 | 1.0% |
| Cricotopus sp. | | 25 | 26.0% |
| Cricotopus/Orthocladius sp. | | 6 | 6.3% |
| Polypedilum flavum | | 14 | 14.6% |
| Pseudochironomus sp. | | 1 | 1.0% |
| Rheotanytarsus exiguus gr. | | 3 | 3.1% |
| Tanytarsus sp. | | 2 | 2.1% |
| Thienemannimyia gr. sp. | | 4 | 4.2% |
| Caloparyphus/Euparyphus sp. | Soldier Fly | 1 | 1.0% |
| Erpobdella sp. | Leech | 1 | 1.0% |
| Helobdella elongata | | 1 | 1.0% |
| Nais sp. | Aquatic Worm | 3 | 3.1% |
| tubificoid w/o cap setae | Aquatic Worm (Bald) | 1 | 1.0% |
| Corbicula sp. | Asian Freshwater Clam | 1 | 1.0% |
| Physa sp. | Lung Snail | 3 | 3.1% |
| Hyalella sp. | Scud | 1 | 1.0% |
| Total | | 96 | 100.0% |
| Total Number of Taxa | | 20 | |

2018 Fred Creek Winter Index Period

Table 28 – Benthic macroinvertebrate counts for Fred Creek summer and winter index periods

**4.3 Primary Body Contact -** The data collected on *E. coli* and *Enterococcus* concentrations show that Fred Creek is impaired for both *E. coli* and *Enterococcus*. The number of samples collected exceeds the number of samples required. While the MS4 permit requires monthly sampling of bacteria, water quality standards only pertain to samples collected during the recreational period.

| Parameter | Sample Geometric Mean (MPN/100mL) | Single Sample (MPN/100mL) | Water Quality Standard (MPN/100mL) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| *E. coli* | 214 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| *Enterococcus* | 462 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |

Table 29 – *E. coli* and *Enterococcus* totals for Fred Creek

Figure 5 - *E. coli* Concentrations for Fred Creek

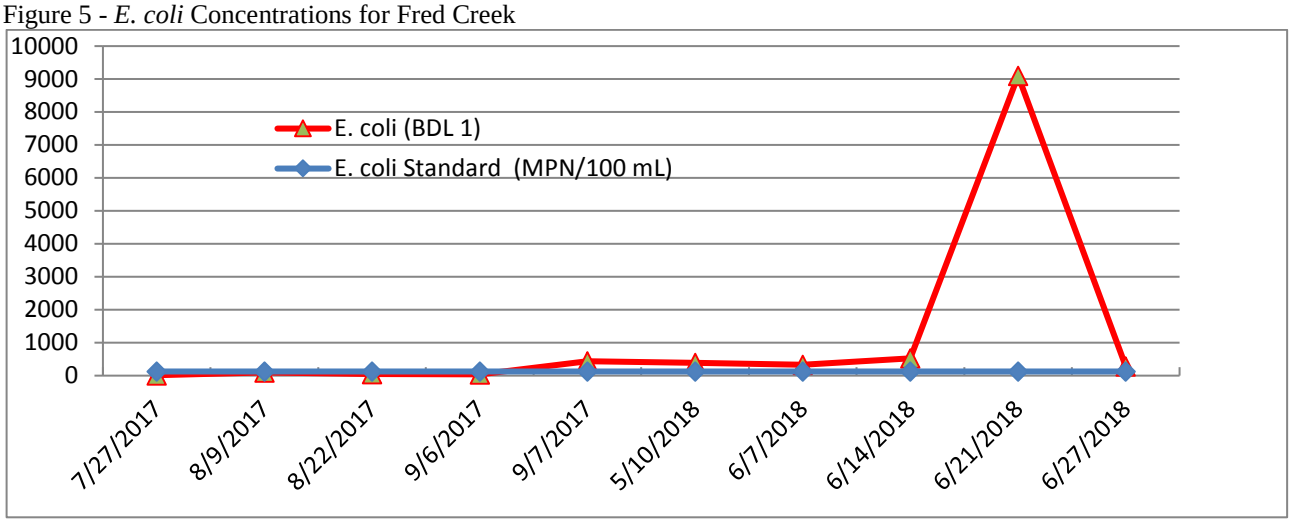
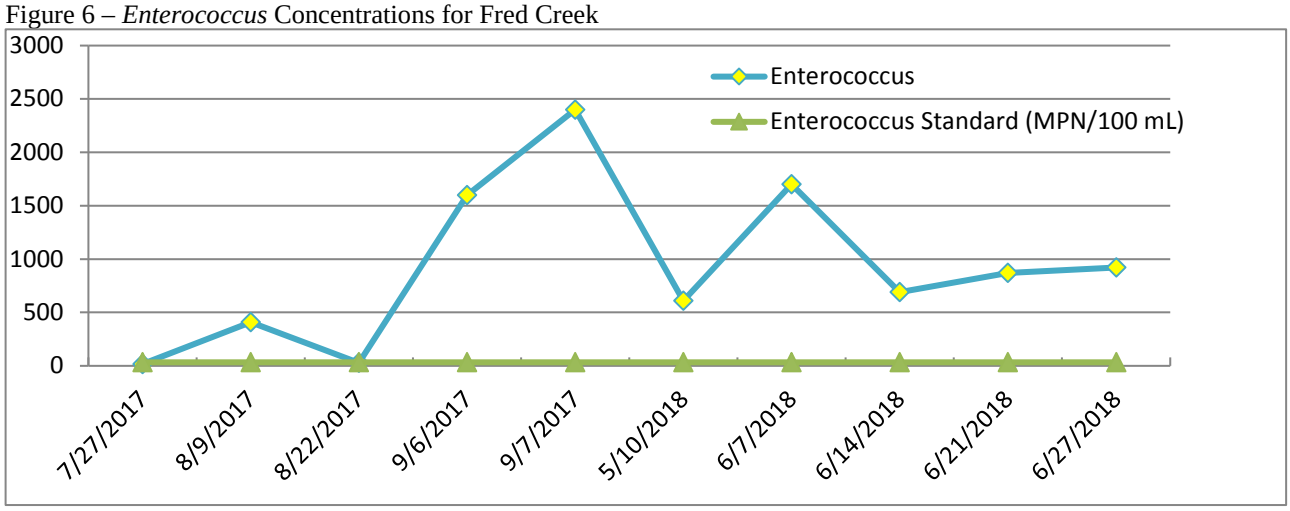



Figure 6 – *Enterococcus* Concentrations for Fred Creek



## 4.4 Anti-Degradation Policy

**4.4.1** Nutrients - Analytical results for Total Phosphorus and Nitrate/Nitrite show no need for further investigation to show support of the beneficial use. The number of samples collected exceeds the number of required samples, and less than 10% of samples exceeded the threshold for further sampling. While Nitrate/Nitrite concentrations have an action level, it is not a required parameter within the MS4 permit (ODEQ, OPDES Permit OKS000201, 2011).

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Threshold (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Phosphorus | 0.04 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| Nitrite - Nitrate | 0.38 | na | 4.95 | 12 | 10 | No more than 10% of samples outside range |

Table 30 – Nutrient totals for Fred Creek

## 5.0 SUMMARY

Analytically, Fred Creek does not reflect any water quality impacts to the stream during the year of sampling with the exception of bacteria. Fish collections reflected an impaired classification according to water quality standards. A lack of intolerant species and diversity of species prevents support. Disappointing macroinvertebrate IBI scores prevent support of the beneficial use with three index periods classified as undetermined and one index period as impaired. While the creek shows species richness, the number of intolerant species is low. Much of Fred Creek is channelized, greatly impacting the habitat of the stream which resulted in a lower than average habitat assessment score. A low habitat score may also be a contributing factor to the poor fish and macroinvertebrate IBI scores.

Table 31 – Oklahoma Water Quality Standards summary of collected data for Fred Creek

| Fred | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Sample Mean** | **Single Sample** | **Water Quality Standard** | **No. of Samples** | **No. of Samples Required (WQS)** | **How Standard is Violated** |
| Cadmium (µg/L) | 0.38 | 0.50 | Acute: 102.36, Chronic: 2.46 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper (µg/L) | 1.84 | 5.16 | Acute: 48.56, Chronic: 29.69 | 12 | 5 | |
| Lead (µg/L) | 0.41 | 0.87 | Acute: 286.15, Chronic: 11.15 | 12 | 5 | |
| Zinc (µg/L) | 11.02 | 37.50 | Acute: 269.64, Chronic: 244.23 | 12 | 5 | |
| Diazinon (µg/L) | 0.15 | na | Acute: 0.17 | 12 | 5 | |
| E. coli (MPN/100ml) | 214 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| Enterococcus (MPN/100ml) | 462 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |
| Oil and Grease (visual | None | na | No visible sheen | 12 | 10 | No more than 10% of observations with oil & grease |
| Total Phosphorus (mg/L) | 0.04 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| *Nitrite – Nitrate (mg/L)* | *0.38* | *na* | *4.95* | *12* | *10* | *No more than 10% of samples outside range* |
| Total Dissolved Solids (mg/L) | 392 | 550 | Sample: 1868, Yearly: 1496 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |
| pH (s.u.) | 6.9 – 7.7 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |
| *D.O. (mg/L)* | *1 samples below 6.0* | *na* | *April 1-June 15: 6.0* | *3* | *10 total* | *No more than 10% of samples outside range* |
| | *0 samples below 5.0* | *na* | *June 16-Mar 31.: 5.0* | *9* | | |
| **Analytes in italics not required by permit* *Analytes in red exceed standards* | | | | | | |

| Analyte | Result | | |
|---|---|---|---|

| | Minimum | Mean | Maximum | Number of Samples | Number of Attempts |
|---|---|---|---|---|---|
| Oxygen Demand, 5-Day Biological (mg/L)(DL 3.0 mg/L) | -- | 3.18 | 5.00 | 12 | 12 |
| Cadmium, Total (µg/L) (DL 0.5 µg/L) | -- | 0.38 | 0.50 | 12 | 12 |
| Coliform, Fecal (CFU/100 mL)(DL 1 CFU/100 mL) | -- | 130 | 15100 | 12 | 17 |
| Conductivity µS | -- | 517 | 644 | 12 | 12 |
| Copper, Total (µg/L) (DL 0.5 µg/L) | -- | 1.84 | 5.16 | 12 | 12 |
| Diazinon (µg/L) (DL 0.17-5.0 µg/L) | -- | 0.15 | 0.17 | 12 | 12 |
| Dissolved Oxygen (mg/L) | 5.16 | 9.14 | 16.78 | 12 | 12 |
| *E. coli* (MPN/100 mL) (DL 1 MPN/100 mL) | -- | 214 | 9100 | 12 | 17 |
| *Enterococcus* (MPN/100 mL)(DL 1 CFU/100 mL) | -- | 462 | 2400 | 12 | 17 |
| Flow (cfs) | 0.00 | 0.25 | 0.71 | 12 | 12 |
| Hardness, Total (mg/L) (DL 3.6 mg/L) | 170 | 244 | 320 | 12 | 12 |
| Lead, Total (µg/L) (DL 0.5 µg/L) | -- | 0.41 | 0.87 | 12 | 12 |
| Nitrogen, Total Kjeldahl (mg/L)(DL 0.50 mg/L) | -- | 0.92 | 1.70 | 12 | 12 |
| Nitrogen, Nitrate-Nitrite (mg/L) (DL 0.2 mg/L) | -- | 0.38 | 1.10 | 12 | 12 |
| Nitrogen, Total as Nitrogen (mg/L)(DL 0.50 mg/L) | -- | 1.13 | 2.20 | 12 | 12 |
| Oil and Grease (mg/L) (DL 6.0-6.5 mg/L) | -- | 8.10 | 24.00 | 12 | 12 |
| Oxygen Demand, Chemical (mg/L)(DL 20 mg/L) | -- | 20 | 20 | 12 | 12 |
| pH (su) | 6.91 | 7.33 | 7.69 | 12 | 12 |
| Phosphorus, Total (mg/L) (DL 0.010 mg/L) | -- | 0.04 | 0.07 | 12 | 12 |
| Phosphorus, Dissolved (mg/L) (DL 0.010 mg/L) | -- | 0.03 | 0.08 | 12 | 12 |
| Solids, Total Dissolved (mg/L) (DL 10 mg/L) | -- | 392 | 550 | 12 | 12 |
| Solids, Total Suspended (mg/L) (DL 2.0 mg/L) | -- | 9.98 | 26.00 | 12 | 12 |
| Temperature, Water (°C) | 6.06 | 14.93 | 26.88 | 12 | 12 |
| Turbidity | -- | 10.22 | 30.20 | 12 | 12 |
| Zinc, Total (µg/L) (DL 10 µg/L) | -- | 11.02 | 37.50 | 12 | 12 |
| Results found to be below the detection limit are reported as the detection limit | | | | | |

Table 32 – MS4 permit required analytical sampling parameters result summaries for Fred Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/12/17 | 8/9/17 | 9/7/17 | 10/12/17 | 11/13/17 | 12/6/17 | 1/8/18 | 2/1/18 | 3/14/18 | 4/4/18 | 5/10/18 | 6/26/18 |
| BOD(5) Day (BDL 3) mg/L | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.2 |
| Cadmium, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.001 | 0.001 | 0.001 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Conductivity µS | 539 | 510 | 559 | 516 | 553 | 451 | 425 | 414 | 521 | 644 | 561 | 536 |
| Copper, Total (BDL 0.5) µg/L | 2.27 | 2.57 | 2.16 | 0.005 | 0.005 | 0.005 | 2.04 | 1.69 | 1.74 | 2.30 | 2.11 | 5.16 |
| Diazinon (BDL 0.17) µg/L | 0.17 | 0.17 | 0.10 | 0.10 | 0.10 | 0.10 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| Dissolved Oxygen mg/L | 5.47 | 7.07 | 5.16 | 8.96 | 7.76 | 8.09 | 10.86 | 11.49 | 10.56 | 16.78 | 11.85 | 5.65 |
| Flow CFS | 0.22 | 0.33 | 0.06 | 0.06 | 0.00 | 0.07 | 0.17 | 0.10 | 0.46 | 0.71 | 0.57 | 0.26 |
| Hardness, Total (BDL 3.6) mg/L | 200 | 210 | 220 | 230 | 280 | 260 | 220 | 220 | 280 | 320 | 320 | 170 |
| Lead, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.0005 | 0.0005 | 0.0005 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.87 |
| Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L | 0.97 | 1.70 | 1.30 | 0.50 | 1.30 | 0.83 | 0.52 | 0.50 | 0.77 | 0.50 | 1.10 | 1.00 |
| Nitrogen, Nitrate-Nitrite (BDL 0.2) mg/L | 0.38 | 0.52 | 0.20 | 0.29 | 0.20 | 0.20 | 0.27 | 0.20 | 0.20 | 0.64 | 0.32 | 1.10 |
| Nitrogen, Total as N (BDL 0.5) mg/L | 1.30 | 2.20 | 1.30 | 0.50 | 1.30 | 0.83 | 0.78 | 0.50 | 0.77 | 0.62 | 1.40 | 2.00 |
| Oil and Grease HEM (BDL 6) mg/L | 6.5 | 6.8 | 6.9 | 6.6 | 6.7 | 6.3 | 6.7 | 6.8 | 24.0 | 6.8 | 6.8 | 6.3 |
| Oxygen Demand, Chemical (BDL 20) mg/L | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |
| pH (s.u.) | 7.50 | 7.69 | 7.31 | 7.33 | 7.33 | 7.23 | 7.20 | 7.09 | 6.91 | 7.25 | 7.58 | 7.56 |
| Phosphorus, Total (BDL 0.010) mg/L | 0.037 | 0.040 | 0.047 | 0.028 | 0.018 | 0.070 | 0.041 | 0.020 | 0.036 | 0.035 | 0.057 | 0.061 |
| Phosphorus, Total Dissolved BDL (0.010) mg/L | 0.033 | 0.022 | 0.016 | 0.025 | 0.078 | 0.062 | 0.028 | 0.013 | 0.017 | 0.013 | 0.023 | 0.065 |
| Solids, Total Dissolved (BDL 10) mg/L | 320 | 370 | 390 | 370 | 420 | 360 | 350 | 320 | 500 | 460 | 550 | 290 |
| Solids, Total Suspended (BDL 2.0) mg/L | 2.0 | 11.0 | 20.0 | 2.0 | 6.3 | 6.8 | 5.3 | 2.3 | 15.0 | 11.0 | 12.0 | 26.0 |
| Temperature, Water °C | 26.88 | 24.18 | 18.69 | 15.40 | 11.05 | 6.45 | 6.06 | 6.70 | 7.70 | 9.21 | 22.2 | 24.63 |
| Turbidity (NTU) | 1.20 | 9.21 | 19.30 | 1.77 | 2.70 | 3.18 | 8.26 | 2.83 | 15.20 | 12.70 | 16.10 | 30.20 |
| Zinc, Total (BDL 10) µg/L | 37.5 | 13.3 | 10.0 | 0.005 | 0.008 | 0.007 | 10.0 | 10.0 | 10.0 | 14.8 | 10.0 | 16.6 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 33 – Complete analytical sampling results for all parameters for Fred Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/26/17 | 8/9/17 | 8/22/17 | 9/6/17 | 9/7/17 | 10/12/17 | 11/13/17 | 12/6/17 | 1/8/18 | 2/1/18 | 3/14/18 | 4/4/18 |
| Coliform, Fecal CFU/100mL | 17 | 370 | 96 | 69 | 340 | 14 | 28 | 19 | 14 | 11 | 92 | 110 |
| *E. coli* (BDL 1) MPN/100mL | 13 | 100 | 50 | 41 | 440 | 20 | 18 | 24 | 47 | 31 | 110 | 150 |
| *Enterococcus* (BDL 1) MPN/100 mL | 17 | 410 | 29 | 1600 | 2400 | 30 | 3 | 12 | 20 | 12 | 31 | 200 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5/10/18 | 6/7/18 | 6/14/18 | 6/21/18 | 6/27/18 | | | | | | | |
| Coliform, Fecal CFU/100mL | 570 | 380 | 840 | 15100 | 1120 | | | | | | | |
| *E. coli* (BDL 1) MPN/100mL | 390 | 330 | 520 | 9100 | 280 | | | | | | | |
| *Enterococcus* (BDL 1) MPN/100 mL | 610 | 1700 | 690 | 870 | 920 | | | | | | | |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 34 – Complete analytical results for bacteria samples for Fred Creek

## Fry Ditch Creek
## WBID: 120420 NOT LISTED

Table 35 - Sampling location and events on Fry Ditch Creek

| Waterbody | Sample Location | | Watershed Area ($mi^2$)* | Sampling/Evaluation Date | | | |
|---|---|---|---|---|---|---|---|
| | Latitude | Longitude | | Fish | Benthic (Summer) | Benthic (Winter) | Habitat |
| Fry Ditch | 36.012583 | -95.893611 | 3.43 | 10/11/2017 | 09/01/2016 | 02/27/2017 | 06/14/2018 |
| | | | | | 08/28/2017 | 01/31/2018 | |

* Collection area captured by sampling point

# 6.0 BENEFICIAL USES

**6.1 Agriculture –** Data collected on Total Dissolved Solids for Fry Ditch Creek indicates attainment of the agricultural beneficial use. The number of samples collected exceeds the number of samples required. The sample mean does not exceed the yearly standard and none of the samples exceeded the sample standard.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 345 | 440 | Sample: 1868, Yearly: 1496 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |

Table 36 – Agriculture standards for Fry Ditch Creek

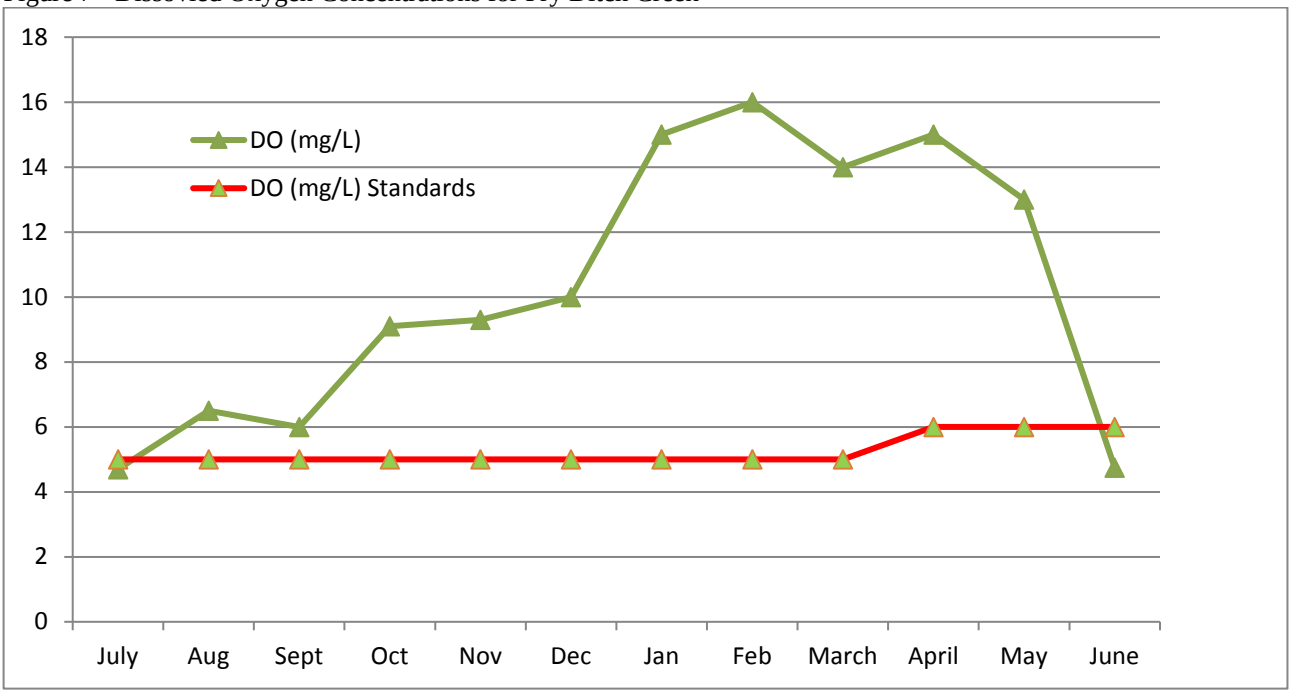
## 6.2 Fish and Wildlife Propagation: Warm Water Aquatic Community

**6.2.1** Dissolved Oxygen - Data collected on Dissolved Oxygen concentrations shows the beneficial use is not supported. The number of samples collected exceeds the number of required samples. Out of 12 samples, two were found to be below the standard.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| D.O. | 1 samples below 6.0 | na | April - June: 5.0 | 3 | 10 total | No more than 10% of samples outside range |
| | 1 samples below 5.0 | na | June - Mar: 6.0 | 9 | | |

Table 37 – Dissolved Oxygen standards for Fry Ditch Creek

Figure 7 - Dissovled Oxygen Concentrations for Fry Ditch Creek



**6.2.2** Toxicants/Metals - Data collected indicate full support of the beneficial use for Toxicants and Metals.

| Parameter | Sample Mean (µg/L) | Single Sample (µg/L) | Water Quality Standard (µg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Cadmium | 0.38 | 0.50 | Acute: 102.36, Chronic: 2.46 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper | 1.39 | 3.36 | Acute: 48.56, Chronic: 29.69 | 12 | 5 | |
| Lead | 0.40 | 0.76 | Acute: 286.15, Chronic: 11.15 | 12 | 5 | |
| Zinc | 10.08 | 20.30 | Acute: 269.64, Chronic: 244.23 | 12 | 5 | |

Table 38 – Toxicants/Metals standards for Fry Ditch Creek

**6.2.3** pH (Hydrogen Ion Activity) - Data collected on pH readings for Fry Ditch Creek show full support of the beneficial use. The number of pH measurements taken exceeds the number of required measurements. All pH measurements fell within the standard range.

| Parameter | Sample Range (s.u.) | Single Sample (s.u.) | Water Quality Standard Range (s.u.) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| pH | 7.2 – 7.6 | Na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |

Table 39 – pH standards for Fry Ditch Creek

**6.2.4** Oil and Grease - Data collected on Oil and Grease concentrations through HEM laboratory analysis show support of the beneficial use. All samples taken showed Oil and Grease amounts to be below the detection limit.

**6.2.5** Suspended and Bedded Sediments - Using habitat assessment data to determine support of the beneficial use is conditional upon the support of turbidity data and fish collection data.

**6.2.5.1** *Turbidity* – Data collected on Turbidity readings for Fry Ditch Creek show full support of the beneficial use.

| Parameter | Sample Mean (NTU) | Single Sample (NTU) | Water Quality Standard (NTU) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Turbidity | 6.45 | 21.20 | 50 | 12 | 10 | No more than 10% exceeding sample standard |

Table 40 – Turbidity standards for Fry Ditch Creek

**6.2.5.2** *Habitat Assessment* - The resulting score of the habitat assessment on Fry Ditch Creek can be compared to the average score of high quality sites within the same ecoregion provided by the Oklahoma Conservation Commission using a scoring workbook derived from OWRB (OWRB, 2001). The results of the habitat assessment produced a score above average for the central irregular plains ecoregion.

| Metric | Score |
|---|---|
| Instream habitat | 17.8 |
| Pool bottom substrate | 6.9 |
| Pool variability | 13.5 |
| Canopy cover | 15.6 |
| Presence of rocky runs and riffles | 2.2 |
| Flow (at representative low flow) | 4.0 |
| Channel alteration | 16.5 |
| Channel sinuosity | 0.8 |
| Bank stability | 5.5 |
| Bank vegetation stability | 4.2 |
| Stream side Cover | 10.0 |
| **Total Score** | **97.00** |
| **Central Irregular Plains Mean Score** | **84.09** |

Table 41 – Habitat assessment metric and total results with ecoregion mean score

### 6.2.6 Biological

**6.2.6.1** *Fish Collections* - Data recorded from fish collections performed on Fry Ditch Creek show that the beneficial use is undetermined.

| Index of Biotic Integrity | Score |
|---|---|
| Sample Composition | 16 |
| Fish Condition | 11 |
| Score Key: 30 + Beneficial Use Supported : 23 - 29 Undetermined : < 22 Impaired | Total: 27 |

Table 42 – Fish IBI score for Fry Ditch Creek

| Family | Species Name | Common Name | Number of Fish | Percentage |
|---|---|---|---|---|
| Ictaluridae | *Ameiurus natalis* | Yellow bullhead catfish | 1 | 0.10% |
| Centrarchidae | *Lepomis cyanellus* | Green sunfish | 100 | 10.4% |
| | *Lepomis megalotis* | Longear sunfish | 327 | 34.1% |
| | *Lepomis macrochirus* | Bluegill sunfish | 315 | 32.8% |
| | *Lepomis YOY* | YOY sunfish | 98 | 10.2% |
| | *Micropterus salmoides* | Largemouth bass | 2 | 0.2% |
| Cyprinidae | *Campostoma anomalum* | Central stoneroller | 15 | 1.6% |
| | *Cyprinella humilis* | Red shiner | 20 | 2.1% |
| | *Pimephales notatus* | Bluntnose minnow | 1 | 0.1% |
| Poeciliidae | *Gambusia affinis* | Mosquitofish | 80 | 8.3% |
| **Total Number:** | | | 959 | 100.00% |
| **Total Number of Taxa:** | | | 10 | |

Table 43 – Fish collection counts for Fry Ditch Creek

^Photograph taken of Fry Ditch Creek sample site

**6.2.6.2** *Benthic Macroinvertebrate Collections* – Data recorded from benthic macroinvertebrate collections during the summer and winter index periods is undetermined and impaired for one of the summer index periods (ODEQ, Continuing Planning Process, 2012).

| Sampling Event | Score |
|---|---|
| Summer 2016 | 52% |
| Winter 2017 | 52% |
| Summer 2017 | 45% |
| Winter 2018 | 59% |
| Fry Ditch Creek - (Central Irregular Plains): >80% Attaining : 50-80% - Undetermined : < 50% Impaired | |

Table 44 – Benthic macroinvertebrate metrics for summer and winter index periods at Fry Ditch Creek

| Genus | Common Class | 9/1/2016 | |
|---|---|---|---|
| | | Count | % |
| *Baetis intercalaris* | Minnow Mayfly | 1 | 0.9% |
| *Fallceon quilleri* | Minnow Mayfly | 7 | 6.0% |
| *Caenis* sp. | Squaregilled Mayfly | 2 | 1.7% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 21 | 17.9% |
| *Argia* sp. | Narrowwinged Damselfly | 1 | 0.9% |
| *Chironomus* sp. | Midge | 1 | 0.9% |
| *Dicrotendipes* sp. | | 1 | 0.9% |
| *Polypedilum flavum* | | 65 | 55.6% |
| *Polypedilum scalaenum* gr. | | 2 | 1.7% |
| *Rheotanytarsus exiguus* gr. | | 1 | 0.9% |
| *Stenochironomus* sp. | | 1 | 0.9% |
| *Tanytarsus* sp. | | 4 | 3.4% |
| *Thienemannimyia* gr. sp. | | 7 | 6.0% |
| *Bratislavia unidentata* | Aquatic Worm | 1 | 0.9% |
| *Erpobdella* sp. | Leech | 1 | 0.9% |
| *Corbicula* sp. | Asian Freshwater Clam | 1 | 0.9% |
| Total | | 117 | 100.0% |
| Total Number of Taxa | | 16 | |

2016 Fry Ditch Creek Summer Index Period

| Genus | Common Class | 2/27/2017 | |
|---|---|---|---|
| | | Count | % |
| *Fallceon quilleri* | Minnow Mayfly | 2 | 1.8% |
| *Canis* sp. | Squaregilled Mayfly | 3 | 2.7% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 3 | 2.7% |
| *Cricotopus bicinctus* gr. | Midge | 1 | 0.9% |
| *Cricotopus* sp. | | 1 | 0.9% |
| *Cricotopus/Orthocladius* sp. | | 5 | 4.5% |
| *Orthocladius* sp. | | 29 | 26.4% |
| *Polypedilum flavum* | | 39 | 35.5% |
| *Polypedilum illinoense* gr. | | 5 | 4.5% |
| *Rheotanytarsus exiguus* gr. | | 2 | 1.8% |
| *Tanytarsus* sp. | | 3 | 2.7% |
| *Thienemanniella* sp. | | 1 | 0.9% |
| *Thienemannimyia* gr. sp. | | 3 | 2.7% |
| *Hygrobates* sp. | Water Mite | 1 | 0.9% |
| *Nais* sp. | Aquatic Worm | 12 | 10.9% |
| Total | | 110 | 100.0% |
| Total Number of Taxa | | 15 | |

2017 Fry Ditch Creek Winter Index Period

| Genus | Common Class | 8/28/2017 | |
|---|---|---|---|
| | | Count | % |
| *Baetis* sp. | Minnow Mayfly | 6 | 5.2% |
| *Caenis* sp. | Squaregilled Mayfly | 3 | 2.6% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 9 | 7.8% |
| *Argia* sp. | Narrowwinged Damselfly | 2 | 1.7% |
| *Corynoneura* sp. | Midge | 1 | 0.9% |
| *Cricotopus* sp. | | 3 | 2.6% |
| *Dicrotendipes neomodestus* | | 2 | 1.7% |
| *Polypedilum flavum* | | 38 | 32.8% |
| *Polypedilum illinoense* gr. | | 21 | 18.1% |
| *Polypedilum scalaenum* gr. | | 1 | 0.9% |
| *Rheotanytarsus exiguus* gr. | | 23 | 19.8% |
| *Tanytarsus* sp. | | 2 | 1.7% |
| *Thienemanniella* sp. | | 1 | 0.9% |
| *Atrichopogon* sp. | Biting Midge | 2 | 1.7% |
| *Hygrobates* sp. | Water Mite | 2 | 1.7% |
| Total | | 116 | 100.0% |
| Total Number of Taxa | | 15 | |

2017 Fry Ditch Creek Summer Index Period

| Genus | Common Class | 1/31/2018 | |
|---|---|---|---|
| | | Count | % |
| *Fallceon* sp. | Minnow Mayfly | 6 | 5.7% |
| *Canis* sp. | Squaregilled Mayfly | 4 | 3.8% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 6 | 5.7% |
| *Chimarra* sp. | Fingernet Caddisfly | 1 | 0.9% |
| *Argia* sp. | Narrowwinged Damselfly | 1 | 0.9% |
| *Coenagrion/Enallagma* sp. | | 1 | 0.9% |
| *Corynoneura* sp. | Midge | 1 | 0.9% |
| *Cricotopus* sp. | | 8 | 7.5% |
| *Cricotopus/Orthocladius* sp. | | 6 | 5.7% |
| *Dicrotendipes* sp. | | 1 | 0.9% |
| *Orthocladius* sp. | | 33 | 31.1% |
| *Paratanytarsus* sp. | | 1 | 0.9% |
| *Polypedilum flavum* | | 14 | 13.2% |
| *Polypedilum illinense* gr. | | 3 | 2.8% |
| *Polypedilum scalaenum* gr. | | 1 | 0.9% |
| *Rheotanytarsus exiguus* gr. | | 11 | 10.4% |
| *Thienemanniella* sp. | | 2 | 1.9% |
| *Thienemannimyia* gr. sp. | | 2 | 1.9% |
| *Hygrobates* sp. | Water Mite | 1 | 0.9% |
| *Nais* sp. | Aquatic Worm | 2 | 1.9% |
| *Planorbidae* | Lung Snail | 1 | 0.9% |
| Total | | 106 | 100.0% |
| Total Number of Taxa | | 21 | |

2018 Fry Ditch Creek Winter Index Period

Table 45 – Benthic macroinvertebrate counts for Fry Ditch Creek summer and winter index periods

**6.3 Primary Body Contact -** The data collected on *E. coli* and *Enterococcus* concentrations show that Fry Ditch Creek is impaired for both *E. coli* and *Enterococcus*. The number of samples collected exceeds the number of samples required. While the MS4 permit requires monthly sampling of bacteria, water quality standards only pertain to samples collected during the recreational period.

| Parameter | Sample Geometric Mean (MPN/100mL) | Single Sample (MPN/100mL) | Water Quality Standard (MPN/100mL) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| *E. coli* | 552 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| *Enterococcus* | 898 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |

Table 46 – *E. coli* and *Enterococcus* totals for Fry Ditch Creek

Figure 8 - *E. coli* Concentrations for Fry Ditch Creek

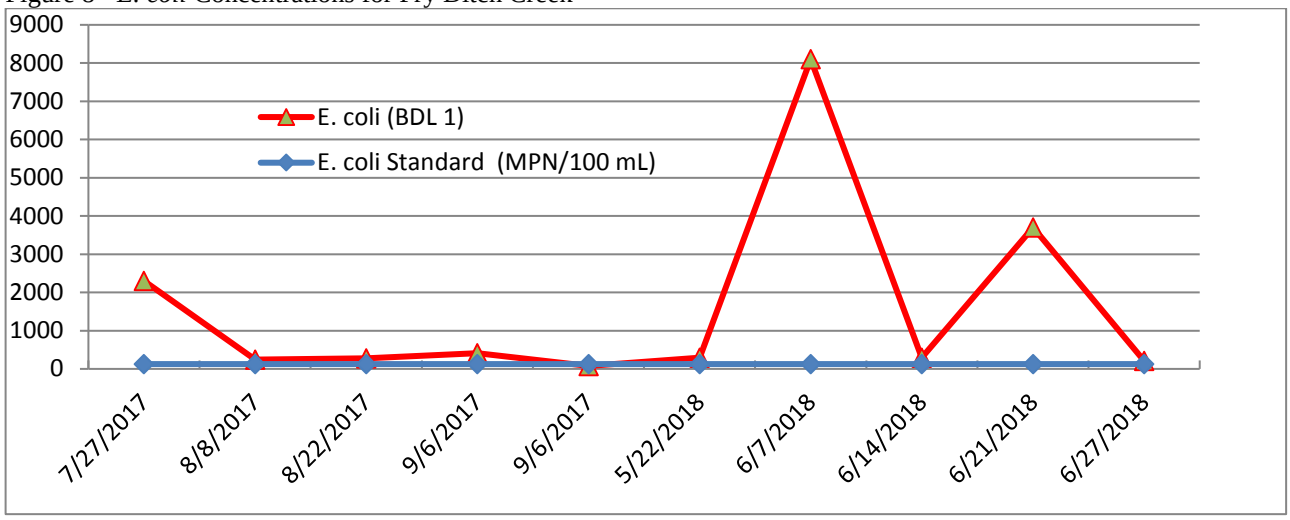
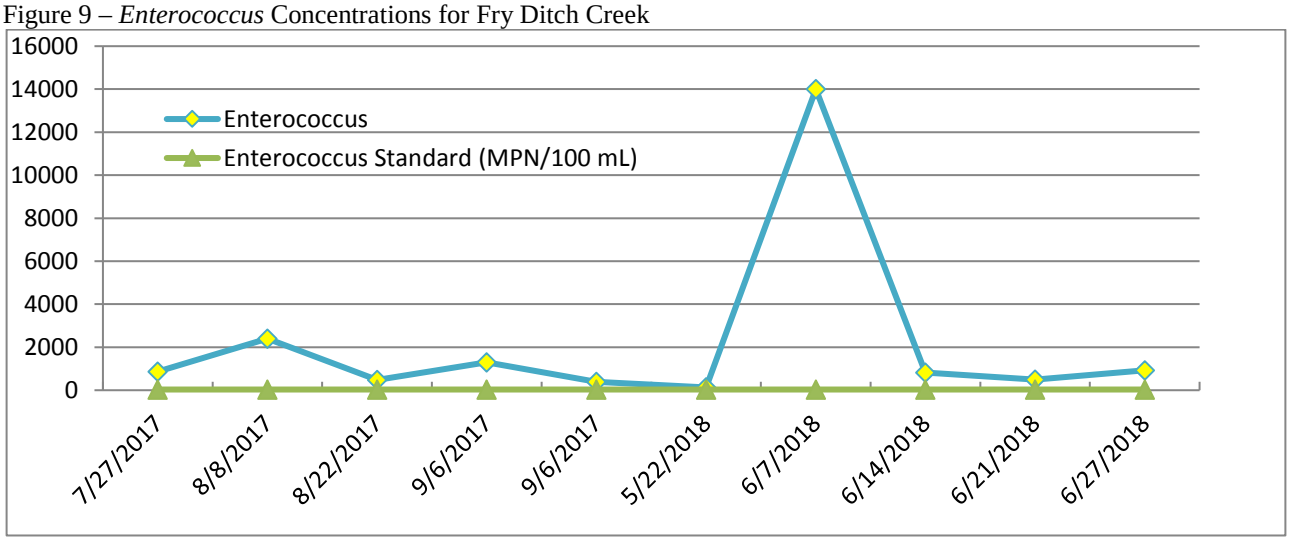



Figure 9 – *Enterococcus* Concentrations for Fry Ditch Creek



## 6.4 Anti-Degradation Policy

**6.4.1** Nutrients - Analytical results for Total Phosphorus and Nitrate/Nitrite show no need for further investigation to show support of the beneficial use. The number of samples collected exceeds the number of required samples, and less than 10% of samples exceeded the threshold for further sampling. While Nitrate/Nitrite concentrations have an action level, it is not a required parameter within the MS4 permit (ODEQ, OPDES Permit OKS000201, 2011).

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Threshold (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Phosphorus | 0.05 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| Nitrite - Nitrate | 0.59 | na | 4.95 | 12 | 10 | No more than 10% of samples outside range |

Table 47 – Nutrient totals for Fry Ditch Creek

## 7.0 SUMMARY

Analytically, Fry Ditch Creek is impaired for bacteria and dissolved oxygen. Fish collections reflected an undetermined classification according to water quality standards. A lack of intolerant species prevents full support; however an increase in species diversity would also be beneficial. A disappointing benthic macroinvertebrate IBI score could also be related to the lack of intolerant species which prevents support of the beneficial use. Conversely, the higher than average habitat assessment score is encouraging and future sampling may show improvements in fish and macroinvertebrate scores.

Table 48 – Oklahoma Water Quality Standards summary of collected data for Fry Ditch Creek

| Fry Ditch | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Sample Mean** | **Single Sample** | **Water Quality Standard** | **No. of Samples** | **No. of Samples Required (WQS)** | **How Standard is Violated** |
| Cadmium (µg/L) | 0.38 | 0.50 | Acute: 102.36, Chronic: 2.46 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper (µg/L) | 1.39 | 3.36 | Acute: 48.56, Chronic: 29.69 | 12 | 5 | |
| Lead (µg/L) | 0.40 | 0.76 | Acute: 286.15, Chronic: 11.15 | 12 | 5 | |
| Zinc (µg/L) | 10.08 | 20.30 | Acute: 269.64, Chronic: 244.23 | 12 | 5 | |
| Diazinon (µg/L) | 0.15 | na | Acute: 0.17 | 12 | 5 | |
| E. coli (MPN/100ml) | 552 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| Enterococcus (MPN/100ml) | 898 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |
| Oil and Grease (visual) | None | na | No visible sheen | 12 | 10 | No more than 10% of observations with oil & grease |
| Total Phosphorus (mg/L) | 0.05 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| *Nitrite – Nitrate (mg/L)* | *0.59* | *na* | *4.95* | *12* | *10* | *No more than 10% of samples outside range* |
| Total Dissolved Solids (mg/L) | 345 | 440 | Sample: 1868, Yearly: 1496 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |
| pH (s.u.) | 7.2 – 7.6 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |
| *D.O. (mg/L)* | *1 samples below 6.0* | *na* | *April 1-June 15: 6.0* | *3* | *10 total* | *No more than 10% of samples outside range* |
| | *1 samples below 5.0* | *na* | *June 16-Mar 31.: 5.0* | *9* | | |
| **Analytes in italics not required by permit* *Analytes in red exceed standards* | | | | | | |

| Analyte | Result | | |
|---|---|---|---|

| | Minimum | Mean | Maximum | Number of Samples | Number of Attempts |
|---|---|---|---|---|---|
| Oxygen Demand, 5-Day Biological (mg/L)(DL 3.0 mg/L) | -- | 3.06 | 5.80 | 12 | 12 |
| Cadmium, Total (µg/L) (DL 0.5 µg/L) | -- | 0.42 | 0.50 | 12 | 12 |
| Coliform, Fecal (CFU/100 mL)(DL 1 CFU/100 mL) | -- | 56 | 4800 | 12 | 17 |
| Conductivity µS | -- | 440 | 604 | 12 | 12 |
| Copper, Total (µg/L) (DL 0.5 µg/L) | -- | 1.72 | 2.94 | 12 | 12 |
| Diazinon (µg/L) (DL 0.17-5.0 µg/L) | -- | 0.15 | 0.17 | 12 | 12 |
| Dissolved Oxygen (mg/L) | 7.30 | 10.59 | 17.77 | 12 | 12 |
| *E. coli* (MPN/100 mL) (DL 1 MPN/100 mL) | -- | 552 | 4600 | 12 | 17 |
| *Enterococcus* (MPN/100 mL)(DL 1 CFU/100 mL) | -- | 898 | 7800 | 12 | 17 |
| Flow (cfs) | 0.02 | 0.38 | 1.59 | 12 | 12 |
| Hardness, Total (mg/L) (DL 3.6 mg/L) | 120 | 194 | 260 | 12 | 12 |
| Lead, Total (µg/L) (DL 0.5 µg/L) | -- | 0.49 | 1.10 | 12 | 12 |
| Nitrogen, Total Kjeldahl (mg/L)(DL 0.50 mg/L) | -- | 1.10 | 3.50 | 12 | 12 |
| Nitrogen, Nitrate-Nitrite (mg/L) (DL 0.2 mg/L) | -- | 0.23 | 0.55 | 12 | 12 |
| Nitrogen, Total as Nitrogen (mg/L)(DL 0.50 mg/L) | -- | 1.15 | 3.50 | 12 | 12 |
| Oil and Grease (mg/L) (DL 6.0-6.5 mg/L) | -- | 6.65 | 7.70 | 12 | 12 |
| Oxygen Demand, Chemical (mg/L)(DL 20 mg/L) | -- | 21 | 26 | 12 | 12 |
| pH (su) | 6.82 | 7.58 | 7.99 | 12 | 12 |
| Phosphorus, Total (mg/L) (DL 0.010 mg/L) | -- | 0.07 | 0.41 | 12 | 12 |
| Phosphorus, Dissolved (mg/L) (DL 0.010 mg/L) | -- | 0.05 | 0.40 | 12 | 12 |
| Solids, Total Dissolved (mg/L) (DL 10 mg/L) | -- | 314 | 390 | 12 | 12 |
| Solids, Total Suspended (mg/L) (DL 2.0 mg/L) | -- | 12.70 | 54.00 | 12 | 12 |
| Temperature, Water (°C) | 1.72 | 16.61 | 29.50 | 12 | 12 |
| Turbidity | -- | 10.78 | 31.70 | 12 | 12 |
| Zinc, Total (µg/L) (DL 10 µg/L) | -- | 12.23 | 24.60 | 12 | 12 |
| Results found to be below the detection limit are reported as the detection limit | | | | | |

Table 49 – Oklahoma Water Quality Standards summary of collected data for Fry Ditch Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/13/17 | 8/8/17 | 9/5/17 | 10/2/17 | 11/7/17 | 12/14/17 | 1/22/18 | 2/12/18 | 3/21/18 | 4/3/18 | 5/23/18 | 6/19/18 |
| BOD(5) Day (BDL 3) mg/L | 3.0 | 2.9 | 3.0 | 2.1 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 2.1 | 2.8 | 5.8 |
| Cadmium, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.50 | 0.001 | 0.001 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Conductivity µS | 430 | 332 | 488 | 409 | 429 | 425 | 403 | 414 | 510 | 486 | 604 | 355 |
| Copper, Total (BDL 0.5) µg/L | 1.92 | 2.94 | 2.16 | 2.00 | 0.005 | 0.005 | 1.20 | 1.75 | 1.80 | 1.53 | 2.37 | 2.94 |
| Diazinon (BDL 0.17) µg/L | 0.17 | 0.17 | 0.10 | 0.10 | 0.10 | 0.10 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| Dissolved Oxygen mg/L | 7.30 | 7.47 | 8.24 | 7.50 | 10.10 | 13.93 | 13.56 | 17.77 | 10.08 | 11.55 | 11.62 | 8.00 |
| Flow CFS | 0.17 | 1.49 | 0.09 | 0.04 | 0.09 | 0.07 | 0.20 | 0.13 | 0.25 | 1.59 | 0.49 | 0.02 |
| Hardness, Total (BDL 3.6) mg/L | 140 | 120 | 150 | 130 | 230 | 260 | 230 | 260 | 240 | 220 | 190 | 160 |
| Lead, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.501 | 0.0005 | 0.0005 | 0.50 | 1.10 | 0.50 | 0.654 | 0.50 | 0.634 |
| Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L | 0.86 | 2.70 | 0.50 | 0.63 | 0.52 | 0.50 | 0.50 | 0.71 | 3.50 | 0.56 | 0.75 | 1.50 |
| Nitrogen, Nitrate-Nitrite (BDL 0.2) mg/L | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.25 | 0.20 | 0.20 | 0.55 | 0.20 | 0.20 |
| Nitrogen, Total as N (BDL 0.5) mg/L | 0.86 | 2.70 | 0.50 | 0.63 | 0.52 | 0.50 | 0.50 | 0.71 | 3.50 | 1.10 | 0.75 | 1.50 |
| Oil and Grease HEM (BDL 6) mg/L | 6.70 | 6.20 | 6.30 | 7.50 | 6.10 | 6.40 | 6.20 | 7.40 | 7.70 | 6.80 | 6.30 | 6.20 |
| Oxygen Demand, Chemical (BDL 20) mg/L | 20 | 26 | 20 | 20 | 20 | 20 | 20 | 21 | 20 | 20 | 20 | 20 |
| pH (s.u.) | 7.69 | 7.80 | 7.83 | 7.73 | 7.64 | 7.65 | 7.46 | 7.31 | 7.47 | 7.58 | 7.99 | 6.82 |
| Phosphorus, Total (BDL 0.010) mg/L | 0.025 | 0.060 | 0.014 | 0.048 | 0.020 | 0.015 | 0.042 | 0.077 | 0.026 | 0.032 | 0.027 | 0.410 |
| Phosphorus, Total Dissolved BDL (0.010) mg/L | 0.011 | 0.028 | 0.013 | 0.037 | 0.010 | 0.010 | 0.017 | 0.022 | 0.010 | 0.018 | 0.013 | 0.400 |
| Solids, Total Dissolved (BDL 10) mg/L | 290 | 203 | 320 | 270 | 360 | 380 | 340 | 370 | 390 | 300 | 300 | 250 |
| Solids, Total Suspended (BDL 2.0) mg/L | 4.4 | 11.0 | 2.0 | 21.0 | 2.0 | 6.7 | 18.0 | 54.0 | 12.0 | 4.7 | 2.6 | 14.0 |
| Temperature, Water °C | 29.50 | 25.04 | 22.69 | 21.42 | 9.58 | 4.70 | 5.91 | 1.72 | 9.87 | 14.14 | 27.80 | 26.90 |
| Turbidity (NTU) | 5.45 | 11.40 | 1.90 | 16.60 | 7.18 | 6.18 | 20.30 | 31.70 | 7.54 | 6.31 | 2.27 | 12.50 |
| Zinc, Total (BDL 10) µg/L | 24.60 | 20.20 | 14.20 | 15.20 | 0.011 | 0.006 | 12.80 | 13.60 | 10.00 | 10.50 | 10.00 | 15.60 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 50 – Complete analytical sampling results for all parameters for Fry Ditch Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/13/17 | 8/8/17 | 8/22/17 | 9/5/17 | 9/6/17 | 10/12/17 | 11/7/17 | 12/14/17 | 1/22/18 | 2/12/18 | 3/21/18 | 4/3/18 |
| Coliform, Fecal CFU/100mL | 4800 | 69 | 17 | 110 | 11 | 47 | 160 | 28 | 22 | 3 | 3 | 19 |
| *E. coli* (BDL 1) MPN/100mL | 3300 | 93 | 2 | 12 | 12 | 26 | 200 | 44 | 44 | 3 | 4.1 | 23 |
| *Enterococcus* (BDL 1) MPN/100 mL | 100 | 690 | 26 | 230 | 140 | 17 | 19 | 24 | 23 | 7.5 | 5.2 | 47 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5/23/18 | 6/7/18 | 6/14/18 | 6/21/18 | 6/27/18 | | | | | | | |
| Coliform, Fecal CFU/100mL | 220 | 900 | 64 | 570 | 14 | | | | | | | |
| *E. coli* (BDL 1) MPN/100mL | 83 | 4600 | 38 | 460 | 3.1 | | | | | | | |
| *Enterococcus* (BDL 1) MPN/100 mL | 1700 | 7800 | 21 | 2400 | 22 | | | | | | | |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 51 – Complete analytical results for bacteria samples for Fry Ditch Creek

## Haikey Creek
## WBID: 120410010210_00

Table 52 - Sampling location on Haikey Creek

| Waterbody | Sample Location | | Watershed Area ($mi^2$)* | Sampling/Evaluation Date | | | |
|---|---|---|---|---|---|---|---|
| | Latitude | Longitude | | Fish | Benthic (Summer) | Benthic (Winter) | Habitat |
| Haikey Creek | 36.029759 | -95.867964 | 2.22 | 10/11/2017 | 09/01/2016 | 02/27/2017 | 06/14/2018 |
| | | | | | 08/28/2017 | 01/31/2018 | |

* Collection area captured by sampling point

# 8.0 BENEFICIAL USES

**8.1 Agriculture –** Data collected on Total Dissolved Solids for Haikey Creek indicates attainment of the agricultural beneficial use. The number of samples collected exceeds the number of samples required. The sample mean does not exceed the yearly standard and none of the samples exceeded the sample standard.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 338 | 480 | Sample: 1782, Yearly: 1419 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |

Table 53 – Agriculture standards for Haikey Creek

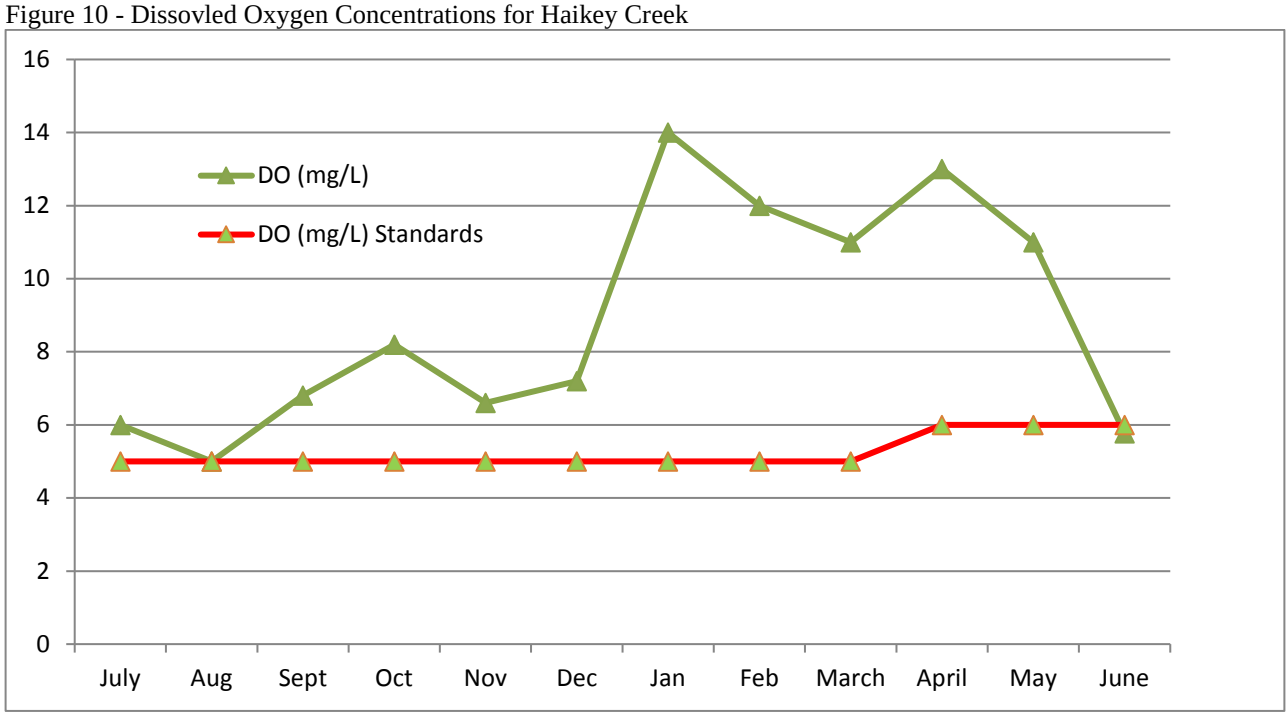
## 8.2 Fish and Wildlife Propagation: Warm Water Aquatic Community

**8.2.1** Dissolved Oxygen - Data collected on Dissolved Oxygen concentrations shows the beneficial use is not supported. The number of samples collected exceeds the number of required samples. Out of 12 samples, two were found to be above the standard. Therefore, more than 10% of the samples were outside the standard range.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| D.O. | 1 samples below 6.0 | na | April - June: 5.0 | 3 | 10 total | No more than 10% of samples outside range |
| | 1 samples below 5.0 | na | June - Mar: 6.0 | 9 | | |

Table 54 – Dissolved Oxygen standards for Haikey Creek

Figure 10 - Dissovled Oxygen Concentrations for Haikey Creek



**8.2.2** Toxicants/Metals - Data collected indicate full support of the beneficial use for Toxicants and Metals.

| Parameter | Sample Mean (µg/L) | Single Sample (µg/L) | Water Quality Standard (µg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Cadmium | 0.38 | 0.50 | Acute: 99.85, Chronic: 2.42 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper | 1.63 | 3.32 | Acute: 47.56, Chronic: 29.14 | 12 | 5 | |
| Lead | 0.57 | 2.11 | Acute: 278.25, Chronic: 10.84 | 12 | 5 | |
| Zinc | 9.91 | 21.60 | Acute: 264.66, Chronic: 239.72 | 12 | 5 | |

Table 55 – Toxicants/Metals standards for Haikey Creek

**8.2.3** pH (Hydrogen Ion Activity) - Data collected on pH readings for Haikey Creek show full support of the beneficial use. The number of pH measurements taken exceeds the number of required measurements. All pH measurements fell within the standard range.

| Parameter | Sample Range (s.u.) | Single Sample (s.u.) | Water Quality Standard Range (s.u.) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| pH | 7.2 – 7.9 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |

Table 56 – pH standards for Haikey Creek

**8.2.4** Oil and Grease - Data collected on Oil and Grease concentrations through HEM laboratory analysis show support of the beneficial use. All samples taken showed Oil and Grease amounts to be below the detection limit.

**8.2.5** Suspended and Bedded Sediments - Using habitat assessment data to determine support of the beneficial use is conditional upon the support of turbidity data and fish collection data.

**8.2.5.1** *Turbidity* – Data collected on Turbidity readings for Haikey Creek show full support of the beneficial use.

| Parameter | Sample Mean (NTU) | Single Sample (NTU) | Water Quality Standard (NTU) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Turbidity | 8.82 | 43.00 | 50 | 12 | 10 | No more than 10% exceeding sample standard |

Table 57 – Turbidity standards for Haikey Creek

**8.2.5.2** *Habitat Assessment* - The resulting score of the habitat assessment on Haikey Creek can be compared to the average score of high quality sites within the same ecoregion provided by the Oklahoma Conservation Commission using a scoring workbook derived from OWRB (OWRB, 2001). The results of the habitat assessment produced a score above average for the central irregular plains ecoregion.

| Metric | Score |
|---|---|
| Instream habitat | 18.2 |
| Pool bottom substrate | 6.3 |
| Pool variability | 17.2 |
| Canopy cover | 19.3 |
| Presence of rocky runs and riffles | 13.3 |
| Flow (at representative low flow) | 2.4 |
| Channel alteration | 9.9 |
| Channel sinuosity | 4.3 |
| Bank stability | 6.2 |
| Bank vegetation stability | 4.4 |
| Stream side Cover | 9.6 |
| **Total Score** | **111.10** |
| **Central Irregular Plains Mean Score** | **84.09** |

Table 58 – Habitat assessment metric and total results with ecoregion mean score

### 8.2.6 Biological

**8.2.6.1** *Fish Collections* - Data recorded from fish collections performed on Haikey Creek show that the beneficial use is undetermined.

| Index of Biotic Integrity | Score |
|---|---|
| Sample Composition | 18 |
| Fish Condition | 11 |
| Score Key: 30 + Beneficial Use Supported : 23 - 29 Undetermined : < 22 Impaired | Total: 29 |

Table 59 – Fish IBI score for Haikey Creek

| Family | Species Name | Common Name | Number of Fish | Percentage |
|---|---|---|---|---|
| Ictaluridae | *Ameiurus natalis* | Yellow bullhead catfish | 2 | 0.5% |
| Centrarchidae | *Lepomis cyanellus* | Green sunfish | 73 | 18.8% |
| | *Lepomis macrochirus* | Bluegill sunfish | 50 | 12.9% |
| | *Lepomis megalotis* | Longear sunfish | 87 | 22.4% |
| | *Lepomis microlophus* | Redear sunfish | 1 | 0.3% |
| | *Lepomis YOY* | YOY sunfish | 96 | 24.7% |
| | *Micropterus salmoides* | Largemouth bass | 1 | 0.3% |
| Cyprinidae | *Cyprinella lutrensis* | Red shiner | 47 | 12.1% |
| | *Campostoma anomalum* | Central stoneroller | 30 | 7.7% |
| Poeciliidae | *Gambusia affinis* | Mosquitofish | 2 | 0.5% |
| **Total Number:** | | | 389 | 100.0% |
| **Total Number of Taxa:** | | | 10 | |

Table 60 – Fish collection counts for Haikey Creek

^Photograph taken of Haikey Creek sample site

**8.2.6.2** *Benthic Macroinvertebrate Collections* – Data recorded from benthic macroinvertebrate collections during the summer and winter index periods is undetermined for one summer index period and impaired for the other index periods (ODEQ, Continuing Planning Process, 2012).

| Sampling Event | Score |
|---|---|
| Summer 2016 | 58% |
| Winter 2017 | 44% |
| Summer 2017 | 39% |
| Winter 2018 | 44% |
| Haikey Creek - (Central Irregular Plains): >80% Attaining : 50-80% - Undetermined : < 50% Impaired | |

Table 61 – Benthic macroinvertebrate metrics for summer and winter index periods at Haikey Creek

| Genus | Common Class | 10/19/2016 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 13 | 12.1% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 9 | 8.4% |
| *Hydroptila* sp. | Micro Caddisfly | 2 | 1.9% |
| *Argia* sp. | Narrowwinged Damselfly | 1 | 0.9% |
| Coenagrionidae | | 1 | 0.9% |
| *Cricotopus* sp. | Midge | 1 | 0.9% |
| *Dicrotendipes* sp. | | 1 | 0.9% |
| *Orthocladius (Symposiocladius) lignicola* | | 1 | 0.9% |
| *Polypedilum flavum* | | 23 | 21.5% |
| *Polypedilum ilinoense* gr. | | 3 | 2.8% |
| *Polypedilum scalaenum* gr. | | 13 | 12.1% |
| *Rheotanytarsus exiguus* gr. | | 2 | 1.9% |
| *Tanytarsus* sp. | | 1 | 0.9% |
| Thienemannimyia gr. sp. | | 8 | 7.5% |
| *Erpobdella* sp. | Leech | 9 | 8.4% |
| *Corbicula* sp. | Asian Freshwater Clam | 6 | 5.6% |
| *Physa* sp. | Lung Snail | 1 | 0.9% |
| *Hyalella* sp. | Scud | 12 | 11.2% |
| Total | | 107 | 100.0% |
| Total Number of Taxa | | 18 | |
| 2016 Haikey Creek Summer Index Period | | | |

| Genus | Common Class | 2/27/2017 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 2 | 1.8% |
| *Cricotopus bicinctus* gr. | Midge | 1 | 0.9% |
| *Cricotopus* sp. | | 5 | 4.5% |
| *Cricotopus/Orthocladius* sp. | | 7 | 6.4% |
| *Orthocladius* sp. | | 16 | 14.5% |
| *Paratendipes* sp. | | 2 | 1.8% |
| *Polypedilum flavum* | | 59 | 53.6% |
| *Polypedilum illinoense* gr. | | 1 | 0.9% |
| *Polypedilum scalaenum* gr. | | 6 | 5.5% |
| *Polypedilum* sp. | | 1 | 0.9% |
| *Rheotanytarsus exiguus* gr. | | 2 | 1.8% |
| *Tanytarsus* sp. | | 1 | 0.9% |
| *Thienemanniella* sp. | | 1 | 0.9% |
| *Corbicula* sp. | Asian Freshwater Clam | 5 | 4.5% |
| Nematoda | Roundworm | 1 | 0.9% |
| Total | | 110 | 100.0% |
| Total Number of Taxa | | 15 | |
| 2017 Haikey Creek Winter Index Period | | | |

| Genus | Common Class | 8/28/2017 | |
|---|---|---|---|
| | | Count | % |
| *Fallceon* sp. | Minnow Mayfly | 1 | 0.8% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 15 | 11.6% |
| *Hydroptila* sp. | Micro Caddisfly | 4 | 3.1% |
| *Dicrotendipes* sp. | Midge | 4 | 3.1% |
| *Polypedilum flavum* | | 72 | 55.8% |
| *Polypedilum illinoense* gr. | | 8 | 6.2% |
| *Rheotanytarsus exiguus* gr. | | 12 | 9.3% |
| *Tanytarsus* sp. | | 3 | 2.3% |
| *Thienemannimyia* gr. sp. | | 7 | 5.4% |
| *Atrichopogon* sp. | Biting Midge | 2 | 1.6% |
| *Hygrobates* sp. | Water Mite | 1 | 0.8% |
| Total | | 129 | 100.0% |
| Total Number of Taxa | | 11 | |
| 2017 Haikey Creek Summer Index Period | | | |

| Genus | Common Class | 1/31/2018 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 2 | 2.0% |
| *Fallceon* sp. | Minnow Mayfly | 1 | 1.0% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 3 | 3.0% |
| *Corynoneura* sp. | Midge | 1 | 1.0% |
| *Cricotopus bicinctus* gr. | | 1 | 1.0% |
| *Cricotopus* sp. | | 16 | 16.0% |
| *Cricotopus/Orthocladius* sp. | | 1 | 1.0% |
| *Eukiefferiella* sp. | | 1 | 1.0% |
| *Nanocladius* sp. | | 1 | 1.0% |
| *Orthocladius* sp. | | 21 | 21.0% |
| *Polypedilum flavum* | | 26 | 26.0% |
| *Polypedilum illinoense* gr. | | 6 | 6.0% |
| *Polypedilum scalaenum* gr. | | 1 | 1.0% |
| *Rheotanytarsus exiguus* gr. | | 10 | 10.0% |
| *Tanytarsus* sp. | | 1 | 1.0% |
| *Thienemanniella* sp. | | 1 | 1.0% |
| *Thienemannimyia* gr. sp. | | 2 | 2.0% |
| *Tipula* sp. | Large Crane Fly | 1 | 1.0% |
| *Erpobdella* sp. | Leech | 1 | 1.0% |
| *Nais* sp. | Aquatic Worm | 2 | 2.0% |
| tubificoid w/o cap setae | Aquatic Worm (Bald) | 1 | 1.0% |
| Total | | 100 | 100.0% |
| Total Number of Taxa | | 21 | |
| 2018 Haikey Creek Winter Index Period | | | |

Table 62 – Benthic macroinvertebrate counts for Haikey Creek summer and winter index periods

**8.3 Primary Body Contact -** The data collected on *E. coli* and *Enterococcus* concentrations show that Haikey Creek is impaired for both *E. coli* and *Enterococcus*. The number of samples collected exceeds the number of samples required. While the MS4 permit requires monthly sampling of bacteria, water quality standards only pertain to samples collected during the recreational period.

| Parameter | Sample Geometric Mean (MPN/100mL) | Single Sample (MPN/100mL) | Water Quality Standard (MPN/100mL) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| *E. coli* | 277 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| *Enterococcus* | 927 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |

Table 63 – *E. coli* and *Enterococcus* totals for Haikey Creek

Figure 11 - *E. coli* Concentrations for Haikey Creek

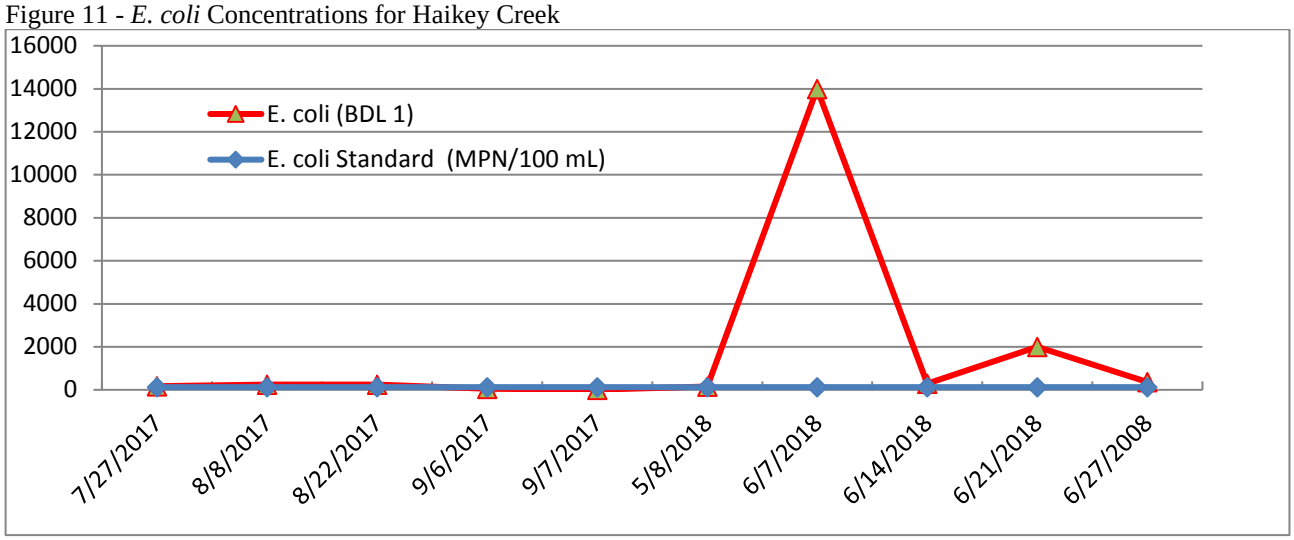
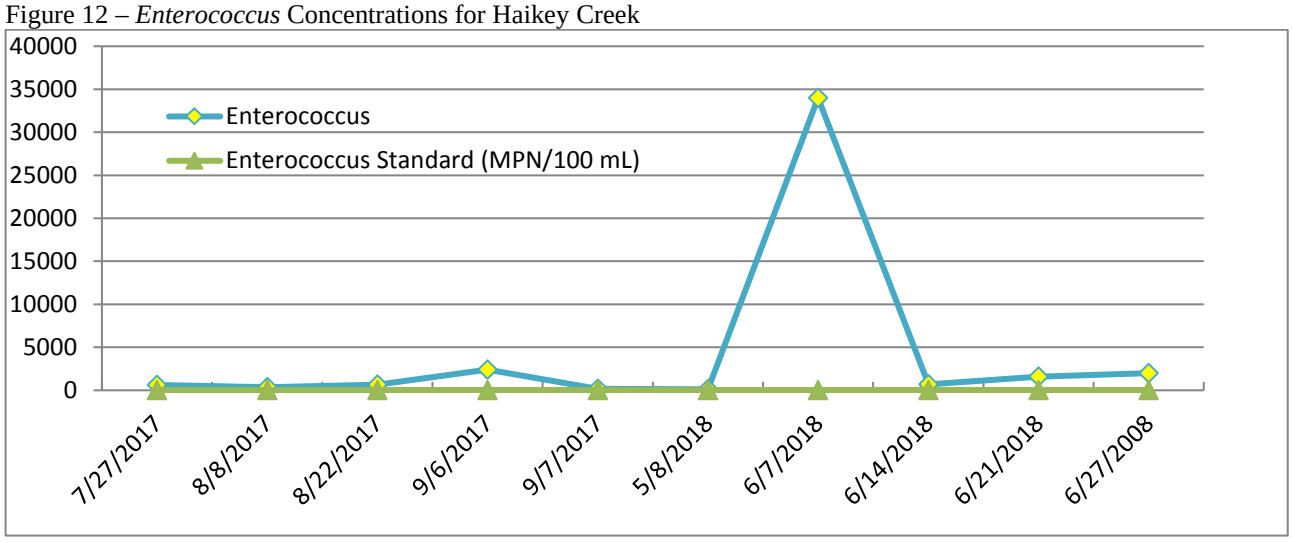



Figure 12 – *Enterococcus* Concentrations for Haikey Creek



## 8.4 Anti-Degradation Policy

**8.4.1** Nutrients - Analytical results for Total Phosphorus and Nitrate/Nitrite show no need for further investigation to show support of the beneficial use. The number of samples collected exceeds the number of required samples, and less than 10% of samples exceeded the threshold for further sampling. While Nitrate/Nitrite concentrations have an action level, it is not a required parameter within the MS4 permit (ODEQ, OPDES Permit OKS000201, 2011).

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Threshold (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Phosphorus | 0.06 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| Nitrite - Nitrate | 0.37 | na | 4.95 | 12 | 10 | No more than 10% of samples outside range |

Table 64 – Nutrient totals for Haikey Creek

## 9.0 SUMMARY

Analytically, Haikey Creek does not reflect any water quality impacts to the stream during the year of sampling with the exception of dissolved oxygen and bacteria. Fish collections reflected an undetermined classification according to water quality standards. An increase in intolerant species would attain full support. A disappointing benthic macroinvertebrate IBI score could also be related to the lack of intolerant species which prevents support of the beneficial use. Conversely, the higher than average habitat assessment score is encouraging and future sampling may show improvements in fish and macroinvertebrate scores.

Table 65 – Oklahoma Water Quality Standards summary of collected data for Haikey Creek

| Haikey | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Sample Mean** | **Single Sample** | **Water Quality Standard** | **No. of Samples** | **No. of Samples Required (WQS)** | **How Standard is Violated** |
| Cadmium (µg/L) | 0.38 | 0.50 | Acute: 99.85, Chronic: 2.42 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper (µg/L) | 1.63 | 3.32 | Acute: 47.56, Chronic: 29.14 | 12 | 5 | |
| Lead (µg/L) | 0.57 | 2.11 | Acute: 278.25, Chronic: 10.84 | 12 | 5 | |
| Zinc (µg/L) | 9.91 | 21.60 | Acute: 264.66, Chronic: 239.72 | 12 | 5 | |
| Diazinon (µg/L) | 0.15 | na | Acute: 0.17 | 12 | 5 | |
| E. coli (MPN/100ml) | 277 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| Enterococcus (MPN/100ml) | 927 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |
| Oil and Grease (visual) | None | na | No visible sheen | 12 | 10 | No more than 10% of observations with oil & grease |
| Total Phosphorus (mg/L) | 0.06 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| *Nitrite – Nitrate (mg/L)* | *0.37* | *na* | *4.95* | *12* | *10* | *No more than 10% of samples outside range* |
| Total Dissolved Solids (mg/L) | 338 | 480 | Sample: 1782, Yearly: 1419 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |
| pH (s.u.) | 7.2 – 7.9 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |
| *D.O. (mg/L)* | *1 samples below 6.0* | *na* | *April 1-June 15: 6.0* | *3* | *10 total* | *No more than 10% of samples outside range* |
| | *1 samples below 5.0* | *na* | *June 16-Mar 31.: 5.0* | *9* | | |
| **Analytes in italics not required by permit* *Analytes in red exceed standards* | | | | | | |

| Analyte | Result | | |
|---|---|---|---|

| | Minimum | Mean | Maximum | Number of Samples | Number of Attempts |
|---|---|---|---|---|---|
| Oxygen Demand, 5-Day Biological (mg/L)(DL 3.0 mg/L) | -- | 3.42 | 6.40 | 12 | 12 |
| Cadmium, Total (µg/L) (DL 0.5 µg/L) | -- | 0.38 | 0.50 | 12 | 12 |
| Coliform, Fecal (CFU/100 mL)(DL 1 CFU/100 mL) | -- | 231 | 12900 | 12 | 17 |
| Conductivity µS | -- | 473 | 700 | 12 | 12 |
| Copper, Total (µg/L) (DL 0.5 µg/L) | -- | 1.63 | 3.32 | 12 | 12 |
| Diazinon (µg/L) (DL 0.17-5.0 µg/L) | -- | 0.15 | 0.17 | 12 | 12 |
| Dissolved Oxygen (mg/L) | 4.96 | 8.85 | 14.05 | 12 | 12 |
| *E. coli* (MPN/100 mL) (DL 1 MPN/100 mL) | -- | 144 | 14000 | 12 | 17 |
| *Enterococcus* (MPN/100 mL)(DL 1 CFU/100 mL) | -- | 261 | 34000 | 12 | 17 |
| Flow (cfs) | 0.06 | 0.48 | 1.35 | 12 | 12 |
| Hardness, Total (mg/L) (DL 3.6 mg/L) | 96 | 189 | 270 | 12 | 12 |
| Lead, Total (µg/L) (DL 0.5 µg/L) | -- | 0.57 | 2.11 | 12 | 12 |
| Nitrogen, Total Kjeldahl (mg/L)(DL 0.50 mg/L) | -- | 0.62 | 0.92 | 12 | 12 |
| Nitrogen, Nitrate-Nitrite (mg/L) (DL 0.2 mg/L) | -- | 0.37 | 1.00 | 12 | 12 |
| Nitrogen, Total as Nitrogen (mg/L)(DL 0.50 mg/L) | -- | 0.77 | 1.60 | 12 | 12 |
| Oil and Grease (mg/L) (DL 6.0-6.5 mg/L) | -- | 7.08 | 8.00 | 12 | 12 |
| Oxygen Demand, Chemical (mg/L)(DL 20 mg/L) | -- | 21 | 32 | 12 | 12 |
| pH (su) | 7.23 | 7.45 | 7.94 | 12 | 12 |
| Phosphorus, Total (mg/L) (DL 0.010 mg/L) | -- | 0.06 | 0.15 | 12 | 12 |
| Phosphorus, Dissolved (mg/L) (DL 0.010 mg/L) | -- | 0.03 | 0.08 | 12 | 12 |
| Solids, Total Dissolved (mg/L) (DL 10 mg/L) | -- | 338 | 480 | 12 | 12 |
| Solids, Total Suspended (mg/L) (DL 2.0 mg/L) | -- | 10.63 | 53.00 | 12 | 12 |
| Temperature, Water (°C) | 2.99 | 15.20 | 27.82 | 12 | 12 |
| Turbidity | -- | 8.82 | 43.00 | 12 | 12 |
| Zinc, Total (µg/L) (DL 10 µg/L) | -- | 9.91 | 21.60 | 12 | 12 |
| Results found to be below the detection limit are reported as the detection limit | | | | | |

Table 66 – MS4 permit required analytical sampling parameters result summaries for Haikey Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/19/17 | 8/21/17 | 9/7/17 | 10/25/17 | 11/20/17 | 12/5/17 | 1/24/18 | 2/13/18 | 3/15/18 | 4/5/18 | 5/8/18 | 6/20/18 |
| BOD(5) Day (BDL 3) mg/L | 3.0 | 3.0 | 3.0 | 3.0 | 3.3 | 4.2 | 3.0 | 3.0 | 4.0 | 3.0 | 2.1 | 6.4 |
| Cadmium, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.0005 | 0.001 | 0.001 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Conductivity µS | 466 | 520 | 498 | 333 | 548 | 337 | 386 | 288 | 514 | 625 | 700 | 463 |
| Copper, Total (BDL 0.5) µg/L | 1.48 | 2.64 | 1.41 | 0.002 | 0.005 | 0.005 | 2.84 | 3.32 | 2.43 | 1.30 | 1.41 | 2.75 |
| Diazinon (BDL 0.17) µg/L | 0.17 | 0.17 | 0.10 | 0.10 | 0.10 | 0.10 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| Dissolved Oxygen mg/L | 6.01 | 4.96 | 6.75 | 8.23 | 6.63 | 7.19 | 14.05 | 11.80 | 11.23 | 12.52 | 11.00 | 5.77 |
| Flow CFS | 0.30 | 0.63 | 0.06 | 0.72 | 0.13 | 0.15 | 0.13 | 0.15 | 0.65 | 1.32 | 1.35 | 0.15 |
| Hardness, Total (BDL 3.6) mg/L | 150 | 180 | 180 | 160 | 260 | 180 | 230 | 160 | 230 | 96 | 270 | 170 |
| Lead, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.01 | 0.0005 | 0.0005 | 2.11 | 0.50 | 0.50 | 0.50 | 1.11 | 0.619 |
| Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L | 0.60 | 0.55 | 0.50 | 0.50 | 0.77 | 0.50 | 0.76 | 0.62 | 0.65 | 0.53 | 0.50 | 0.92 |
| Nitrogen, Nitrate-Nitrite (BDL 0.2) mg/L | 0.22 | 0.42 | 0.20 | 0.52 | 0.20 | 0.20 | 0.20 | 0.20 | 0.24 | 1.00 | 0.89 | 0.20 |
| Nitrogen, Total as N (BDL 0.5) mg/L | 0.81 | 0.55 | 0.50 | 0.51 | 0.77 | 0.50 | 0.76 | 0.62 | 0.88 | 1.60 | 0.85 | 0.92 |
| Oil and Grease HEM (BDL 6) mg/L | 6.40 | 6.70 | 6.80 | 6.90 | 7.00 | 7.00 | 7.60 | 7.60 | 7.10 | 8.00 | 7.70 | 6.10 |
| Oxygen Demand, Chemical (BDL 20) mg/L | 20 | 20 | 20 | 20 | 23 | 32 | 22 | 20 | 20 | 20 | 20 | 20 |
| pH (s.u.) | 7.54 | 7.68 | 7.57 | 7.23 | 7.47 | 7.33 | 7.27 | 7.44 | 7.36 | 7.32 | 7.30 | 7.94 |
| Phosphorus, Total (BDL 0.010) mg/L | 0.037 | 0.061 | 0.028 | 0.100 | 0.140 | 0.026 | 0.150 | 0.016 | 0.033 | 0.036 | 0.034 | 0.058 |
| Phosphorus, Total Dissolved BDL (0.010) mg/L | 0.022 | 0.041 | 0.015 | 0.046 | 0.084 | 0.026 | 0.019 | 0.014 | 0.013 | 0.010 | 0.019 | 0.031 |
| Solids, Total Dissolved (BDL 10) mg/L | 290 | 320 | 300 | 290 | 400 | 290 | 350 | 290 | 370 | 480 | 420 | 260 |
| Solids, Total Suspended (BDL 2.0) mg/L | 4.0 | 9.0 | 5.6 | 6.7 | 6.0 | 9.6 | 53.0 | 4.0 | 6.9 | 6.7 | 4.0 | 12.0 |
| Temperature, Water °C | 27.82 | 27.16 | 19.91 | 11.74 | 9.00 | 10.25 | 2.99 | 6.10 | 10.30 | 9.55 | 22.00 | 25.63 |
| Turbidity (NTU) | 3.81 | 7.00 | 4.10 | 10.60 | 4.99 | 2.59 | 43.00 | 1.36 | 4.14 | 4.40 | 4.00 | 15.90 |
| Zinc, Total (BDL 10) µg/L | 13.6 | 21.6 | 10.0 | 0.019 | 0.008 | 0.013 | 17.0 | 10.0 | 14.1 | 10.0 | 10.0 | 12.6 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 67 – Complete analytical sampling results for all parameters for Haikey Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/27/17 | 8/21/17 | 8/22/17 | 9/6/17 | 9/7/17 | 10/25/17 | 11/20/17 | 12/5/17 | 1/24/18 | 2/13/18 | 3/15/18 | 4/5/18 |
| Coliform, Fecal CFU/100mL | 460 | 560 | 530 | 130 | 22 | 490 | 230 | 280 | 4 | 4 | 53 | 340 |
| *E. coli* (BDL 1) MPN/100mL | 170 | 250 | 250 | 57 | 9.8 | 580 | 220 | 250 | 3.1 | 1 | 65 | 290 |
| *Enterococcus* (BDL 1) MPN/100 mL | 610 | 340 | 650 | 2400 | 150 | 490 | 140 | 25 | 27 | 3 | 9.8 | 200 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5/8/18 | 6/7/18 | 6/14/18 | 6/21/18 | 6/27/18 | | | | | | | |
| Coliform, Fecal CFU/100mL | 110 | 12900 | 730 | 5400 | 750 | | | | | | | |
| *E. coli* (BDL 1) MPN/100mL | 150 | 14000 | 290 | 2000 | 370 | | | | | | | |
| *Enterococcus* (BDL 1) MPN/100 mL | 120 | 34000 | 690 | 1600 | 2000 | | | | | | | |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 68 – Complete analytical results for bacteria samples for Haikey Creek

## Joe Creek
## WBID: 120420010050_00

Table 69 - Sampling location on Joe Creek

| Waterbody | Sample Location | | Watershed Area ($mi^2$)* | Sampling/Evaluation Date | | | |
|---|---|---|---|---|---|---|---|
| | Latitude | Longitude | | Fish | Benthic (Summer) | Benthic (Winter) | Habitat |
| Joe Creek | 36.059835 | -95.967266 | 13.11 | 10/11/2017 | 10/19/2016 | 02/17/2017 | 11/09/2017 |
| | | | | | 08/30/2017 | 01/31/2018 | |

* Collection area captured by sampling point

# 10.0 BENEFICIAL USES

**10.1 Agriculture –** Data collected on Total Dissolved Solids for Joe Creek indicates attainment of the agricultural beneficial use. The number of samples collected exceeds the number of samples required. The sample mean does not exceed the yearly standard and none of the samples exceeded the sample standard.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 308 | 370 | Sample: 1868, Yearly: 1496 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |

Table 1 – Agriculture standards for Joe Creek

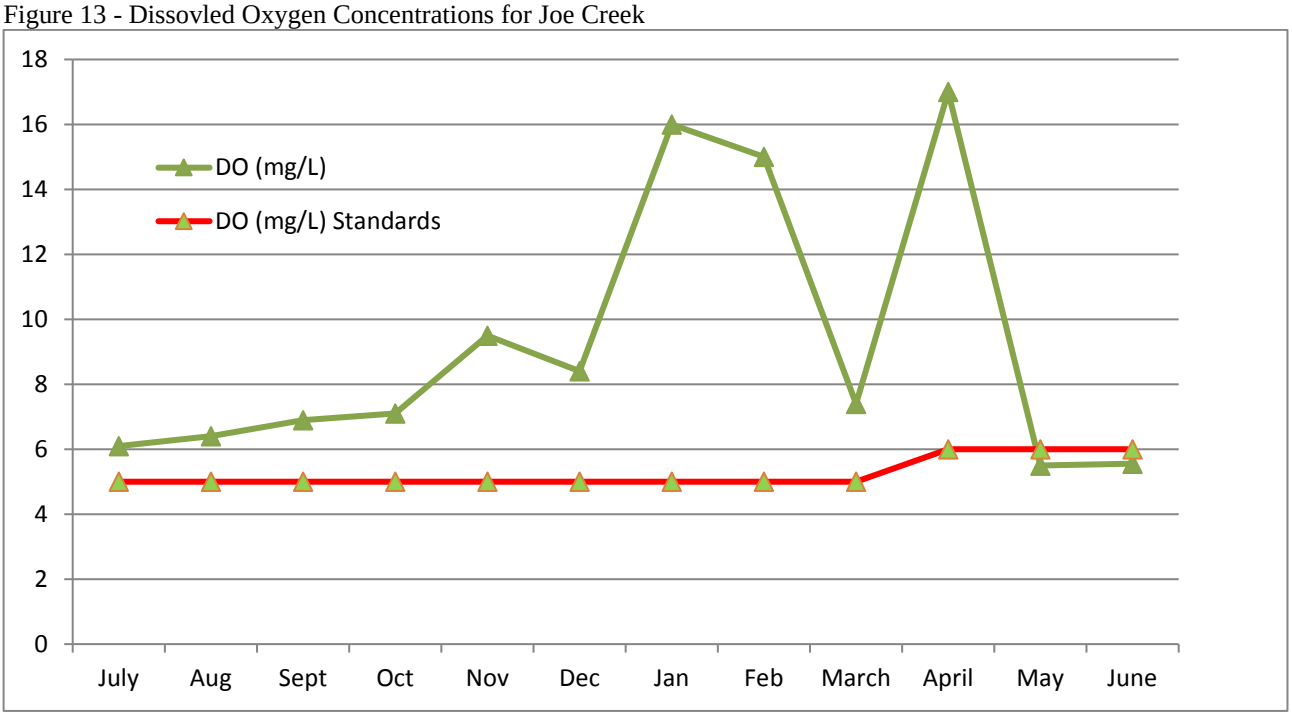
## 10.2 Fish and Wildlife Propagation: Warm Water Aquatic Community

**10.2.1** Dissolved Oxygen - Data collected on Dissolved Oxygen concentrations shows the beneficial use is not supported. The number of samples collected exceeds the number of required samples. Out of 12 samples, two were found to be below the standard. Therefore, more than 10% of the samples were outside the standard range.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| D.O. | 2 samples below 6.0 | na | April - June: 5.0 | 3 | 10 total | No more than 10% of samples outside range |
| | 0 samples below 5.0 | na | June - Mar: 6.0 | 9 | | |

Table 71 – Dissolved Oxygen standards for Joe Creek

Figure 13 - Dissovled Oxygen Concentrations for Joe Creek



**10.2.2** Toxicants/Metals - Data collected indicate full support of the beneficial use for Toxicants and Metals.

| Parameter | Sample Mean (µg/L) | Single Sample (µg/L) | Water Quality Standard (µg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Cadmium | 0.38 | 0.50 | Acute: 102.36, Chronic: 2.46 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper | 1.49 | 4.39 | Acute: 48.56, Chronic: 29.69 | 12 | 5 | |
| Lead | 0.38 | 0.50 | Acute: 286.15, Chronic: 11.15 | 12 | 5 | |
| Zinc | 8.99 | 19.00 | Acute: 269.64, Chronic: 244.23 | 12 | 5 | |

Table 72 – Toxicants/Metals standards for Joe Creek

**10.2.3** pH (Hydrogen Ion Activity) - Data collected on pH readings for Joe Creek show full support of the beneficial use. The number of pH measurements taken exceeds the number of required measurements. All pH measurements fell within the standard range.

| Parameter | Sample Range (s.u.) | Single Sample (s.u.) | Water Quality Standard Range (s.u.) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| pH | 7.1 – 7.7 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |

Table 73 – pH standards for Joe Creek

**10.2.4** Oil and Grease - Data collected on Oil and Grease concentrations through HEM laboratory analysis show support of the beneficial use. All samples taken showed Oil and Grease amounts to be below the detection limit.

**10.2.5** Suspended and Bedded Sediments - Using habitat assessment data to determine support of the beneficial use is conditional upon the support of turbidity data and fish collection data.

**10.2.5.1** *Turbidity* – Data collected on Turbidity readings for Joe Creek show full support of the beneficial use.

| Parameter | Sample Mean (NTU) | Single Sample (NTU) | Water Quality Standard (NTU) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Turbidity | 5.55 | 25.10 | 50 | 12 | 10 | No more than 10% exceeding sample standard |

Table 74 – Turbidity standards for Joe Creek

**10.2.5.2** *Habitat Assessment* - The resulting score of the habitat assessment on Joe Creek can be compared to the average score of high quality sites within the same ecoregion provided by the Oklahoma Conservation Commission using a scoring workbook derived from OWRB (OWRB, 2001). The results of the habitat assessment produced a score above average for the central irregular plains ecoregion.

| Metric | Score |
|---|---|
| Instream habitat | 18.0 |
| Pool bottom substrate | 9.3 |
| Pool variability | 14.4 |
| Canopy cover | 10.6 |
| Presence of rocky runs and riffles | 4.1 |
| Flow (at representative low flow) | 10.6 |
| Channel alteration | 9.9 |
| Channel sinuosity | -0.3 |
| Bank stability | 8.6 |
| Bank vegetation stability | 0.1 |
| Stream side Cover | 9.9 |
| **Total Score** | **95.17** |
| **Central Irregular Plains Mean Score** | **84.09** |

Table 75 – Habitat assessment metric and total results with ecoregion mean score

### 10.2.6 Biological

**10.2.6.1** *Fish Collections* - Data recorded from fish collections performed on Joe Creek show that the beneficial use is undetermined.

| Index of Biotic Integrity | Score |
|---|---|
| Sample Composition | 20 |
| Fish Condition | 9 |
| Score Key: 30 + Beneficial Use Supported : 23 - 29 Undetermined : < 22 Impaired | Total: 29 |

Table 76 – Fish IBI score for Joe Creek

| Family | Species Name | Common Name | Number of Fish | Percentage |
|---|---|---|---|---|
| Ictaluridae | *Ameiurus natalis* | Yellow bullhead catfish | 2 | 0.5% |
| Centrarchidae | *Lepomis cyanellus* | Green sunfish | 73 | 18.8% |
| | *Lepomis macrochirus* | Bluegill sunfish | 50 | 12.9% |
| | *Lepomis megalotis* | Longear sunfish | 87 | 22.4% |
| | *Lepomis microlophus* | Redear sunfish | 1 | 0.3% |
| | *Lepomis YOY* | YOY sunfish | 96 | 24.7% |
| | *Micropterus salmoides* | Largemouth bass | 1 | 0.3% |
| Cyprinidae | *Cyprinella lutrensis* | Red shiner | 47 | 12.1% |
| | *Campostoma anomalum* | Central stoneroller | 30 | 7.7% |
| Poeciliidae | *Gambusia affinis* | Mosquitofish | 2 | 0.5% |
| **Total Number:** | | | 389 | 100.0% |
| **Total Number of Taxa:** | | | 10 | |

Table 77 – Fish collection counts for Joe Creek

^Photograph taken of Joe Creek sample site

**10.2.6.2** *Benthic Macroinvertebrate Collections* – Data recorded from benthic macroinvertebrate collections during the summer and winter index periods is undetermined for both summer index periods and impaired for both winter index periods (ODEQ, Continuing Planning Process, 2012).

| Sampling Event | Score |
|---|---|
| Summer 2016 | 52% |
| Winter 2017 | 37% |
| Summer 2017 | 52% |
| Winter 2018 | 44% |
| Joe Creek - (Central Irregular Plains): >80% Attaining : 50-80% - Undetermined : < 50% Impaired | |

Table 76 – Benthic macroinvertebrate metrics for summer and winter index periods at Joe Creek

| Genus | Common Class | 10/19/2016 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 70 | 56.9% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 2 | 1.6% |
| *Hydroptila* sp. | Micro Caddisfly | 4 | 3.3% |
| *Oecetis* sp. | Long-horned Caddisfly | 1 | 0.8% |
| *Argia* sp. | Narrowwinged Damselfly | 1 | 0.8% |
| *Coenagrion/Enallagma* sp. | | 5 | 4.1% |
| *Microcylloepus* sp. | Riffle Beetle | 1 | 0.8% |
| *Polypedilum flavum* | Midge | 2 | 1.6% |
| *Polypedilum ilinoense* gr. | | 3 | 2.4% |
| *Rheotanytarsus exiguus* gr. | | 2 | 1.6% |
| *Zavrelimyia* sp. | | 1 | 0.8% |
| *Corbicula* sp. | Asian Freshwater Clam | 3 | 2.4% |
| *Gyraulus* sp. | Rams Horn Lung Snail | 3 | 2.4% |
| *Hyalella* sp. | Scud | 25 | 20.3% |
| Total | | 123 | 100.0% |
| Total Number of Taxa | | 14 | |

2016 Joe Creek Summer Index Period

| Genus | Common Class | 2/17/2017 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 6 | 5.4% |
| *Cricotopus bicinctus* gr. | Midge | 3 | 2.7% |
| *Cryptochironomus* sp. | | 1 | 0.9% |
| *Orthocladius* sp. | | 4 | 3.6% |
| *Polypedilum flavum* | | 1 | 0.9% |
| *Pseudochironomus* sp. | | 2 | 1.8% |
| *Rheotanytarsus exiguus* gr. | | 2 | 1.8% |
| *Erioptera* sp. | Crane Fly | 23 | 20.5% |
| Enchytraeidae | Aquatic Worm | 1 | 0.9% |
| *Erpobdella* sp. | Leech | 1 | 0.9% |
| Corbiculoidea | Asian Freshwater Clam | 8 | 7.1% |
| *Hyalella* sp. | Scud | 60 | 53.6% |
| Total | | 112 | 100.0% |
| Total Number of Taxa | | 12 | |

2017 Joe Creek Winter Index Period

| Genus | Common Class | 8/30/2017 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 2 | 1.6% |
| *Fallceon* sp. | Minnow Mayfly | 8 | 6.6% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 20 | 16.4% |
| *Chimarra* sp. | Fingernet Caddisfly | 1 | 0.8% |
| *Stenelmis* sp. | Riffle Beetle | 2 | 1.6% |
| *Corynoneura* sp. | Midge | 1 | 0.8% |
| *Cricotopus bicinctus* gr. | | 2 | 1.6% |
| *Dicrotendipes* sp. | | 2 | 1.6% |
| *Polypedilum flavum* | | 48 | 39.3% |
| *Rheotanytarsus exiguus* gr. | | 29 | 23.8% |
| *Saetheria tylus* | | 2 | 1.6% |
| *Tanytarsus* sp. | | 1 | 0.8% |
| *Thienemannimyia* gr. sp. | | 3 | 2.5% |
| *Corbicula* sp. | Asian Freshwater Clam | 1 | 0.8% |
| Total | | 122 | 100.0% |
| Total Number of Taxa | | 14 | |

2017 Joe Creek Summer Index Period

| Genus | Common Class | 1/31/2018 | |
|---|---|---|---|
| | | Count | % |
| *Fallceon* sp. | Minnow Mayfly | 1 | 1.0% |
| *Caenis* sp. | Squaregilled Mayfly | 2 | 2.0% |
| *Cheumatopsyche* | Netspinner Caddisfly | 3 | 3.0% |
| *Corynoneura* sp. | Midge | 1 | 1.0% |
| *Cricotopus bicinctus* gr. | | 1 | 1.0% |
| *Cricotopus* sp. | | 16 | 16.0% |
| *Cricotopus/Orthocladius* sp. | | 1 | 1.0% |
| *Eukiefferiella* sp. | | 1 | 1.0% |
| *Nanocladius* sp. | | 1 | 1.0% |
| *Orthocladius* sp. | | 21 | 21.0% |
| *Polypedilum flavum* | | 26 | 26.0% |
| *Polypedilum illinoense* gr. | | 6 | 6.0% |
| *Polypedilum scalaenum* gr. | | 1 | 1.0% |
| *Rheotanytarsus exiguus* gr. | | 10 | 10.0% |
| *Tanytarsus* sp. | | 1 | 1.0% |
| *Thienemanniella* sp. | | 1 | 1.0% |
| *Thienemannimyia* gr. sp. | | 2 | 2.0% |
| *Tipula* sp. | Large Crane Fly | 1 | 1.0% |
| *Erpobdella* sp. | Leech | 1 | 1.0% |
| *Nais* sp. | Aquatic Worm | 2 | 2.0% |
| tubificoid w/o cap setae | Aquatic Worm (Bald) | 1 | 1.0% |
| Total | | 100 | 100.0% |
| Total Number of Taxa | | 21 | |

2018 Joe Creek Winter Index Period

Table 77 – Benthic macroinvertebrate counts for Joe Creek summer and winter index periods

**10.3 Primary Body Contact -** The data collected on *E. coli* and *Enterococcus* concentrations show that Joe Creek is impaired for both *E. coli* and *Enterococcus*. The number of samples collected exceeds the number of samples required. While the MS4 permit requires monthly sampling of bacteria, water quality standards only pertain to samples collected during the recreational period.

| Parameter | Sample Geometric Mean (MPN/100mL) | Single Sample (MPN/100mL) | Water Quality Standard (MPN/100mL) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| *E. coli* | 194 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| *Enterococcus* | 141 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |

Table 78 – *E. coli* and *Enterococcus* totals for Joe Creek

Figure 14 - *E. coli* Concentrations

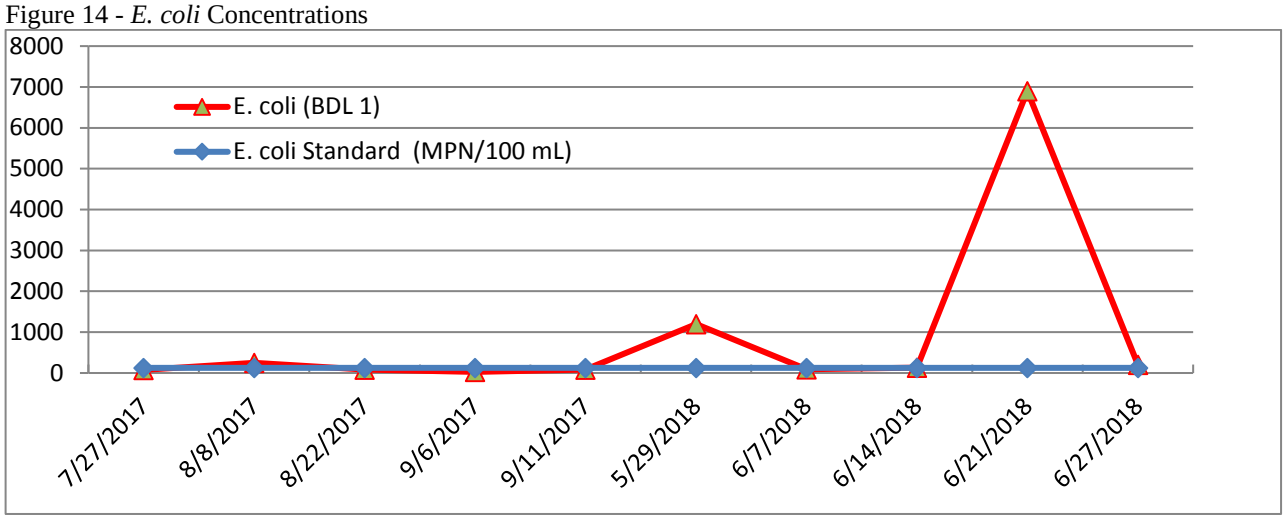
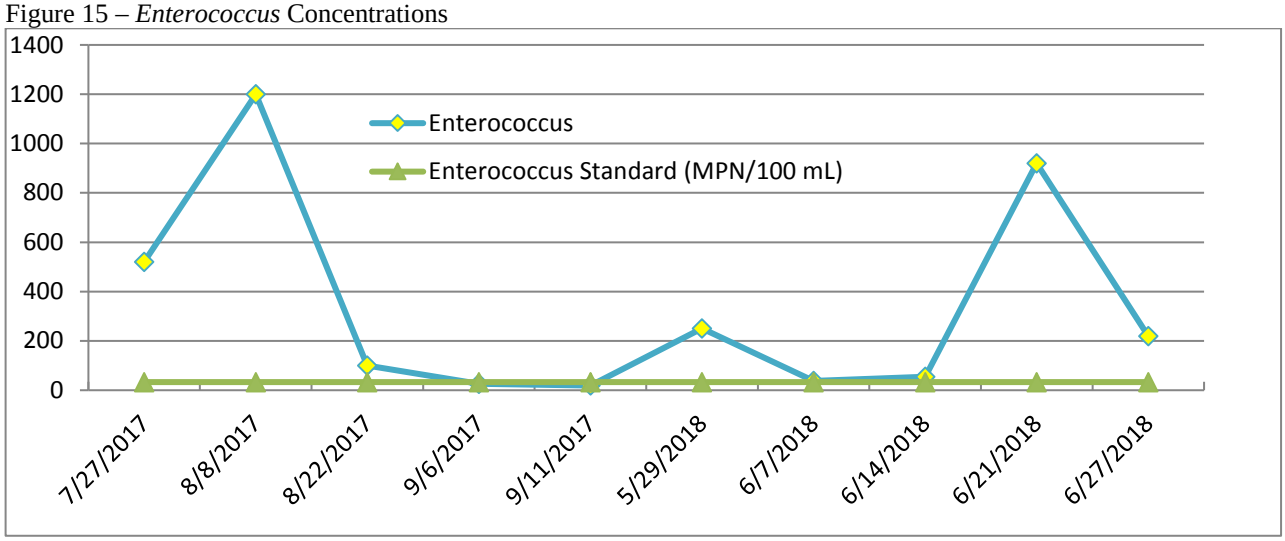



Figure 15 – *Enterococcus* Concentrations



## 10.4 Anti-Degradation Policy

**10.4.1** Nutrients - Analytical results for Total Phosphorus and Nitrate/Nitrite show no need for further investigation to show support of the beneficial use. The number of samples collected exceeds the number of required samples, and less than 10% of samples exceeded the threshold for further sampling. While Nitrate/Nitrite concentrations have an action level, it is not a required parameter within the MS4 permit (ODEQ, OPDES Permit OKS000201, 2011).

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Threshold (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Phosphorus | 0.04 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| Nitrite - Nitrate | 0.24 | na | 4.95 | 12 | 10 | No more than 10% of samples outside range |

Table 79 – Nutrient totals for Joe Creek

## 11.0 SUMMARY

Analytically, Joe Creek does not reflect any water quality impacts to the stream during the year of sampling with the exception of bacteria and dissolved oxygen. Fish collections reflected an undetermined classification according to water quality standards. An increase in intolerant species would achieve full support. A disappointing benthic macroinvertebrate IBI score could also be related to the lack of intolerant species which prevents support of the beneficial use. The higher than average habitat assessment score is encouraging and future sampling may show improvements in fish and macroinvertebrate scores.

Table 63 – Oklahoma Water Quality Standards summary of collected data for Joe Creek

| Joe | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Sample Mean** | **Single Sample** | **Water Quality Standard** | **No. of Samples** | **No. of Samples Required (WQS)** | **How Standard is Violated** |
| Cadmium (µg/L) | 0.38 | 0.50 | Acute: 102.36, Chronic: 2.46 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper (µg/L) | 1.49 | 4.39 | Acute: 48.56, Chronic: 29.69 | 12 | 5 | |
| Lead (µg/L) | 0.38 | 0.50 | Acute: 286.15, Chronic: 11.15 | 12 | 5 | |
| Zinc (µg/L) | 8.99 | 19.00 | Acute: 269.64, Chronic: 244.23 | 12 | 5 | |
| Diazinon (µg/L) | 0.15 | na | Acute: 0.17 | 12 | 5 | |
| E. coli (MPN/100ml) | 194 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| Enterococcus (MPN/100ml) | 141 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |
| Oil and Grease (visual) | None | na | No visible sheen | 12 | 10 | No more than 10% of observations with oil & grease |
| Total Phosphorus (mg/L) | 0.04 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| *Nitrite – Nitrate (mg/L)* | *0.24* | *na* | *4.95* | *12* | *10* | *No more than 10% of samples outside range* |
| Total Dissolved Solids (mg/L) | 308 | 370 | Sample: 1868, Yearly: 1496 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |
| pH (s.u.) | 7.1 – 7.7 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |
| *D.O. (mg/L)* | *2 samples below 6.0* | *na* | *April 1-June 15: 6.0* | *3* | *10 total* | *No more than 10% of samples outside range* |
| | *0 samples below 5.0* | *na* | *June 16-Mar 31.: 5.0* | *9* | | |

**Analytes in italics not required by permit*
*Analytes in red exceed standards*

| Analyte | Result | | | Number of Samples | Number of Attempts |
|---|---|---|---|---|---|
| | Minimum | Mean | Maximum | | |
| Oxygen Demand, 5-Day Biological (mg/L)(DL 3.0 mg/L) | -- | 4.00 | 11.0 | 12 | 12 |
| Cadmium, Total (µg/L) (DL 0.5 µg/L) | -- | 0.38 | 0.50 | 12 | 12 |
| Coliform, Fecal (CFU/100 mL)(DL 1 CFU/100 mL) | -- | 176 | 20000 | 12 | 17 |
| Conductivity µS | -- | 456 | 630 | 12 | 12 |
| Copper, Total (µg/L) (DL 0.5 µg/L) | -- | 1.49 | 4.39 | 12 | 12 |
| Diazinon (µg/L) (DL 0.17-5.0 µg/L) | -- | 0.15 | 0.17 | 12 | 12 |
| Dissolved Oxygen (mg/L) | 5.46 | 9.20 | 16.51 | 12 | 12 |
| *E. coli* (MPN/100 mL) (DL 1 MPN/100 mL) | -- | 113 | 6900 | 12 | 17 |
| *Enterococcus* (MPN/100 mL)(DL 1 CFU/100 mL) | -- | 78 | 1200 | 12 | 17 |
| Flow (cfs) | 1.08 | 2.34 | 3.76 | 12 | 12 |
| Hardness, Total (mg/L) (DL 3.6 mg/L) | 130 | 177 | 240 | 12 | 12 |
| Lead, Total (µg/L) (DL 0.5 µg/L) | -- | 0.38 | 0.50 | 12 | 12 |
| Nitrogen, Total Kjeldahl (mg/L)(DL 0.50 mg/L) | -- | 0.61 | 0.84 | 12 | 12 |
| Nitrogen, Nitrate-Nitrite (mg/L) (DL 0.2 mg/L) | -- | 0.24 | 0.49 | 12 | 12 |
| Nitrogen, Total as Nitrogen (mg/L)(DL 0.50 mg/L) | -- | 0.66 | 0.98 | 12 | 12 |
| Oil and Grease (mg/L) (DL 6.0-6.5 mg/L) | -- | 6.89 | 8.00 | 12 | 12 |
| Oxygen Demand, Chemical (mg/L)(DL 20 mg/L) | -- | 22 | 38 | 12 | 12 |
| pH (su) | 7.07 | 7.37 | 7.67 | 12 | 12 |
| Phosphorus, Total (mg/L) (DL 0.010 mg/L) | -- | 0.04 | 0.07 | 12 | 12 |
| Phosphorus, Dissolved (mg/L) (DL 0.010 mg/L) | -- | 0.03 | 0.10 | 12 | 12 |
| Solids, Total Dissolved (mg/L) (DL 10 mg/L) | -- | 308 | 370 | 12 | 12 |
| Solids, Total Suspended (mg/L) (DL 2.0 mg/L) | -- | 2.84 | 6.40 | 12 | 12 |
| Temperature, Water (°C) | 0.90 | 17.29 | 29.40 | 12 | 12 |
| Turbidity | -- | 5.55 | 25.10 | 12 | 12 |
| Zinc, Total (µg/L) (DL 10 µg/L) | -- | 8.99 | 19.00 | 12 | 12 |
| Results found to be below the detection limit are reported as the detection limit | | | | | |

Table 81 – MS4 permit required analytical sampling parameters result summaries for Joe Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/20/17 | 8/9/17 | 9/11/17 | 10/17/17 | 11/14/17 | 12/4/17 | 1/18/18 | 2/8/18 | 3/20/18 | 4/17/18 | 5/29/18 | 6/27/18 |
| BOD(5) Day (BDL 3) mg/L | 11.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 4.3 | 2.0 | 4.3 | 3.8 |
| Cadmium, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.001 | 0.001 | 0.001 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Conductivity µS | 496 | 402 | 564 | 399 | 437 | 472 | 382 | 342 | 421 | 515 | 630 | 411 |
| Copper, Total (BDL 0.5) µg/L | 1.42 | 2.64 | 1.11 | 0.005 | 0.005 | 0.005 | 1.19 | 1.80 | 2.82 | 1.81 | 0.698 | 4.39 |
| Diazinon (BDL 0.17) µg/L | 0.17 | 0.17 | 0.10 | 0.10 | 0.10 | 0.11 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| Dissolved Oxygen mg/L | 6.06 | 6.40 | 6.90 | 7.09 | 9.50 | 8.38 | 16.03 | 15.15 | 7.39 | 16.51 | 5.46 | 5.56 |
| Flow CFS | 1.97 | 2.74 | 1.58 | 2.42 | 2.02 | 2.47 | 2.14 | 2.11 | 2.62 | 3.76 | 3.14 | 1.08 |
| Hardness, Total (BDL 3.6) mg/L | 140 | 130 | 170 | 160 | 200 | 200 | 240 | 200 | 180 | 190 | 170 | 140 |
| Lead, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.0005 | 0.0005 | 0.0005 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L | 0.52 | 0.50 | 0.51 | 0.69 | 0.63 | 0.51 | 0.50 | 0.50 | 0.72 | 0.84 | 0.73 | 0.62 |
| Nitrogen, Nitrate-Nitrite (BDL 0.2) mg/L | 0.26 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.49 | 0.25 | 0.28 | 0.20 | 0.20 | 0.20 |
| Nitrogen, Total as N (BDL 0.5) mg/L | 0.77 | 0.50 | 0.51 | 0.69 | 0.63 | 0.51 | 0.50 | 0.58 | 0.98 | 0.84 | 0.73 | 0.62 |
| Oil and Grease HEM (BDL 6) mg/L | 8.0 | 7.9 | 6.1 | 6.8 | 6.8 | 6.6 | 6.3 | 7.2 | 7.6 | 6.7 | 6.4 | 6.3 |
| Oxygen Demand, Chemical (BDL 20) mg/L | 38 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 28 | 20 |
| pH (s.u.) | 7.37 | 7.37 | 7.33 | 7.32 | 7.34 | 7.45 | 7.37 | 7.23 | 7.07 | 7.47 | 7.50 | 7.67 |
| Phosphorus, Total (BDL 0.010) mg/L | 0.031 | 0.043 | 0.023 | 0.047 | 0.021 | 0.040 | 0.025 | 0.032 | 0.051 | 0.027 | 0.058 | 0.067 |
| Phosphorus, Total Dissolved BDL (0.010) mg/L | 0.022 | 0.027 | 0.013 | 0.024 | 0.100 | 0.022 | 0.018 | 0.016 | 0.013 | 0.012 | 0.049 | 0.058 |
| Solids, Total Dissolved (BDL 10) mg/L | 320 | 280 | 330 | 230 | 320 | 340 | 370 | 320 | 290 | 340 | 290 | 260 |
| Solids, Total Suspended (BDL 2.0) mg/L | 2.0 | 2.2 | 2.6 | 2.0 | 2.0 | 3.6 | 2.0 | 2.5 | 6.4 | 2.0 | 2.0 | 4.8 |
| Temperature, Water °C | 29.40 | 25.62 | 23.32 | 16.34 | 13.11 | 15.79 | 0.90 | 2.36 | 10.54 | 14.24 | 28.90 | 27.01 |
| Turbidity (NTU) | 1.41 | 1.77 | 2.98 | 1.54 | 1.81 | 1.53 | 2.15 | 1.98 | 6.00 | 1.07 | 25.10 | 19.20 |
| Zinc, Total (BDL 10) µg/L | 10.3 | 19.0 | 12.5 | 0.022 | 0.006 | 0.007 | 10.0 | 10.0 | 11.2 | 10.0 | 10.0 | 14.8 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 82 – Complete analytical sampling results for all parameters for Joe Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/26/17 | 8/9/17 | 8/22/17 | 9/6/17 | 9/11/17 | 10/17/17 | 11/14/17 | 12/4/17 | 1/18/18 | 2/8/18 | 3/20/18 | 4/17/18 |
| Coliform, Fecal CFU/100mL | 80 | 470 | 110 | 31 | 140 | 17 | 67 | 190 | 8 | 3 | 3300 | 72 |
| *E. coli* (BDL 1) MPN/100mL | 75 | 250 | 86 | 27 | 84 | 160 | 75 | 160 | 1 | 6.3 | 2200 | 41 |
| *Enterococcus* (BDL 1) MPN/100 mL | 520 | 1200 | 100 | 26 | 19 | 110 | 31 | 27 | 3.1 | 6.2 | 770 | 37 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5/29/18 | 6/7/18 | 6/14/18 | 6/21/18 | 6/27/18 | | | | | | | |
| Coliform, Fecal CFU/100mL | 2400 | 120 | 550 | 20000 | 2200 | | | | | | | |
| *E. coli* (BDL 1) MPN/100mL | 1200 | 96 | 130 | 6900 | 200 | | | | | | | |
| *Enterococcus* (BDL 1) MPN/100 mL | 250 | 38 | 54 | 920 | 220 | | | | | | | |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 83 – Complete analytical results for bacteria samples for Joe Creek

## South Park Creek
## WBID: 121300 NOT LISTED

Table 84 - Sampling location on South Park Creek

| Waterbody | Sample Location | | Watershed Area ($mi^2$)* | Sampling/Evaluation Date | | | |
|---|---|---|---|---|---|---|---|
| | Latitude | Longitude | | Fish | Benthic (Summer) | Benthic (Winter) | Habitat |
| South Park | 36.098056 | -95.850556 | 0.9 | 10/10/2017 | 09/07/2016 | 02/17/2017 | 06/27/2018 |
| Creek | | | | | 10/13/2017 | 02/15/2018 | |

* Collection area captured by sampling point

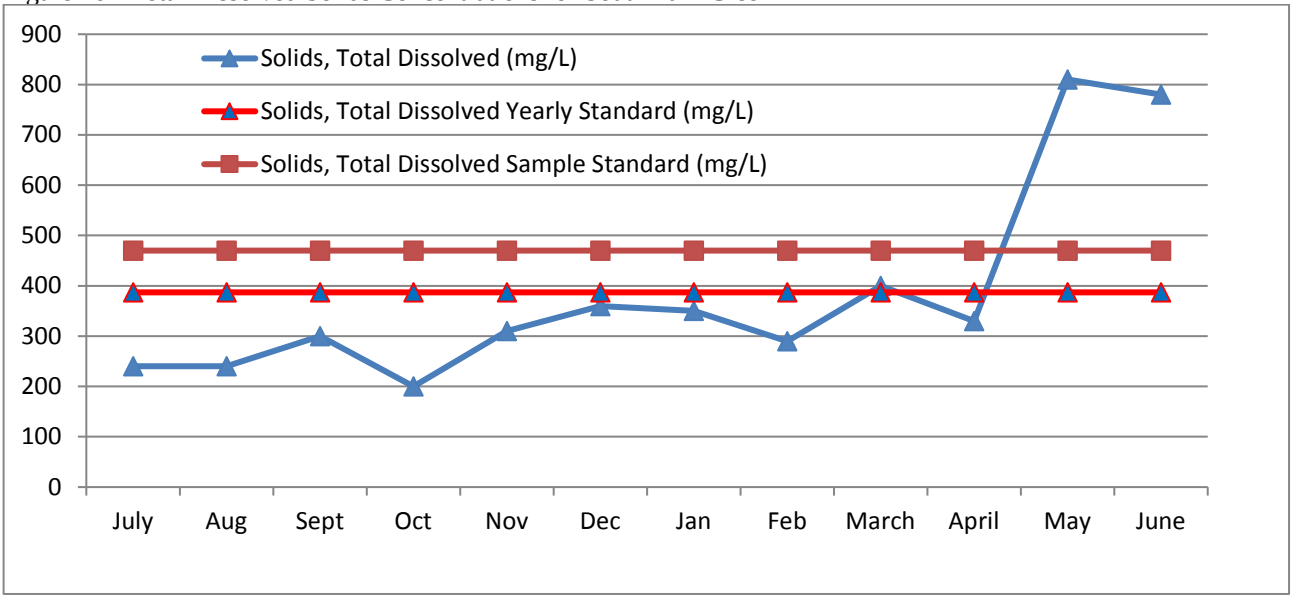
# 12.0 BENEFICIAL USES

**12.1 Agriculture –** Data collected on Total Dissolved Solids for South Park Creek indicates that attainment of the agricultural beneficial use is not met. The number of samples collected exceeds the number of samples required. The sample mean exceeds the yearly standard and two of the samples exceeded the sample standard.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 384 | 810 | Sample: 470, Yearly: 387 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |

Table 85 – Agriculture standards for South Park Creek

Figure 16 - Total Dissolved Solids Concentrations for South Park Creek



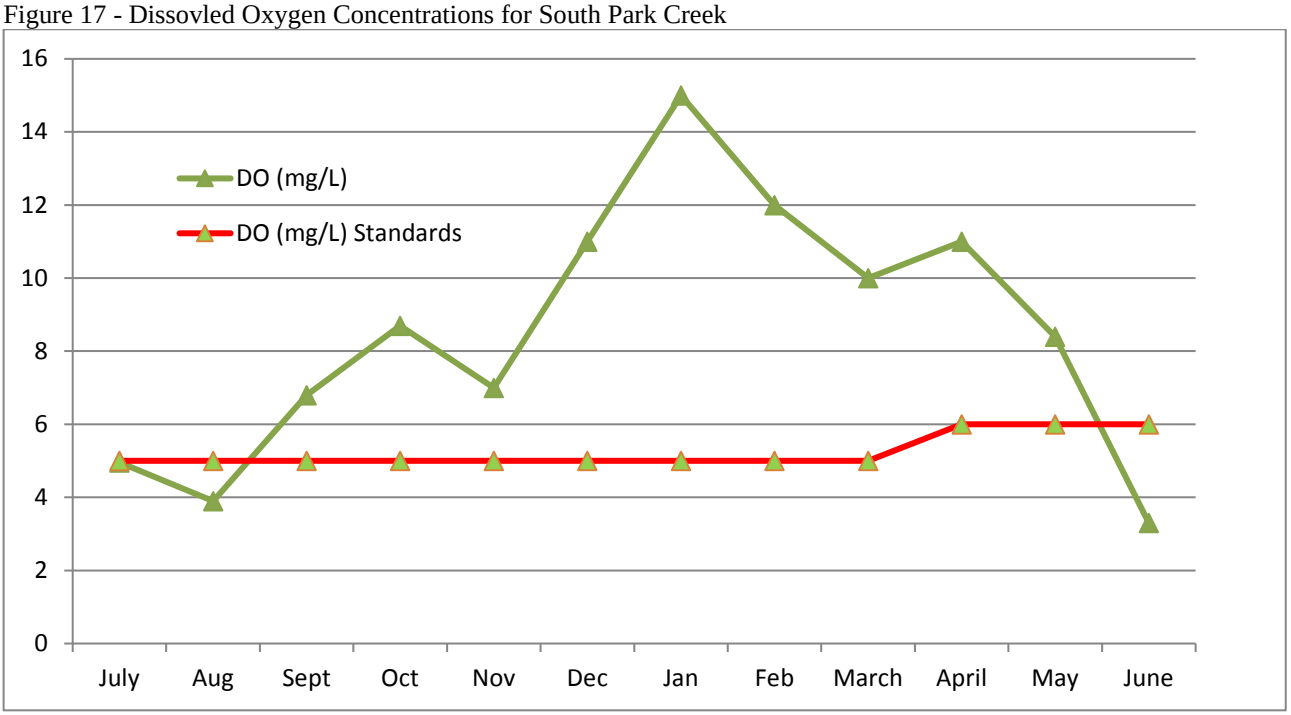
## 12.2 Fish and Wildlife Propagation: Warm Water Aquatic Community

**12.2.1** Dissolved Oxygen - Data collected on Dissolved Oxygen concentrations shows the beneficial use is not supported. The number of samples collected exceeds the number of required samples. Out of 12 samples, three were found to be below the standard. Therefore, less than 10% of the samples were outside the standard range.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| D.O. | 1 samples below 6.0 | na | April - June: 5.0 | 3 | 10 total | No more than 10% of samples outside range |
| | 2 samples below 5.0 | na | June - Mar: 6.0 | 9 | | |

Table 86 – Dissolved Oxygen standards for South Park Creek

Figure 17 - Dissovled Oxygen Concentrations for South Park Creek



**12.2.2** Toxicants/Metals - Data collected indicate full support of the beneficial use for Toxicants and Metals.

| Parameter | Sample Mean (µg/L) | Single Sample (µg/L) | Water Quality Standard (µg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Cadmium | 0.38 | 0.50 | Acute: 54.43, Chronic: 1.58 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper | 1.59 | 6.45 | Acute: 28.65, Chronic: 18.40 | 12 | 5 | |
| Lead | 0.62 | 1.68 | Acute: 140.30, Chronic: 5.47 | 12 | 5 | |
| Zinc | 10.47 | 25.40 | Acute: 167.79, Chronic: 151.97 | 12 | 5 | |

Table 87 – Toxicants/Metals standards for South Park Creek

**12.2.3** pH (Hydrogen Ion Activity) - Data collected on pH readings for South Park Creek show full support of the beneficial use. The number of pH measurements taken exceeds the number of required measurements. All pH measurements fell within the standard range.

| Parameter | Sample Range (s.u.) | Single Sample (s.u.) | Water Quality Standard Range (s.u.) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| pH | 7.0 – 7.7 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |

Table 88 – pH standards for South Park Creek

**12.2.4** Oil and Grease - Data collected on Oil and Grease concentrations through HEM laboratory analysis show support of the beneficial use. All samples taken showed Oil and Grease amounts to be below the detection limit.

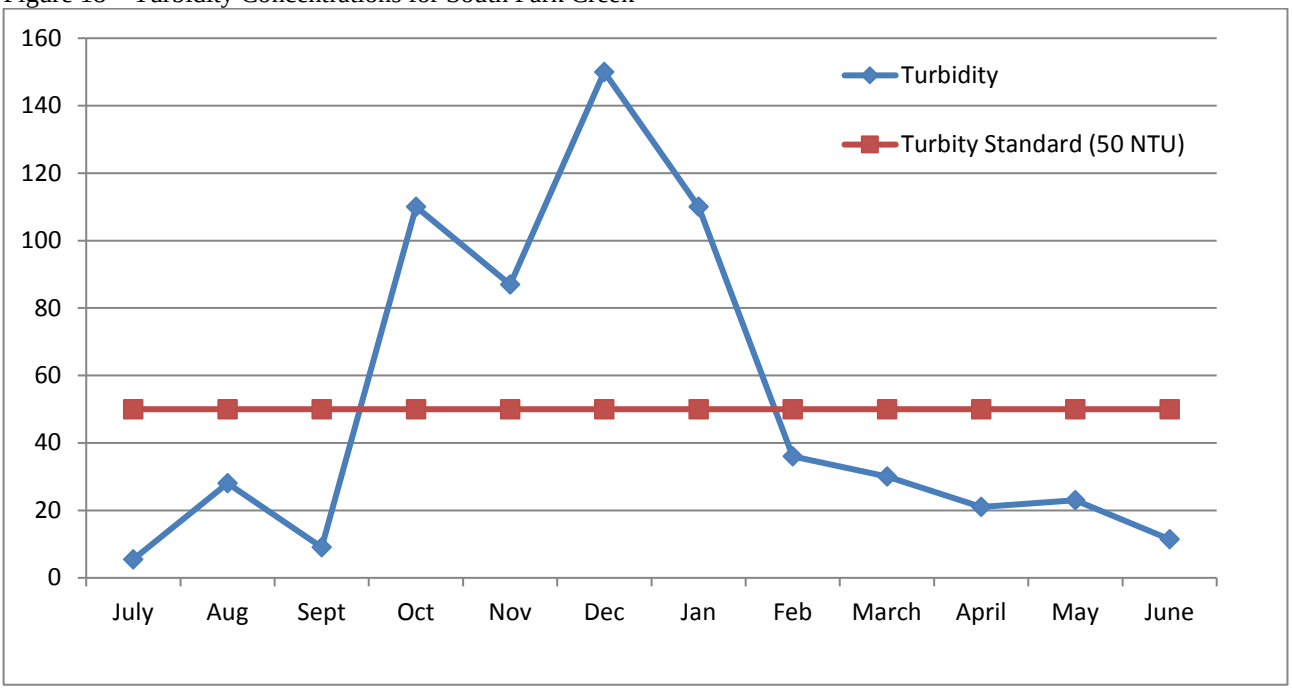
**12.2.5** Suspended and Bedded Sediments - Using habitat assessment data to determine support of the beneficial use is conditional upon the support of turbidity data and fish collection data.

**12.2.5.1** *Turbidity* – Data collected on Turbidity readings for South Park Creek show the beneficial use is not supported.

| Parameter | Sample Mean (NTU) | Single Sample (NTU) | Water Quality Standard (NTU) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Turbidity | 52.26 | 154.00 | 50 | 12 | 10 | No more than 10% exceeding sample standard |

Table 89 – Turbidity standards for South Park Creek

Figure 18 – Turbidity Concentrations for South Park Creek



**12.2.5.2** *Habitat Assessment* - The resulting score of the habitat assessment on South Park Creek can be compared to the average score of high quality sites within the same ecoregion provided by the Oklahoma Conservation Commission using a scoring workbook derived from OWRB (OWRB, 2001). The results of the habitat assessment produced a score below average for the central irregular plains ecoregion.

| Metric | Score |
|---|---|
| Instream habitat | 16.7 |
| Pool bottom substrate | 3.2 |
| Pool variability | 16.3 |
| Canopy cover | 18.2 |
| Presence of rocky runs and riffles | 0.0 |
| Flow (at representative low flow) | 0.4 |
| Channel alteration | 12.3 |
| Channel sinuosity | 1.4 |
| Bank stability | 4.0 |
| Bank vegetation stability | 3.4 |
| Stream side Cover | 5.0 |
| **Total Score** | **80.90** |
| **Central Irregular Plains Mean Score** | **84.09** |

Table 90 – Habitat assessment metric and total results with ecoregion mean score

### 12.2.6 Biological

**12.2.6.1** *Fish Collections* - Data recorded from fish collections performed on South Park Creek show that the beneficial use is impaired.

| Index of Biotic Integrity | Score |
|---|---|
| Sample Composition | 14 |
| Fish Condition | 9 |
| Score Key: 30 + Beneficial Use Supported : 23 - 29 Undetermined : < 22 Impaired | Total: 23 |

Table 91 – Fish IBI score for South Park Creek

| Family | Species Name | Common Name | Number of Fish | Percentage |
|---|---|---|---|---|
| Centrarchidae | *Lepomis cyanellus* | Green sunfish | 107 | 51.4% |
| | *Lepomis macrochirus* | Bluegill sunfish | 28 | 13.5% |
| | *Lepomis microlophus* | Redear sunfish | 1 | 0.5% |
| | *Lepomis gulosus* | Warmouth sunfish | 4 | 1.9% |
| | *Micropterus salmoides* | Largemouth bass | 12 | 5.8% |
| Cyprinidae | *Notemigonus crysoleucas* | Golden shiner | 5 | 2.4% |
| Poeciliidae | *Gambusia affinis* | Mosquitofish | 51 | 24.5% |
| **Total Number:** | | | 208 | 100.0% |
| **Total Number of Taxa:** | | | 7 | |

Table 92 – Fish collection counts for South Park Creek

^Photograph taken of South Park Creek sample site

**12.2.6.2** *Benthic Macroinvertebrate Collections* – Data recorded from benthic macroinvertebrate collections during the summer and winter index periods is undetermined (ODEQ, Continuing Planning Process, 2012).

| Sampling Event | Score |
|---|---|
| Summer 2016 | 55% |
| Winter 2017 | 59% |
| Summer 2017 | 58% |
| Winter 2018 | 67% |
| South Park Creek - (Central Irregular Plains): >80% Attaining : 50-80% - Undetermined : < 50% Impaired | |

Table 93 – Benthic macroinvertebrate metrics for summer and winter index periods at South Park Creek

| Genus | Common Class | 9/7/2016 | |
|---|---|---|---|
| | | Count | % |
| *Caenis latipennis* | Minnow Mayfly | 32 | 32.3% |
| *Oxyethira sp.* | Micro Caddisfly | 1 | 1.0% |
| Coenagrionidae | Narrowwinged Damselfly | 6 | 6.1% |
| Libellulidae | Skimmer Dragonsfly | 1 | 1.0% |
| *Ablabesmyia mallochi* | Midge | 1 | 1.0% |
| *Chironomus sp.* | | 2 | 2.0% |
| *Cladopelma sp.* | | 1 | 1.0% |
| *Cricotopus bicinctus gr.* | | 1 | 1.0% |
| *Dicrotendipes fumidus* | | 5 | 5.1% |
| *Dicrotendipes modestus* | | 11 | 11.1% |
| *Dicrotendipes neomodestus* | | 1 | 1.0% |
| *Goeldichironomus sp.* | | 2 | 2.0% |
| *Labrundinia sp.* | | 2 | 2.0% |
| *Microtendipes pedellus gr.* | | 1 | 1.0% |
| *Polypedilum flavum* | | 2 | 2.0% |
| *Polypedilum iinoense gr.* | | 4 | 4.0% |
| *Tanytarsus sp.* | | 2 | 2.0% |
| *Zavrelimyia sp.* | | 14 | 14.1% |
| *Bezzia/Palpomyia sp.* | Biting Midge | 1 | 1.0% |
| Tabanidae | Horse Fly | 1 | 1.0% |
| tubificoid Naididae w/o cap setae | Aquatic Worm (Bald) | 1 | 1.0% |
| *Musculium sp.* | Fingernail Clam | 2 | 2.0% |
| *Physa sp.* | Lung Snail | 3 | 3.0% |
| *Hyalella sp.* | Scud | 2 | 2.0% |
| Total | | 99 | 100.0% |
| Total Number of Taxa | | 24 | |

2016 South Park Creek Summer Index Period

| Genus | Common Class | 2/17/2017 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 19 | 18.3% |
| *Argia* sp. | Narrowwinged Damselfly | 2 | 1.9% |
| *Erythemis* sp. | Skimmer Dragonfly | 1 | 1.0% |
| *Cricotopus bicinctus* gr. | Midge | 14 | 13.5% |
| *Cricotopus* sp. | | 3 | 2.9% |
| *Cricotopus/Orthocladius* sp. | | 12 | 11.5% |
| *Orthocladius* sp. | | 13 | 12.5% |
| *Paraphaenocladius* sp. | | 1 | 1.0% |
| *Paratanytarsus* sp. | | 1 | 1.0% |
| *Polypedilum flavum* | | 3 | 2.9% |
| *Polypedilum illinoense* gr. | | 3 | 2.9% |
| *Rheotanytarsus exiguus* gr. | | 3 | 2.9% |
| *Thienemanniella* sp. | | 3 | 2.9% |
| *Atrichopogon* sp. | Biting Midge | 1 | 1.0% |
| Ceratopogoninae | | 3 | 2.9% |
| Tipulidae | Large Crane Fly | 1 | 1.0% |
| *Ferrissia* sp. | Limpet | 1 | 1.0% |
| *Micromenetus* sp. | Lung Snail | 1 | 1.0% |
| *Hyalella* sp. | Scud | 16 | 15.4% |
| Ostracoda | Seed Shrimp | 2 | 1.9% |
| *Prostoma* sp. | Ribbon Worm | 1 | 1.0% |
| Total | | 104 | 100.0% |
| Total Number of Taxa | | 21 | |

2017 South Park Creek Winter Index Period

| Genus | Common Class | 10/13/2017 | |
|---|---|---|---|
| | | Count | % |
| *Caenis sp.* | Minnow Mayfly | 38 | 35.8% |
| Coenagrionidae | Narrowwinged Damselfly | 1 | 0.9% |
| *Cricotopus bicinctus gr.* | Midge | 2 | 1.9% |
| *Cryptochironomus sp.* | | 1 | 0.9% |
| *Dicrotendipes neomodestus* | | 11 | 10.4% |
| *Parametriocnemus sp.* | | 1 | 0.9% |
| *Polypedilum illioense gr.* | | 16 | 15.1% |
| *Rheotanytarsus exiguus gr.* | | 2 | 1.9% |
| *Thienemanniella sp.* | | 1 | 0.9% |
| *Thienemannimyia gr. sp.* | | 7 | 6.6% |
| *Ceratopogoninae* | Biting Midge | 6 | 5.7% |
| *Dasyhelea sp.* | | 1 | 0.9% |
| *Tipula sp.* | Large Crane Fly | 5 | 4.7% |
| Enchytraeidae | Aquatic Worm | 1 | 0.9% |
| Lumbriculidae | | 1 | 0.9% |
| *Placobdella sp.* | Leech | 1 | 0.9% |
| *Sphaerium sp.* | Pea Clam | 2 | 1.9% |
| *Physella sp.* | Lung Snail | 3 | 2.8% |
| Cambaridae | Crayfish | 3 | 2.8% |
| *Hyalella sp.* | Scud | 3 | 2.8% |
| Total | | 106 | 100.0% |
| Total Number of Taxa | | 20 | |

2017 South Park Creek Summer Index Period

| Genus | Common Class | 2/15/2018 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 22 | 18.8% |
| *Fallceon* sp. | Minnow Mayfly | 1 | 0.9% |
| *Ablabesmyia mallochi* | Midge | 2 | 1.7% |
| *Cricotopus bicinctus* gr. | | 1 | 0.9% |
| *Cricotopus* sp. | | 4 | 3.4% |
| *Cricotopus/Orthocladius* sp. | | 1 | 0.9% |
| *Crytochironomus* sp. | | 6 | 5.1% |
| *Dicrotendipes* sp. | | 13 | 11.1% |
| *Hydrobaenus* sp. | | 3 | 2.6% |
| *Larisa* sp. | | 3 | 2.6% |
| *Nanocladius* sp. | | 1 | 0.9% |
| *Orthocladius* sp. | | 1 | 0.9% |
| *Polypedilum flavum* | | 3 | 2.6% |
| *Polypedilum illinense* gr. | | 6 | 5.1% |
| *Rheotanytarsus exiguus* gr. | | 1 | 0.9% |
| *Thienemannimyia* gr. sp. | | 2 | 1.7% |
| Ceratopgoninae | Biting Midge | 19 | 16.2% |
| Acari | Water Mite | 1 | 0.9% |
| *Dero digitata* | Aquatic Worm | 1 | 0.9% |
| *Nais* sp. | | 1 | 0.9% |
| Enchytraeidae | | 1 | 0.9% |
| *Helobdella* | Leech | 1 | 0.9% |
| *Physa* sp. | Lung Snail | 1 | 0.9% |
| Cambaridae | Crayfish | 2 | 1.7% |
| *Hyalella* sp. | Scud | 20 | 17.1% |
| Total | | 117 | 100.0% |
| Total Number of Taxa | | 25 | |

2018 South Park Creek Winter Index Period

Table 94 – Benthic macroinvertebrate counts for South Park Creek summer and winter index periods

**12.3 Primary Body Contact -** The data collected on *E. coli* and *Enterococcus* concentrations show that South Park Creek is impaired for both *E. coli* and *Enterococcus*. The number of samples collected exceeds the number of samples required. While the MS4 permit requires monthly sampling of bacteria, water quality standards only pertain to samples collected during the recreational period.

| Parameter | Sample Geometric Mean (MPN/100mL) | Single Sample (MPN/100mL) | Water Quality Standard (MPN/100mL) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| *E. coli* | 186 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| *Enterococcus* | 747 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |

Table 95 – *E. coli* totals for South Park Creek

Figure 19 - *E. coli* Concentrations for South Park Creek

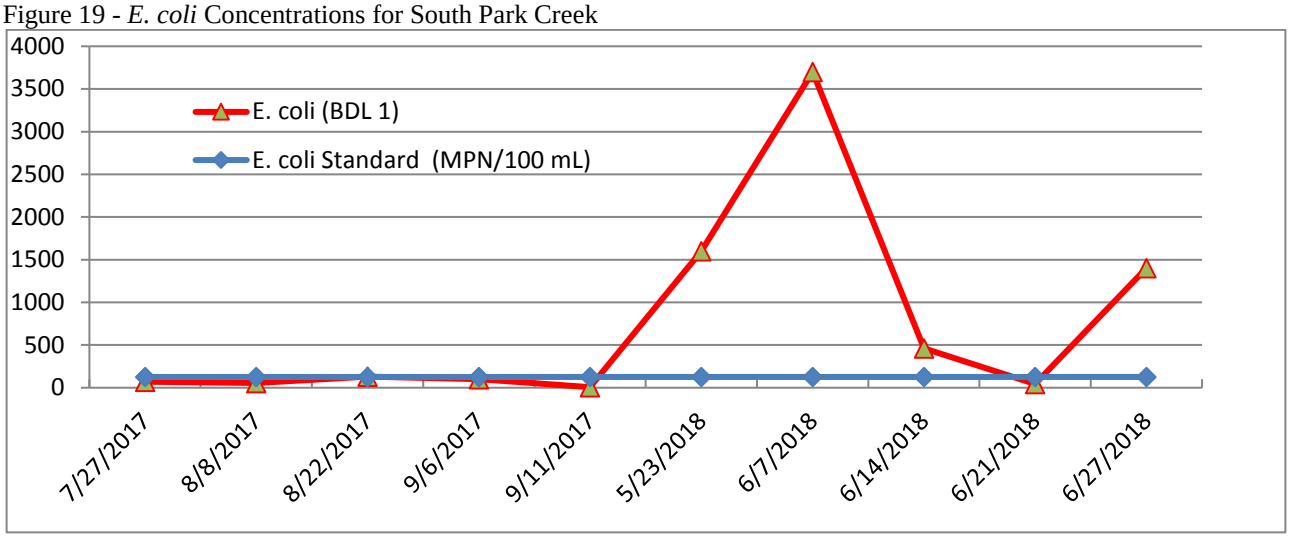
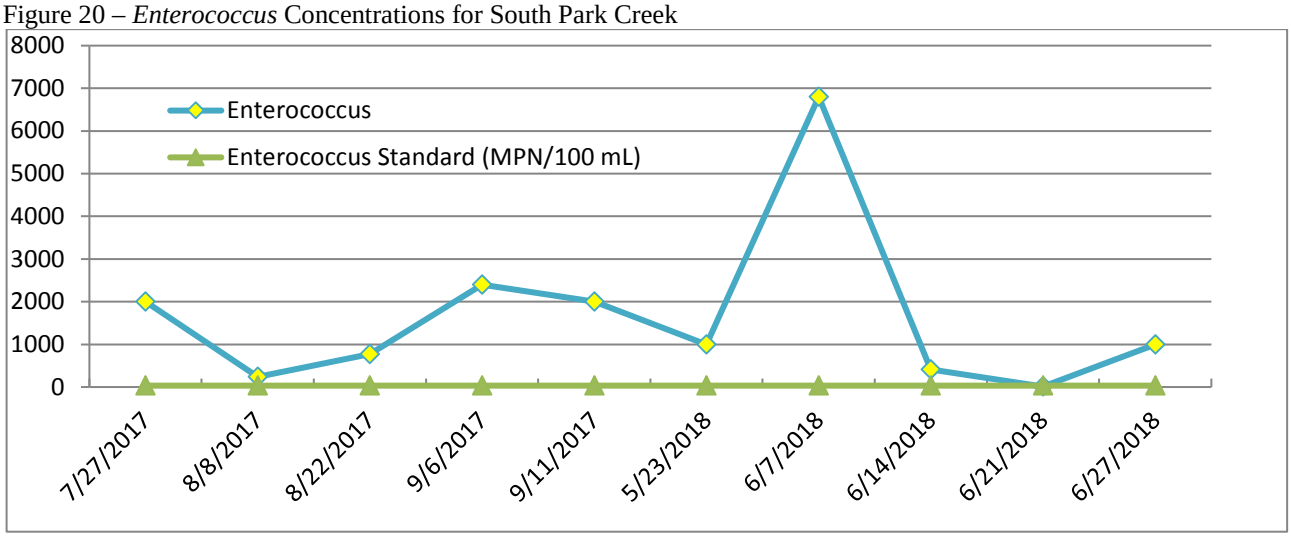



Figure 20 – *Enterococcus* Concentrations for South Park Creek



## 12.4 Anti-Degradation Policy

**12.4.1** Nutrients - Analytical results for Total Phosphorus and Nitrate/Nitrite show no need for further investigation to show support of the beneficial use. The number of samples collected exceeds the number of required samples, and less than 10% of samples exceeded the threshold for further sampling. While Nitrate/Nitrite concentrations have an action level, it is not a required parameter within the MS4 permit (ODEQ, OPDES Permit OKS000201, 2011).

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Threshold (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Phosphorus | 0.15 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| Nitrite - Nitrate | 0.23 | na | 4.95 | 12 | 10 | No more than 10% of samples outside range |

Table 96 – Nutrient totals for South Park Creek

## 13.0 SUMMARY

Analytically, South Park Creek is impaired for several water quality parameters including total dissolved solids, dissolved oxygen, turbidity and bacteria. Fish collections reflected an impaired classification according to water quality standards. A lack of intolerant species prevents full support; however an increase in species diversity and/or an increase in lithophilic fish would also be beneficial. A disappointing benthic macroinvertebrate IBI score could also be related to the lack of intolerant species which prevents support of the beneficial use. South Park Creek has some channelization which could possibly make repopulation of fish and macroinvertebrates difficult. The lower than average habitat assessment score may well be a contributing factor to the fish and macroinvertebrate scores. South Park Creek has very few runs and riffles as well as low flow.

Table 97 – Oklahoma Water Quality Standards summary of collected data for South Park Creek

| South Park | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Sample Mean** | **Single Sample** | **Water Quality Standard** | **No. of Samples** | **No. of Samples Required (WQS)** | **How Standard is Violated** |
| Cadmium (µg/L) | 0.38 | 0.50 | Acute: 54.43, Chronic: 1.58 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper (µg/L) | 1.59 | 6.45 | Acute: 28.65, Chronic: 18.40 | 12 | 5 | |
| Lead (µg/L) | 0.62 | 1.68 | Acute: 140.30, Chronic: 5.47 | 12 | 5 | |
| Zinc (µg/L) | 10.47 | 25.40 | Acute: 167.79, Chronic: 151.97 | 12 | 5 | |
| Diazinon (µg/L) | 0.15 | Na | Acute: 0.17 | 12 | 5 | |
| E. coli (MPN/100ml) | 186 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| Enterococcus (MPN/100ml) | 747 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |
| Oil and Grease (visual) | None | na | No visible sheen | 12 | 10 | No more than 10% of observations with oil & grease |
| Total Phosphorus (mg/L) | 0.15 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| *Nitrite – Nitrate (mg/L)* | *0.23* | *na* | *4.95* | *12* | *10* | *No more than 10% of samples outside range* |
| Total Dissolved Solids (mg/L) | 384 | 810 | Sample: 470, Yearly: 387 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |
| pH (s.u.) | 7.0 – 7.7 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |
| *D.O. (mg/L)* | *1 samples below 6.0* | *na* | *April 1-June 15: 6.0* | *3* | *10 total* | *No more than 10% of samples outside range* |
| | *2 samples below 5.0* | *na* | *June 16-Mar 31.: 5.0* | *9* | | |
| **Analytes in italics not required by permit* *Analytes in red exceed standards* | | | | | | |

| Analyte | Result | | |
|---|---|---|---|

| | Minimum | Mean | Maximum | Number of Samples | Number of Attempts |
|---|---|---|---|---|---|
| Oxygen Demand, 5-Day Biological (mg/L)(DL 3.0 mg/L) | -- | 5.0 | 11.0 | 12 | 12 |
| Cadmium, Total (µg/L) (DL 0.5 µg/L) | -- | 0.38 | 0.50 | 12 | 12 |
| Coliform, Fecal (CFU/100 mL)(DL 1 CFU/100 mL) | -- | 151 | 3200 | 12 | 17 |
| Conductivity µS | -- | 528 | 1346 | 12 | 12 |
| Copper, Total (µg/L) (DL 0.5 µg/L) | -- | 1.59 | 6.45 | 12 | 12 |
| Diazinon (µg/L) (DL 0.17-5.0 µg/L) | -- | 0.15 | 0.17 | 12 | 12 |
| Dissolved Oxygen (mg/L) | 3.30 | 8.52 | 15.42 | 12 | 12 |
| *E. coli* (MPN/100 mL) (DL 1 MPN/100 mL) | -- | 117 | 3700 | 12 | 17 |
| *Enterococcus* (MPN/100 mL)(DL 1 CFU/100 mL) | -- | 389 | 6800 | 12 | 17 |
| Flow (cfs) | 0.00 | 0.09 | 0.66 | 12 | 12 |
| Hardness, Total (mg/L) (DL 3.6 mg/L) | 130 | 210 | 400 | 12 | 12 |
| Lead, Total (µg/L) (DL 0.5 µg/L) | -- | 0.62 | 1.68 | 12 | 12 |
| Nitrogen, Total Kjeldahl (mg/L)(DL 0.50 mg/L) | -- | 1.25 | 2.80 | 12 | 12 |
| Nitrogen, Nitrate-Nitrite (mg/L) (DL 0.2 mg/L) | -- | 0.23 | 0.57 | 12 | 12 |
| Nitrogen, Total as Nitrogen (mg/L)(DL 0.50 mg/L) | -- | 1.29 | 2.80 | 12 | 12 |
| Oil and Grease (mg/L) (DL 6.0-6.5 mg/L) | -- | 6.53 | 7.20 | 12 | 12 |
| Oxygen Demand, Chemical (mg/L)(DL 20 mg/L) | -- | 32 | 53 | 12 | 12 |
| pH (su) | 7.04 | 7.37 | 7.69 | 12 | 12 |
| Phosphorus, Total (mg/L) (DL 0.010 mg/L) | -- | 0.15 | 0.27 | 12 | 12 |
| Phosphorus, Dissolved (mg/L) (DL 0.010 mg/L) | -- | 0.04 | 0.08 | 12 | 12 |
| Solids, Total Dissolved (mg/L) (DL 10 mg/L) | -- | 384 | 810 | 12 | 12 |
| Solids, Total Suspended (mg/L) (DL 2.0 mg/L) | -- | 41.2 | 110.0 | 12 | 12 |
| Temperature, Water (°C) | 4.17 | 15.17 | 27.80 | 12 | 12 |
| Turbidity | -- | 52.26 | 154.00 | 12 | 12 |
| Zinc, Total (µg/L) (DL 10 µg/L) | -- | 10.47 | 25.40 | 12 | 12 |
| Results found to be below the detection limit are reported as the detection limit | | | | | |

Table 98 – MS4 permit required analytical sampling parameters result summaries for South Park Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/24/17 | 8/15/17 | 9/11/17 | 10/18/17 | 11/20/17 | 12/11/17 | 1/22/18 | 2/27/18 | 3/22/18 | 4/16/18 | 5/23/18 | 6/19/18 |
| BOD(5) Day (BDL 3) mg/L | 9.8 | 3.0 | 3.0 | 3.0 | 4.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 11.0 | 5.9 |
| Cadmium, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.001 | 0.001 | 0.001 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Conductivity µS | 394 | 341 | 495 | 288 | 319 | 338 | 381 | 323 | 515 | 490 | 1346 | 1111 |
| Copper, Total (BDL 0.5) µg/L | 0.849 | 1.85 | 1.12 | 0.005 | 0.005 | 0.005 | 1.47 | 1.59 | 1.53 | 1.14 | 6.45 | 3.05 |
| Diazinon (BDL 0.17) µg/L | 0.17 | 0.17 | 0.106 | 0.10 | 0.114 | 0.10 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| Dissolved Oxygen mg/L | 4.96 | 3.93 | 6.82 | 8.67 | 6.97 | 10.56 | 15.42 | 12.30 | 10.32 | 10.67 | 8.37 | 3.30 |
| Flow CFS | 0.00 | 0.66 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 | 0.19 | 0.03 | 0.00 | 0.00 | 0.06 |
| Hardness, Total (BDL 3.6) mg/L | 130 | 130 | 210 | 130 | 150 | 200 | 190 | 180 | 230 | 220 | 400 | 350 |
| Lead, Total (BDL 0.5) µg/L | 0.50 | 0.74 | 0.50 | 0.0015 | 0.0005 | 0.0005 | 1.68 | 1.46 | 0.86 | 0.696 | 0.50 | 0.50 |
| Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L | 1.30 | 0.73 | 0.52 | 1.20 | 0.80 | 1.10 | 0.86 | 1.30 | 2.80 | 0.95 | 2.00 | 1.40 |
| Nitrogen, Nitrate-Nitrite (BDL 0.2) mg/L | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.20 | 0.25 | 0.57 | 0.20 | 0.20 | 0.20 | 0.20 |
| Nitrogen, Total as N (BDL 0.5) mg/L | 1.30 | 0.73 | 0.52 | 1.20 | 0.80 | 1.10 | 0.86 | 1.80 | 2.80 | 0.95 | 2.00 | 1.40 |
| Oil and Grease HEM (BDL 6) mg/L | 6.7 | 6.6 | 6.1 | 6.7 | 7.1 | 6.2 | 6.2 | 6.1 | 7.0 | 7.2 | 6.2 | 6.3 |
| Oxygen Demand, Chemical (BDL 20) mg/L | 44 | 34 | 20 | 40 | 36 | 46 | 26 | 22 | 20 | 21 | 53 | 20 |
| pH (s.u.) | 7.32 | 7.41 | 7.69 | 7.37 | 7.67 | 7.30 | 7.59 | 7.12 | 7.20 | 7.09 | 7.61 | 7.04 |
| Phosphorus, Total (BDL 0.010) mg/L | 0.150 | 0.160 | 0.033 | 0.200 | 0.160 | 0.270 | 0.170 | 0.150 | 0.100 | 0.073 | 0.240 | 0.057 |
| Phosphorus, Total Dissolved BDL (0.010) mg/L | 0.070 | 0.078 | 0.014 | 0.037 | 0.026 | 0.023 | 0.013 | 0.024 | 0.013 | 0.017 | 0.084 | 0.028 |
| Solids, Total Dissolved (BDL 10) mg/L | 240 | 240 | 300 | 200 | 310 | 360 | 350 | 290 | 400 | 330 | 810 | 780 |
| Solids, Total Suspended (BDL 2.0) mg/L | 7.6 | 29.0 | 12.0 | 110.0 | 61.0 | 110.0 | 76.0 | 32.0 | 27.0 | 12.0 | 7.7 | 10.0 |
| Temperature, Water °C | 27.67 | 25.41 | 18.08 | 14.37 | 8.75 | 4.17 | 5.35 | 8.72 | 7.27 | 7.84 | 26.60 | 27.80 |
| Turbidity (NTU) | 10.1 | 28.0 | 9.1 | 106.0 | 87.1 | 154.0 | 112.0 | 36.1 | 29.5 | 20.7 | 23.1 | 11.4 |
| Zinc, Total (BDL 10) µg/L | 13.8 | 15.9 | 10.0 | 0.032 | 0.018 | 0.013 | 17.4 | 25.4 | 10.0 | 10.4 | 11.5 | 11.2 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 99 – Complete analytical sampling results for all parameters for South Park Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/27/17 | 8/15/17 | 8/22/17 | 9/6/17 | 9/11/17 | 10/18/17 | 11/20/17 | 12/11/17 | 1/22/18 | 2/27/18 | 3/22/18 | 4/16/18 |
| Coliform, Fecal CFU/100mL | 91 | 200 | 300 | 170 | 72 | 320 | 250 | 56 | 3 | 120 | 110 | 17 |
| *E. coli* (BDL 1) MPN/100mL | 69 | 55 | 130 | 99 | 6.3 | 370 | 230 | 25 | 8.6 | 74 | 75 | 28 |
| *Enterococcus* (BDL 1) MPN/100 mL | 2000 | 240 | 770 | 2400 | 2000 | 2000 | 80 | 250 | 68 | 81 | 520 | 17 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5/23/18 | 6/7/18 | 6/14/18 | 6/21/18 | 6/27/18 | | | | | | | |
| Coliform, Fecal CFU/100mL | 800 | 3200 | 360 | 53 | 1170 | | | | | | | |
| *E. coli* (BDL 1) MPN/100mL | 1600 | 3700 | 460 | 43 | 1400 | | | | | | | |
| *Enterococcus* (BDL 1) MPN/100 mL | 1000 | 6800 | 410 | 11 | 1000 | | | | | | | |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 100 – Complete analytical results for bacteria samples for South Park Creek

## Spunky Creek
## WBID: 121500020480_00

Table 101 - Sampling location on Spunky Creek

| Waterbody | Sample Location | | Watershed Area ($mi^2$)* | Sampling/Evaluation Date | | | |
|---|---|---|---|---|---|---|---|
| | Latitude | Longitude | | Fish | Benthic (Summer) | Benthic (Winter) | Habitat |
| Spunky Creek | 36.161944 | -95.745278 | 15.01 | 09/22/2017 | 08/16/2016 | 02/24/2017 | 11/02/2017 |
| | | | | | 08/30/2017 | 03/12/2018 | |

* Collection area captured by sampling point

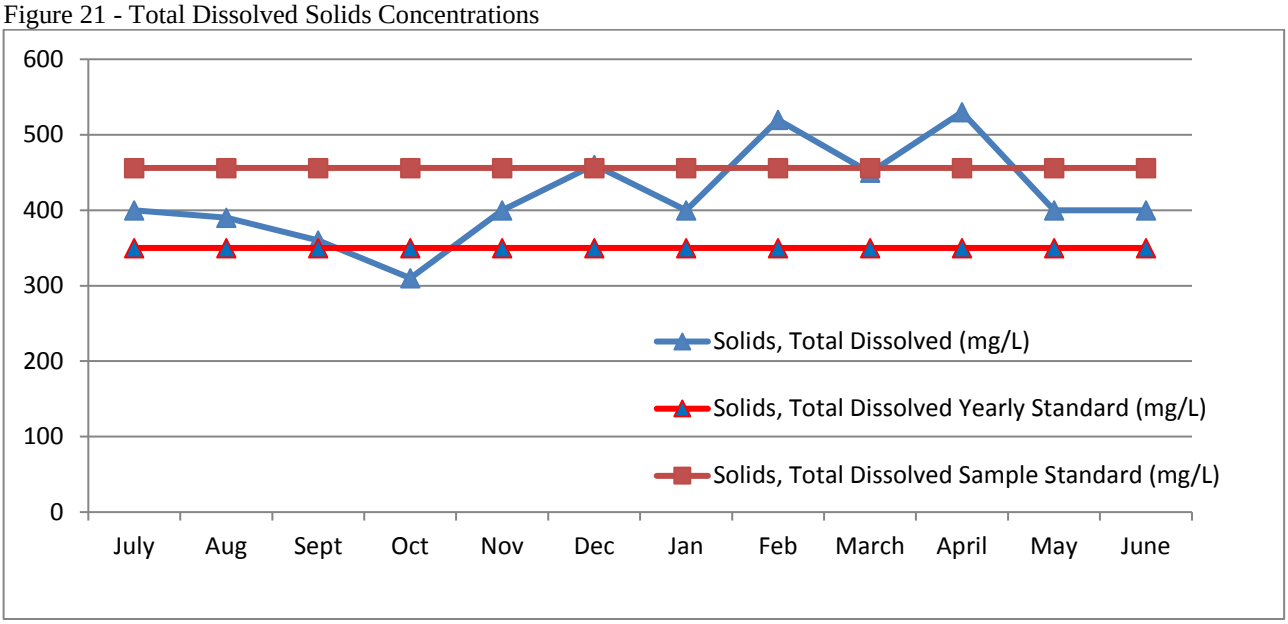
# 14.0 BENEFICIAL USES

**14.1 Agriculture –** Data collected on Total Dissolved Solids for Spunky Creek indicates attainment of the agricultural beneficial use is not met. The number of samples collected exceeds the number of samples required. The sample mean does exceed the yearly standard and three of the samples exceeded the sample standard.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 418 | 530 | Sample: 456, Yearly: 350 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |

Table 102 – Agriculture standards for Spunky Creek

Figure 21 - Total Dissolved Solids Concentrations



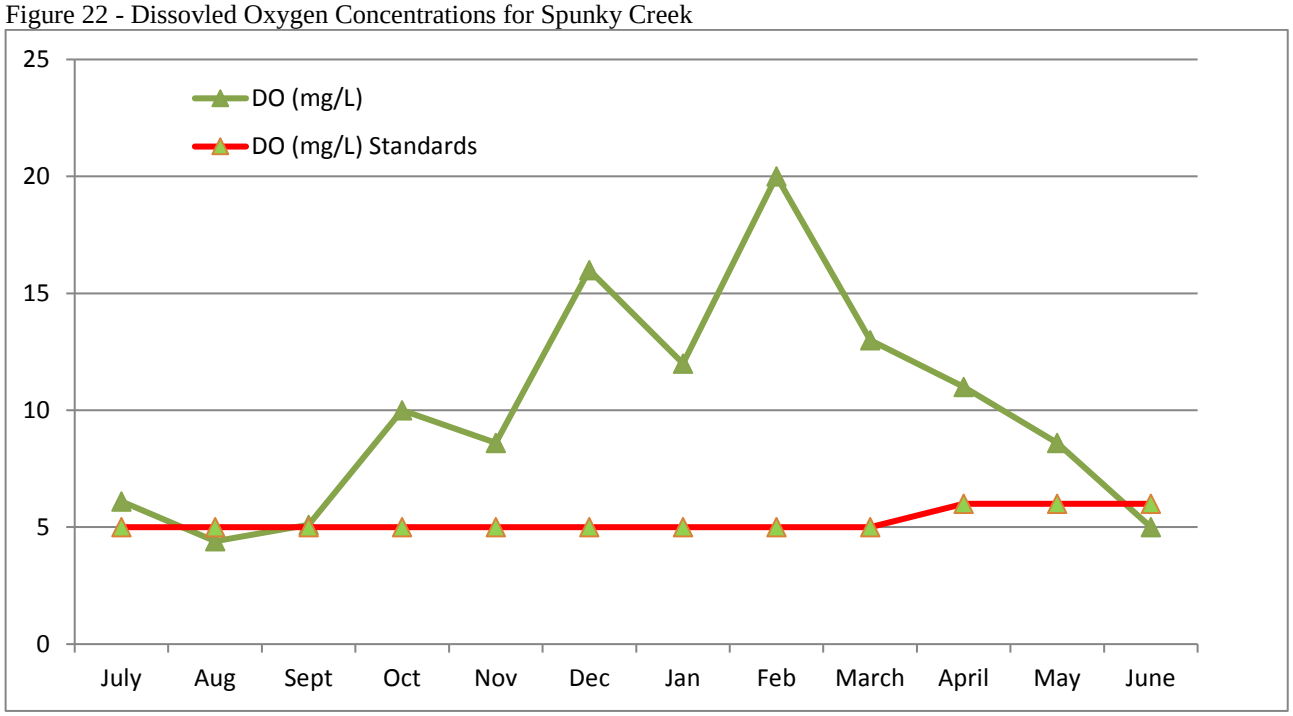
## 14.2 Fish and Wildlife Propagation: Warm Water Aquatic Community

**14.2.1** Dissolved Oxygen - Data collected on Dissolved Oxygen concentrations shows the beneficial use is not supported. The number of samples collected exceeds the number of required samples. Out of 12 samples, two were found to be below the standard. Therefore, more than 10% of the samples were outside the standard range.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| D.O. | 1 samples below 6.0 | na | April - June: 5.0 | 3 | 10 total | No more than 10% of samples outside range |
| | 1 samples below 5.0 | na | June - Mar: 6.0 | 9 | | |

Table 103 – Dissolved Oxygen standards for Spunky Creek

Figure 22 - Dissovled Oxygen Concentrations for Spunky Creek



**14.2.2** Toxicants/Metals - Data collected indicate full support of the beneficial use for Toxicants and Metals.

| Parameter | Sample Mean (µg/L) | Single Sample (µg/L) | Water Quality Standard (µg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Cadmium | 0.38 | 0.50 | Acute: 58.21, Chronic: 1.66 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper | 1.83 | 3.53 | Acute: 30.31, Chronic: 16.36 | 12 | 5 | |
| Lead | 0.39 | 0.72 | Acute: 151.33, Chronic: 5.90 | 12 | 5 | |
| Zinc | 9.74 | 19.10 | Acute: 176.46, Chronic: 159.83 | 12 | 5 | |

Table 104 – Toxicants/Metals standards for Spunky Creek

**14.2.3** pH (Hydrogen Ion Activity) - Data collected on pH readings for Spunky Creek show full support of the beneficial use. The number of pH measurements taken exceeds the number of required measurements. All pH measurements fell within the standard range.

| Parameter | Sample Range (s.u.) | Single Sample (s.u.) | Water Quality Standard Range (s.u.) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| pH | 7.3 – 8.4 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |

Table 105 – pH standards for Spunky Creek

**14.2.4** Oil and Grease - Data collected on Oil and Grease concentrations through HEM laboratory analysis show support of the beneficial use. All samples taken showed Oil and Grease amounts to be below the detection limit.

**14.2.5** Suspended and Bedded Sediments - Using habitat assessment data to determine support of the beneficial use is conditional upon the support of turbidity data and fish collection data.

**14.2.5.1** *Turbidity* – Data collected on Turbidity readings for Spunky Creek show full support of the beneficial use.

| Parameter | Sample Mean (NTU) | Single Sample (NTU) | Water Quality Standard (NTU) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Turbidity | 10.68 | 30.40 | 50 | 12 | 10 | No more than 10% exceeding sample standard |

Table 106 – Turbidity standards for Spunky Creek

**14.2.5.2** *Habitat Assessment* - The resulting score of the habitat assessment on Spunky Creek can be compared to the average score of high quality sites within the same ecoregion provided by the Oklahoma Conservation Commission using a scoring workbook derived from OWRB (OWRB, 2001). The results of the habitat assessment produced a score above average for the central irregular plains ecoregion.

| Metric | Score |
|---|---|
| Instream habitat | 17.5 |
| Pool bottom substrate | 7.1 |
| Pool variability | 15.9 |
| Canopy cover | 20.0 |
| Presence of rocky runs and riffles | 9.0 |
| Flow (at representative low flow) | 10.2 |
| Channel alteration | 12.3 |
| Channel sinuosity | 1.4 |
| Bank stability | 4.9 |
| Bank vegetation stability | 2.9 |
| Stream side Cover | 9.5 |
| **Total Score** | **110.67** |
| **Central Irregular Plains Mean Score** | **84.09** |

Table 107 – Habitat assessment metric and total results with ecoregion mean score

### 14.2.6 Biological

**14.2.6.1** *Fish Collections* - Data recorded from fish collections performed on Spunky Creek show that the beneficial use is supported.

| Index of Biotic Integrity | Score |
|---|---|
| Sample Composition | 20 |
| Fish Condition | 13 |
| Score Key: 30 + Beneficial Use Supported : 23 - 29 Undetermined : < 22 Impaired | Total: 33 |

Table 108 – Fish IBI score for Spunky Creek

| Family | Species Name | Common Name | Number of | Percentage |
|---|---|---|---|---|
| Ictaluridae | *Ictalurus punctatus* | Channel catfish | 3 | 0.5% |
| Centrarchidae | *Lepomis cyanellus* | Green sunfish | 31 | 5.0% |
| | *Lepomis macrochirus* | Bluegill sunfish | 80 | 12.8% |
| | *Lepomis megalotis* | Longear sunfish | 66 | 10.6% |
| | *Lepomis microlophus* | Redear sunfish | 3 | 0.5% |
| | *Lepomis YOY* | YOY sunfish | 18 | 2.9% |
| | *Micropterus salmoides* | Largemouth bass | 14 | 2.2% |
| Cyprinidae | *Campostoma anomalum* | Central stoneroller | 165 | 26.4% |
| | *Pimephalus notatus* | Bluntnose minnow | 99 | 15.9% |
| | *Cyprinella* sp. | Shiner sp. | 2 | 0.3% |
| Clupeidae | *Dorosoma cepedianum* | Gizzard shad | 25 | 4.0% |
| Percidae | *Etheostoma spectabile* | Orangethroat darter | 62 | 9.9% |
| | *Percina caprodes* | Common logperch | 1 | 0.2% |
| Poeciliidae | *Gambusia affinis* | Mosquitofish | 16 | 2.6% |
| Atherinopsidae | *Labidesthes sicculus* | Brook silverside | 36 | 5.8% |
| Catostomidae | *Minytrema melanops* | Spotted sucker | 3 | 0.5% |
| **Total Number:** | | | 624 | 100.0% |
| **Total Number of Taxa:** | | | 16 | |

Table 109 – Fish collection counts for Spunky Creek

^Photograph taken of Spunky Creek sample site

**14.2.6.2** *Benthic Macroinvertebrate Collections* – Data recorded from benthic macroinvertebrate collections during the summer and winter index periods is impaired for one winter index period, undetermined for one summer index period, supporting for the other two index periods (ODEQ, Continuing Planning Process, 2012).

| Sampling Event | Score |
|---|---|
| Summer 2016 | 77% |
| Winter 2017 | 44% |
| Summer 2017 | 65% |
| Winter 2018 | 104% |
| Spunky Creek - (Central Irregular Plains): >80% Attaining : 50-80% - Undetermined : < 50% Impaired | |

Table 110 – Benthic macroinvertebrate metrics for summer and winter index periods at Spunky Creek

| Genus | Common Class | 8/16/2016 | |
|---|---|---|---|
| | | Count | % |
| *Caenis sp.* | Squaregilled Mayfly | 1 | 0.9% |
| *Fallceon quilleri* | Minnow Mayfly | 3 | 2.8% |
| *Stenacron sp.* | Flathead Mayfly | 1 | 0.9% |
| *Tricorythodes sp.* | Stout Crawler Mayfly | 3 | 2.8% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 9 | 8.5% |
| *Chimarra sp.* | Fingernet Caddisfly | 16 | 15.1% |
| Coenagrionidae | Narrowwinged Damselfly | 1 | 0.9% |
| Libellulidae | Skimmer Damselfly | 1 | 0.9% |
| *Microcylloepus sp.* | Riffle Beetle | 5 | 4.7% |
| *Stenelmis* sp. | | 34 | 32.1% |
| *Corynoneura sp.* | Midge | 2 | 1.9% |
| *Nanocladius sp.* | | 1 | 0.9% |
| *Polypedilum flavum* | | 8 | 7.5% |
| *Polypedilum ilinoense gr.* | | 1 | 0.9% |
| *Polypedilum scalaenum gr.* | | 4 | 3.8% |
| *Rheotanytarsus exiguus gr.* | | 1 | 0.9% |
| *Tanytarsus sp.* | | 2 | 1.9% |
| *Thienemanniella sp.* | | 1 | 0.9% |
| *Thienemannimyia gr. sp.* | | 4 | 3.8% |
| *Bezzia/Palpomyia sp.* | Biting Midge | 1 | 0.9% |
| *Dero sp.* | Aquatic Worm | 1 | 0.9% |
| *tubificoid Naididae w/o cap setae* | Aquatic Worm (Bald) | 1 | 0.9% |
| *Erpobdella sp.* | Leech | 1 | 0.9% |
| Cambaridae | Crayfish | 1 | 0.9% |
| *Hyalella sp.* | Scud | 2 | 1.9% |
| Turbellaria | Flatworm | 1 | 0.9% |
| Total | | 106 | 100.0% |
| Total Number of Taxa | | 26 | |

2016 Spunky Creek Summer Index Period

| Genus | Common Class | 2/24/2017 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 2 | 1.9% |
| *Fallceon quilleri* | Minnow Mayfly | 1 | 1.0% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 2 | 1.9% |
| *Chimarra* sp. | Fingernet Caddisfly | 5 | 4.8% |
| *Argia* sp. | Narrowwinged Damselfly | 1 | 1.0% |
| *Berosus* sp. | Waver Scavenger Beetle | 1 | 1.0% |
| *Stenelmis* sp. | Riffle Beetle | 9 | 8.7% |
| *Cricotopus bicinctus* gr. | Midge | 1 | 1.0% |
| *Eukiefferiella brevicalcar* gr. | | 1 | 1.0% |
| *Orthocladius* sp. | | 2 | 1.9% |
| *Polypedilum flavum* | | 71 | 68.3% |
| *Polypedilum illinoense* gr. | | 5 | 4.8% |
| *Erpobdella* sp. | Leech | 2 | 1.9% |
| Corbiculoidea | Asian Freshwater Clam | 1 | 1.0% |
| Total | | 104 | 100.0% |
| Total Number of Taxa | | 14 | |

2017 Spunky Creek Winter Index Period

| Genus | Common Class | 8/30/2017 | |
|---|---|---|---|
| | | Count | % |
| *Baetis sp.* | Minnow Mayfly | 1 | 1.0% |
| *Stenonema femoratum* | Flathead Mayfly | 2 | 2.0% |
| *Tricorythodes sp.* | Stout Crawler Mayfly | 1 | 1.0% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 16 | 15.8% |
| *Chimarra sp.* | Fingernet Caddisfly | 10 | 9.9% |
| *Argia sp.* | Narrowwinged Damselfly | 5 | 5.0% |
| *Stenelmis* sp. | Riffle Beetle | 29 | 28.7% |
| *Dicrotendipes neomodestus* | Midge | 1 | 1.0% |
| *Micropsectra sp.* | | 1 | 1.0% |
| *Polypedilum flavum* | | 10 | 9.9% |
| *Polypedilum ilinoense gr.* | | 10 | 9.9% |
| *Rheotanytarsus exiguus gr.* | | 8 | 7.9% |
| *Thienemannimyia gr. sp.* | | 3 | 3.0% |
| *Bezzia/Palpomyia sp.* | Biting Midge | 1 | 1.0% |
| *Erpobdella sp.* | Leech | 2 | 2.0% |
| *Corbicula sp.* | Asian Freshwater Clam | 1 | 1.0% |
| Total | | 101 | 100.0% |
| Total Number of Taxa | | 16 | |

2017 Spunky Creek Summer Index Period

| Genus | Common Class | 3/12/2018 | |
|---|---|---|---|
| | | Count | % |
| *Caenis* sp. | Squaregilled Mayfly | 11 | 10.8% |
| *Fallceon* sp. | Minnow Mayfly | 11 | 10.8% |
| Heptageniidae | Flathead Mayfly | 1 | 1.0% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 2 | 2.0% |
| *Chimarra* sp. | Fingernet Caddisfly | 2 | 2.0% |
| *Helicopsyche* sp. | Snail-case Caddisfly | 1 | 1.0% |
| *Hydroptila* sp. | Micro Caddisly | 1 | 1.0% |
| *Microcylloepus* sp. | Riffle Beetle | 1 | 1.0% |
| *Stenelmis* sp. | | 8 | 7.8% |
| *Ablabesmyia* sp. | Midge | 1 | 1.0% |
| *Corynoneura* sp. | | 2 | 2.0% |
| *Cricotopus bicinctus* gr. | | 3 | 2.9% |
| *Cricotopus* sp. | | 2 | 2.0% |
| *Eukiefferiella* sp. | | 1 | 1.0% |
| *Hydrobaenus* sp. | | 1 | 1.0% |
| *Nilothauma* sp. | | 1 | 1.0% |
| *Orthocladius* sp. | | 21 | 20.6% |
| *Polypedilum flavum* | | 14 | 13.7% |
| *Polypedilum scalaenum* gr. | | 3 | 2.9% |
| *Rheotanytarsus exiguus* gr. | | 1 | 1.0% |
| *Tanytarsus* sp. | | 6 | 5.9% |
| *Nais* sp. | Aquatic Worm | 1 | 1.0% |
| tubificoid w/o cap setae | Aquatic Worm (Bald) | 1 | 1.0% |
| *Corbicula* sp. | Asian Freshwater Clam | 2 | 2.0% |
| *Hyalella* sp. | Scud | 1 | 1.0% |
| Turbellaria | Flatworm | 3 | 2.9% |
| Total | | 102 | 100.0% |
| Total Number of Taxa | | 26 | |

2018 Spunky Creek Winter Index Period

Table 111 – Benthic macroinvertebrate counts for Spunky Creek summer and winter index periods

**14.3 Primary Body Contact -** The data collected on *E. coli* and *Enterococcus* concentrations show that Spunky Creek is impaired for *Enterococcus*. The number of samples collected exceeds the number of samples required. While the MS4 permit requires monthly sampling of bacteria, water quality standards only pertain to samples collected during the recreational period.

| Parameter | Sample Geometric Mean (MPN/100mL) | Single Sample (MPN/100mL) | Water Quality Standard (MPN/100mL) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| *E. coli* | 102 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| *Enterococcus* | 213 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |

Table 112 – *E. coli* and *Enterococcus* totals for Spunky Creek

Figure 23 - *E. coli* Concentrations for Spunky Creek

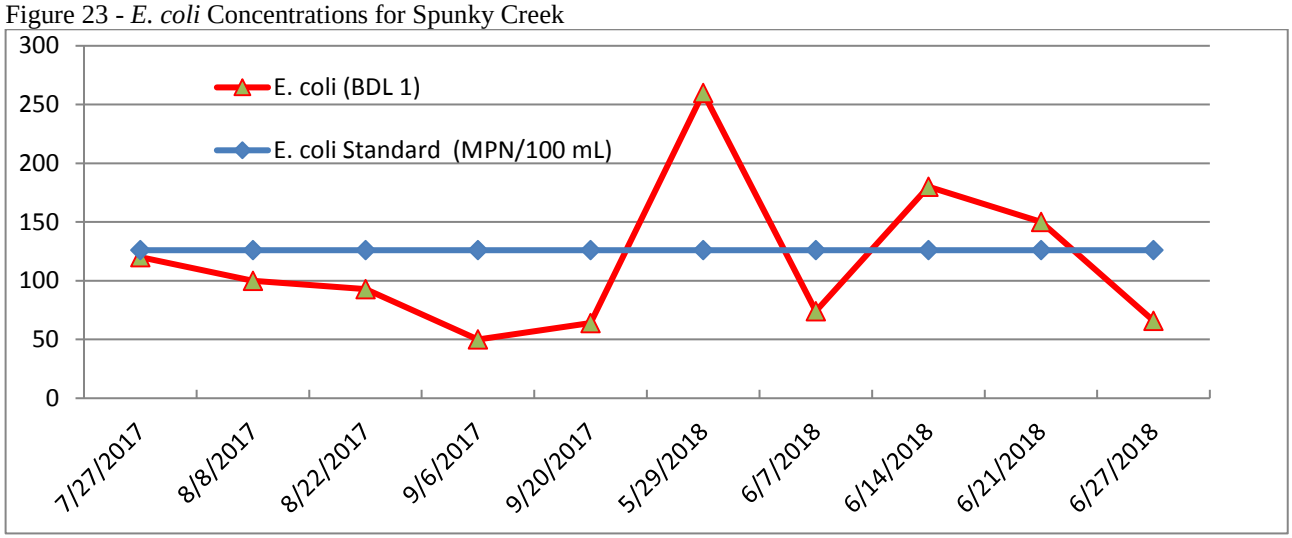
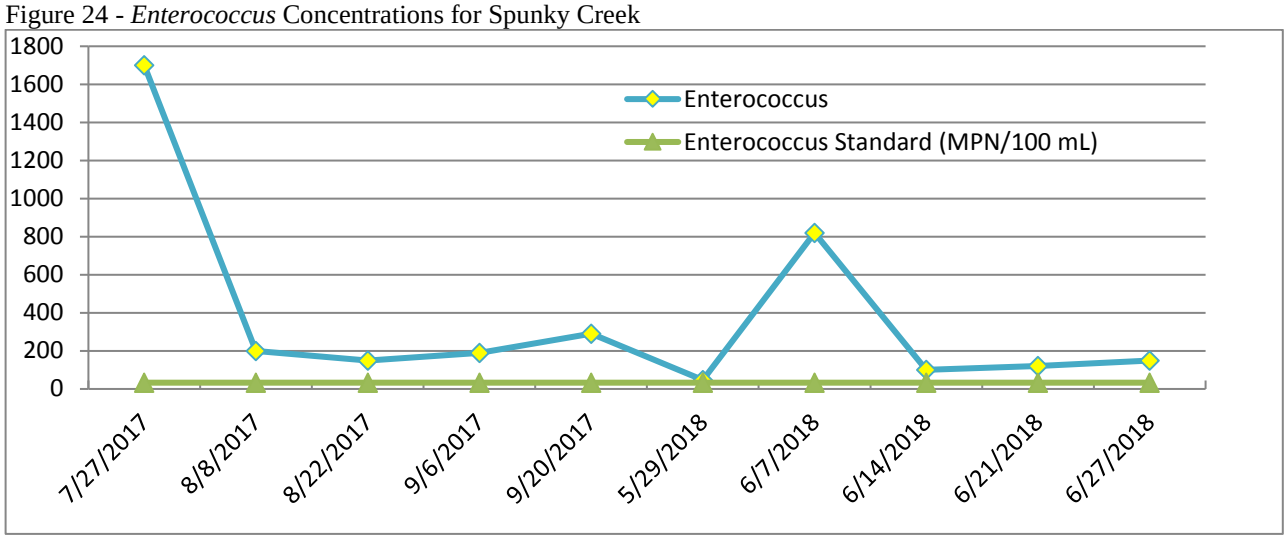



Figure 24 - *Enterococcus* Concentrations for Spunky Creek



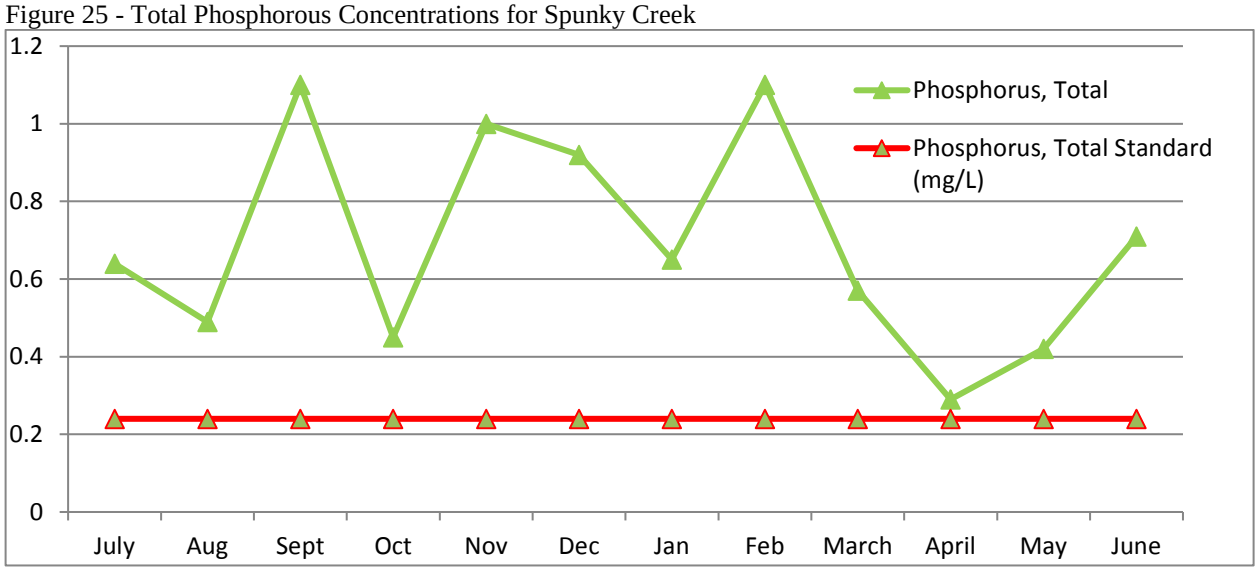
## 14.4 Anti-Degradation Policy

**14.4.1** Nutrients - Analytical results for Nitrate/Nitrite show no need for further investigation to show support of the beneficial use. Total Phosphorous, however, does not show support of the beneficial use. The number of samples collected exceeds the number of required samples, and less than 10% of samples exceeded the threshold for further sampling for Nitrate/Nitrite but all samples for Total Phosphorous exceeded water quality standards. While Nitrate/Nitrite concentrations have an action level, it is not a required parameter within the MS4 permit (ODEQ, OPDES Permit OKS000201, 2011).

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Threshold (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Phosphorus | 0.70 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| Nitrite - Nitrate | 1.19 | na | 4.95 | 12 | 10 | No more than 10% of samples outside range |

Table 113 – Nutrient totals for Spunky Creek

Figure 25 - Total Phosphorous Concentrations for Spunky Creek



## 15.0 SUMMARY

Analytically, Spunky Creek shows a few water quality impacts to the stream during the year of sampling which include total dissolved solids, dissolved oxygen, total phosphorous and *Enterococcus*. A wastewater treatment plant discharge was determined to be the cause of elevated total phosphorous levels. Fish collections reflected a supporting classification according to water quality standards. Spunky Creek had a few disappointing benthic macroinvertebrate IBI scores that could be related to the lack of intolerant species which prevents support of the beneficial use. The higher than average habitat assessment score is encouraging and future sampling may show improvements in macroinvertebrate scores.

Table 114 – Oklahoma Water Quality Standards summary of collected data for Spunky Creek

| Spunky | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Sample Mean** | **Single Sample** | **Water Quality Standard** | **No. of Samples** | **No. of Samples Required (WQS)** | **How Standard is Violated** |
| Cadmium (µg/L) | 0.38 | 0.50 | Acute: 58.21, Chronic: 1.66 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper (µg/L) | 1.83 | 3.53 | Acute: 30.31, Chronic: 19.36 | 12 | 5 | |
| Lead (µg/L) | 0.39 | 0.72 | Acute: 151.33, Chronic: 5.90 | 12 | 5 | |
| Zinc (µg/L) | 9.74 | 19.10 | Acute: 176.46, Chronic: 159.83 | 12 | 5 | |
| Diazinon (µg/L) | 0.15 | na | Acute: 0.17 | 12 | 5 | |
| E. coli (MPN/100ml) | 102 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| Enterococcus (MPN/100ml) | 213 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |
| Oil and Grease (visual) | None | na | No visible sheen | 12 | 10 | No more than 10% of observations with oil & grease |
| Total Phosphorus (mg/L) | 0.70 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| *Nitrite – Nitrate (mg/L)* | *1.19* | *na* | *4.95* | *12* | *10* | *No more than 10% of samples outside range* |
| Total Dissolved Solids (mg/L) | 418 | 530 | Sample: 470, Yearly: 387 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |
| pH (s.u.) | 7.3 – 8.4 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |
| *D.O. (mg/L)* | *1 samples below 6.0* | *na* | *April 1-June 15: 6.0* | *3* | *10 total* | *No more than 10% of samples outside range* |
| | *1 samples below 5.0* | *na* | *June 16-Mar 31.: 5.0* | *9* | | |

*Analytes in italics not required by permit
*Analytes in red exceed standards*

| Analyte | Result | | |
|---|---|---|---|

| | Minimum | Mean | Maximum | Number of Samples | Number of Attempts |
|---|---|---|---|---|---|
| Oxygen Demand, 5-Day Biological (mg/L)(DL 3.0 mg/L) | -- | 3.00 | 3.20 | 12 | 12 |
| Cadmium, Total (µg/L) (DL 0.5 µg/L) | -- | 0.38 | 0.50 | 12 | 12 |
| Coliform, Fecal (CFU/100 mL)(DL 1 CFU/100 mL) | -- | 70 | 280 | 12 | 17 |
| Conductivity µS | -- | 570 | 740 | 12 | 12 |
| Copper, Total (µg/L) (DL 0.5 µg/L) | -- | 1.83 | 3.53 | 12 | 12 |
| Diazinon (µg/L) (DL 0.17-5.0 µg/L) | -- | 0.15 | 0.17 | 12 | 12 |
| Dissolved Oxygen (mg/L) | 4.39 | 9.97 | 19.53 | 12 | 12 |
| *E. coli* (MPN/100 mL) (DL 1 MPN/100 mL) | -- | 65 | 260 | 12 | 17 |
| *Enterococcus* (MPN/100 mL)(DL 1 CFU/100 mL) | -- | 85 | 1700 | 12 | 17 |
| Flow (cfs) | 0.41 | 2.14 | 7.73 | 12 | 12 |
| Hardness, Total (mg/L) (DL 3.6 mg/L) | 180 | 237 | 290 | 12 | 12 |
| Lead, Total (µg/L) (DL 0.5 µg/L) | -- | 0.39 | 0.72 | 12 | 12 |
| Nitrogen, Total Kjeldahl (mg/L)(DL 0.50 mg/L) | -- | 0.84 | 1.50 | 12 | 12 |
| Nitrogen, Nitrate-Nitrite (mg/L) (DL 0.2 mg/L) | -- | 1.19 | 2.50 | 12 | 12 |
| Nitrogen, Total as Nitrogen (mg/L)(DL 0.50 mg/L) | -- | 1.94 | 2.90 | 12 | 12 |
| Oil and Grease (mg/L) (DL 6.0-6.5 mg/L) | -- | 6.68 | 7.30 | 12 | 12 |
| Oxygen Demand, Chemical (mg/L)(DL 20 mg/L) | -- | 22 | 30 | 12 | 12 |
| pH (su) | 7.29 | 7.67 | 8.36 | 12 | 12 |
| Phosphorus, Total (mg/L) (DL 0.010 mg/L) | -- | 0.70 | 1.10 | 12 | 12 |
| Phosphorus, Dissolved (mg/L) (DL 0.010 mg/L) | -- | 0.63 | 1.10 | 12 | 12 |
| Solids, Total Dissolved (mg/L) (DL 10 mg/L) | -- | 418 | 530 | 12 | 12 |
| Solids, Total Suspended (mg/L) (DL 2.0 mg/L) | -- | 8.78 | 30.00 | 12 | 12 |
| Temperature, Water (°C) | 1.87 | 15.80 | 27.81 | 12 | 12 |
| Turbidity | -- | 10.68 | 30.40 | 12 | 12 |
| Zinc, Total (µg/L) (DL 10 µg/L) | -- | 9.74 | 19.10 | 12 | 12 |
| Results found to be below the detection limit are reported as the detection limit | | | | | |

Table 115 – MS4 permit required analytical sampling parameters result summaries for Spunky Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/24/17 | 8/15/17 | 9/20/17 | 10/18/17 | 11/21/17 | 12/14/17 | 1/11/18 | 2/8/18 | 3/22/18 | 4/16/18 | 5/29/18 | 6/27/18 |
| BOD(5) Day (BDL 3) mg/L | 3.0 | 3.0 | 3.2 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.2 |
| Cadmium, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.001 | 0.001 | 0.001 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Conductivity µS | 686 | 506 | 597 | 479 | 517 | 430 | 467 | 491 | 611 | 620 | 740 | 699 |
| Copper, Total (BDL 0.5) µg/L | 2.85 | 2.79 | 3.53 | 0.005 | 0.005 | 0.005 | 1.62 | 3.31 | 2.28 | 1.91 | 1.64 | 2.02 |
| Diazinon (BDL 0.17) µg/L | 0.17 | 0.17 | 0.10 | 0.108 | 0.108 | 0.106 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| Dissolved Oxygen mg/L | 6.10 | 4.39 | 5.10 | 10.27 | 8.63 | 15.53 | 12.40 | 19.53 | 12.78 | 11.37 | 8.58 | 5.01 |
| Flow CFS | 1.27 | 7.73 | 0.80 | 1.71 | 1.47 | 1.84 | 2.04 | 1.32 | 2.77 | 2.77 | 1.56 | 0.41 |
| Hardness, Total (BDL 3.6) mg/L | 240 | 180 | 180 | 210 | 240 | 230 | 250 | 280 | 280 | 290 | 250 | 215 |
| Lead, Total (BDL 0.5) µg/L | 0.50 | 0.715 | 0.50 | 0.0005 | 0.0005 | 0.0005 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L | 1.10 | 0.65 | 0.86 | 0.64 | 0.65 | 0.50 | 0.66 | 0.56 | 1.50 | 0.87 | 1.10 | 0.99 |
| Nitrogen, Nitrate-Nitrite (BDL 0.2) mg/L | 0.47 | 0.72 | 1.20 | 1.20 | 1.80 | 2.50 | 1.70 | 1.70 | 1.50 | 0.39 | 0.40 | 0.73 |
| Nitrogen, Total as N (BDL 0.5) mg/L | 1.50 | 1.40 | 2.00 | 1.80 | 2.40 | 2.50 | 2.30 | 2.20 | 2.90 | 1.20 | 1.40 | 1.70 |
| Oil and Grease HEM (BDL 6) mg/L | 6.5 | 7.3 | 6.2 | 6.9 | 6.9 | 6.2 | 7.2 | 6.7 | 7.1 | 6.5 | 6.1 | 6.5 |
| Oxygen Demand, Chemical (BDL 20) mg/L | 21 | 28 | 20 | 22 | 20 | 20 | 20 | 30 | 20 | 20 | 20 | 20 |
| pH (s.u.) | 7.72 | 7.64 | 7.29 | 7.52 | 7.48 | 7.82 | 7.29 | 8.36 | 7.87 | 7.81 | 7.48 | 7.73 |
| Phosphorus, Total (BDL 0.010) mg/L | 0.640 | 0.490 | 1.100 | 0.450 | 1.000 | 0.920 | 0.650 | 1.100 | 0.570 | 0.290 | 0.420 | 0.710 |
| Phosphorus, Total Dissolved BDL (0.010) mg/L | 0.550 | 0.440 | 1.000 | 0.400 | 0.900 | 0.830 | 0.560 | 1.100 | 0.520 | 0.250 | 0.370 | 0.650 |
| Solids, Total Dissolved (BDL 10) mg/L | 400 | 390 | 360 | 310 | 400 | 460 | 400 | 520 | 450 | 530 | 400 | 400 |
| Solids, Total Suspended (BDL 2.0) mg/L | 9.5 | 30.0 | 5.6 | 15.0 | 10.0 | 2.0 | 5.2 | 3.3 | 4.3 | 2.0 | 8.5 | 10.0 |
| Temperature, Water °C | 27.81 | 25.21 | 23.40 | 14.82 | 9.85 | 5.14 | 6.43 | 1.87 | 11.06 | 10.65 | 26.10 | 26.99 |
| Turbidity (NTU) | 11.90 | 21.00 | 5.31 | 4.85 | 5.51 | 2.50 | 5.10 | 3.51 | 4.64 | 2.99 | 30.40 | 30.40 |
| Zinc, Total (BDL 10) µg/L | 16.5 | 19.1 | 10.8 | 0.014 | 0.011 | 0.009 | 10.5 | 17.1 | 10.6 | 10.0 | 10.0 | 12.2 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 116 – Complete analytical sampling results for all parameters for Spunky Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/26/17 | 8/15/17 | 8/22/17 | 9/6/17 | 9/20/17 | 10/18/17 | 11/21/17 | 12/14/17 | 1/11/18 | 2/8/18 | 3/22/18 | 4/16/18 |
| Coliform, Fecal CFU/100mL | 200 | 280 | 140 | 120 | 28 | 110 | 17 | 33 | 14 | 3 | 110 | 42 |
| *E. coli* (BDL 1) MPN/100mL | 120 | 100 | 93 | 50 | 64 | 120 | 16 | 31 | 52 | 3.1 | 110 | 50 |
| *Enterococcus* (BDL 1) MPN/100 mL | 1700 | 200 | 150 | 190 | 290 | 170 | 11 | 14 | 11 | 8.6 | 70 | 17 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5/29/18 | 6/7/18 | 6/14/18 | 6/21/18 | 6/27/18 | | | | | | | |
| Coliform, Fecal CFU/100mL | 270 | 84 | 190 | 160 | 110 | | | | | | | |
| *E. coli* (BDL 1) MPN/100mL | 260 | 74 | 180 | 150 | 66 | | | | | | | |
| *Enterococcus* (BDL 1) MPN/100 mL | 47 | 820 | 100 | 120 | 150 | | | | | | | |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 117 – Complete analytical results for bacteria samples for Spunky Creek

## Vensel Creek
## WBID: 120420 NOT LISTED

Table 118 - Sampling location on Vensel Creek

| Waterbody | Sample Location | | Watershed Area ($mi^2$)* | Sampling/Evaluation Date | | | |
|---|---|---|---|---|---|---|---|
| | Latitude | Longitude | | Fish | Benthic (Summer) | Benthic (Winter) | Habitat |
| Vensel Creek | 36.029576 | -95.940415 | 1.00 | 09/20/2017 | 08/24/2016 | 02/24/2017 | 11/6/2017 |
| | | | | | 08/28/2017 | 02/15/2018 | |

* Collection area captured by sampling point

# 16.0 BENEFICIAL USES

**16.1 Agriculture –** Data collected on Total Dissolved Solids for Vensel Creek indicates attainment of the agricultural beneficial use. The number of samples collected exceeds the number of samples required. The sample mean does not exceed the yearly standard and none of the samples exceeded the sample standard.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Dissolved Solids | 388 | 570 | Sample: 1868, Yearly: 1496 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |

Table 119 – Agriculture standards for Vensel Creek

## 16.2 Fish and Wildlife Propagation: Warm Water Aquatic Community

**16.2.1** Dissolved Oxygen - Data collected on Dissolved Oxygen concentrations shows the beneficial use is supported. The number of samples collected exceeds the number of required samples. Out of 12 samples, none were found to be below the standard. Therefore, less than 10% of the samples were outside the standard range.

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Standard (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| D.O. | 0 samples below 6.0 | na | April - June: 5.0 | 3 | 10 total | No more than 10% of samples outside range |
| | 0 samples below 5.0 | na | June - Mar: 6.0 | 9 | | |

Table 120 – Dissolved Oxygen standards for Vensel Creek

**16.2.2** Toxicants/Metals - Data collected indicate full support of the beneficial use for Toxicants and Metals.

| Parameter | Sample Mean (µg/L) | Single Sample (µg/L) | Water Quality Standard (µg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Cadmium | 0.38 | 0.50 | Acute: 102.36, Chronic: 2.46 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper | 1.83 | 8.87 | Acute: 48.56, Chronic: 29.69 | 12 | 5 | |
| Lead | 0.38 | 0.50 | Acute: 286.15, Chronic: 11.15 | 12 | 5 | |
| Zinc | 10.51 | 23.50 | Acute: 269.64, Chronic: 244.23 | 12 | 5 | |

Table 121 – Toxicants/Metals standards for Vensel Creek

**16.2.3** pH (Hydrogen Ion Activity) - Data collected on pH readings for Vensel Creek show full support of the beneficial use. The number of pH measurements taken exceeds the number of required measurements. All pH measurements fell within the standard range.

| Parameter | Sample Range (s.u.) | Single Sample (s.u.) | Water Quality Standard Range (s.u.) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| pH | 7.1 – 7.8 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |

Table 122 – pH standards for Vensel Creek

**16.2.4** Oil and Grease - Data collected on Oil and Grease concentrations through HEM laboratory analysis show support of the beneficial use. All samples taken showed Oil and Grease amounts to be below the detection limit.

**16.2.5** Suspended and Bedded Sediments - Using habitat assessment data to determine support of the beneficial use is conditional upon the support of turbidity data and fish collection data.

**16.2.5.1** *Turbidity* – Data collected on Turbidity readings for Vensel Creek show full support of the beneficial use.

| Parameter | Sample Mean (NTU) | Single Sample (NTU) | Water Quality Standard (NTU) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Turbidity | 8.40 | 18.70 | 50 | 12 | 10 | No more than 10% exceeding sample standard |

Table 123 – Turbidity standards for Vensel Creek

**16.2.5.2** *Habitat Assessment* - The resulting score of the habitat assessment on Vensel Creek can be compared to the average score of high quality sites within the same ecoregion provided by the Oklahoma Conservation Commission using a scoring workbook derived from OWRB (OWRB, 2001). The results of the habitat assessment produced a score above average for the central irregular plains ecoregion.

| Metric | Score |
|---|---|
| Instream habitat | 18.6 |
| Pool bottom substrate | 3.3 |
| Pool variability | 19.1 |
| Canopy cover | 20.0 |
| Presence of rocky runs and riffles | 4.1 |
| Flow (at representative low flow) | 1.8 |
| Channel alteration | 16.5 |
| Channel sinuosity | 1.3 |
| Bank stability | 4.1 |
| Bank vegetation stability | 2.8 |
| Stream side Cover | 9.3 |
| **Total Score** | **100.93** |
| **Central Irregular Plains Mean Score** | **84.09** |

Table 124 – Habitat assessment metric and total results with ecoregion mean score

### 16.2.6 Biological

**16.2.6.1** *Fish Collections* - Data recorded from fish collections performed on Vensel Creek show that the beneficial use is impaired.

| Index of Biotic Integrity | Score |
|---|---|
| Sample Composition | 10 |
| Fish Condition | 7 |
| Score Key: 30 + Beneficial Use Supported : 23 - 29 Undetermined : < 22 Impaired | Total: 17 |

Table 125 – Fish IBI score for Vensel Creek

| Family | Species Name | Common Name | Number of | Percentage |
|---|---|---|---|---|
| Ictaluridae | *Ameiurus natalis* | Yellow bullhead catfish | 8 | 2.0% |
| Centrarchidae | *Lepomis cyanellus* | Green sunfish | 266 | 66.5% |
| | *Lepomis macrochirus* | Bluegill sunfish | 47 | 11.8% |
| | *Micropterus salmoides* | Largemouth bass | 1 | 0.3% |
| Cyprinidae | *Pimephalus notatus* | Bluntnose minnow | 5 | 1.3% |
| | *Cyprinella lutrensis* | Red shiner | 73 | 18.3% |
| **Total Number:** | | | 400 | 100.0% |
| **Total Number of Taxa:** | | | 6 | |

Table 126 – Fish collection counts for Vensel Creek

^Photograph taken of Vensel Creek sample site

**16.2.6.2** *Benthic Macroinvertebrate Collections* – Data recorded from benthic macroinvertebrate collections during the summer and winter index periods is impaired for two index periods, undetermined for one of the summer index periods and attaining for one of the winter index periods (ODEQ, Continuing Planning Process, 2012).

| Sampling Event | Score |
|---|---|
| Summer 2016 | 26% |
| Winter 2017 | 44% |
| Summer 2017 | 52% |
| Winter 2018 | 89% |
| Vensel Creek - (Central Irregular Plains): >80% Attaining : 50-80% - Undetermined : < 50% Impaired | |

Table 127 – Benthic macroinvertebrate metrics for summer and winter index periods at Vensel Creek

| Genus | Common Class | 8/24/2016 | |
|---|---|---|---|
| | | Count | % |
| *Fallceon quilleri* | Minnow Mayfly | 2 | 1.9% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 3 | 2.9% |
| *Chimarra sp.* | Fingernet Caddisfly | 3 | 2.9% |
| *Hydroptila sp.* | Micro Caddisfly | 2 | 1.9% |
| *Chironomus sp.* | Midge | 2 | 1.9% |
| *Cricotopus sp.* | | 1 | 1.0% |
| *Polypedilum flavum* | | 46 | 44.7% |
| *Polypedilum illinoense gr.* | | 2 | 1.9% |
| *Rheotanytarsus exiguus gr.* | | 39 | 37.9% |
| *Thienemanniella sp.* | | 1 | 1.0% |
| *Thienemannimyia gr. sp.* | | 2 | 1.9% |
| Total | | 103 | 100.0% |
| Total Number of Taxa | | 11 | |

2016 Vensel Creek Summer Index Period

| Genus | Common Class | 2/24/2017 | |
|---|---|---|---|
| | | Count | % |
| *Caenis sp.* | Squaregilled Mayfly | 4 | 3.7% |
| *Fallceon quilleri* | Minnow Mayfly | 5 | 4.7% |
| *Chimarra sp.* | Fingernet Caddisfly | 1 | 0.9% |
| *Argia sp.* | Narrowwinged Damselfly | 2 | 1.9% |
| *Cricotopus sp.* | Midge | 6 | 5.6% |
| *Cricotopus/Orthocladius sp.* | | 6 | 5.6% |
| *Dicrotendipes sp.* | | 1 | 0.9% |
| *Microsectra sp.* | | 3 | 2.8% |
| *Orthocladius sp.* | | 48 | 44.9% |
| *Polypedilum flavum* | | 15 | 14.0% |
| *Polypedilum illinoense gr.* | | 2 | 1.9% |
| *Polypedilum sp.* | | 1 | 0.9% |
| *Rheotanytarsus exiguus gr.* | | 1 | 0.9% |
| *Thienemannimyia gr. sp.* | | 9 | 8.4% |
| *Nais sp.* | Aquatic Worm | 2 | 1.9% |
| *Hyalella sp.* | Scud | 1 | 0.9% |
| Total | | 107 | 100.0% |
| Total Number of Taxa | | 16 | |

2017 Vensel Creek Winter Index Period

| Genus | Common Class | 8/28/2017 | |
|---|---|---|---|
| | | Count | % |
| *Fallceon sp.* | Minnow Mayfly | 3 | 2.4% |
| *Cheumatopsyche* sp. | Netspinner Caddisfly | 6 | 4.9% |
| *Chimarra sp.* | Fingernet Caddisfly | 8 | 6.5% |
| *Hydroptila sp.* | Micro Caddisfly | 3 | 2.4% |
| *Chironomus sp.* | Midge | 2 | 1.6% |
| *Cricotopus bicinctus gr.* | | 3 | 2.4% |
| *Cricotopus sp.* | | 4 | 3.3% |
| *Dicrotendipes neomodestus* | | 24 | 19.5% |
| *Dicrotendipes sp.* | | 1 | 0.8% |
| *Orthocladius (Symposiocladius) lignicola* | | 1 | 0.8% |
| *Polypedilum flavum* | | 20 | 16.3% |
| *Polypedilum illinoense gr.* | | 14 | 11.4% |
| *Pseudochironomus sp.* | | 2 | 1.6% |
| *Rheotanytarsus exiguus gr.* | | 20 | 16.3% |
| *Tanytarsus sp.* | | 1 | 0.8% |
| *Thienemanniella sp.* | | 4 | 3.3% |
| *Atrichopogon sp.* | Biting Midge | 3 | 2.4% |
| *Limonia sp.* | Crane Fly | 1 | 0.8% |
| *Stratiomyidae* | Soldier Fly | 1 | 0.8% |
| *Petrophila sp.* | Snout Moth | 1 | 0.8% |
| *Hygrobates sp.* | Water Mite | 1 | 0.8% |
| Total | | 123 | 100.0% |
| Total Number of Taxa | | 21 | |

2017 Vensel Creek Summer Index Period

| Genus | Common Class | 2/15/2018 | |
|---|---|---|---|
| | | Count | % |
| *Caenis sp.* | Squaregilled Mayfly | 11 | 9.6% |
| *Fallceon sp.* | Minnow Mayfly | 2 | 1.8% |
| *Cheumatopsyche sp.* | Netspinner Caddisfly | 3 | 2.6% |
| *Chimarra sp.* | Fingernet Caddisfly | 8 | 7.0% |
| *Argia sp.* | Narrowwinged Damselfly | 2 | 1.8% |
| *Brillia sp.* | Midge | 1 | 0.9% |
| *Cricotopus bicinctus gr.* | | 4 | 3.5% |
| *Cricotopus/Orthocladius sp.* | | 4 | 3.5% |
| *Cryptochironomus sp.* | | 1 | 0.9% |
| *Dicrotendipes sp.* | | 1 | 0.9% |
| *Hydrobaenus sp.* | | 1 | 0.9% |
| *Orthocladius sp.* | | 3 | 2.6% |
| *Paratanytarsus sp.* | | 2 | 1.8% |
| *Polypedilum flavum* | | 10 | 8.8% |
| *Polypedilum illinoense gr.* | | 2 | 1.8% |
| *Rheotanytarsus exiguus gr.* | | 10 | 8.8% |
| *Tanytarsus sp.* | | 3 | 2.6% |
| *Thienemanniella sp.* | | 25 | 21.9% |
| *Thienemannimyia gr. sp.* | | 13 | 11.4% |
| *Caloparyphus/Euparyphus sp.* | Soldier Fly | 1 | 0.9% |
| *Petrophila sp.* | Snout Moth | 1 | 0.9% |
| *Oribatei* | Beetle Mite | 1 | 0.9% |
| tubificoid w/o cap setae | Aquatic Worm (Bald) | 4 | 3.5% |
| Corbiculoidea | Asian Freshwater | 1 | 0.9% |
| Total | | 114 | 100.0% |
| Total Number of Taxa | | 24 | |

2018 Vensel Creek Winter Index Period

Table 128 – Benthic macroinvertebrate counts for Vensel Creek summer and winter index periods

**16.3 Primary Body Contact -** The data collected on *E. coli* and *Enterococcus* concentrations show that Vensel Creek is impaired for both *E. coli* and *Enterococcus*. The number of samples collected exceeds the number of samples required. While the MS4 permit requires monthly sampling of bacteria, water quality standards only pertain to samples collected during the recreational period.

| Parameter | Sample Geometric Mean (MPN/100mL) | Single Sample (MPN/100mL) | Water Quality Standard (MPN/100mL) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| *E. coli* | 311 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| *Enterococcus* | 343 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |

Table 129 – *E. coli* and *Enterococcus* totals for Vensel Creek

Figure 26 - *E. coli* Concentrations for Vensel Creek

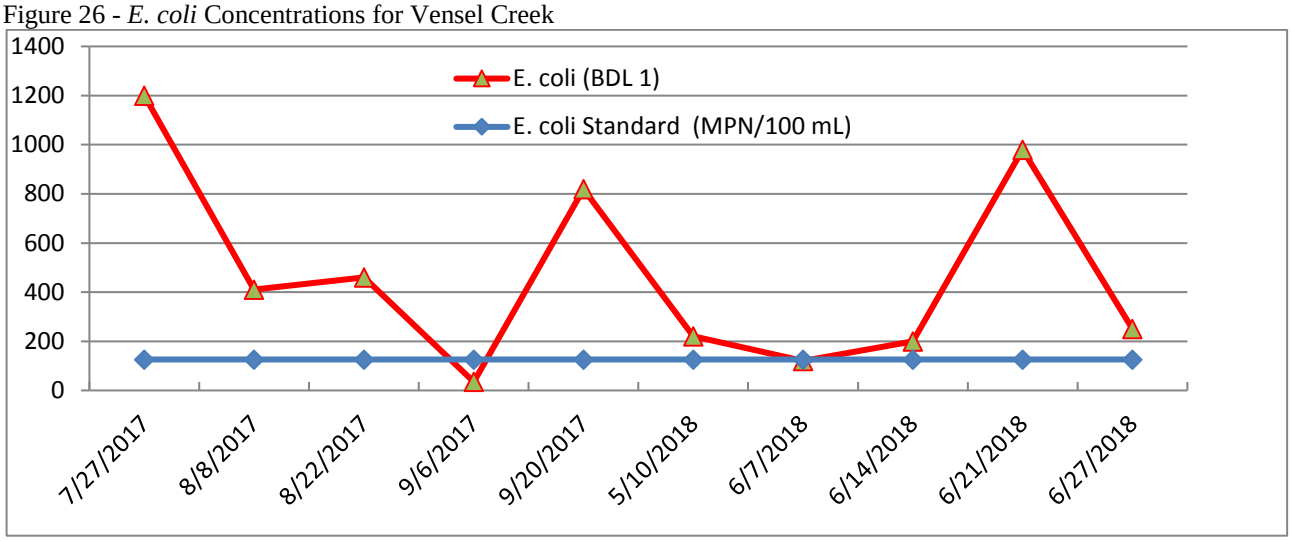
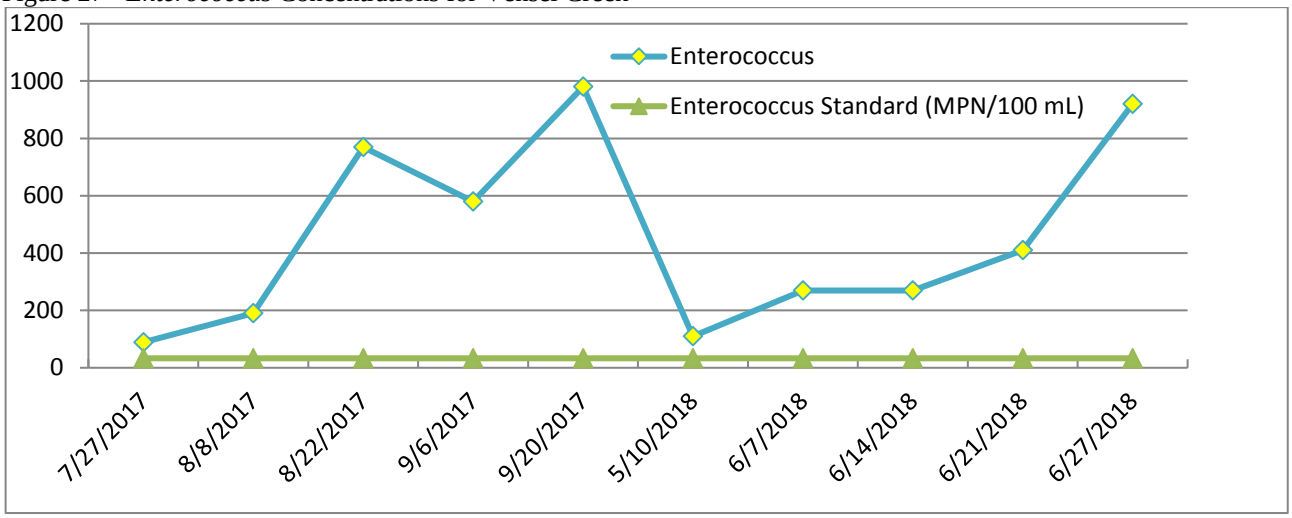



Figure 27 - *Enterococcus* Concentrations for Vensel Creek



## 16.4 Anti-Degradation Policy

**16.4.1** Nutrients - Analytical results for Total Phosphorus and Nitrate/Nitrite show no need for further investigation to show support of the beneficial use. The number of samples collected exceeds the number of required samples, and less than 10% of samples exceeded the threshold for further sampling. While Nitrate/Nitrite concentrations have an action level, it is not a required parameter within the MS4 permit (ODEQ, OPDES Permit OKS000201, 2011).

| Parameter | Sample Mean (mg/L) | Single Sample (mg/L) | Water Quality Threshold (mg/L) | No. of Samples | No. of Samples Required (WQS) | How Standard is Violated |
|---|---|---|---|---|---|---|
| Total Phosphorus | 0.05 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| Nitrite - Nitrate | 0.29 | na | 4.95 | 12 | 10 | No more than 10% of samples outside range |

Table 130 – Nutrient totals for Vensel Creek

## 17.0 SUMMARY

Analytically, Vensel Creek does not reflect any water quality impacts to the stream during the year of sampling with the exception of bacteria. Fish collections reflected an impaired classification according to water quality standards. A lack of intolerant species prevents full support; however an increase in species diversity would also be beneficial. A disappointing benthic macroinvertebrate IBI score for 3 out of the 4 index periods could also be related to the lack of intolerant species which prevents support of the beneficial use. The higher than average habitat assessment score is encouraging and future sampling may show improvements in fish and macroinvertebrate scores.

Table 131 – Oklahoma Water Quality Standards summary of collected data for Vensel Creek

| Vensel | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Sample Mean** | **Single Sample** | **Water Quality Standard** | **No. of Samples** | **No. of Samples Required (WQS)** | **How Standard is Violated** |
| Cadmium (µg/L) | 0.38 | 0.50 | Acute: 102.36, Chronic: 2.46 | 12 | 5 | Acute: No more than one sample concentration exceeding WQS Chronic: No more than one sample or 10% exceeding |
| Copper (µg/L) | 1.83 | 8.87 | Acute: 48.56, Chronic: 29.69 | 12 | 5 | |
| Lead (µg/L) | 0.38 | 0.50 | Acute: 286.15, Chronic: 11.15 | 12 | 5 | |
| Zinc (µg/L) | 10.51 | 23.50 | Acute: 269.64, Chronic: 244.23 | 12 | 5 | |
| Diazinon (µg/L) | 0.15 | na | Acute: 0.17 | 12 | 5 | |
| E. coli (MPN/100ml) | 311 | na | 126 | 10 | 5 | Geometric mean not exceeding standard |
| Enterococcus (MPN/100ml) | 343 | na | 33 | 10 | 5 | Geometric mean not exceeding standard |
| Oil and Grease (visual) | None | na | No visible sheen | 12 | 10 | No more than 10% of observations with oil & grease |
| Total Phosphorus (mg/L) | 0.05 | na | 0.24 | 12 | 10 | No more than 10% of samples outside range |
| *Nitrite – Nitrate (mg/L)* | *0.29* | *na* | *4.95* | *12* | *10* | *No more than 10% of samples outside range* |
| Total Dissolved Solids (mg/L) | 388 | 570 | Sample: 1868, Yearly: 1496 | 12 | 10 | Mean of samples not exceeding yearly standard & no more than 10% exceeding sample standard |
| pH (s.u.) | 7.1 – 7.8 | na | 6.5-9.0 | 12 | 10 | No more than 10% of samples outside range |
| *D.O. (mg/L)* | *0 samples below 6.0* | *na* | *April 1-June 15: 6.0* | *3* | *10 total* | *No more than 10% of samples outside range* |
| | *0 samples below 5.0* | *na* | *June 16-Mar 31.: 5.0* | *9* | | |

*Analytes in italics not required by permit
*Analytes in red exceed standards*

| Analyte | Result | | |
|---|---|---|---|

| | Minimum | Mean | Maximum | Number of Samples | Number of Attempts |
|---|---|---|---|---|---|
| Oxygen Demand, 5-Day Biological (mg/L)(DL 3.0 mg/L) | -- | 3.0 | 3.2 | 12 | 12 |
| Cadmium, Total (µg/L) (DL 0.5 µg/L) | -- | 0.38 | 0.50 | 12 | 12 |
| Coliform, Fecal (CFU/100 mL)(DL 1 CFU/100 mL) | -- | 210 | 2500 | 12 | 17 |
| Conductivity µS | -- | 562 | 811 | 12 | 12 |
| Copper, Total (µg/L) (DL 0.5 µg/L) | -- | 1.83 | 8.87 | 12 | 12 |
| Diazinon (µg/L) (DL 0.17-5.0 µg/L) | -- | 0.15 | 0.17 | 12 | 12 |
| Dissolved Oxygen (mg/L) | 5.06 | 10.61 | 18.84 | 12 | 12 |
| *E. coli* (MPN/100 mL) (DL 1 MPN/100 mL) | -- | 214 | 1200 | 12 | 17 |
| *Enterococcus* (MPN/100 mL)(DL 1 CFU/100 mL) | -- | 153 | 980 | 12 | 17 |
| Flow (cfs) | 0.13 | 0.36 | 1.00 | 12 | 12 |
| Hardness, Total (mg/L) (DL 3.6 mg/L) | 120 | 244 | 320 | 12 | 12 |
| Lead, Total (µg/L) (DL 0.5 µg/L) | -- | 0.38 | 0.50 | 12 | 12 |
| Nitrogen, Total Kjeldahl (mg/L)(DL 0.50 mg/L) | -- | 0.81 | 2.90 | 12 | 12 |
| Nitrogen, Nitrate-Nitrite (mg/L) (DL 0.2 mg/L) | -- | 0.29 | 0.52 | 12 | 12 |
| Nitrogen, Total as Nitrogen (mg/L)(DL 0.50 mg/L) | -- | 0.94 | 2.90 | 12 | 12 |
| Oil and Grease (mg/L) (DL 6.0-6.5 mg/L) | -- | 9.01 | 33.00 | 12 | 12 |
| Oxygen Demand, Chemical (mg/L)(DL 20 mg/L) | -- | 20 | 22 | 12 | 12 |
| pH (su) | 7.07 | 7.36 | 7.80 | 12 | 12 |
| Phosphorus, Total (mg/L) (DL 0.010 mg/L) | -- | 0.05 | 0.08 | 12 | 12 |
| Phosphorus, Dissolved (mg/L) (DL 0.010 mg/L) | -- | 0.03 | 0.09 | 12 | 12 |
| Solids, Total Dissolved (mg/L) (DL 10 mg/L) | -- | 388 | 570 | 12 | 12 |
| Solids, Total Suspended (mg/L) (DL 2.0 mg/L) | -- | 6.20 | 14.00 | 12 | 12 |
| Temperature, Water (°C) | 2.27 | 16.14 | 26.73 | 12 | 12 |
| Turbidity | -- | 8.40 | 18.70 | 12 | 12 |
| Zinc, Total (µg/L) (DL 10 µg/L) | -- | 10.51 | 23.50 | 12 | 12 |
| Results found to be below the detection limit are reported as the detection limit | | | | | |

Table 132 – MS4 permit required analytical sampling parameters result summaries for Vensel Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/20/17 | 8/21/17 | 9/20/17 | 10/17/17 | 11/21/17 | 12/6/17 | 1/18/18 | 2/14/18 | 3/20/18 | 4/17/18 | 5/10/18 | 6/26/18 |
| BOD(5) Day (BDL 3) mg/L | 3.2 | 3.0 | 3.1 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |
| Cadmium, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.001 | 0.001 | 0.001 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Conductivity µS | 600 | 649 | 339 | 473 | 599 | 520 | 503 | 571 | 556 | 683 | 811 | 442 |
| Copper, Total (BDL 0.5) µg/L | 1.21 | 2.38 | 4.06 | 0.005 | 0.005 | 0.005 | 0.833 | 0.746 | 1.14 | 0.789 | 1.93 | 8.87 |
| Diazinon (BDL 0.17) µg/L | 0.17 | 0.17 | 0.10 | 0.10 | 0.10 | 0.10 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 |
| Dissolved Oxygen mg/L | 5.66 | 6.72 | 7.07 | 10.58 | 9.07 | 10.81 | 18.84 | 12.53 | 12.72 | 12.66 | 13.56 | 7.08 |
| Flow CFS | 0.26 | 1.00 | 0.20 | 0.29 | 0.32 | 0.18 | 0.20 | 0.13 | 0.42 | 0.53 | 0.43 | 0.32 |
| Hardness, Total (BDL 3.6) mg/L | 220 | 220 | 120 | 200 | 300 | 270 | 310 | 290 | 240 | 280 | 320 | 160 |
| Lead, Total (BDL 0.5) µg/L | 0.50 | 0.50 | 0.50 | 0.0005 | 0.0005 | 0.0005 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L | 0.52 | 0.65 | 0.70 | 0.53 | 0.75 | 0.50 | 0.61 | 0.50 | 2.90 | 0.93 | 0.53 | 0.62 |
| Nitrogen, Nitrate-Nitrite (BDL 0.2) mg/L | 0.20 | 0.34 | 0.27 | 0.50 | 0.20 | 0.20 | 0.52 | 0.20 | 0.20 | 0.20 | 0.20 | 0.41 |
| Nitrogen, Total as N (BDL 0.5) mg/L | 0.52 | 0.65 | 0.95 | 1.00 | 0.75 | 0.50 | 1.10 | 0.50 | 2.90 | 0.93 | 0.53 | 1.00 |
| Oil and Grease HEM (BDL 6) mg/L | 6.6 | 33.0 | 6.7 | 7.5 | 6.7 | 6.3 | 6.6 | 7.2 | 7.0 | 6.9 | 7.2 | 6.4 |
| Oxygen Demand, Chemical (BDL 20) mg/L | 20 | 20 | 20 | 20 | 20 | 22 | 20 | 20 | 20 | 20 | 20 | 20 |
| pH (s.u.) | 7.31 | 7.55 | 7.30 | 7.44 | 7.14 | 7.31 | 7.33 | 7.07 | 7.25 | 7.42 | 7.34 | 7.80 |
| Phosphorus, Total (BDL 0.010) mg/L | 0.027 | 0.054 | 0.084 | 0.044 | 0.055 | 0.056 | 0.065 | 0.058 | 0.033 | 0.037 | 0.042 | 0.061 |
| Phosphorus, Total Dissolved BDL (0.010) mg/L | 0.019 | 0.029 | 0.055 | 0.021 | 0.019 | 0.019 | 0.016 | 0.013 | 0.010 | 0.011 | 0.016 | 0.086 |
| Solids, Total Dissolved (BDL 10) mg/L | 390 | 370 | 200 | 310 | 450 | 380 | 470 | 440 | 370 | 440 | 570 | 260 |
| Solids, Total Suspended (BDL 2.0) mg/L | 2.0 | 7.0 | 6.2 | 2.0 | 8.7 | 6.8 | 8.0 | 6.8 | 3.2 | 6.5 | 3.2 | 14.0 |
| Temperature, Water °C | 26.73 | 26.50 | 25.52 | 14.94 | 10.39 | 8.00 | 2.27 | 7.63 | 10.70 | 14.55 | 22.30 | 24.09 |
| Turbidity (NTU) | 3.79 | 4.15 | 6.66 | 3.96 | 7.13 | 11.20 | 12.80 | 11.80 | 5.87 | 10.10 | 4.64 | 18.70 |
| Zinc, Total (BDL 10) µg/L | 16.3 | 19.0 | 23.5 | 0.015 | 0.013 | 0.008 | 10.0 | 10.0 | 10.0 | 10.0 | 12.6 | 14.7 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 133 – Complete analytical sampling results for all parameters for Vensel Creek

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 7/26/17 | 8/21/17 | 8/22/17 | 9/6/17 | 9/20/17 | 10/17/17 | 11/21/17 | 12/6/17 | 1/18/18 | 2/14/18 | 3/20/18 | 4/17/18 |
| Coliform, Fecal CFU/100mL | 1200 | 560 | 340 | 53 | 1210 | 340 | 3 | 130 | 47 | 92 | 250 | 200 |
| *E. coli* (BDL 1) MPN/100mL | 1200 | 410 | 460 | 35 | 820 | 370 | 15 | 1000 | 100 | 71 | 190 | 68 |
| *Enterococcus* (BDL 1) MPN/100 mL | 89 | 190 | 770 | 580 | 980 | 180 | 43 | 96 | 4 | 21 | 120 | 80 |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

| ANALYTE | Date Sampled | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5/10/18 | 6/7/18 | 6/14/18 | 6/21/18 | 6/27/18 | | | | | | | |
| Coliform, Fecal CFU/100mL | 130 | 140 | 560 | 2500 | 270 | | | | | | | |
| *E. coli* (BDL 1) MPN/100mL | 220 | 120 | 200 | 980 | 250 | | | | | | | |
| *Enterococcus* (BDL 1) MPN/100 mL | 110 | 270 | 270 | 410 | 920 | | | | | | | |
| Results found to be below the detection limit are reported as the detection limit | | | | | | | | | | | | |

Table 134 – Complete analytical results for bacteria samples for Vensel Creek

# 18.0 REFERENCES

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# Section 5

## Annual Expenditures for the Reporting Period/Budget for the Year Following Each Annual Report

| **City of Tulsa** | | |
|---|---|---|
| * FY 2017/2018 reflects migration to ERP system | **FY 2017/2018 Actual** | **FY 2018/2019 Budget** |
| Section Name | | |
| Warehouse | 18,679 | 21,835 |
| Customer Care | 154,532 | 206,435 |
| Security (Direct charge fund 7010) | 53,943 | 62,837 |
| Asset Management Admin | 10,603 | 7,444 |
| Security | 177,123 | 217,255 |
| Building Operations – Administration | 1,754 | 1,824 |
| Building Operations – Contracts | 2,681 | 2,806 |
| Building Maintenance | 33,235 | 32,516 |
| Custodial Services | 11,237 | 11,400 |
| IT Capital Direct Charges | - | 36,000 |
| Engineering Services Administration | 96,056 | 80,825 |
| Engineering Administration – Stormwater | 299,901 | 594,299 |
| Reproduction changed to Central Services | 162,104 | 214,314 |
| Design Services – Administration | 33,359 | 34,028 |
| Design | 665,981 | 797,384 |
| Hydrology and Hydraulics | 1,516 | 46,496 |
| Alert System | 46,698 | 78,210 |
| Field Engineering – Administration | 41,281 | 45,983 |
| Construction Inspection | 492,702 | 543,729 |
| Call OKIE – Encroachments | 61,984 | 60,565 |
| Field Surveys | 122,435 | 161,044 |
| Planning and Project Management Administration | 62,144 | 63,590 |
| Project Management | 23,090 | 27,323 |
| Infrastructure Management | 69,194 | 121,289 |
| Graphics / CADDS | 240,634 | 254,068 |
| Floodplain Management | 2,073,008 | 2,602,984 |
| Planning Stormwater/General | 101,386 | 112,945 |
| Engineering Graphics | 51,519 | 62,042 |
| Right of Way | 95,487 | 123,496 |
| Streets & Stormwater – Administration | 121,146 | 139,990 |
| SS Payroll & Accts Payable | 14,675 | 22,378 |
| SS – Stormwater Fund | 3,694,729 | 3,906,147 |
| Stormwater & Land Management Admin | 884,953 | 979,453 |

| | | |
|---|---|---|
| Detention, Ditch, Concrete Channel | 1,682,018 | 1,786,392 |
| Channel Maintenance and Ditching | 1,719,678 | 2,611,666 |
| Storm Sewer Maintenance | 2,854,573 | 2,988,397 |
| Stormwater Quality | 1,195,383 | 1,296,421 |
| Stormwater Vegetation | 2,429,492 | 2,522,816 |
| Household Pollutant Collection | 57,443 | 44,460 |
| Stormwater Roadside Mowing | 471,316 | 500,302 |
| STREET MAINT & INSPECTIONS - ADMIN | 132,205 | 139,328 |
| STREET MAINTENANCE -- PATCHING | 777,925 | 818,603 |
| Paving Cut Administration | 29,815 | 66,986 |
| Street Sweeping | 1,041,537 | 1,576,716 |
| Water and Sewer Admin. | 19,602 | 19,258 |
| Water & Sewer Dept. – Stormwater | 41,908 | 113,083 |
| Quality Assurance – Administration | 4,002 | 8,581 |
| Quality Assurance – Operations Support | 346 | 1,785 |
| Laboratories | 73,960 | 82,516 |
| Distribution Systems - Administration | 17,873 | 14,242 |
| Field Cust. Serv. Rep. I (Meter Reading) | 58,699 | 69,226 |
| Field Cust. Serv. Rep. II (Meter Turn On/Off) | 5,437 | - |
| Sewer O & M – Admin | 69,423 | 79,032 |
| Lift and Pump Stations | 243,230 | 287,535 |
| General Site Services changed to P&R Fac Sys Land & Gen Maint | 130,792 | 301,710 |
| Horticulture changed to P&R Uti Svs Horticulture | 53,951 | 147,843 |
| Utilities Administration | 564,500 | 555,869 |
| IT Administration | 16,882 | 19,697 |
| IT Operations | 153,888 | 159,351 |
| IT Client Services | 135,049 | 157,793 |
| Sewer O & M – Support Services / Dispatch | 12,648 | 6,045 |
| Total | 23,449,556 | 28,048,587 |

# Section 6

# A Summary of Enforcement Actions, Inspections, and Public Education

## A. Enforcement Actions

It is the philosophy of the City of Tulsa to bring responsible parties into compliance through education prior to initiating any enforcement action. Enforcement actions are taken only when deemed necessary to ensure permit compliance.

During this reporting period 238 investigations were conducted identifying 17 illicit discharges to the storm sewers. Title 11-A Chapter 5 (Pollution Ordinance) was adopted November 1995 and continues to be utilized for the removal of non-storm water discharges (see Section 6). This Ordinance allows the City of Tulsa to recover cleanup cost from the responsible party.

A summary of the investigations conducted by the Stormwater Management Division are as follows:

| Number of Investigations | Description of Investigations |
|---|---|
| **20** | Construction (relating to construction site potential violations) |
| **16** | Hazmat (relating to potential discharges of pollutants from fire department responses involving the hazardous materials unit) |
| **238** | Stormwater (relating to potential releases of pollutants to the storm sewer or violations of the pollution ordinance) |
| **11** | Drug Labs (relating to the potential release of pollutants from drug lab remediation to the storm sewer or violations of the pollution ordinance) |
| **285** | Total number of investigations for this reporting year |

- Construction Site – Erosion Control
    - The Stormwater Management Division conducted 1,809 construction site inspections resulting in 14 enforcement actions. These actions consisted of issuing a notice of violation that may involve fines and cost recovery. The total amount of fines and penalties collected was $400.
- Industrial, Commercial and Residential Sites
    - Tulsa continued to use the Industrial and High Risk Runoff program to identify, monitor and control pollutants from municipal landfills; treatment, storage and disposal facilities for municipal waste; facilities subject to EPCRA Title III, Section 313 reporting requirements; and any other industrial or commercial discharge the City determined had the potential to contribute substantial pollutant loading to the City's storm sewer system. This program contains procedures for inspecting, monitoring and controlling pollution from the aforementioned sources. A database of industrial storm water sources discharging to the City's storm sewer continues to be maintained. During this reporting period, 481 industrial stormwater inspections were conducted. Five enforcement actions were taken against industries or facilities in order to eliminate illegal or illicit discharges. $450 in fines were levied during this fiscal year.

## B. Inspections

The following is a summary of inspections that were conducted during this reporting period. These inspections were previously mentioned in other sections of this report.

Sewer Operations Maintenance and SLM conducted the following:

- Sanitary sewer lines TV inspected – 161.5 miles

SLM conducted the following inspections:

- Storm sewer lines inspected – 7.2 miles
- Industrial and commercial storm water runoff inspections – 481
- Construction site erosion control inspections – 1,809

Development Services conducted the following number of inspections:

- 1,301 construction site inspections were conducted with attention on erosion controls measures.

Engineering Services conducted the following inspections:

- Daily inspections at construction projects (195 city and privately funded Infrastructure Development Process (IDP) projects).

## C. Public Education Programs

The public education programs utilized by the City of Tulsa have been described in Section 1 of this report. The City of Tulsa understands that public education plays a major role in reducing non-point source pollution and improving stormwater runoff quality. Tulsa believes that it is better to prevent non-point source pollution at the source through education than to control it after it is generated. Many educational programs used by the City of Tulsa to meet permit requirements are completed through the cooperative efforts of other groups, such as The M.e.t. and the Tulsa County Conservation District, as well as various City of Tulsa departments. Through activities such as educational events, presentations, school visits, summer day camps, conferences, television/radio commercials, billboards etc. education material was viewed approximately 2,734,243 times during this reporting period. See below for more information on Tulsa's Public Education Program's.

Attachment A "Public Education 2017-2018" lists the educational material distributed during this reporting period by the City of Tulsa.

Attachment B "Education Events 2017-2018" lists the educational activities performed during this period by the City of Tulsa.

Attachment C "Children's Education Activities 2017-2018" lists various educational activities performed for children's groups.

Attachment A: Education Materials Distributed or Used in FY 17/18

| | Illicit Discharges | Animal Waste | Antifreeze | Motor Oil | Paint | Fertilizer | Pesticides | LID | Compost | Yard Waste | Erosion | Floatables | Master Gardener | HHPCF | Customer Care Line/website | # Distributed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| General Brochure | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | 1251 |
| Pet Waste | X | X | | | | | X | | | | | | | | X | 983 |
| Pesticides | X | | | | | X | X | | | | | X | X | X | X | 692 |
| Motor Oil | X | | X | X | | | | | | | | | | X | X | 670 |
| Fertilizer | X | | | | | X | | | | | | | X | X | X | 684 |
| Pollution Prevention Plan | X | | | | | | | | | | | | | | X | 454 |
| Outside Washing | X | | X | X | | | | | | | | X | | | X | 117 |
| Car Wash | X | | X | X | | X | X | | | | | | | | X | 135 |
| Pool Water Disposal | X | | | | | | | | | | | | X | | X | 123 |
| Landscaping BMP | X | | | | | X | X | | | X | | | X | | X | 194 |
| Pond Maintenance BMP | X | | | X | | | | | | | X | X | | | X | 18 |
| Carpet Cleaning BMP | X | | | | | | | | | | | | | | X | 0 |
| Construction Brochure | X | | | | | | | | | | X | | | | X | 532 |
| HHPCF Brochure | X | | X | X | X | X | X | | | | | | | X | X | 972 |
| Enviroscape Activity | X | X | X | X | X | X | X | X | | | X | X | | X | | 3362 |
| Fish Prints Activity | X | X | | | | | | | | | | | | | | 400 |
| Fishing Poles | X | | | | | | | | | | | | | | | 381 |
| Rain Guages | X | | | | | | | | | | | | | | X | 796 |
| Pencils | X | | | | | | | | | | | | | | X | 693 |
| Educational Display | X | X | X | X | X | X | X | X | X | X | X | X | | X | X | 5,000 |
| Cups | | | | | | | | | | | | | | | X | 360 |
| Pet Waste Bags | | X | | | | | | | | | | | | | | 1288 |
| Pens | | | | | | | | | | | | | | | X | 2486 |
| Tattoos | | | | | | | | | | | | | | | | 720 |
| Seed Packets | X | | | | | X | X | | | | | | | | X | 1528 |
| SOS Tote Bags | | | | | | | | | | | | | | | X | 1681 |
| Total Materials | | | | | | | | | | | | | | | | 25520 |

Attachment B: Education Events FY 17/18

| Date | Event Name | Decription | # attended |
|---|---|---|---|
| 7/6/2017 | Sustainable Tulsa First Thursday | Educational Event for Sustainable Tulsa | 175 |
| 7/12/2007 | HBA Develpores Council | HBA Council for developers | 20 |
| 7/12/2017 | Grogg's Green Barn Camp | Dragonfly activity | 15 |
| 7/19/2017 | Drillers Bark in the Park | Event focusing on pet waste awareness | 4200 |
| 7/20/2017 | GCSA Employee Training | OKRO5 Training | 160 |
| 7/20/2017 | Internal Stormwater Certification | Inform employees about stormwater | 13 |
| 7/26/2017 | Builders Council | HBA Council for developers | 18 |
| 7/1/2017 | City Life | Save Our Streams article promoting Stormwater Quality | 400000 |
| 7/31/2017 | Internet facebook post | HHPCF post | 7995 |
| 8/3/2017 | Sustainable Tulsa First Thursday | Sustainable Tulsa First Thursday | 120 |
| 8/2/2017 | Drillers Bark in the Park | Event focusing on pet waste awareness | 4200 |
| 8/16/2017 | Drillers Bark in the Park | Event focusing on pet waste awareness | 4200 |
| 8/30/2017 | Drillers Bark in the Park | Event focusing on pet waste awareness | 4200 |
| 8/15/2017 | HHPCF Facbook Post | Post on Facebook about Paint and HHPCF disposal | 7995 |
| 8/12/2017 | Back to Shchool Event | Cox Media STEM sponsroed event Fish Tanks | 5000 |
| 8/19/2017 | Clear the Shelter | Event to clear the shelter of pets with TAW | 500 |
| 9/5/2017 | LID Landscape code update | Landscaping code meeting to help LID | 14 |
| 9/7/2017 | SS City Edu | Handed out Landscaping BMP | 4 |
| 9/11/2017 | LID PDM Saginaw Wharehouse | Predevelopment where LID is talked about | 12 |
| 9/11/2017 | LID PDM Saltgrass Steakhouse | Predevelopment where LID is talked about | 10 |
| 9/15/2017 | WIN Newsletter | Helping Promote Crow Creek Clean up | 30000 |
| 9/16/2017 | Crow Creek Clean up | Clean up for Adopt a watershed program | 15 |
| 9/18/2017 | Crow Creek  Clean up new media post | KTUL Newsclip on Crow Creek | 300000 |
| 9/18/2017 | LID OFMA Confernece | Jacob Spoke about Crow Creek project | 60 |
| 9/20/2017 | LID PDM OCC Meeting | Spoke about Crow Creek and LID to OCC | 20 |
| 9/21/2017 | STEM Allience Flight Night | Engineering prestenation for middle schoolers (fish tank) | 1200 |
| 9/23/2017 | Facebook Post | About Leaves and Grass | 8041 |
| 9/23/2017 | Monarch on the Mountain | Event to promote rain gardens and no use of chemicals | 1500 |
| 9/25/2017 | LID PDM Morelos Wharehouse | Predevelopment where LID is talked about | 12 |

| Date | Event Name | Decription | # attended |
|---|---|---|---|
| 9/26/2017 | KTUL Coverage of Chemical Spill | Spill of Sodium Hydroxide that can hurt fish down storm drain | 300000 |
| 10/8/2017 | Tulsa State Fair | State Fair where materials were distributed | 1150000 |
| 10/5/2017 | Sustainable Tulsa First Thursday | Educational Event for Sustainable Tulsa | 120 |
| 10/5/2017 | PPI Committee Meeting | Public informaiton meeting pertaining to stormwater | 11 |
| 10/5/2017 | TPS Earth Day Community event mtg | Planning for next event in 2018 and recap of last one | 6 |
| 10/9/2017 | Monarch on the Mountain Planning mtg | Planning for next event in 2018 and recap of last one | 12 |
| 10/11/2017 | Email about the PPI Monthly Message | Message to partners "storm drains are for Rain" | #REF! |
| 10/13/2017 | WIN Newsletter | Newsletter Storm Drains are for Rain | 29378 |
| 10/16/2017 | LID PDM Cooper Creek Subdivision | Predevelopment where LID is talked about | 12 |
| 10/16/2017 | LID PDM Elwood Villas | Predevelopment where LID is talked about | 13 |
| 10/18/2017 | National Community Planning Month | Guthrie Green event enviroscape, city event | 500 |
| 10/19/2017 | Crow Creek Planning Meeting | Crow Creek Discussion of upcoming events | 5 |
| 10/26/2017 | Internal Stormwater Certification | Inform employees about stormwater | 14 |
| 10/27/2017 | Internal Stormwater Certification | Inform employees about stormwater | 7 |
| 10/27/2017 | WIN Newsletter | HHPCF special event promoted | 29378 |
| 10/30/2017 | News Release for HHPCF Special Event | Details to news media of event | Unknown |
| 10/30/2017 | Internet facebook post | HHPCF special event promoted | 8134 |
| 10/31/2017 | From Brian Nutt Newsclips | HHPCF special event promoted | Unknown |
| 11/16/2017 | internal training Watershed Presentation | Meeting with engineering to go over results of watershed prgm | 7 |
| 11/6/2017 | LID PDM 51st St Storage | Predevelopment where LID is talked about | 12 |
| 11/6/2017 | LID PDM Utica Plaza East | Predevelopment where LID is talked about | 14 |
| 11/6/2017 | LID PDM Summit Pl | Predevelopment where LID is talked about | 12 |
| 11/2/2017 | Sustainable Tulsa First Thursday | Educational Event for Sustainable Tulsa | 125 |
| 11/2/2017 | PPI Committee Meeting | Public informaiton meeting pertaining to stormwater | 10 |
| 11/2/2017 | TPS Earth Day Community event mtg | Planning for next event in 2018 and recap of last one | 5 |
| 11/4/2017 | HHPCF Special Collection Event | Collected expaneded list of items | 250 |
| 11/5/2017 | Project Wet Training | Training for Julie to administar and expanded program offerings | 6 |
| 11/6/2017 | Training with Blue Thumb | Helped Blue Thumb present Project Wet programs at St Mary's | 107 |
| 11/7/2017 | Pest Waste meeting with TAW | Met w/Jean Letcher, 2 dogs & a bird, to discuss pet waste issues | 5 |
| 11/7/2017 | OKAEE Board Conference Call | Board Meeting to discuess Environmental Education Expo | 12 |
| 11/16/2017 | YMCA Redesigne Planning Panel | Met with YMCA to discuss upcoming renovation, LID | 21 |
| 11/28/2017 | Stormwate Certification Syllabus meeting | Approval of syllabus for stormwatere certification | 4 |
| 11/30/2017 | Sustainable Tulsa B2B | Education event to discuss environmental issues | 75 |

| Date | Event Name | Decription | # attended |
|---|---|---|---|
| 12/19/2017 | SDHMAB Meeting | Stormwater Board Meeting | 12 |
| 1/8/2018 | LID PDM OSU Medical Center | Predeveleopment Meeting with LID promotion | 10 |
| 1/8/2018 | LID PDM Fiesta Pools | Predeveleopment Meeting with LID promotion | 10 |
| 1/16/2018 | Stormwater Hazard Mitigation Board meeting | Stromwater board meeting | 19 |
| 1/22/2018 | LID PDM Quik Trip | Predeveleopment Meeting with LID promotion | 10 |
| 2/19/2018 | LID PDM Gilcrease Development | Predeveleopment Meeting with LID promotion | 10 |
| 2/19/2018 | LID PDM Quik Trip | Predevelopment Meeting with LID promotion | 10 |
| 2/20/2018 | SDHMAB Meeting | Stormwater Board Meeting | 15 |
| 2/23/2018 | Natural Resources Conference | Stormwater Quality Presentation | 311 |
| 2/23/2018 | Natural Resources Conference | Stormwater Quality Presentation | 311 |
| 2/26/2018 | LID PDM Cedar Ridge South 75 Storage | Predevelopment Meeting with LID promotion | 10 |
| 2/28/2018 | Stormwater Operator Certification | Stormwater Training for City of Tulsa employees | 14 |
| 3/1/2018 | City Life | Article promoting the HHPCF and Tulsa Master Gardeners | 400000 |
| 3/5/2018 | LID PDM S&A Concrete | Predevelopment Meeting with LID promotion | 8 |
| 3/5/2018 | LID PDM Tulsa Educare | Predevelopment Meeting with LID promotion | 8 |
| 3/8/2018 | HBA Home and Garden Show | City of Tulsa Public Educaton Show Booth | 25000 |
| 3/19/2018 | LID PDM Woodland Valley | Predevelopment Meeting with LID promotion | 14 |
| 3/19/2018 | LID PDM Stratford Ridge | Predevelopment Meeting with LID promotion | 14 |
| 3/21/2018 | Stormwater Operator Certification | Stormwater Training for City of Tulsa employees | 7 |
| 3/24/2018 | HHPCF Special Collection Event | Special event accepting electronics, medicine and ammo | 332 |
| 3/26/2018 | LID PDM | Predevelopment Meeting with LID promotion | 14 |
| 3/26/2018 | LID PDM | Predevelopment Meeting with LID promotion | 14 |
| 3/28/2018 | ORU SWQ Presentation | General Stormwater Quality Presentation | 12 |
| 3/31/2018 | TCC Ecofest | Event celebrating nature at TCC Northeast Campus | 400 |
| 4/4/2018 | Tulsa Roughnecks Bark in the Park | Bark in the Park event booth | 100 |
| 4/16/2018 | COT Engineering Training | Internal training for engineering inspectors | 50 |
| 4/17/2018 | SDHMAB Meeting | Stormwater Board Meeting | 15 |
| 4/18/2018 | Guthrie Green Eviro Expo | Table set up at Environmetnal Expo promoting SWQ | 1200 |
| 4/27/2018 | Earth Day Celebrate Community Event | Earth Day Education Event at Tulsa University | 1500 |
| 4/28/2018 | City Fest | Archer Park City Fest | 25 |
| 4/30/2018 | LID PDM Sandy Silman | Predeveleopment Meeting with LID promotion | 16 |
| 5/9/2018 | Tulsa Roughnecks Bark in the Park | Bark in the Park event booth | 100 |
| 5/15/2018 | SDHMAB Meeting | Stormwater Board Meeting | 15 |

| Date | Event Name | Decription | # attended |
|---|---|---|---|
| 5/17/2018 | Drillers Go Green Night | Tulsa Drillers Go Green Game booth | 2000 |
| 5/19/2018 | Annual Creek Clean-Up | Joe Creek Clean-Up | 25 |
| 5/20/2018 | City Fest | Hicks Park City Fest | 200 |
| 5/30/2018 | Tulsa Drillers Bark in the Park | Bark in the Park event booth | 1500 |
| 5/30/2018 | State Farm Insurance Facility | Litter Education | 400 |
| 6/18/2018 | LID PDM Nelson Tunnel Car Wash | Predeveleopment Meeting with LID promotion | 10 |
| 6/4/2018 | LID PDM Green Country Cohousing | Predeveleopment Meeting with LID promotion | 10 |
| 6/11/2018 | LID PDM Speedy Splash | Predeveleopment Meeting with LID promotion | 10 |
| 6/14/2018 | Tulsa Drillers Bark in the Park | Bark in the Park event booth | 2500 |
| 6/26/2018 | SDHMAB Meeting | Stormwater Board Meeting | 15 |
| 6/30/2018 | Facebook posts | Various Stormwater Quality messages | 79515 |
| 6/30/2018 | Instagram posts | Various Stormwater Quality messages | 26289 |
| 6/30/2018 | Twitter | Various Stormwater Quality messages | 1701000 |
| Totals | | | 4,541,014 |

Attachment C: Tulsa Kids Education FY 17/18

| Date | Event | Attended | Attended |
|---|---|---|---|
| 7/12/2017 | Grogg's Green Barn Camp | Dragonfly activity | 15 |
| 8/12/2017 | Back to Shchool Event | Cox Media STEM sponsroed event Fish Tanks | 5000 |
| 9/21/2017 | STEM Allience Flight Night | Engineering prestenation for middle schoolers (fish tank) | 1200 |
| 3/31/2018 | TCC Ecofest | Event celebrating nature at TCC Northeast Campus | 400 |
| 4/27/2018 | Earth Day Celebrate Community Event | Earth Day Education Event at Tulsa University | 1,500 |
| Total | | | 8115 |

# Section 7

# Identification of Water Quality Improvements or Degradation

No water quality improvements or degradation were noted during this reporting period. The City of Tulsa has preliminarily identified some factors that appear to be negatively influencing the health of Tulsa's streams. We are also developing a baseline condition which will allow us to better determine improvements or degradation in water quality. Additional personnel recently added have begun to give further insight into the precise reasons behind water quality degradation and will be reported on in the future.

# Section 8
# Watershed Characterization Program

In accordance with MS4 Permit #OKS000201 requirement Part IV(C)(8) the City of Tulsa submitted the Comprehensive Assessment of the Watershed Characterization Project in the FY 2014-2015 Annual Report.

# Section 9
# Co-permittee Reports

# Appendix A

## Oklahoma Department of Transportation

## Annual Report

For Reporting Period:
July 1, 2017 through June 30, 2018

Oklahoma Department of Transportation

August 28, 2018

Roy Teeters, Storm Water & Land Management Division Manager
Department of Streets and Storm Water
City of Tulsa
4502 S. Galveston Ave.
Tulsa, OK 74107

Attention: Jacob Hagen

Dear Mr. Hagen:

Enclosed is the Oklahoma Department of Transportation portion of the Fiscal Year 2018 Annual Report to be submitted to the Oklahoma Department of Environmental Quality in accordance with the Tulsa Municipal Separate Storm Sewer System (MS4) Permit Number OKS000201. This report covers the period from July 1, 2017 through June 30, 2018.

Please provide this office with one copy of the Annual Report as it is submitted. If you have any questions or require further information, please contact Rachel Hanigan, P.E., Permits and Mitigation Engineering Manager at (405) 521-2676.

Sincerely,

Casey Shell
Chief Engineer

Enclosure

# Oklahoma Department of Transportation

## Annual Report
## For
## July 1, 2017 through June 30, 2018

Oklahoma Department of Transportation

CERTIFICATION STATEMENT

NPDES Permit No. OKS000201
Review of Storm Water Annual Report

I certify under penalty that this document and all attachments were prepared under my direction or supervision, in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.

Casey Shell
Chief Engineer

8/28/18
Date

FISCAL YEAR
2018
ANNUAL REPORT
BY THE
OKLAHOMA DEPARTMENT OF TRANSPORTATION (ODOT)
ON
TULSA MS4 PERMIT # OKS000201

August 28, 2018

Status

The Oklahoma Department of Transportation (ODOT) has implemented and is in compliance with the Storm Water Management Plan. The following items demonstrate activities undertaken for this annual report period.

Expenditures

As part of ODOT's Storm Water Management Program, the Tulsa metro area highway system shoulders are swept to remove sediment and debris. This sweeping program for the annual report period covered one thousand, one hundred and fifty lane miles at a cost of approximately $937,000. Two inmate crews and one private contractor pick up litter from the highways in the city at an annual cost of $840,000. The estimated total expenditure for ODOT in anti-litter efforts statewide is approximately $4,500,000.

Erosion and Sediment Control

ODOT's "Storm Water Management Guidelines for Design and Construction Activities" is used by ODOT design, construction and maintenance personnel, consulting engineers and contractors to select, design and maintain appropriate erosion control measures for our construction and maintenance activities. Currently, ODOT is working with a consultant to create manuals for Design, Implementation and Inspection of erosion and sediment control devices for construction projects. An internal Erosion and Sediment Control task force was formed in January 2003 to improve and standardize best management practices for ODOT and entities acting on their behalf.

The Department formed four Storm Water Advisory Teams (SWAT) for the development of Design, Construction, Maintenance and Public Education/ Public Involvement Best Management

Practices for the agency in 2009. Currently, these teams are in the process of developing and conducting training and materials for educating ODOT personnel on Storm Water regulations.

The American Association of State Highway and Transportation Officials (AASHTO) collected Best Management Practices from all fifty DOT's and developed guideline manuals for Construction and Maintenance personnel. ODOT's Environmental Program Division gave a presentation at six of the eight Field Division Supervisors meetings about the MS4 Storm Water Program and handed out a manual for every construction and maintenance employee for public education.

ODOT has developed a Construction Site Storm Water Performance Review Guideline process to ensure that Storm Water requirements are incorporated throughout the Design, Construction, and Document Retention phases. This oversight review is being implemented, initially, in the regulated areas of the State.

ODOT/ DEQ Enforcement staff has conducted multiple inspections on thirteen construction site road projects across the state. Any project with compliance issues was given fourteen days to remedy prior to a second inspection. Five Contractors were given non-compliance assessments from DEQ. These inspections will be ongoing for the foreseeable future. The goal is to inspect all road construction contractors with every ODOT construction office at least one time.

ODOT adopted a non-compliance assessment specification for construction contractors. The specification gives ODOT a mechanism to assess per day monetary fees for failure to comply with effective and timely measures, as requested by the construction inspections.

Phase II MS4 Program

As of February 2005, ODOT was required to obtain a Phase II MS4 permit from DEQ. During this process, ODOT has been reviewing all aspects of our operations to comply with these additional requirements. ODOT has hired a consultant to advise the agency on the six Minimum Control Measures; Public Education and Outreach, Public Participation and Involvement, Illicit Discharge Detection and Elimination, Construction, Post Construction and Good Housekeeping / Pollution Prevention programs. ODOT has delivered to DEQ an application for a statewide Non-Traditional MS4 permit that is currently being reviewed by DEQ.

Illicit Discharge Detection and Elimination Program (IDDE)

ODOT continues to conduct Outfall Mapping in the regulated areas of the State. This effort is being done by Consultants. This data (pictures, inspection results) is being built into ODOT's Geographical Resource Intranet Portal system that contains multiple databases with many facets of highway information. Ongoing training for the IDDE Program continues. This includes information gathered during the Outfall Inspections and how to identify and report an Illicit Discharge. This training was developed from meetings with the Maintenance SWAT team and a

Consultant. Discussion on tracking Highway Spills from accidents is ongoing between DEQ, ODOT Risk Managers, Maintenance personnel and the Highway Patrol.

Good Housekeeping / Pollution Prevention Plans (GHPPP)

ODOT has completed an inventory survey of facilities statewide to develop training on Good Housekeeping and Pollution Prevention. Funding for facility upgrades and/ or relocation is being pursued by the Agency. ODOT has built new maintenance facilities for Okmulgee County, Ellis County, Roger Mills County, Cotton County, Custer County, Kingfisher County, Cleveland, County, Atoka County, Oklahoma County and McIntosh County. Currently, each of the eight Field Divisions are evaluating location, condition and need to determine which County facility will be moved or rebuilt on site. These upgrades will further the Good Housekeeping /Pollution Prevention Minimum Control Measure. In addition, ODOT has developed a Good Housekeeping Pollution Prevention Plan Facility template. The templates are being completed for facilities in the regulated areas to satisfy DEQ requirements. Currently, all the facilities located in the regulated areas have been inspected for pollution prevention opportunities, procedures have been reviewed with their Maintenance Supervisors. GHPPP's and training are being developed.

ODOT has incorporated a "Clean Sweep" program at all of the facilities throughout the State. This program is intended to remove old materials that may be potential pollutants. This program is ongoing and is being conducted with the assistance of the Department of Central Services on the sale of the material that can be repurposed. This undertaking is being done for the Good Housekeeping/ Pollution Prevention MCM, as well as evaluating which facilities will require Spill Prevention, Control and Countermeasure (SPCC) plans. It has been determined that many facilities will not meet the required capacity for SPCC plans, after the Clean Sweep operation has been conducted.

Additionally, ODOT has hired a Consultant to map all the maintenance facilities in the regulated areas for possible water quality impacts, e.g., sensitive waters, aquatic resources of concern, endangered and threatened species. This information will be incorporated into the mapping database mentioned in the IDDE section.

Herbicide Application

The application of herbicides is performed by Oklahoma Department of Transportation employees. ODOT closely follows the procedures, rules, and regulations contained in the Oklahoma Pesticide Applicators Law. ODOT requires all its applicators to be licensed and are subject to the implementing regulations of this law. ODOT partners with the Oklahoma Department of Agriculture to offer the Pesticide Applicators test required for a license during our annual workshops.

ODOT has a contract with the Oklahoma State University/ Oklahoma Cooperative Extension Service to provide annual herbicide applicator workshops. Thirteen continuing education

workshops were held across the state in each of the eight field divisions. Approximately six hundred people attended the workshops statewide, which includes seventy two employees from the Tulsa area. A large portion of this workshop covered the various issues concerning environmentally safe usage of herbicides. Six Certification Workshops were held statewide with ninety seven employees attending. ODOT has scheduled the continuation of this training / certification for the coming year.

On October 31st, 2011, new EPA regulations were promulgated that brought Pesticide Application under the Clean Water Act, if applicable. ODOT has adopted a thirty foot buffer zone from all USGS "Blue Line" streams to meet EPA's Pesticide General Permit requirements. By applying "terrestrial only" applications, ODOT will not be required to obtain Pesticide Application permits under the Clean Water Act. ODOT Environmental Programs Division attended the Field Division workshops, explained the buffer zone requirements, demonstrated how this process of shutting off the spray in the correct areas and the importance of complying with this regulation. USGS "Blue Line" maps were provided for their prospective roadways.

Public Education/ Litter Program

ODOT has continued the statewide anti-litter campaign, "Oklahoma, Keep Our Land Grand". The litter hot-line (1-888-5-LITTER), is available to report littering anywhere across the state. Callers can report the offenders tag number. The people observed littering were sent a postcard requesting them to help "Keep Our Land Grand". Littering is against the law and offenders can be fined from $200 to $2000.

School-age children are invited annually to enter a poster contest, sponsored by ODOT; Oklahoma Department of Environmental Quality, Oklahoma State Department of Education, Keep Oklahoma Beautiful, Oklahoma Environmental Management Authority, Oklahoma Rural Water Association, Oklahoma Chapter of the Sierra Club, Solid Waste Institute of NE Oklahoma, Waste Research, Inc., Oklahoma Arts Council, Oklahoma Employees Credit Union, OGE Energy Corporation, Veolia Water, Oklahoma Tourism & Recreation Department (Oklahoma State Parks), Wal-Mart, AEP-Public Service Company of Oklahoma, Oklahoma Turnpike Authority and the Oklahoma Highway Safety Office. Nearly nine thousand students, grade Kindergarten through 12th participated in 2017/2018 contest. The winning posters are printed for distribution to schools, businesses, and chambers of commerce. A quantity of forty five thousand calendars, featuring the winning posters, will be printed and distributed statewide to schools, libraries city, county, state and federal offices. One of the thirteen winning posters will be featured on fourteen thousand color reprints distributed for promotional display purposes to spread the anti-litter message to Oklahoma citizens of all ages.

The 27th Annual State poster contest winners were honored at an April awards luncheon at ODOT's office in Oklahoma City. Luncheon speaker was Mr. Mike Patterson, ODOT's Director. Guests were treated to lunch. Each state poster winner received a monetary award of $250, $150 or $100 for first, second or third place respectively. Winners also received a mounted reprint of

their poster, placemats and t-shirts bearing their design. The thirteen winners were then presented to the Oklahoma State House of Representatives at the Capitol. Each of the thirteen students had the opportunity to get their photos taken with their respective representative.

Adopt-a-Highway/ TRASH-OFF

ODOT'S anti-litter efforts are still on-going and include one hundred thirty eight separate "Adopt-a-Highway" groups who remove litter from their two mile section of state highways at an interval of four times a year, and the "TRASH-OFF", an annual volunteer spring roadside cleaning sponsored by ODOT. Tulsa has sixty three "Adopt-a-Highway" groups covering one hundred twenty six miles at a minimum of four times a year.

The Thirtieth Annual TRASH-OFF was held on Saturday, April 21, 2018. This year's event involved one hundred and thirty eight cities, eighteen counties, twenty five groups/ organizations, two Corps of Engineers lakes, sixty one "Adopt-a-Highway" groups and twenty State parks in the clean up effort. Many groups have expanded TRASH-OFF day to TRASH-OFF week or month. ODOT distributes trash bags for the annual TRASH-OFF. Last year, this effort resulted in two million nine hundred thousand pounds of litter and debris collected from Oklahoma roadsides and public areas by 41,000 volunteers. This saved taxpayers an estimated five million dollars. In addition, Keep Oklahoma Beautiful sponsors a banquet in the fall where awards are given to participants for "Best First Effort" and "Best Overall Effort".

ODOT is a member of the newly formed Central Oklahoma Storm Water Alliance (COWSA). ODOT created a Storm Water contact link to the Website to receive questions or concerns regarding our processes and/or construction projects.

Wildflowers

Wildflower planting was ODOT's first landscaping program which started in 1976, but went into full scale planting in 1987. There are more than two thousand, two hundred acres in five hundred eighty six sites planted statewide. The Oklahoma Legislature passed a bill in May 2006 creating a new Oklahoma wildflower car tag. Every wildflower tag will donate twenty dollars toward the planting of wildflowers on Oklahoma roadsides.

Citizen donations of $280,086 have purchased wildflower seed for planting along highways during the last 24 years. To date, ODOT has planted approximately two thousand three hundred acres on roadside sites statewide.

Three drill seeders, specifically designed for wildflower seed, are used by ODOT for planting on highway roadsides. These drills are available for use by Oklahoma communities and organizations.

In the spring of 2016 a memorandum of agreement was signed in partnership with the Federal Highway Administration and the Missouri, Texas, Iowa, Kansas and Minnesota DOTs designating Interstate 35 as the Monarch Highway. The goal is to protect more of the Monarch Butterfly's natural habitat by allowing milkweed and native flowers to grow in the right-of-way where possible. In anticipation of the collaboration, ODOT began refraining from mowing highway rights-of-way statewide, except where necessary, until July when the flowers are primed for seed dispersal. Mowing was continued in urban areas and safety zones, which includes medians and rights-of-way up to 30 feet from the pavement's edge. A pollinator garden was also planted by ODOT staff at the Oklahoma City Welcome Center. The garden, a registered Monarch Waystation, is a 20 foot by 40 foot plot containing five types of milkweed, Black-eyed Susans, purple coneflower and other types of wildflowers. The garden will serve as an educational tool for the public to help them recognize and protect milkweed and other native wildflowers.

Collection and Recycling

ODOT's Maintenance personnel recycled approximately eighteen hundred gallons of oil this past year. The oil is picked up by a private contractor five times a year. Additionally, ODOT recycled approximately five barrels of oil filters this past year. Approximately, two hundred and fifty gallons of antifreeze was recycled. Sixty three batteries were returned to the manufacturer for reuse. Approximately, four thousand and forty pounds of tires were recycled.

Mowing

ODOT's maintenance activities are being performed by private contractors that mow just over forty seven hundred acres per year in the Tulsa metropolitan area. This is done five times a year at a cost of approximately $2,200,000.

# Appendix B

## Oklahoma Turnpike Authority

## Annual Report

For Reporting Period:
July 1, 2017 through June 30, 2018

OKLAHOMA
TURNPIKE
AUTHORITY

August 1, 2018

Mr. Scott Van Loo
Operations Manager, Stormwater and Land Management
Streets and Stormwater Department, City of Tulsa
4502 S. Galveston Ave.
Tulsa, Oklahoma 74107

Dear Mr. Van Loo,

Enclosed is the Oklahoma Turnpike Authority's portion of the Annual Report to be submitted to the Oklahoma Department of Environmental Quality (DEQ) in accordance with the City of Tulsa Municipal Separate Storm Sewer System (MS4) Permit Number OKS000201. This report covers the period from July 1, 2017 through June 30, 2018.

Please provide this office with one copy of the Annual Report as it is submitted to DEQ.

Sincerely,

Edward Dihrberg, P.E.
Project Engineer

NPDES Permit No. OKS000201
July 1, 2017 through June 30, 2018
Annual Report for
Oklahoma Turnpike Authority (OTA)

## Overview

This report summarizes the OTA stormwater management activities for Turnpike areas in the City of Tulsa Municipal Separate Storm Sewer System (MS4) area. The Creek Turnpike Maintenance yard and approximately 29% of the Creek Turnpike roadway are within Tulsa's MS4 boundary. The roadway areas include 5.7 miles of roadway in the south Tulsa area that crosses parts of the Vensel Creek, Fry Ditch, and Haikey Creek watersheds. The roadway areas also include 4 miles in the east Tulsa area that crosses parts of the Spunky Creek and Adams Creek watersheds. The Creek Turnpike statistics shown in the remainder of this report refer to the entire Creek Turnpike, not just the portions that are in the Tulsa MS4 area. Construction on the Gilcrease Turnpike will be begin during the next annual report period. When complete, the Gilcrease Turnpike will add approximately 0.7 miles of roadway to the Tulsa MS4 area in the Arkansas River watershed.

1. Status of the Implementation of the Storm Water Management Program.

   Responsibilities of OTA outlined in the NPDES Part 2 Application have been met.

   *Structural Controls and Storm Water Collection System Operations:*

   OTA's commitment to a superior functioning storm water system is demonstrated by its regular inspections all of the below ground storm water carrying structures. All of the drainage structures on the Creek Turnpike are inspected every other year. The 2017-2018 report period was an off year for Creek Turnpike inspections. All stormwater structures on the Creek Turnpike will be inspected during the 2018-2019 report period.

   Above ground storm water controls are monitored daily by the maintenance staff who are equipped to handle any flow problems that could potentially arise. Examples of

such controls would be detention areas, roadside ditches, and culverts. To ensure the storm water is flowing efficiently, OTA mows 4 to 7 cycles per season. Approximately 2022 acres are mowed per cycle.

*Areas of New Development and significant redevelopment:*

A five (5) year capital plan has been developed by the Turnpike Authority to identify future construction projects. This Capital Plan is updated yearly to incorporate priority areas and any lessons learned are incorporated into future projects. OTA shall continue to look for opportunities to use low impact development and adopt Best Management Practices to minimize the impact that runoff discharges have to receiving streams.

*Roadways:*

All storm grates and drains used to move water off of the roadway were cleaned in March 2018.

OTA requires a storm water management plan for all construction projects. The OTA requires contractors to obtain necessary permits for placement of dredge or fill material (from the US Army Corps of Engineers) as well as floodplain and watershed permits (from relevant municipalities).

Approximately 5600 cubic yards of litter were collected and properly disposed by providing 33 trash containers along the Creek Turnpike. In addition, a private contractor collected litter from 1598 acres of turnpike right of way on a two-week frequency. Maintenance staff collected 2,403 cubic yards of litter, including 855 cubic yards collected during the Great American Clean Up Campaign in March, April, and May 2018.

In September and October 2017, OTA Maintenance cleaned debris and fixed erosion on all large concrete inlets and outlets that discharge to area streams.

Finally, OTA Maintenance covers sand piles at Creek Turnpike Maintenance yards with tarps to prevent sand from washing off in the rain.

*Pesticide, Herbicide, and Fertilizer Application:*

The OTA requires all turnpike herbicide applicators as well as all contract applicators to be licensed and subject to all of the regulations under the Oklahoma Herbicide Applicators Law including re-certification. Applicators receive yearly training on pesticides, herbicides, and fertilizer chemicals from the Oklahoma Vegetation Management Association (OKVMA). The OTA has four certified applicators on the Creek Turnpike. Approximately 236 gallons of herbicide were applied around sign footings, fences, and at various other locations within the limits of the right of way.

*Illicit Discharge and Improper Disposal:*

The bridges and culverts on the Creek Turnpike are inspected every other year. The next round of inspections will take place during the 2018-2019 annual report period.

OTA's maintenance staff collected and recycled 120 gallons of oil. The oil is routinely picked up at the maintenance yard by a private contractor (Safety Kleen). In addition to the oil, OTA recycled 62 filters. Batteries and tires were returned to locations where new ones could be purchased.

*Construction Site Runoff:*

The OTA understands the significance of construction site runoff and the adverse effects it can cause. As a result, strict guidelines are set forth to ensure that each construction site has adequate controls for reducing pollutants. As stated previously, all construction plans that are produced by or for the OTA have a mandatory Storm Water Management Plan and Erosion Control Plan. These sheets provide information such as location/description of project, sequence of erosion control activities, area disturbed, name of receiving waters, soil stabilization practices, structural practices, offsite vehicle tracking, a layout drawing showing exactly where soil stabilization and structural practices should be placed, and references to the OTA Standard Specification for all Storm Water Guidelines. The most optimal approach and recommendations are discussed and agreed upon prior to project implementation to ensure the best option is chosen for the project.

During construction, the approved storm water management plan is monitored and enforced regularly by the OTA's on-site representative.

Upon project completion, OTA conducts a final inspection and assures that the work areas are restored to compliance level.

*Public Education:*

The OTA dedicates space on its website to the subject of Storm Water Management. On the site there are links to the Phase I Annual Reports. The site includes a phone number to allow the public to contact OTA with suggestions, comments, or questions about OTA's stormwater program.

A stormwater pollution prevention bookmark was produced which included 10 suggestions for preventing stormwater pollution. This bookmark was distributed to members of the public at OTA headquarters and other locations. The bookmark can also be seen by going to OTA's website.

The OTA is also part of the anti-litter campaign, "Oklahoma Keep Our Land Grand." As part of this campaign, the OTA offers a toll free number to call to report littering as well as a place to report it on the website. Individuals who are reported littering are sent a postcard to remind them that littering is a punishable offense and that the goal is

to keep Oklahoma land looking grand. For the period July 2017 – June 2018, the OTA received 520 littering report calls for the whole turnpike system. This was roughly the same number of calls received during the same period the previous year.

*Employee Education:*

In order to keep up to date with herbicide management practices, six OTA Maintenance employees attended the OKVMA Conferences held October 3-5, 2017. Stormwater topics are discussed during weekly Maintenance meetings at the Creek Turnpike.

*Landscape:*

OTA partners with the organization "Up With Trees" to landscape areas in and around the major interchanges in the Tulsa and Broken Arrow communities. OTA also partners with "Color Oklahoma" and maintains two wildflower plots on the right of way adjacent to the Creek Turnpike.

2. Proposed Storm Water Management Program Changes.

   The OTA does not propose any changes to the Storm Water Management Program.

3. Revision to the Assessment of Controls and the Fiscal Analysis.

   OTA proposes no revision to the assessments of controls. The Fiscal Analysis is as shown on the City of Tulsa's Report.

4. Monitoring Data Accumulated Throughout the Reporting Year.

   Refer to the Regional Storm Monitoring Report.

5. Annual Expenditures for the Reporting Period with a Breakdown for the Major Elements of the Storm Water Management Program.

| Description | Cost |
|---|---|
| Mowing | 143,420.84 |
| Sweeping | 46,220.86 |
| Trash Collection and Disposal | 91,340.00 |
| Herbicide | 4,460.73 |
| Total | $ 285,442.43 |

Note that a new mowing contract and vendor have resulted in a significant savings in mowing costs compared to previous years.

6. A Summary Describing the Number and Nature of Enforcement Actions, Inspection and Public Education Program.

   All enforcement actions in OTA's watershed are issued by the City of Tulsa in concurrence with the OTA. None occurred during the year covered by this report.

7. Identification of Water Quality Improvements or Degradation.

   OTA was not able to identify any water quality improvements or degradations during this report period.

8. Regional Monitoring Report.

   Please see the City of Tulsa's report.

# CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Edward Dihrberg, P. E.
Oklahoma Turnpike Authority

August 1, 2015
Date